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JTech Medical Industries
Sales and Return Policies

JTech Medical Industries makes every effort to provide high quality products that make you more efficient, your business more profitable and your patient care more effective. We also strive to provide the best customer service possible. That is why we have taken time to outline our sales and return policies.

Sales Policy

Orders

Orders may be placed with JTech Customer Service or authorized JTech representatives. Orders are accepted only on the condition that in the event of conflicting terms, the terms set forth herein prevail.

Prices

Prices are subject to change without notice. Prices in effect at the time the order is accepted will prevail. Written quotations are valid for 60 days unless otherwise noted. All applicable taxes and handling charges will be added to the invoice.

Terms

Shipments are F.O.B. the shipping point. Shipments will be pre-paid unless credit has been established. Credit references will be required for new accounts.

Shipping

Examine all goods upon receipt. They are carefully packed to minimize in-transit damage. If shipment has been damaged, immediately document the nature and extent of the damage and contact the carrier. If concealed loss or damage is discovered, retain all packing materials and notify the carrier at once, requesting an inspection. ***This is essential and must be done within seven days of delivery.*** If order is received with parts missing, you must contact the carrier and JTech Customer Service.

Changes and Cancellations

Changes to, or cancellations of, any order by the customer, must receive the consent of the JTech Customer Service Department. Changes greater than $500.00 must be approved by the National Sales Manager or the President. JTech is not liable for damages caused by delays or non-delivery due to any cause.

Partial Shipments

JTech reserves the right to make partial shipments on any order; invoice for same shall be payable upon receipt unless otherwise agreed to in writing.

RETURN POLICY

A **Return Material Authorization (RMA)** number must be obtained from JTech Customer Service prior to returning any merchandise. When phoning or writing for an authorization number to return merchandise, please contact the Customer Service Department with:

1. Your name or customer number as it appears on the invoice or packing slip.

2. Your telephone number and person to contact.

3. Your applicable P.O. number.

4. The catalog number(s) and description.

5. The reason for the return.

JTech reserves the right to refuse or to return-collect any merchandise sent back without prior authorization of our Customer Service Department. Authorized returns must be shipped pre-paid to:

> **JTech Medical Industries**
> **4314 ZEVEX Park Lane**
> **Salt Lake City, UT 84123**
> **ATTN.: RMA# (insert number)**

Shipping charges will be reimbursed if the return was due to JTech's error. When returning merchandise, please include a copy of your original invoice or packing slip to ensure prompt issuing of credit.

Full credit will only be issued for items returned within 15 days of receipt, and all items must be in new condition and in the original packaging. Hardware items returned after 15 days and before 45 days will be subject to a 20% restocking fee, provided the hardware items are in new condition and in the original packaging. If items require refurbishing or repacking and are accepted for credit, a service charge will be deducted from the amount of credit. Other return conditions:

- *No software returns will be allowed after 15 days. Systems returned after 15 days will be eligible for credit for hardware only.*

- *No returns will be accepted after 45 days.*

  No returns of demonstration or sample inventory will be accepted.

- *Etched, engraved or otherwise modified inventory may not be returned.*

Register Your Equipment!

Please register your purchase so that we can ensure you of easy access to JTech's Customer Service and Technical Support, as well as guarantee that you will be fully covered under your hardware warranty.

Registering your Tracker Hardware will also allow us to notify you of:

- *Product upgrades*
- *New product announcements*
- *Special offers*

For your convenience, your Registration Card has been placed in the back of this manual.

Tracker Hardware Warranty

One-year Limited Warranty
Tracker Hardware is designed to perform reliably, and meet specifications. In spite of care exercised in manufacture, it is impossible to eliminate malfunctions due to random component failure. Therefore, JTech will, at its option, repair or replace the product with a new or reconditioned unit at no charge for a period of one year from date of purchase.

In view of the varied conditions in which the equipment will be used, it is sold "as is" and JTech's responsibility does not go beyond the terms set forth above. JTech will not be responsible for medical expenses or any direct, incidental, or consequential damages arising from the use of this product.

THIS WARRANTY IS MADE EXPRESSLY IN LIEU OF ANY OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING AN IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. UNDER NO CIRCUMSTANCES SHALL JTECH BE LIABLE FOR ANY DIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES. THE REMEDIES SET FORTH IN THIS WARRANTY SHALL BE THE ONLY REMEDIES AVAILABLE, EXCEPT AS SPECIFICALLY PROVIDED BY STATE LAW. NO PERSON HAS ANY AUTHORITY TO BIND JTECH TO ANY REPRESENTATION OR WARRANTY EXCEPT AS SPECIFICALLY SET FORTH HEREIN.

NOTE: Tracker Software is covered by a separate license and warranty agreement. See software packaging for a complete copy of the licensing and warranty agreement.

Tracker Hardware Repair

1. Contact JTech to describe the problem and receive a return authorization. Return the Tracker (including all accessories) postage paid and insured to JTech.

   JTECH IS NOT RESPONSIBLE FOR DAMAGES OR LOSSES INCURRED DURING SHIPMENT.

2. Submit original date and proof of purchase.

3. Include a brief explanation describing the problem.

Customer Support

JTech Medical Industries offers customer support for all the products we sell. You may register up to three individuals from your office who will be eligible to call for support (this can be done anytime during your support agreement). These three users will be permanently registered for the life of your support agreement. Please note that support will only be available to those
individuals who are registered with your office.

I   Support Policies and Limitations

1. Software
   a.   Your three registered users are eligible to receive software support for 6 months from the date of purchase.
   b.   An extended service contact may be purchased for assistance after the initial 6 months has expired. Please refer to the Extended Service Plan insert included with your purchase or contact JTECH for further details.

2. Hardware
   a.   Your hardware is shipped with a one year warranty (Please refer to warranty document).
   b.   You will be charged for any hardware issues (repair, replacement, shipping, etc.) after the initial year time period.

II   Do the following before you call:

1. If your question deals with using the software, be sure that you have read this User's Guide. This guide was written to acquaint you with the software. It explains how to use the program and how to interpret the data. Please read through this documentation carefully.

2. Refer to the Troubleshooting section in your documentation. Many software and hardware issues can be resolved by referring to this section.

III   Be prepared with the following information when you call:

   1.   Name of clinic and doctor
   2.   Product name and date of purchase
   3.   Product serial number
   4.   Software version and module code
   5.   General information/specifications of your computer

If you are unable to solve your problem using the documentation, please have someone who is registered for support contact our Customer Support Division at **1-800-985-8324**.

Chapter 1
Hardware Setup

Congratulations on your recent purchase of the Tracker M.E. ™ Series System for musculoskeletal evaluation! You've joined the m any who are successfully using the system for effective, time-saving documentation and outcomes assessment. The Tracker System is designed to be upgradable so that you can add testing components in the future as your budget permits, or as new products are introduced. Contact JTech to learn about new Tracker products or future developments.

Please verify that all components of yo ur Tracker System are present and in new condition by using the enclosed packing list. If a part is missing or has been damaged, contact JTech at 1-800-985-8324 or 435-657-2500.

To begin the setup of your system, complete the following:

1. Connect the f emale end of the beige 9 -pin serial cable (found in the case lid) to a serial port on the back of your computer. If your comput er's serial port is a 25-pin jack, use the 25-pin female to 9 -pin male converter included with your system.

Note:

The serial port on your computer will be a male 9 -pin or 25-pin jack usually located next to the mouse port. The serial COM por ts should be labeled. If you are unsure if a serial port is available, or do not know the number of the serial port (i.e COM1, COM2, COM3, or COM4) consult your computer supplier. The COM port number will be needed during the software installation.

WARNING: Make sure the interface box is not plugged into an electrical outlet while performing steps 2-4!

2. Connect the male e nd of the beige 9 -pin serial cable to the port marked "Serial Com Port" located on the back of the interface box. (See illustra tion on next page.)

3. Connect the instruments (Dualer Plus inclinometers, PowerTrack II muscle tester, GripTrack dynamometer, etc.) to the appropriate ports on the front of the interface box. If installing Tracker ROM (Dualer Plus inclinometers), make s ure the RJ-11 jacks are the proper size and fit snugly. Also, make sure the "Main" inclinometer is connected to the "Main" por t.

4. If the foot switches are part of your system, connect them to the back of the interface box. Be sure the port connections match the foot switch labels.

5. Plug the interface box power supply into an outlet and connect the power supply cord to the back of the interface box.

6. Turn the interface box on using the switch located on the back of the unit. The light on the front of the interface box should be on.

Attach 9-pin connector to back of computer. If your computer only has a 25-pin port available, adapter goes here.

On/off switch for interface

Heartbeat

Serial Com Port   **Port A**   **ON/OFF**   **Power**   **Enter Next**

Attach foot switches here.
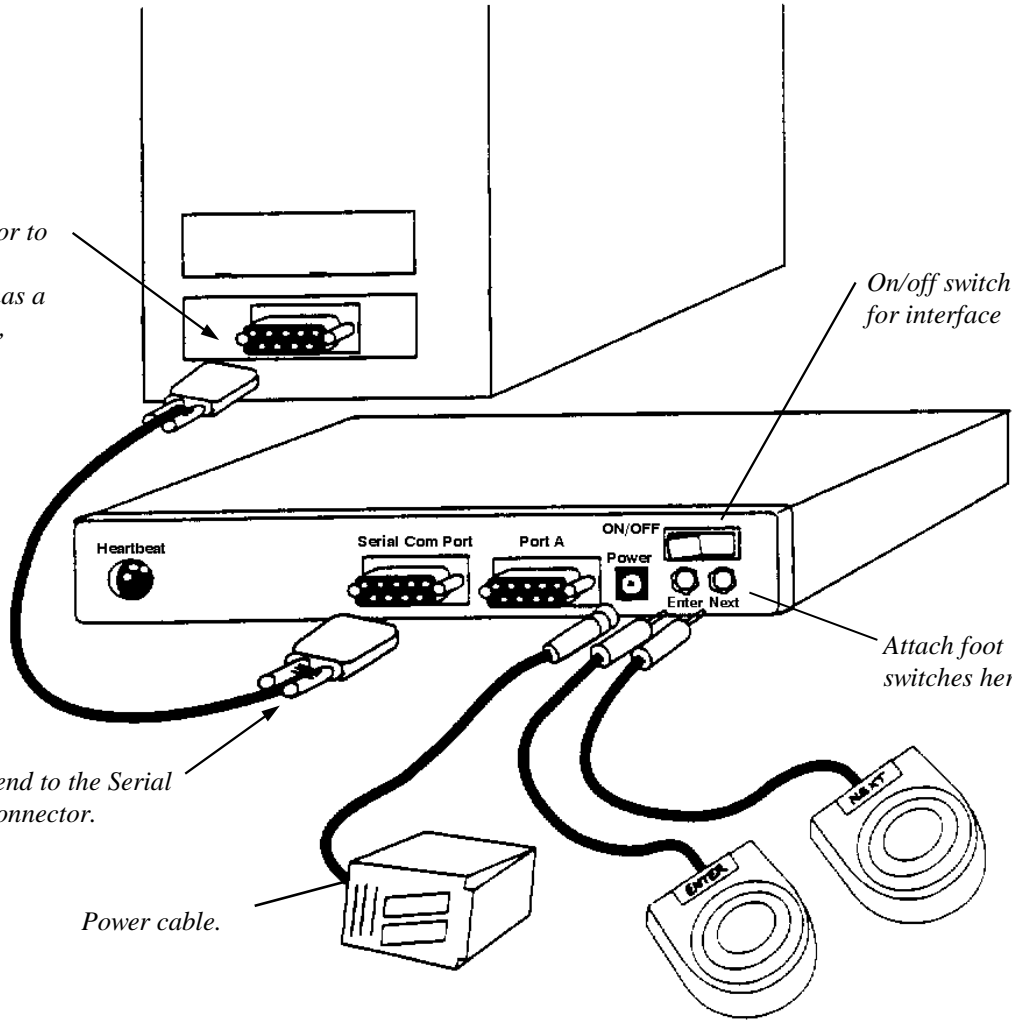
Attach this end to the Serial Com Port connector.

Power cable.

Chapter 2
Software Installation

Terms

We will refer to the following terms throughout the manual. Please understand each one before proceeding.

Click - depress a button on the mouse, and release.
Select - use the mouse to point to the feature and click the left mouse button.
Double Click - while pointing the arrow or cursor at the requested feature, press the left mouse button twice in rapid succession.
Enter - press the "Enter" or "Return" key on the keyboard.

Software

Tracker M.E. Series software from JTech Medical Industries requires Windows95™ or Windows NT™ to run properly. To install the so ftware follow the instructions below:

1. Make sure that the computer and monitor are turned on, and that Microsoft Windows 95 or NT is installed. If Windows 95 or NT is not installed, consult the *Microsoft Windows User's Guide* for information on upgrading Windows 3.x.

2. Insert the Tracker M.E. Series system software CD into the CD -ROM. If your computer does not have a CD -ROM, contact JTECH at 1-800-985-8324 or 435-657-2500.

3. The CD will initiate the install process by itself. The following dialog will appear. Click on "Install Tracker 4.3" to confirm your choice. If you have a default pathway to the internet, you can also access the JTECH website automatically by clicking "Find us on the Web."

Click the mouse anywhere along the text to install the disk. Text turns red when activated.

Click "Exit" if you change your mind.

4. If your computer is not configured for autorun capability, click on "Start," then "Run," and type d:\setup on the command line. After clicking "OK," the following sequence of screens will appear.

Clicking "Next" at the Welcome screen indicates that you understand and acknowledge that you will be given thirty days of unlim ited use of the software. At the end of thirty days the software will no longer function unless it is purchased.

By clicking "Next" here, you acknowledge that you must register your system with JTECH within 30 days form this install. Failure to register will cause the system to become non - functional until registration occurs.

Read the terms of the license agreement before moving forward. It is important to understand the importance of complying with the agre e-ment. Clicking "OK" indicates that you unde r-stand and agree to the terms of the license.
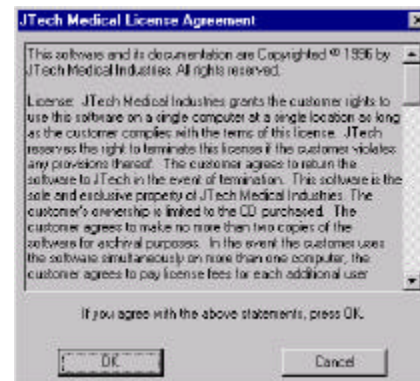
Enter data specific to your clinic into the dialog shown at right. This information will be used as a header for the cover pages of the TRACKER report writing functions. Use the "Tab" key to advance from one field to the next.
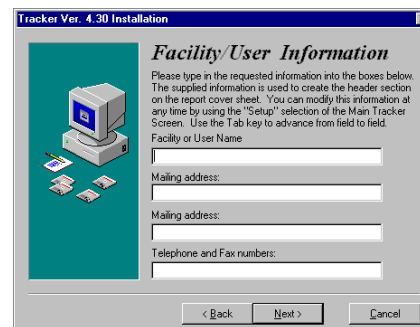
The screen to the right confirms the subdirectory Tracker will be installed to.   The installation process will automatically cre ate the subdirectory if it does not already exist. If an earlier version of Tracker exists, this install will preserve patient data.   Click "Browse" to install Tracker to a subdirectory different than the one listed. Click "Next" to continue or "Cancel" to stop the installation process.
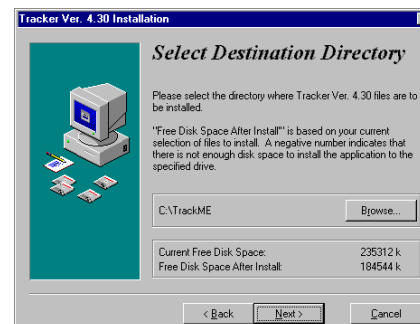
Custom installation can be performed when the Select Components screen appears. Clicking on the white boxes places or removes the "√." Items marked with an "√." will be installed. If you purchased the CD-ROM Help system or just want to preview the CDs, e nsure "Multimedia Help" is selected.

Tracker Documentation consists of an electronic format manual for this version of software. This manual can be printed out and u sed as a reference. If this is a brand new system, a hardcopy manual is already included. Additional hardcopy manuals are availa ble from JTECH for a nominal fee.

The READ-ME file may contain updated information that is not contained in the manual. We recommended that the READ -ME file be reviewed prior to starting your software.

The calibration information box should be checked if you received a new Tracker Interface Box and any of the following devices: RangeTrack, PowerTrack II, GripTrack, PinchTrack, OnSite Gauge, LiftTrack or IsoTrack. Before checking this box, make sure a c alibration diskette was included with your system. The calibration diskette should only be used on the initial loading of your software. When adding up -grades to your current system, devices must be manually calibrated. For calibration instructions, see the module in this manual corresponding to the specific device purchased.

Removing previous versions of Tracker is typically not recommended unless you are installing over an old version (2.19 or earlier). Contact the customer service department if the re any questions.

 Click "Next" to continue.

Tracker can function in a local area network environment. By selecting "Network Installation", the software will load Tracker on the local workstation and the data subdirectory onto the LAN server. If Tracker is to be loaded on multiple workstations, multi ple site licenses must be purchased. Contact JTECH Customer Service for more information.
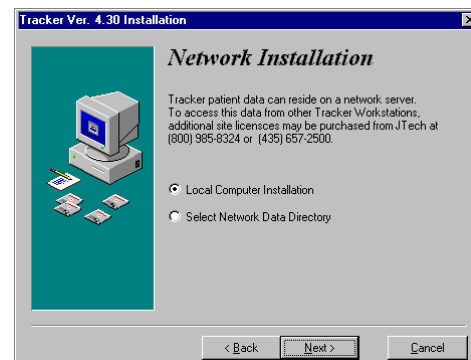
Tracker gives you a last opportunity to change the configuration of the installation. If you have any questions, please contact JTECH at 435-657-2500.
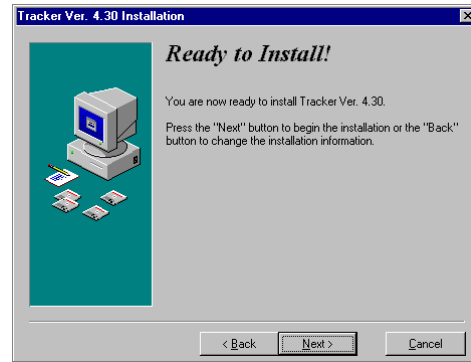
The status bar updates the user on the progress of the installation. Billboards are displayed indicating new features which may be of interest.
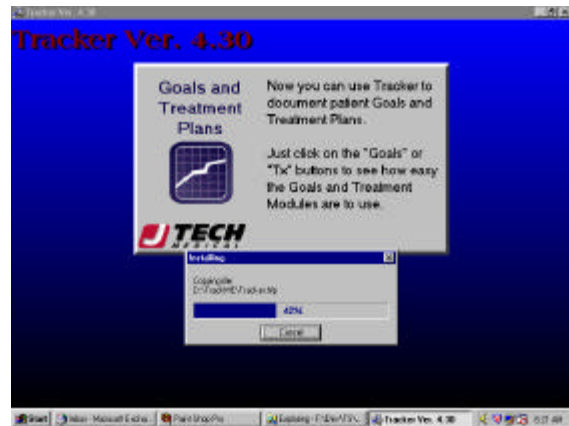
Tracker requires the serial number and module code be entered for new installations. These numbers are found on the inside cover of the CD. Demo users are not required to enter a serial number or module code.

Tracker users must enter your serial number and module code in the appropriate fields. Click on the appropriate settings to iden tify the COM port and the type of sound system. Click "Next" to continue.
If this is a 30 day demo version of software, leave the serial number and module code fields blank and hit the "Cancel" button to continue.
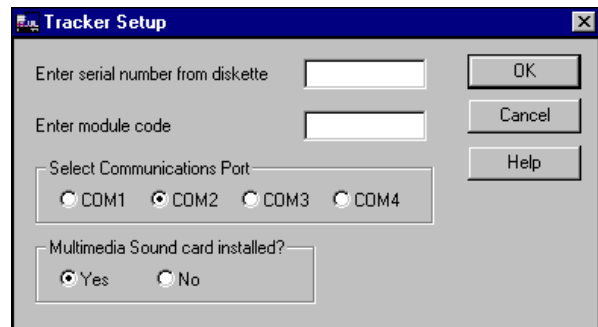
The screen at right is displayed upon completion of the software installation process. Click "Next" to install necessary compone nts for on-line manual and CD -ROM Help systems.

Adobe is used to display and print the Tracker Manual. Acrobat is automatically installed if you checked "Tracker Documentation" in the "Select Components" dialog. If you already have Adobe Acrobat loaded on your computer, hit "Cancel" to proceed with the Tracker install without re -loading Acrobat.
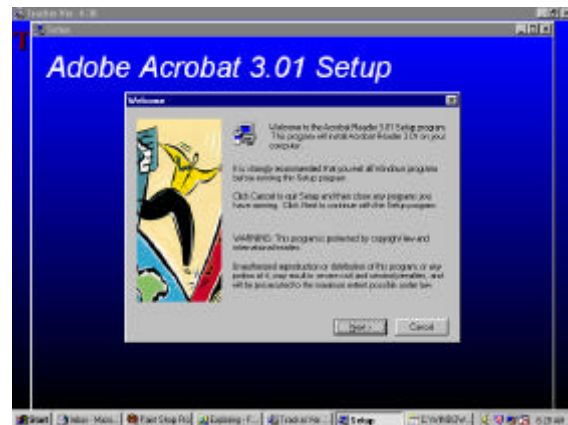
It is a good idea to restart the co m-puter after installing any program. This ensures that any required changes to files take effect before running the program.
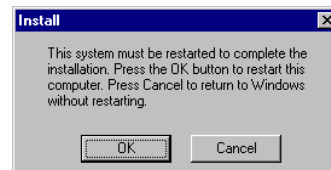
Once the software installation is complete, the Tracker Program Group will appear on the screen with several icons. Double -clicking on the "Run Tracker" icon initiates the program. The other icons are for marketing purposes and to show the features of t he system.

Refer to your Windows manual for information about placing a Tracker "short cut" on your desktop.
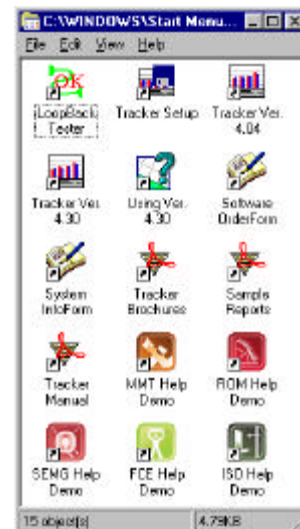
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Chapter 3
General Information

Starting the Program

To start the Tracker Program, double click the icon labeled "Start Tracker."

Note:

If the following program group is not available, click on "Start," then "Programs," then "Tracker." Consult the Windows95 user guide for information about creating a shortcut to Tracker from your desktop.

To begin, double click on the "Start Tracker" icon….

..Or single click here.
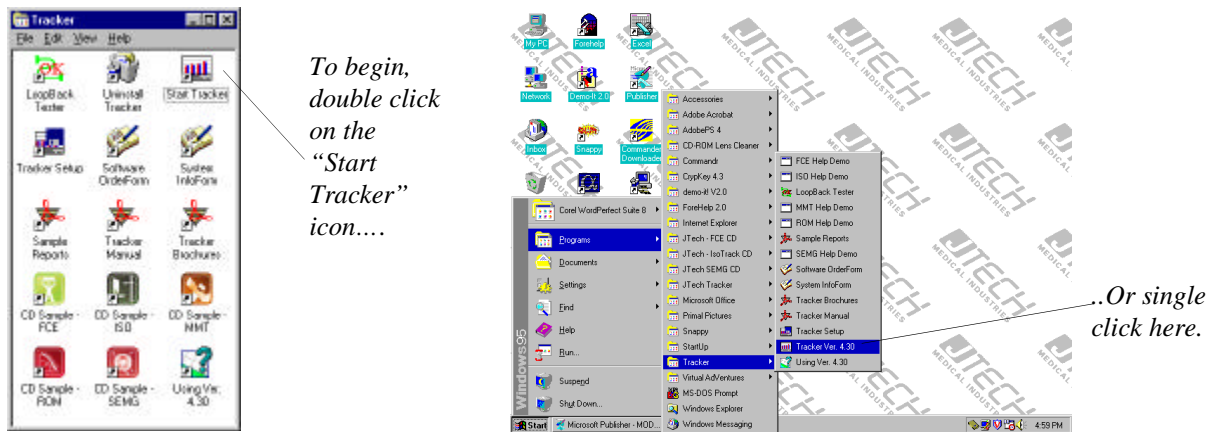
If the software has been registered, the Tracker Main screen should now be visible. Refer to page 20 of this chapter if the system has not been registered. The illustration below summarizes the features of the main screen.

Menu Item line.

Button toolbar.

Module Selection buttons. Only the testing modules installed will be displayed. For additional testing modules, call JTech at 1-

Status line.

Patient ID line.

Test Selection boxes.

Exam Date and Description box.

AMA Guides version indicator.
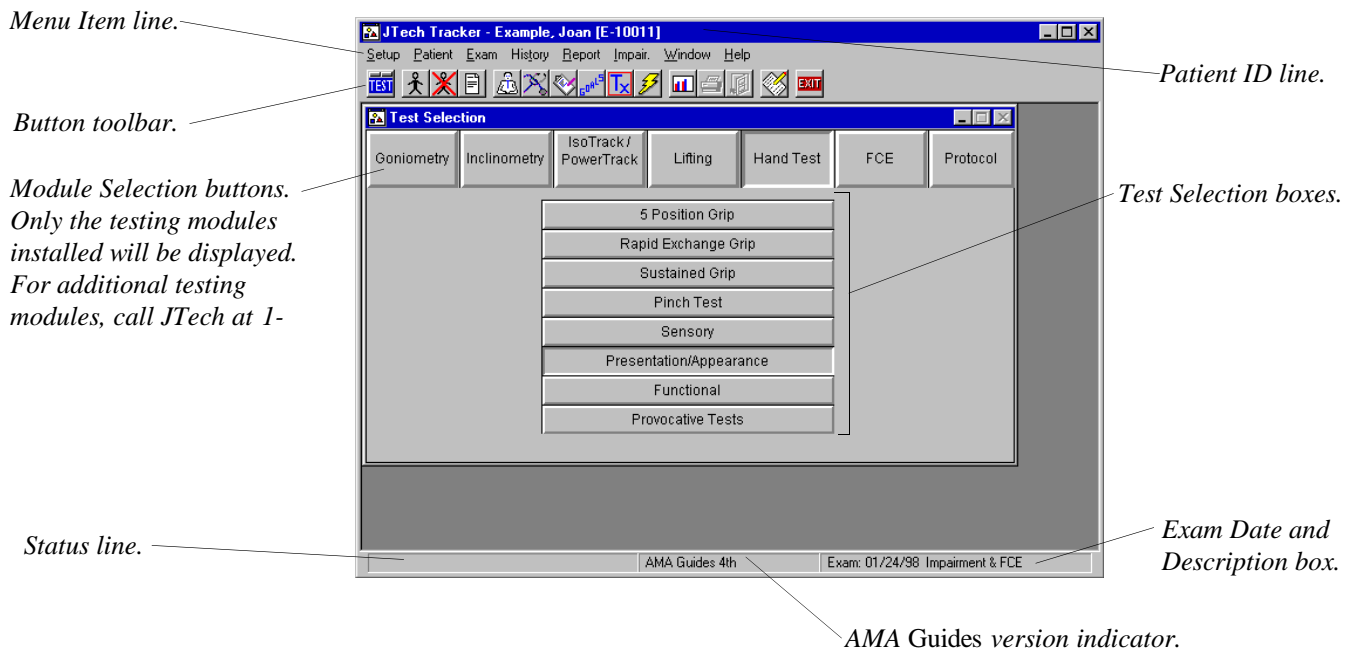
Help Menus and Help Screens

Most Tracker software dialog boxes include a "Help" button. Selecting the button provides detailed information regarding that s creen. Additional help is available by accessing the "Help Contents" via the "Help" menu item on the Main screen.
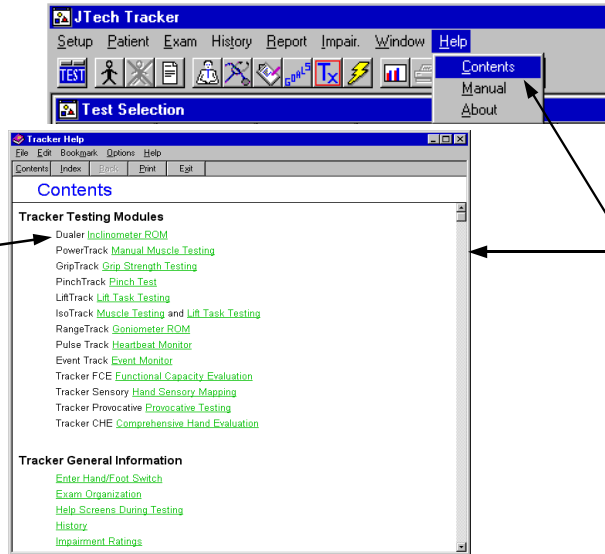
2. Selecting the subject "Dualer Inclinometer ROM," for example, results in the sub-topic menu below.

1. Selecting "Contents" from above results in menu at left.
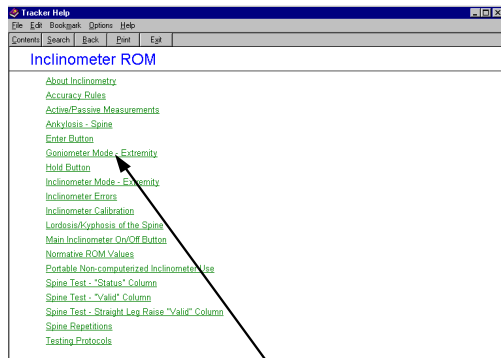
*Select the buttons to perform functions within "Help," such as go to the **Contents** list, **Search** for a specific topic, go **Back** to the previous screen, or **Print** the Help screen. Select **Exit** when finished.*

3. Selecting the sub-topic "Accuracy Rules" results in the corresponding Help screen.
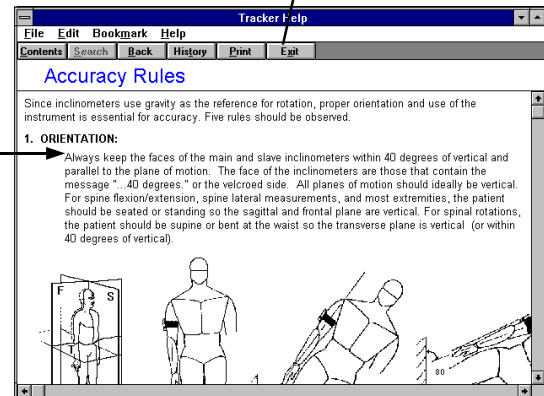
Clicking on items in "See also" lists jumps to that Help screen. To return to the original Help screen from a "See also" jump, select the "Back" button. Clicking on words highlighted in green displays a brief "pop-up" with more information.

Some software buttons in the Help screens are active. Clicking on active buttons will display additional information about the button's use in the software.

Tracker Manual in Electronic Format

The Tracker manual is available electronically to view, print, or paste into other word processing applications. To access the manual, select "Help" from the Tracker menu item line, and then "Manual" from the resulting menu.

To access the electronic manual, select "Help", then "Manual." The dialog at left appears.

Downward arrows indicate the heading is expanded to the fullest. Arrows pointing to the right indicate more information is under the

Click on the specific section you wish to see.
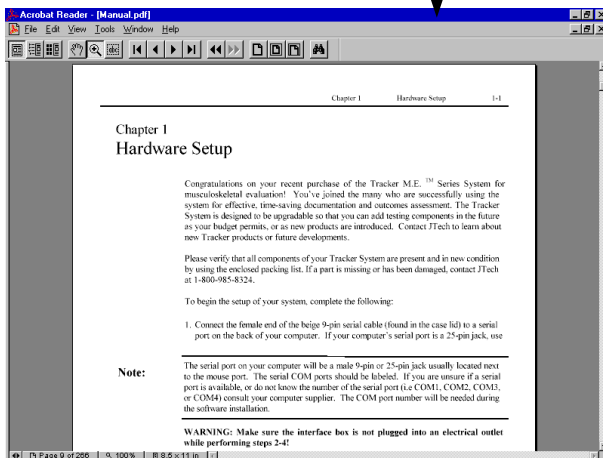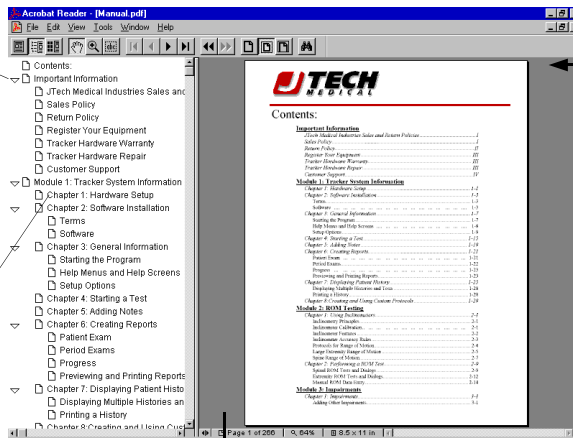
Use the Adobe Acrobat toolbar (as pictured below) to control the function and appearance of the manual on the screen. Refer to the Acrobat Program Help system for more information.

These 3 buttons control the manual navigation and layout. Display the page only, the page and index, or the page and thumbnails of the rest of the chapter.

Text selection for copying and pasting into other applica-

Page advance or page back is controlled with these buttons.

Control the zoom factor with these buttons.

Setup Options

Within the software, many settings and program configurations can be adjusted to customize the program to meet your needs and a variety of different computer systems. A number of settings are accessed through the "Setup" menu item. Most of the setup sele ctions have defaults, while others are enhancements that require information supplied by the user.

Selecting "Setup" from the M enu Item line yields a pull -down menu with multiple options.

The "Setup" menu item accesses a wide range of setup options.
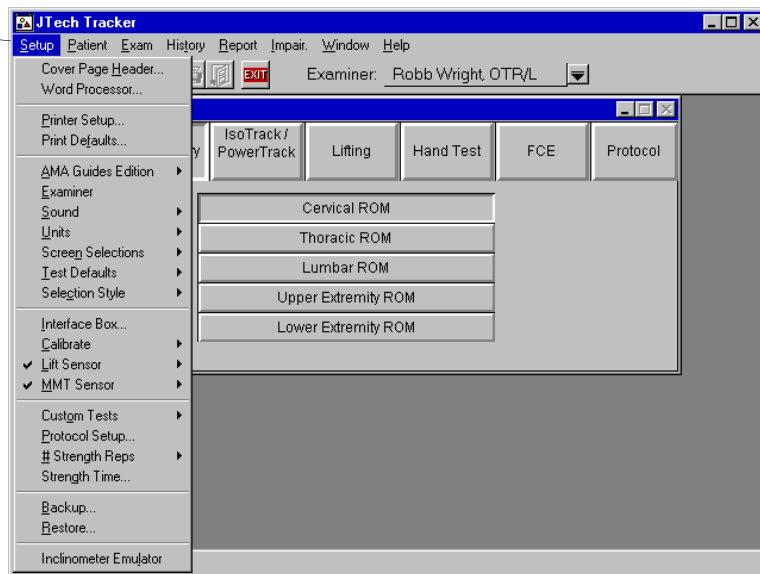
Selecting "**Cover Page Header**" allows the entry of company or clinic information which will appear at the top of all report cover pages. Information entered at the install is automatically input here. To overwrite this data, click the mouse into the corresponding field and edit the entry. Use the mouse or "Tab" key to move down from line to line. Press "Enter" or select "OK" to accept the information.
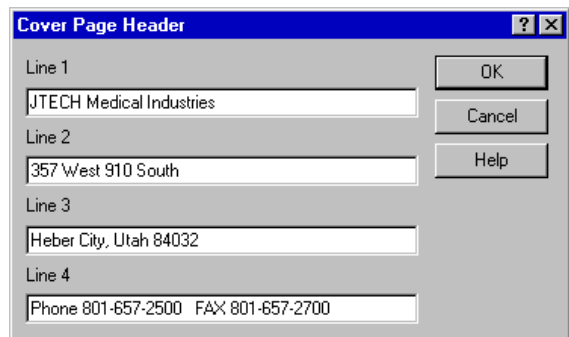
Tip: For information about the function of a screen or dialog box, select the "Help" button. Other Help screens can be accessed throu gh the "Help" selection in the Main menu.

"Word Processor" allows the flexibility to control which word processing program is used for the cover page, narrative, and FCE narrative elements of the software. At the "Look in" prompt, find the subdirectory the desired word processor program is located. Under "file name", enter the name of the .exe file used to launch the program. Tracker uses WordPad (standard with Windows 95/NT) as the default if no word processor is selected.
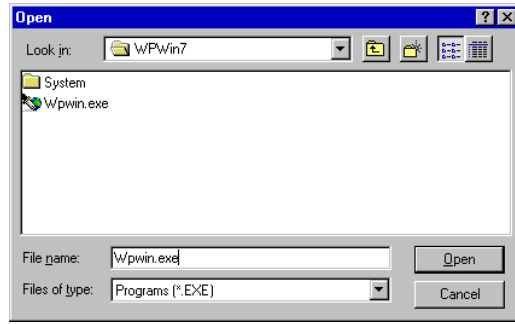
"**Printer Setup**" allows customization of the standard printer options that come loaded with your printer driver software. Select the "Setup" button to view options which facilitate graphics printing. For further information refer to the printer's user guide or contact the printer supplier.

"**Print Defaults**" allows selection of color graphs and reports for printing with color printers. Shading can be selected to accent black and white reports. Page numbering can be turned off or on. "Page Offset" is used only if the reports are not centered on the page. Print size (%) should only be used if the report needs to take up more or less of the paper. The default settings are listed to the right.
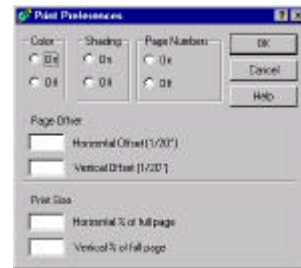
Selecting "**AMA Guides Edition**" allows calculation of impairment ratings based upon the edition of the *Guides to the Evaluation of Permanent Impairment* used in your state. Since most states use the 4th edition, this is the default setting. If you are unsure about the edition used in your state, call your state agency.

Select "Setup" for more options.
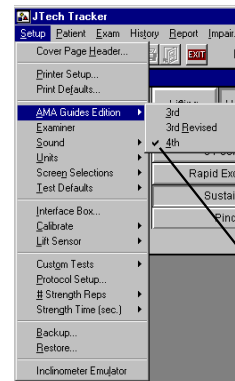
The check mark indicates the current setting.

The "**Examiner**" selection allows preview of the current database of examiners. Select "new" to add a name to the list. The Add Ex aminer dialog will appear. Type in the examiner's name and select "OK."
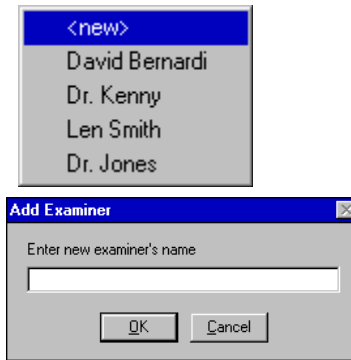
Selecting "**Sound**" activates a submenu. The initial setting is determined by the user during software installation.   For Computers with a 16-bit sound card and speakers, selecting "Multimedia" activates Tracker's built-in voice prompting.
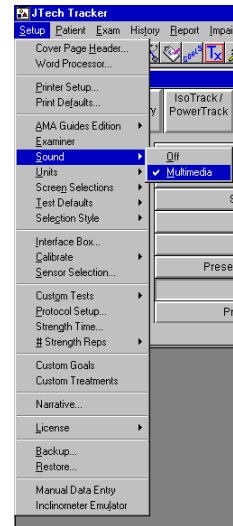
The default for "**Screen Selections**" is "Single." With this selection, the previous window is automatically closed whenever a new window is opened. This is the recommended setting for users new to Windows™.
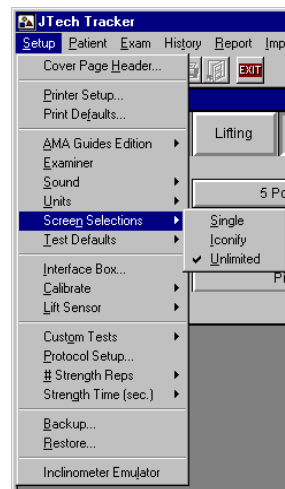
If "Iconify" is selected, each time a new window is opened the previous window transforms into an icon and resides in the lower left-hand corner of the screen until it is selected again.

If "Unlimited" is selected, the number of windows open at one time is only limited by your computer's memory. This setting empl oys the full functionality of Windows by allowing multiple test screens or history graphs to be viewed at the same time.

Selecting "**Units**" provides the option of choosing pounds, kilograms, or newtons as the unit of measure for any of the strength measuring devices.
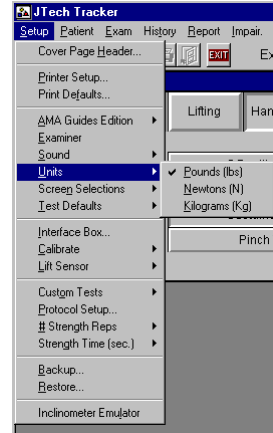
"**Test Defaults**" refers to the parameters that can be selected for a range of motion (ROM) test. It is only available when a ROM test window is active. See Module 2, Chapter 1: *Using Inclinometers* for more details. If you do not currently have ROM and are interested in finding out more, contact JTech at 800-985-8324.
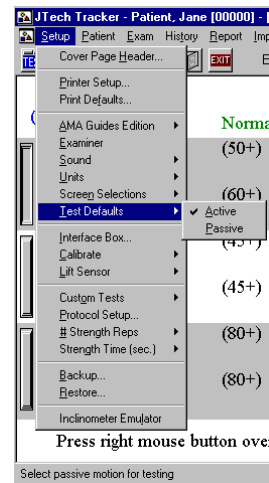
"Selection style" allows the user to pick the format in which the main selection screen is presented. The choices are "Standard" which employs the traditional TRACKER layout, and "FCE" which uses a more "recipe-like" layout designed for a more functional testing approach. See Chapter 4, "Starting a Test" for details.
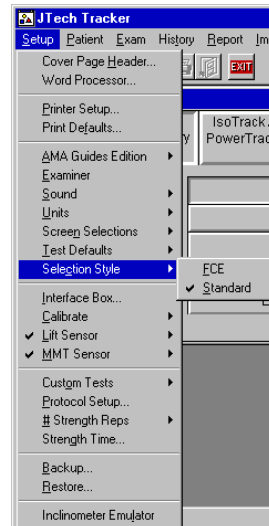
"**Interface Box...**" displays a dialog box for selecting the COM port to which the interface box is connected. The COM port is initially set during the software installation. It should not be adjusted unless the computer configuration is changed. The upda te rate should not be changed from 10.
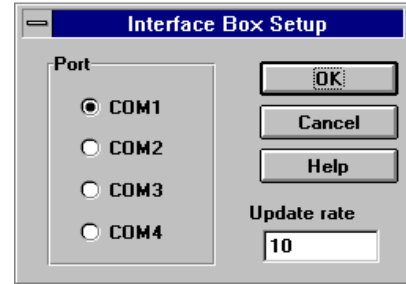
Selecting "**Calibrate**" allows recalibration of the instruments. Typically, the software will prompt for recalibration as necessar y. However, **if you inadvertently disconnect an inclinometer from the interface box while the box is on, the inclinometers must be re-calibrated using this menu item!**
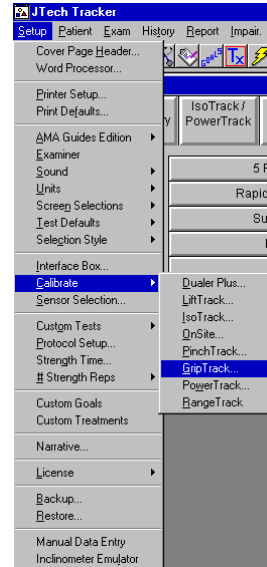
JTech manufactures three load sensing devices (LiftTrack, IsoTrack and the OnSite Gauge) that can be used to quantify static lif ting ability. There are also two dynamometers which can be used for manual muscle testing.The   " **Sensor Selection**" dialog dictates which devices will be the input sensors to the software.
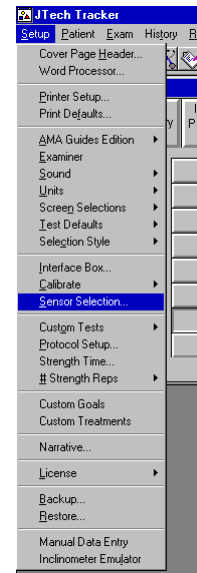
The resulting dialog is pictured below. Simply   click   on   the   radio   bu tton corresponding to the desired selections.

For IsoTrack, select both buttons labeled "IsoTrack". For "LiftTrack",   select "LiftTrack" under Lift Sensor, and for the OnSite Gauge, select "IsoTrack" as the Lift Sensor and "Push/Pull" as the Isometric Port.
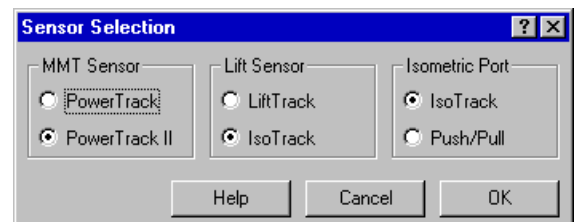
"Custom Tests" is used to create custom strength tests for common usage or for specific patients. For more information, refer t o the section "Creating Custom Tests" found in the module for each of the respective devices.
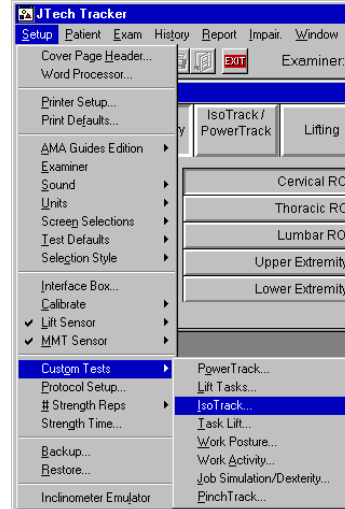
"**Protocol Setup"** allows creation of an infinite number of testing protocols that encompass a standard battery of tests from any or all installed Tracker devices. Refer to the Chapter 9: *Creating and Using Protocols* of this module for more information.

The "**Strength Time...**" selection controls the length of isometric, or static, strength tests. This setting allows you to control both "ready time" and "test time." Ready time is the time between the exertion of force and the recording of data by the software. Test time is the total time from crossing threshold to the end of the test.
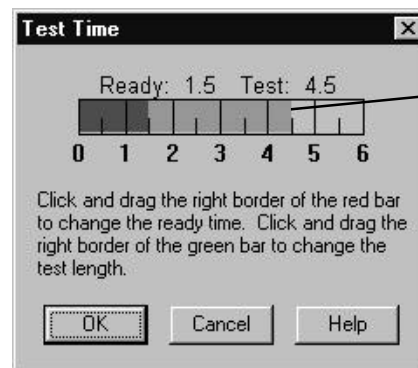
Drag the right edges of the color bars to adjust ready time or test time.

Ready time and test time are changed by clicking on the edge of the bar graph and dragging. Once these value are set, they beco me the automatic default for IsoTrack, LiftTrack and GripTrack sustained grip tests. These settings can be overridden for indiv idual tests at the Test screen using the "Test Time" button. Changing the test time at the Test screen does not change this setting.

 # Strength Reps dictates the number of repetitions to be performed as part of the testing protocol for each Tracker strength evaluation device (PowerTrack, Lif t-Track, IsoTrack and GripTrack sustained grip). The default is four, but validity is determined after at least two repetitions have been completed.
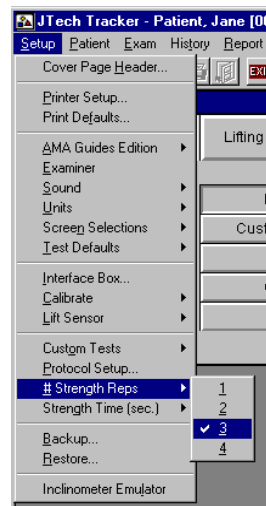
Tracker 4.3 and later has a module designed to document and track patient goals and treatment plans. This is designed to streamline the documentation process of the clinician. Custom goals and treatments can be created via these menus. For more information on how this software functions, refer to Module 15, Chapter 1 of the Tracker manual.
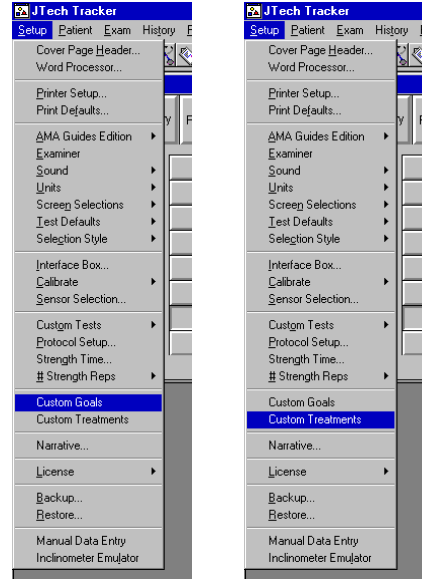
Tracker 4.3 also has a module designed to summarize the results of Tracker testing in a narrative format. Additional narrative phrases and templates can be created to facilitate efficient report writing. The ability to create custom narrative components a nd templates is accessed from this setup selection. For more information on the Tracker narrative writer, refer to Module 15, chapter 2 of the Tracker manual.
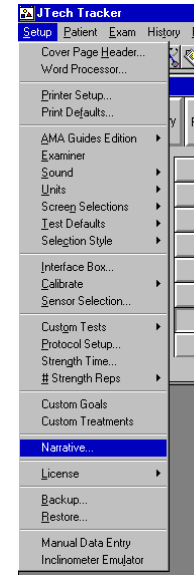
Tracker version 4.3 and later comes with the ability to preview and try new features of the software. In order for us to provid e our customers with this convenience, we must monitor the registering of software closely. Registering of software and transference of the site license is performed via this menu. For instructions on this process, refer to page 20 of this chapter.
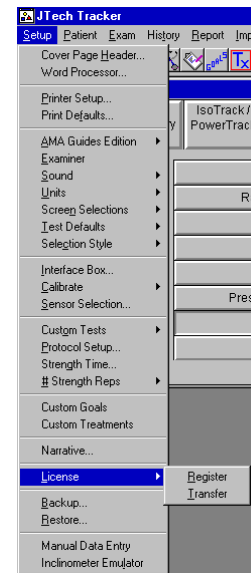
"**Backup**" is used to create copies of patient data files. When the screen at right appears, select the drive where the files are to be copied to.

"Restore" is used to retrieve data which has been stored on disk. The files will be copied back onto the computer's hard drive.
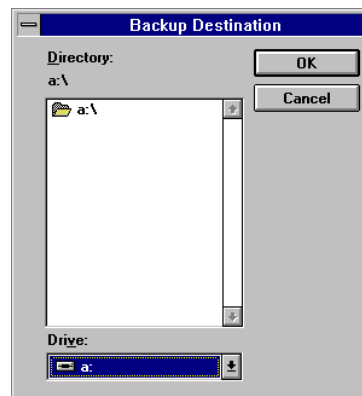
Note: JTech suggests backing up patient files on a daily basis. Backup disks should be stored in a safe place where they will not be e xposed to magnets or heat. **Hard drives do occasionally fail, and viruses do destroy data. Failure to regularly backup files may result in permanent loss of your patient database should your hard drive malfunction or a virus attack.**

JTECH has created an automatic, database backup routine to assist the user in the event the aforementioned "Backup" utility is n ot used. Each time the TRACKER software is exited, this routine is executed and creates a file in the format of trbk###.zip whic h is located in the data subdirectory. The # stands for a digit 0 -9, with trbk0001 being the first backup performed, etc. Once t he program has been exited 10 times, the most recent backup will overwrite the oldest backup file, thereby conserving disk space , i.e. the maximum number of backup files appearing in the data subdirectory will be 10. This file can then be saved to diskette for save keeping, and reopened using the "Restore" command.

Manual data entry is another module available in Tracker 4.3 and later. This feature allows the examiner to collect data with hi s Tracker hardware independent from the computer, and then manually enter the data to generate the report, and/or monitor the pa tient's progress. This also allows the user who may not have some of the Tracker components to generate a fully integrated repor t while collecting data with hardware already existing in the clinic. Manual data entry exists for ROM, MMT, Pinch, Grip and Lift data. For more information on this module, refer to Module 14, chapter 2 of the Tracker manual.
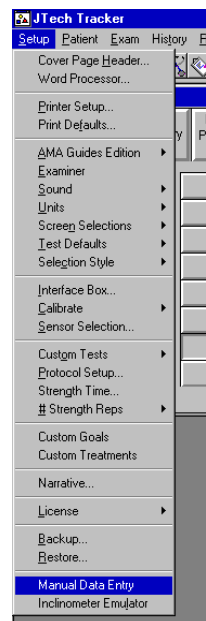
"Inclinometer Emulator" allows manual input of ROM data. For more information, refer to Module 2, Chapter 2: *Performing a ROM Test*. The emulator allows for input of both the main and the slave inclinometer data. Some states such as Texas require both value s to be reported. The conventional manual entry for ROM does not accommodate this need.
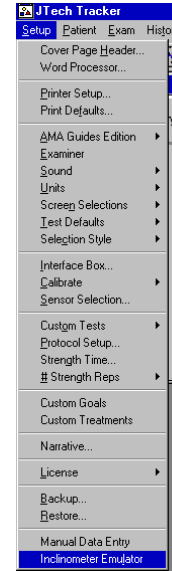
Registering Your Software

As part of this upgrade, we wanted to provide our customers with the convenience of "test - driving" the new Tracker System softwa re features. To do this, we had to develop a means of allowing the existing user 30 days of unlimited use and somehow return the system to the previous settings at the end of the demo. We also needed to provide potential customers the need to review the s oftware for 30 days, and have it shut off automatically if they decided not to purchase. As a result, existing Tracker users wil l be required to register their system with us, prior to the end of the 30 day trial period. This registration will insure that   all previous modules which were present remain present through the upgrade process.

Warning   **Failure register prior to the end of the 30 day trial will result in the entire system becoming inoperable until the registration occurs.**

During the 30 day trial period a new introductory dialog for Tracker will appear on your screen.
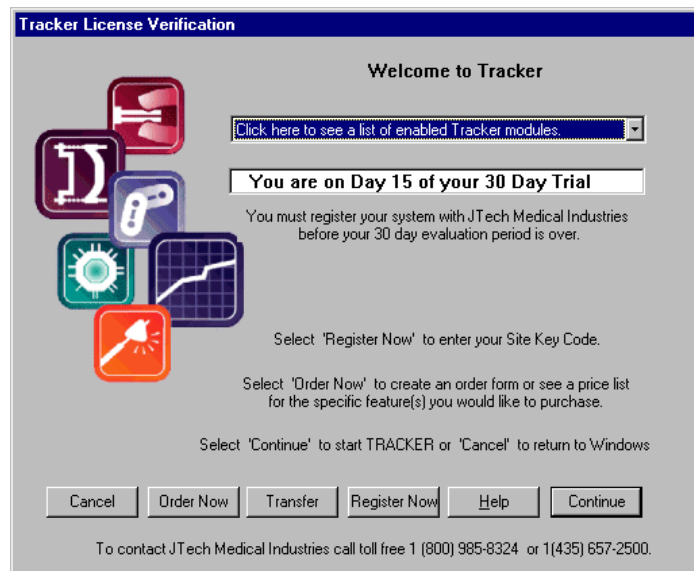
This screen serves as a reminder to register your system, displays modules you are getting free use of, shows the number of days left for the trial, and will disapear after registration occurs.

If you wish to bypass the intro screen and access the Tracker software, click "Continue." To exit the dialog and return to the Windows desktop, select "Cancel." To order a module or obtain more information or pricing, select "Order Forms." To see the new modules for Tracker, click on the downward arrow to see the dr opdown list of available items.

To register your system and obtain a site key, select "Register Now". The following screen appears.

Contact JTECH Customer Service at 800-985-8324 or 435-657-2500 and provide the representative the number listed in the box marke d "Site Code." The customer service representative will then provide you a 16 digit alpha -numeric Site Key. Enter that number in the block labeled "Site Key" and read it back to the JTECH representative. Click the " Authorize" button, and the modules you ha ve previously paid for will appear in the list above the authorization box. Other information pertinent to your site license wil l also appear. If you are concerned about the accuracy of the information contained in this dialog, alert the customer service representative immediately so that we may rectify the situation.

Transferring a Site License

By registering your software, you are assigning the software to run on a specific computer. The site key is specific to the site code. Each site code is unique and established by computer har d-ware. To use the Tracker software without purchasing an additional site license requires tran s-ferring the site key from the "source" computer to the alternate (hereafter referred to as the "destination") computer. This proces s is a multi-step process and proceeds as follows:

1. Ensure the Tracker software is loaded onto the destination computer.
2. Double-click on the "Run Tracker" icon to access the program.
3. Place a blank diskette into the destination computer flopp y drive.
4. Select the "Transfer" button at the opening dialog.
5. From the resulting dialog, select "Register Transfer" bu tton.

6. Remove the diskette from the destination computer, place into the source computer and select the "Transfer Out" button.

7. Remove the floppy diskette, and return it to the destination computer.

8. Select the "Transfer In" button on the destinati on computer as shown in the dialog below.

Be sure to follow the instructions outlined in the License Transfer Dialog. The dia log will walk you through the transfer process, and indicate if transfers were successful or failed. If a transfer fails, call JTECH for technical support.
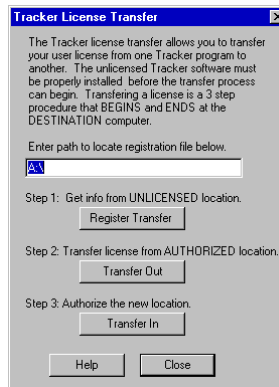
WARNING

As with any floppy diskette, ensure the diskette does not come into contact with any ma g-netic source including PC speakers, or the Dualer inclinometers. You may wish to make copies of the transfer diskette as a backup in the event your original floppy disk becomes unreadable. To do this, copy the contents of the diskette to your hard drive, t hen copy the files to another diskette. Direct copy from diskette to diskette will not work.

Long Distance Transfer

If the two computers are in separate offices which are miles apart this process is obviously not a handy solution. To make this w ork, have available two floppy diskettes. After completing step 6 in the above transfer procedure, place the second floppy in th e source computer and click the "Register Transfer" button. Bring both diskettes to the facility housing the destination comput er. Use the initial floppy to perform step 8 and then use Tracker. Prior to returning to the original clinic, insert the second floppy into the computer, and perform step 6 (steps 1 -5 were already completed previously). Reinsert the original floppy and hit "Register Transfer" so the process can be repeated next time.

Be sure to follow the instructions outlined in the License Trans fer Dialog. The dialog will walk you through the transfer process, and indicate if transfers were successful or failed. If trans fer does fail, insert the second floppy and try again. If not labeled appropriately, the diskette with the expected file may ha ve been mistaken for the other floppy.

If this procedure is not acceptable or too cumbersome, the solution would be one of two scena r-ios:

1. Purchase an additional site license from JTECH,

2. Use a laptop computer.

Chapter 4
Starting a Test

1. A patient must be selected before testing can begin. To select a patient, click on "Patient" or "Exam" from the top menu line , or the button with the stick figure icon, or click on a "Testing Module" button then a "Region" or "Test" button.

To start, click here...,

...or here,

...or on one of these buttons followed by one of these.

All included software modules are listed here as selectable buttons. Select a button to display the functions available for that module. If only one module has been purchased, selecting here is unnecessary.
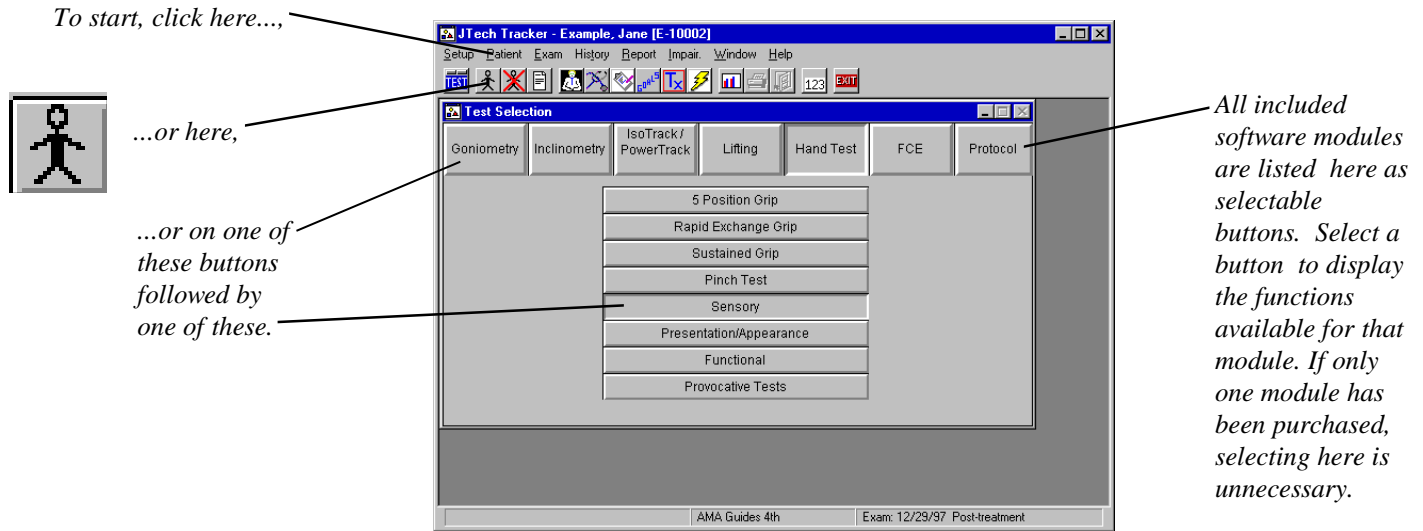
Note:

If a patient has not been selected and a menu pick requires a patient selection, the software automatically prompts for a selection by bringing up the following screens.

2. After making one of the preceding selections, the Patient Selection window will open. For a new patient, select the "Add" button. To test an existing patient, highlight the patient from the patient list and select "OK."

For large patient lists, use the search feature by typing in the first few letters of the last name.

Select this button when adding a new claim number for a separate disease or injury for the selected current patient. The test history for the new claim will be kept separate from previous test results.
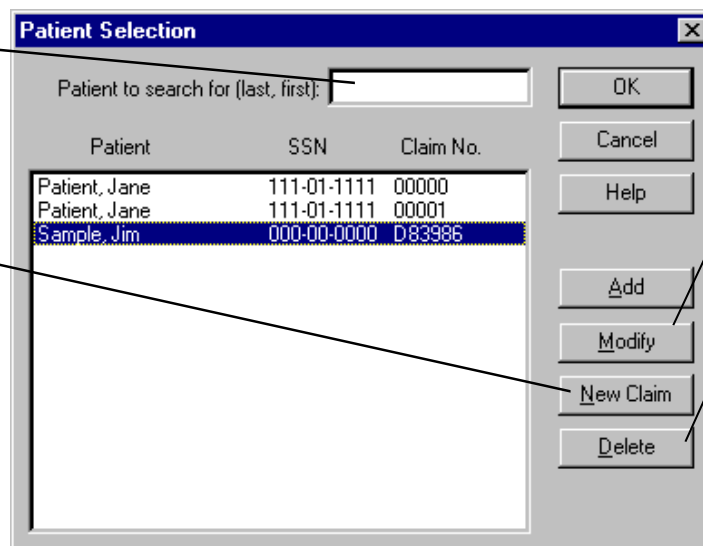
Use "Modify" to change patient information.

This button deletes the highlighted patient file. A warning prompt is displayed before the file is deleted.

3. Upon selecting "Add" or "Modify," the Personal Data screen appears. All information entered on this screen will appear on th e reports cover sheet. The last name, social security number, and claim number should be completed to uniquely identify this patient.

Use the mouse or the the arrow keys to toggle between Tab headers.

Patient Information   ? X

Personal | Medical | Referral Source | Notes |

Name
First & M.I.   Last
Ian J.   MacIntyre

Birth Date 02/12/1954   SSN 334-42-1637

Gender   ● Male ○ Female
Handedness   ● Right ○ Left
Occupation   Metal Casting Inspector
Claim Number: 456-789Q

OK   Cancel   Help

The Tab button on the keyboard moves the cursor from box to box.

The year must be expressed as a four digit number, i.e. "1954."

Click "OK" to save data and return to test selection screen.

Note: See Module 1, Chapter 5 *"Documenting Patient Intake Information"* for more details on this dialog.

4. Once a patient has been selected or added, the Exam Selection window may open, depending on how the Patient Selection screen was opened. If the Exam Selection window does not open, either select "Exam" from the Main menu list and "Select" from the dro p-down list, or select the "Module," then the "Region" button. From the Exam Selection screen you must select either "New Exam" to begin a new test, or highlight and click on a previous test from the list to open and edit or continue that test.

Exam Selection   X

Date   Description   OK
10/04/96 IsoTrack
08/07/96 progress   Cancel
07/10/96 progress
06/05/96 progress   Help
05/08/96 progress
05/02/96 progress
04/10/96 progress
03/06/96 progress   New Exam...
03/02/96 progress
02/07/96 new patient

To open and edit a previous test session, highlight the test and click "OK."

Click here to begin a new test.

5. Selecting "New Exam" from the previous window opens the Description/Examiner window. Use the description to help distinguish tests.   Every entry for both "Description" and "Examiner" is automatically saved as part of a database and becomes accessible for re-use through the pull -down menus. Click "OK" when finished.

"Description" is intended to be an identifying aid in reports and progress charts. To identify the effects of a treatment, the descriptions "Before Treatment" and "After Treatment" could be entered. The results could then be graphed using the history feature of the software.

"Examination Type" is used as part of the FCE narrative and is reported on the cover page.

Click on the downward ar-rows to access pull-down menus.

Note: The description of a test and/or the examiner name can be changed any time by selecting "Exam" from the Main menu item list, and   then "Modify Descriptions" from the drop - down list. If a patient has not be selected, the Patient Selection screen will be dis   played before the Exam Description window.

Selection Screen Layout

As summarized in chapter 3, selecting "Setup" from the menu items, then "Selection Method" from the resulting menu, controls the layout of the test selection screen. Pick the setting which works best for you.
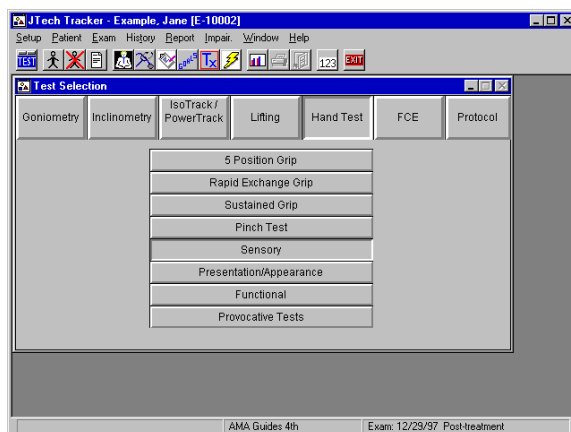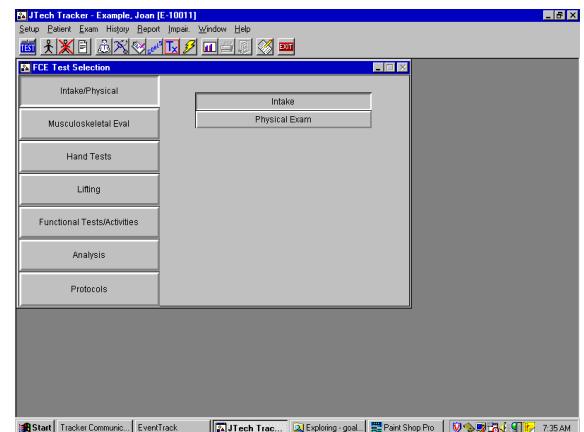
Standard Mode   FCE Mode

6. If you haven't already done so, select the button corresponding to test you want to perform from the Test Selection screen. F or more information about testing selections and software capabilities, refer to the respective modules in this manual.

Note: For more information on specific test protocols, refer to the appropriate test module documentation.

7. Once a test has been completed, choose the next test from the Test Selection screen. If the Test Selection screen is not vis ible, click on the first button on the button bar (labeled "Test") to bring the screen to the foreground.

Chapter 5
Documenting Patient Intake Information

Establishing a good rapport with the individual you are about to evaluate is very important, and the intake process is a good op portunity to do that. The individual needs to trust that you are not going to force him/her to do something that he/she is not c omfortable with or sure about. The individual will be more likely to provide you with their best effort and demonstrate their tr ue abilities if they are comfortable with you and know all of the rules. This is especially true for individuals with anxiety wh o do not understand or know their physical abilities and limits.

Access the dialog for adding new patient information as outli ned in Chapter 4, *Starting a Test*. To enter data on an existing patient, highlight the patient's name from the list, and select "Modify". In either case, the following dialog is displayed.

Patient Dialogs:

Personal History

A minimum of a patient name is required to continue with testing. The software uses patient name, social secur ity number ("SSN"), and claim number to uniquely define a patient record. All information entered in this dialog will appear on the cover page of the report and is available for use in the narrative writer. As with all the following dialogs, use the "Tab" key to advance from one field to the next, or simply click the mouse in the field of interest. In those fields in which multiple lines of input may be added, there is no need to hit the "Enter" button at the end of the line. The data will automatically wra p around. To start a new paragraph within the field, use "CTRL" and the "Enter" keys simultaneously.

Click the mouse on the heading tabs to toggle between the dialogs.

The year must be expressed as a four digit number, i.e "1954"

Use the "Tab" key on the keyboard to move the cursor between fields.

Click "OK" when finished to save entered data.

Patient Information

Personal | Medical | Referral Source

Name
First & M.I.   Last
Ian J.   MacIntyre

Birth Date 02/12/1954   SSN 334-42-1637
Gender   ● Male ○ Female
Handedness   ● Right ○ Left
Occupation Metal Casting
Claim Number: 456-789Q

OK   Cancel   Help

Medical History

Aside from establishing rapport, your interview process should also explore the individual's medical history. Fill any gaps in the medical history if a history is provided. If the individual's history is extensive, state such and refer the requesting party to the medical history for formal review. If no medical history was made available, attempt to complete a his tory by report of the individual. And identify it as such. This data will appear on the cover page of the report and is accessible for the narrative writer.

There is no need to hit "Enter" at the end of a line. The data will automatically wrap. To start a new line or paragraph within the field, use the "CTRL" and "Enter" keys simultaneously.

Referral Source

Identify the referral source as formally as possible and the goals of the referral source, i.e. Can this indivi dual resume their typical work duties? Can this individual perform modified duty? Is further rehabilitation necessary to return this individual maximum medical improvement in terms of functional ability?, etc. Referral source goals print on the cover page and are accessible for the narrative.

Notes:

Up to a half page of notes can be added in this dialog. These notes will appear on the cover page and are typically used to further summarize the medical history, presenting symptoms, goals for treatment etc..
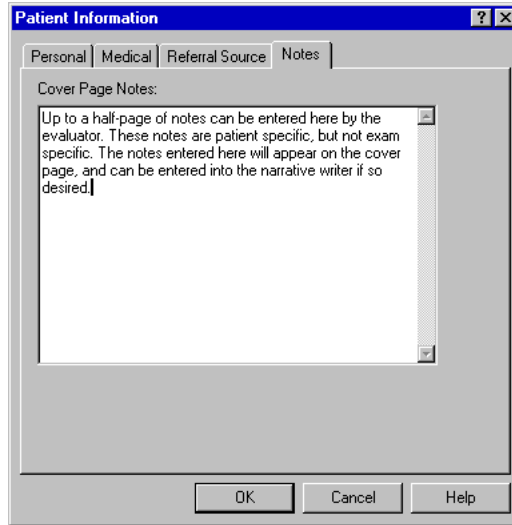
Intake Dialogs:

Select "Exam" from the Menu Item Line and then "Intake" from the resulting menu, or click on the button for "Intake" (pictured b elow). If in FCE mode, click "Intake" from the button list which appears under the heading of the main button "Intake/Physical"   . See chapter 2, *Software: General Information* for more information on selecting the menu mode.
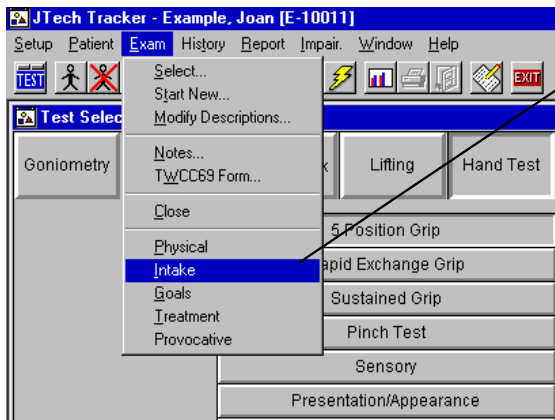
Select "Intake" or the button pictured below to access the following

Standard Mode

Intake Button
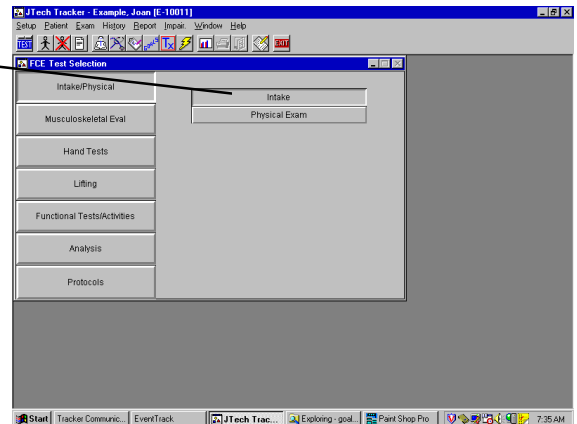
FCE Mode

Work History

If appropriate, identify whether a formal job description or analysis was provided. If provided, indicate the pert inent essential functions and associated critical demands. If not, attempt by report to understand the physical parameters of t he individual's job duties.

As with all intake data screens, the data entered in this dialog is printed on the report cover sh   eet and can be entered into the narrative writer. Use the mouse to toggle between tab headings.

Click the mouse on the heading tabs to toggle between the dialogs.

Functional Activity Questionnaire

In order to gain insight as to how the individual is performing outside of work and to offer a comparison to his/her actual participation in the testing, having the individual complete a questionnaire can be helpful. It m ay also give you information regarding siting, standing, walking and other functional tolerances. It may also give insight as t o how the individual's family life has been changed by the injury. Note any signs that disability behaviors exist outside of work, whether signs of role reversal or maladaptation appear or are reported.

Behavioral Profile

Getting an idea whether the individual has come to some form of homeostasis with the injury can also be impor tant. Doing so will help you better judge whether the individual can be relied upon to give best effort, exceed safe limits,   or misrepresent his/her abilities. A behavior profile will offer this insight into the individual. Use caution not to stereotyp e or prejudge an individual. Use the information to support or refute the actual efforts the individual demonstrates.

Intake

Use the interview process to establish the rapport that is critical to gaining insight and confidence regarding the patie nt's efforts. Document the overall results of the interview in the dialog.

Symptoms

Document symptoms the patient is currently complaining of or has experienced in the past

Procedures

Document any procedures (surgical, diagnostic, treatment, etc.) the patient has undergone pr   evi-ously.

Physical Information:

Once a patient has been selected, click "Exam" from the Menu Item List, then "Physical" from the resulting menu, or click on th e "Physical" button on the button toolbar (pictured below). In FCE screen mode, click on "Physical" from the button list which   appears under the heading of the main button "Intake/Physical" as another option.

or click here ...

....then here

to document physical observations.

Physical Button

In FCE Mode, first click here....

then here.

FCE Screen Style

Use the "Tab" button to toggle from field to field, or just click the mouse in the desired field.

Type in the requested data. If you have the TRACKER Heart Module, data is automatically entered when the heart icon is clicked.

Click on the respective button to add notes specific to that category.

The data fields on the previous screen are printed on the cover page of the report as well as on the physical findings report. U se the "tab" key to toggle between fields, or simply click the mouse in the desired space. If the TRACKER Heart Rate module is e nabled, click on the red heart to import data from the monitor into that field. Use the radio buttons within the "Physical Info rmation" dialog to signify standard or metric units for the anthropometric data. To document observations associated with postur e, mobility, sensation, strength, pain, reflexes, ROM, balance, presentation/appearance, mental, neurologic, or non -organic sign s, click on the respective button. This data is printed on the physical findings report page.

For each tab that is selected, a   corresponding general -edit field is displayed (as pictured below). Place the cursor in the edit box and begin typing. All notes   that are entered are printed out on the "Physical Findings" report page, and can be accessed as part of the narrative writer.
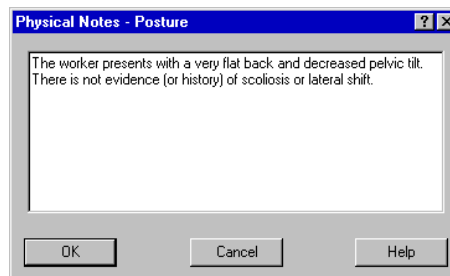
Chapter 6
Adding Notes

Note writing can be accessed two ways: through the "Exam" menu item, or by selecting the "Notes" button.
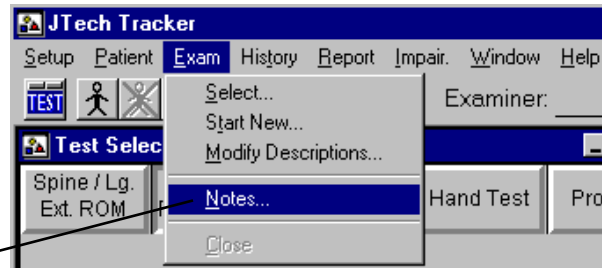
To access "Notes," click here....

...or here.

Note: Notes are keyed to the selected exam and are printed on the last page of the report. The number of notes is limited to 40, and the maximum number of characters per note is 399. For general notes not keyed to a specific exam, use the cover page notes foun d under "Patient," "Modify."

When selected, the Notes window appears as below. If the cursor is blinking in the bottom box, begin typing the note. (If the b linking cursor does not appear in the bottom box, move the pointer to the bottom box and click.) When the first note is complet e, click on the "Add" button. The first words of the note will appear in the top box. If additional notes are to be added, begin typing the second note in the bottom box. Click on "Close" when you are finished adding notes.

To delete a note, highlight t he note in the top box by clicking on it, and then select the "Delete" button.

To edit a note, highlight it in the top box and it will appear in the bottom box. Make the required changes in the bottom box, then click on "Add."

Compiled notes box.

Adds any open notes to the database and closes the dialog.

Click to "Add" a new note

Notes editing box.
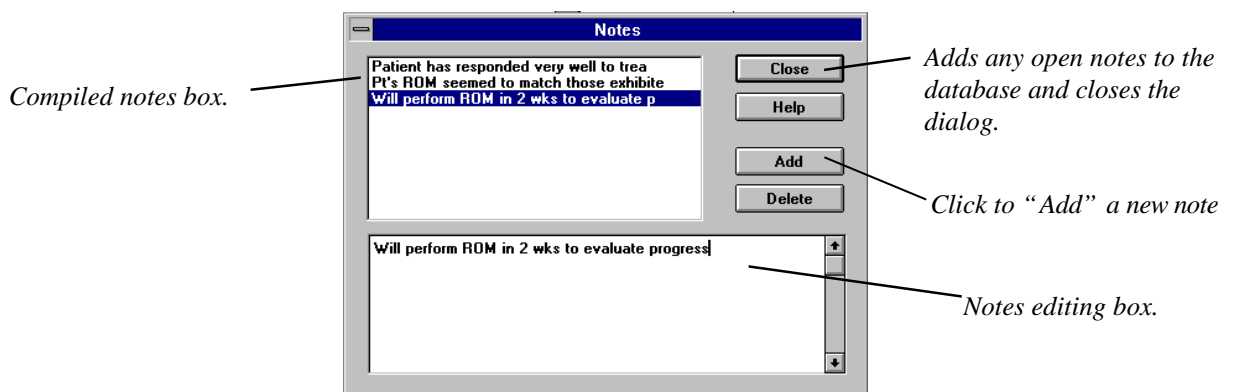
Note: To delete sections of text in the bottom box, drag the cursor to highlight the text and press the "Delete" key on the keyboard. To insert text, place the cursor at the desired location and begin entering text.

This page left blank intentionally.

Chapter 7
Creating Reports

Tracker software allows a complete report to be sent to a printer, or to a computer screen for previewing. The software is al so flexible enough to create reports for only those components which are needed, such as the cover page, testing reports or deta ils, impairment calculations, history charts or notes. With a color printer, some report components are colorized to help impro ve presentation of the data.

Tip:

Prior to printing, make sure your printer driver is set to run in a Windows™ environment and is configured to print graphics.

To initiate report creation, select "Report" from the menu item list.

Click here to access report writing.
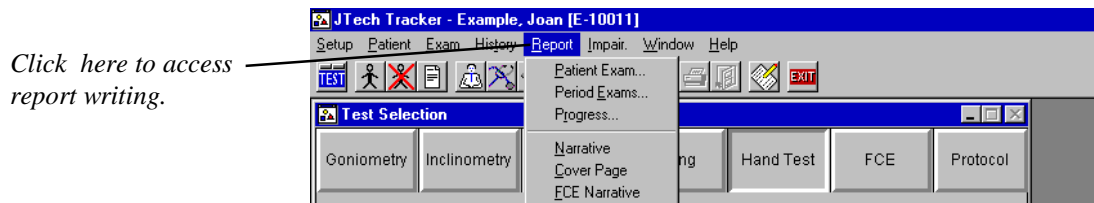
Click on the "Sample Reports" icon to see sample printouts of each Tracker component.

Patient Exam...

To create a report for only one patient, select "Patient Exam" and the following dialog box is displayed with the patient name, test dates, and report options listed.

Highlight the test to be printed by clicking the mouse over the desired selection

Highlight the desired report components from the list by clicking on each with the mouse. Use the scroll bar to see all options.

Select the output option by clicking the mouse in the corresponding white circle.
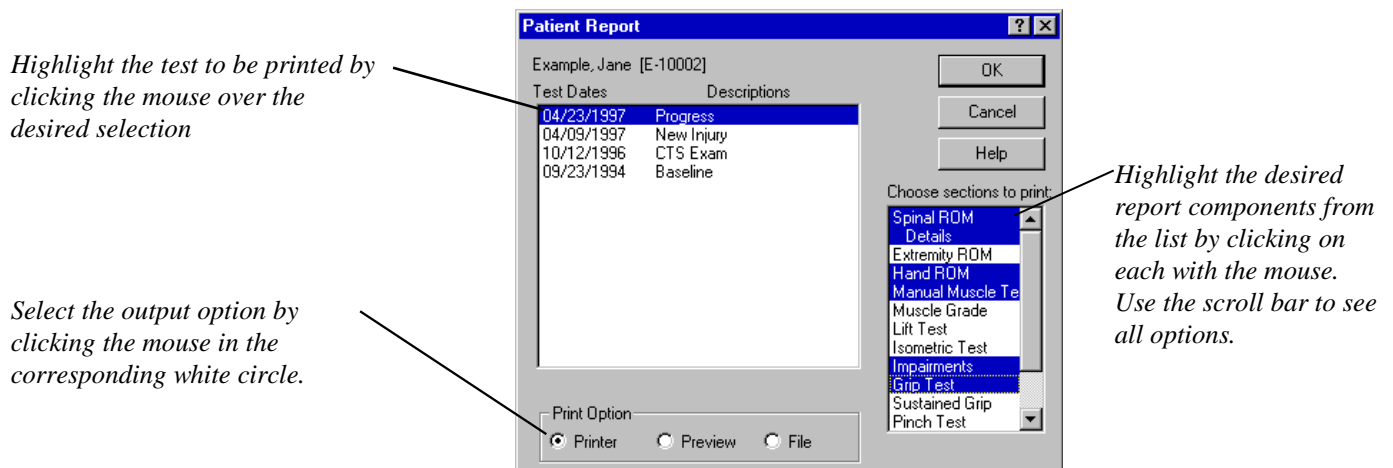
Select the appropriate test date or drag the cursor to select multiple dates. Highlight the desired report components with the cursor. Printing to the printer is the default, but the report can also be previewed on the screen.

The "Preview" radio button at the bottom of the dialog allows you to view reports before printing. After selecting a report to view, click the "Preview" button then "OK." This will take you to the Report List dialog, which is explained below in *Previewing and Printing Reports*.

Period Exams...

In some instances printing all exams for a certain time period can be advantageous. If, for example, a practice is set up to p erform many tests during the course of a day, there may not be enough time to print out a report after each patient. With the " Period Exam" option, all exams performed on a given day, week, month, etc. can be easily accessed and printed at the same time. If "Period Exam" is selected, the following screen will appear. Use the pointer to select the tests to print.

To print a block of reports, select the first date, hold the "Shift" key down and click on the last test in the block.

To print multiple blocks of tests, select the first test, then while holding the "Ctrl" key down the entire time, drag the cursor over the tests in the first block, then skip to and drag over all subsequent blocks.

To select only specific tests, hold down the "Ctrl" key and click on each test.
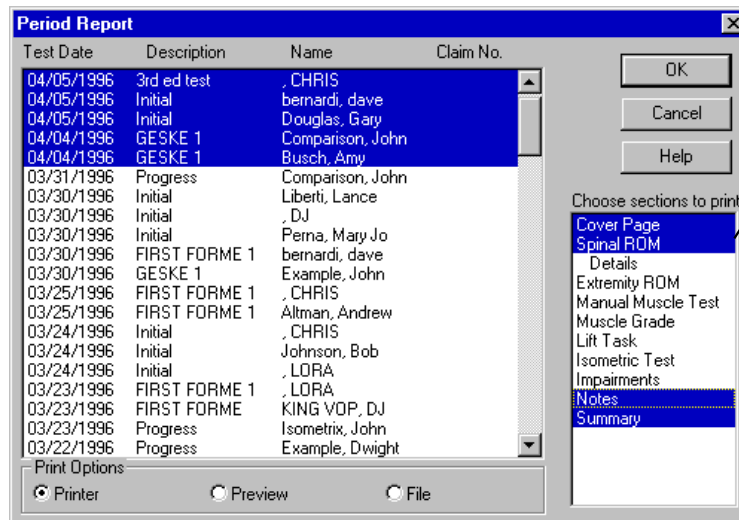
Highlight the report compo- nents to be printed out for the selected tests.

The "Print" and "Preview" radio buttons function the same as in the Patient Report dialog.

Progress

The "Progress" selection allows you to preview and print graphical history charts for the selected patient. (For more informati on, see Chapter 7: *Displaying Patient History* of this module.) After selecting "Report," then "Progress," the following dialog appears. From this dialog you can print and/or preview a history/progress chart for one or more specific tests, or all the list ed tests. To select specific tests, place the cursor on a test and click, repeating for each additional test. To deselect, cl ick on the highlighted test. To print or preview all available tests for the patient, click on "Select All."
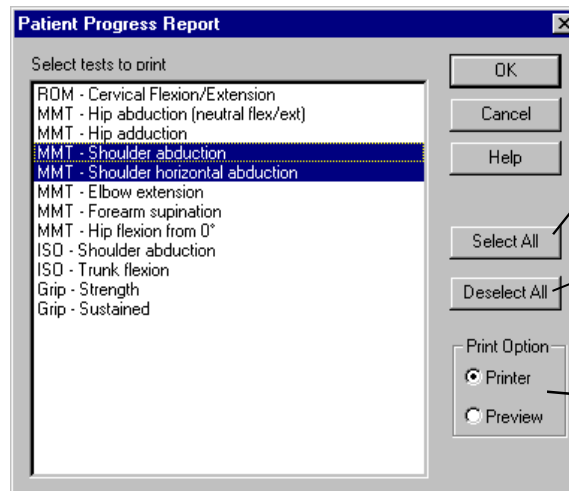
Click here to select all tests listed to the left.

Clicking here deselects all tests and allows you to start over.

Use these radio buttons to go directly to printing or to preview the charts first. The default is printer.

Narrative

All Tracker test data and patient specific data can be summarized in a narrative report format. Refer to module 7, chapter 2 *Narrative Writing* for more details. Creation of the narrative occurs from this dialog. Depending upon the configuration established in "Setup" , "Word Processor", the compiled report is entered into a word processor as an RTF file. If no word processor preference is selected, the software defaults to Microsoft WordPad. Once imported and converted (This conversion happens automat ically), the document can be edited, added to, printed, saved and deleted just like any other word processed file.

FCE Narrative works in similar fashion. Refer to the Tracker FCE Manual for more details.
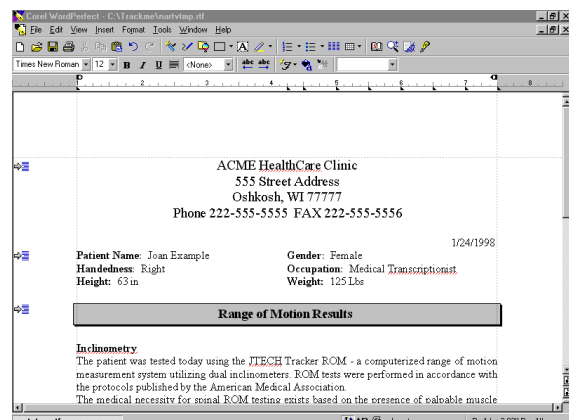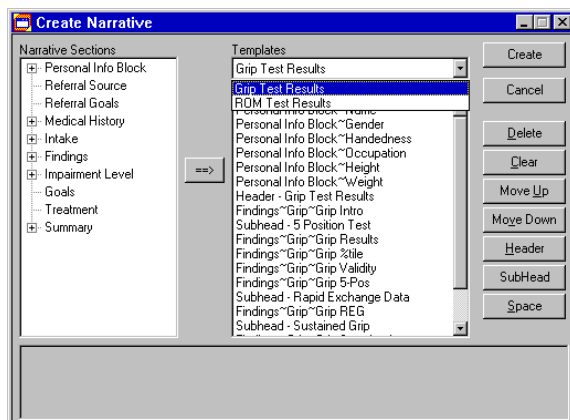
Cover Page

This menu item is functional for all TRACKER modules if running version 4.0 or later. Depending upon the configuration establish ed in "Setup" , "Word Processor", the compiled cover page report is entered into a word processor as an RTF file. If no word pro cessor preference is selected, the software defaults to Microsoft WordPad. Once imported and converted (This conversion happens automatically), the document can be edited, added to, printed, saved and deleted just like any other word processed file. Refer   to your word processor manual for more information on how to perform these operations.

Data which appears as part of the cover page includes patient data, medical history, referral source, work history, physical findings, and summary notes. Only those fi elds with entered data will print as part of the report.

This cover page prints in a different format than the cover page which   is selectable as part of the "Patient Exam" report list.

Previewing and Printing Reports

After clicking "OK" in either the "Patient Report" or "Period Report" dialogs, the following screen appears. If "Printer" was selected, a standard Windows printer dialog appears aut o-matically. If "Preview" was selected, click on the document icon to preview the selected r e-ports on the monitor. When you are finished previewing the reports, click the printer icon to print the reports or click "Exit. "

The Narrative and Cover Page Reports do not print in preview mode. Use the word proce s-sor to visualize the report prior to printing.

Prints the listed reports.

Closes the window.

List of print jobs awaiting action.

		Report List	▼ ▲
File View Help			
Close	🖨	📄	⊗
Reports to print			
Dwight G.Example, (04/17/1995), Progress 4			

Previews the highlighted report. To preview other reports, select from the list and press this button.

Deletes the highlighted print job.
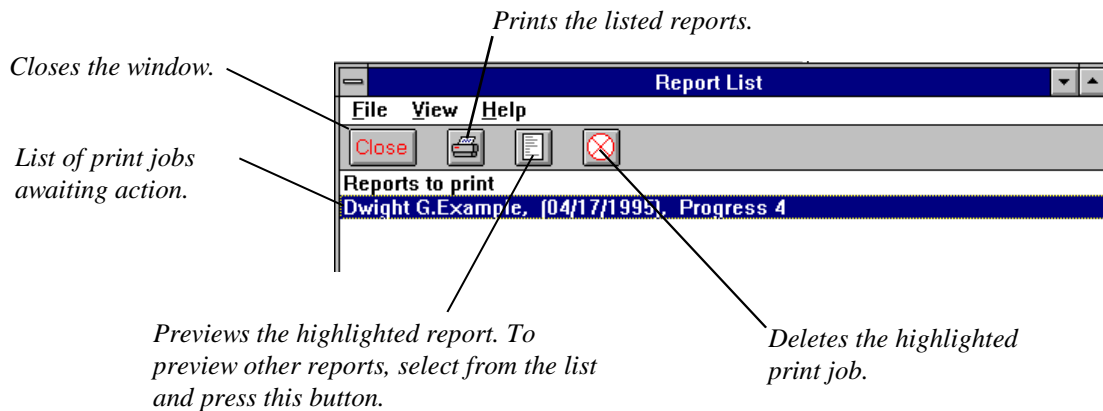
As an alternative, select "File" from the command menu in this window for a list of options including: "Print," "Print Preview,"   "Delete," and "Exit."

Chapter 8
Displaying Patient History

Once a test has been completed, a history or progress comparison can be displayed and printed in a bar graph format. To view a H istory chart, select a patient from the patient database, select "History" and "Graph" from the pull -down menu, click on the bar -graph icon, and select a patient from the resulting dialog.
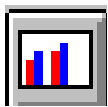
Clicking on this button acts as a shortcut.
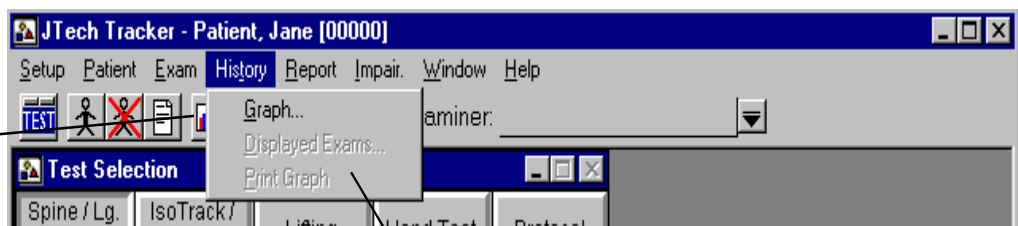
The grayed-out menu selections can be selected after a history chart is displayed. Their uses are explained below.

A list of all the tests completed for a patient is displayed in the History Selection window. Highlight the test of interest an d click "OK."
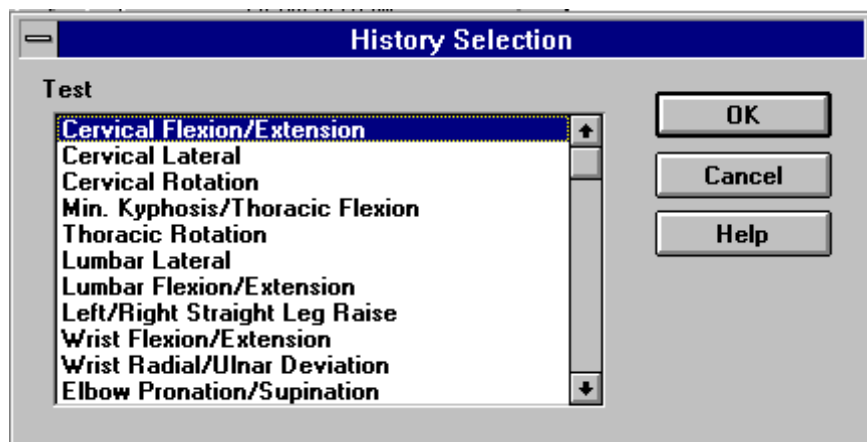
Note: Multiple histories can be displayed at one time by repeating the above process (see page 28 of this chapter). The "Screen Selec tions" setting in **Setup** must be set to "Unlimited" to access this advanced feature.

A maximum of eight sets of bars can be displayed on a graph at one time. If more than eight tests exist, the additional tests c an be viewed by using the scroll bar.

Maximum values are graphed and displayed numerically above the bars. Norms are indicated by arrows.

Test dates and descriptions are used to identify and document tests.

Time interval and corresponding increase (or decrease) in ROM or strength are displayed here.

By placing the cursor over any set of bars and clicking the right mouse button, a menu is displayed (as illustrated below). Cli cking on "Statistics" displays all of the data for that specific test. Refer to the applicable test module documentation for detailed information on the significance of the statistic boxes.
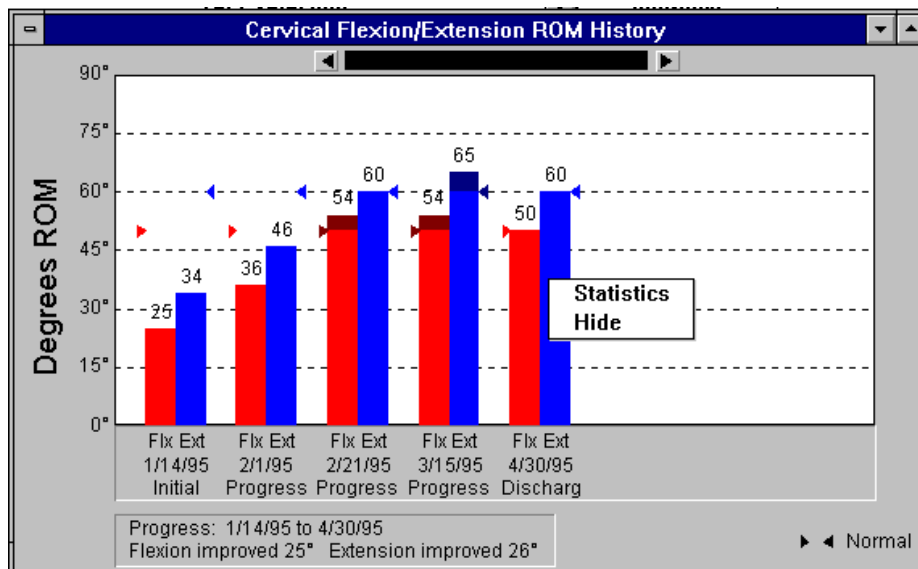
By selecting "Hide" rather than "Statistics" from the aforementioned menu, the selected set of data bars disappears. The progress information will then be updated to reflect the changed bar graph. Using the "Hide" feature allows you to select only those e xams you wish to display.

Progress dates and improvement values are automatically updated to reflect changed graph.

Test on 4/30/95 was eliminated with the "Hide" feature. (See history graph on previous page.)
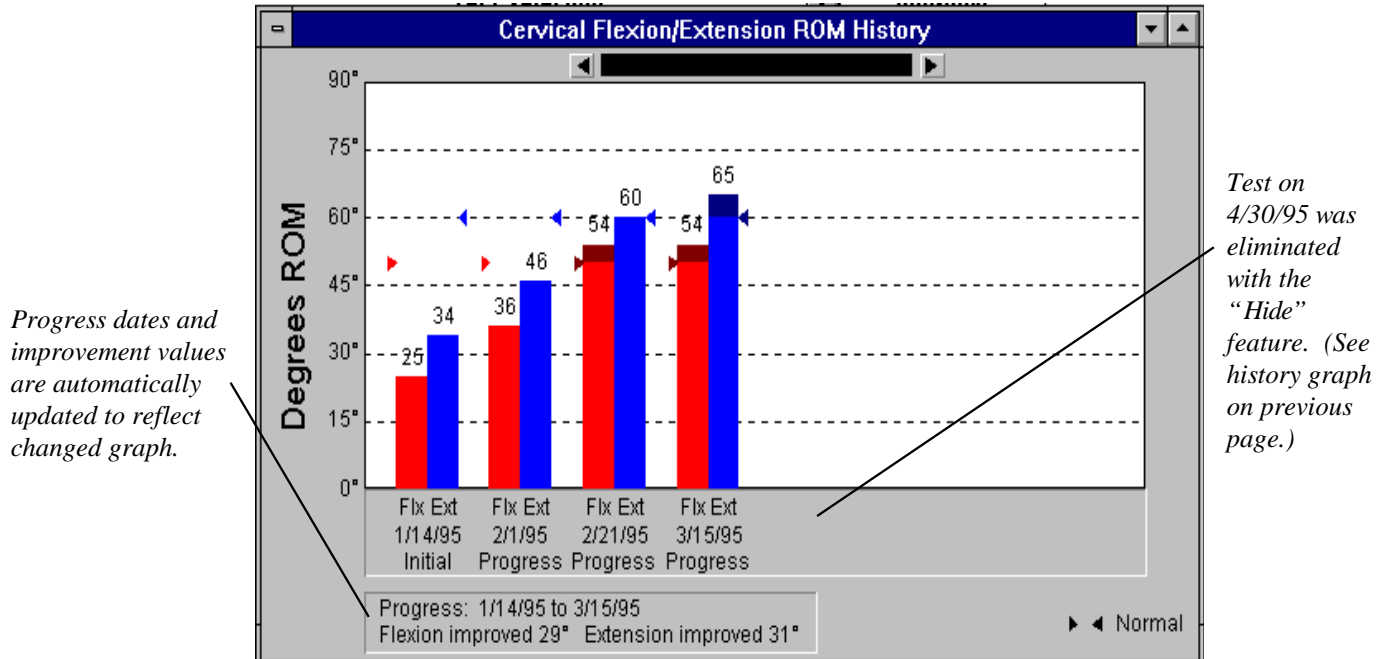
The same results can be achieved after a History graph is displayed by selecting "Displayed Exams" from the "History" pull -down menu. A list of test dates and their descriptions will appear. Highlight those tests which are to be displayed on the graph and press "OK."   If more than one History chart is displayed, the selection is for the active chart. The "Displayed Exams" select ion can also be used to restore hidden bars.

Click on those exams you would like displayed on your History graph.
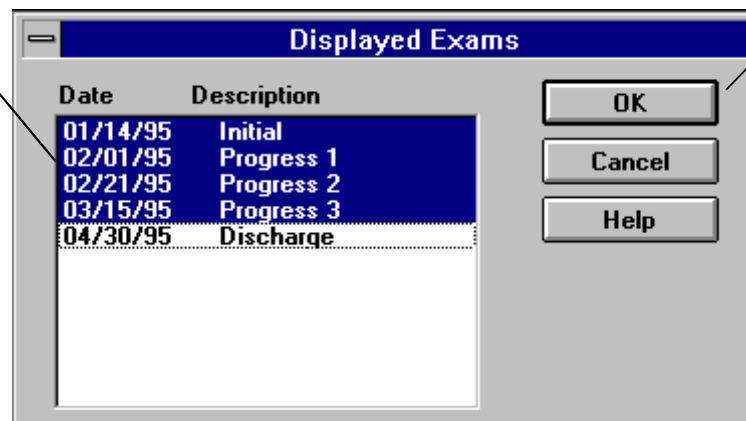
Click "OK" to see modified graph.

Note: Hiding bars in the displayed histories does not remove the test from the patient database.

Displaying Multiple Histories and Tests

Multiple History charts and tests can be displayed simultaneously. To use this advanced feature the "Screen Selections" setting in "**Setup"** must be set to "Unlimited."

Select tests individually through the History Selection dialog. To arrange the histor ies for easier viewing, use the "Window" menu bar item to cascade or tile the histories. "Cascade" overlaps one history chart o n another. "Tile Vertical" or "Tile Horizontal" displays the history graphs so they can all be seen at one time.

Printing a History

When a History chart is displayed, it can be printed in either of two ways: First, simply click on the printer button on the Tr acker menu bar; or second, click on the "History" menu item, then select "Print Graph."

To print multiple history charts for a patient, select "Report" then "Progress..." from the menu and the dialog below appears. Highlight the History charts to be prin ted and click "OK."

Under normal circumstances, the first two tests selected will print on the first page, the next two on the following page, etc. If more than eight exam dates are present for a particular test, the History graph will spill over into t he next graph and will be labeled accordingly. All subsequent histories would then be shifted down a page. Use the "Print Preview" option (explained in the previous chapter) to view the resulting graphs prior to printing.

Highlight those tests for which the History is to be printed.

Patient Progress Report

Select tests to print

ROM - Cervical Flexion/Extension
ROM - Cervical Lateral
ROM - Cervical Rotation
ROM - Lumbar Lateral
ROM - Lumbar Flexion/Extension
ROM - Left/Right Straight Leg Raise
MMT - Ankle dorsi flexion/inversion
MMT - Shoulder flexion
MMT - Shoulder abduction
MMT - Elbow flexion (forearm supinated)
MMT - Apple
MMT - Peach
MMT - Broccoli
MMT - Chocolate
MMT - Peanuts
MMT - Eggs
Lift - NIOSH Arm Lift
Lift - NIOSH High Near Lift
ISO - Shoulder abduction

OK
Cancel
Help
Select All
Deselect All

Print Option
• Printer
○ Preview

Use these buttons to highlight all tests, or deselect all tests.

These radio buttons are used to preview the graphs or send to the printer.

Tip: Using a color printer, the graphs can be printed in vivid red and blue, which makes a more dynamic presentation.

Chapter 9
Creating and Using Custom Protocols

Tracker's ability to custom create protocols allows the user to perform a standardized, predetermined set of diagnostic tests on patients. Clinicians can now tell assistants to perform a particular diagnostics protocol on patients fitting a particular desc ription, and the software will guide them through the entire test series. Based on the results of the tests in the predefined protocol, the clinician can then decide if further tests should be performed.

A custom protocol is an orderly arrangement of se lected tests (standard or custom) available in the Tracker System. Custom Protocol can incorporate any Tracker testing module o n the user's system. Tests are identified and then placed in order according to convenience, logistics, or other criterion. Whe n a protocol is selected, the software will display each test in the predetermined sequential order. This allows the examiner t o complete the test series with minimal interaction with the computer keyboard during testing.

The Tracker "Next" foot switch i s a very useful tool when using custom protocols. The "Next" switch can be used instead of the keyboard to close dialogs and ad vance through tests.

To create a custom protocol, select "**Protocol Setup**" from the "Setup" menu item.

Click here...

...then here to set up a testing protocol.

Click here to view previously created protocols

Click here to add a new protocol.
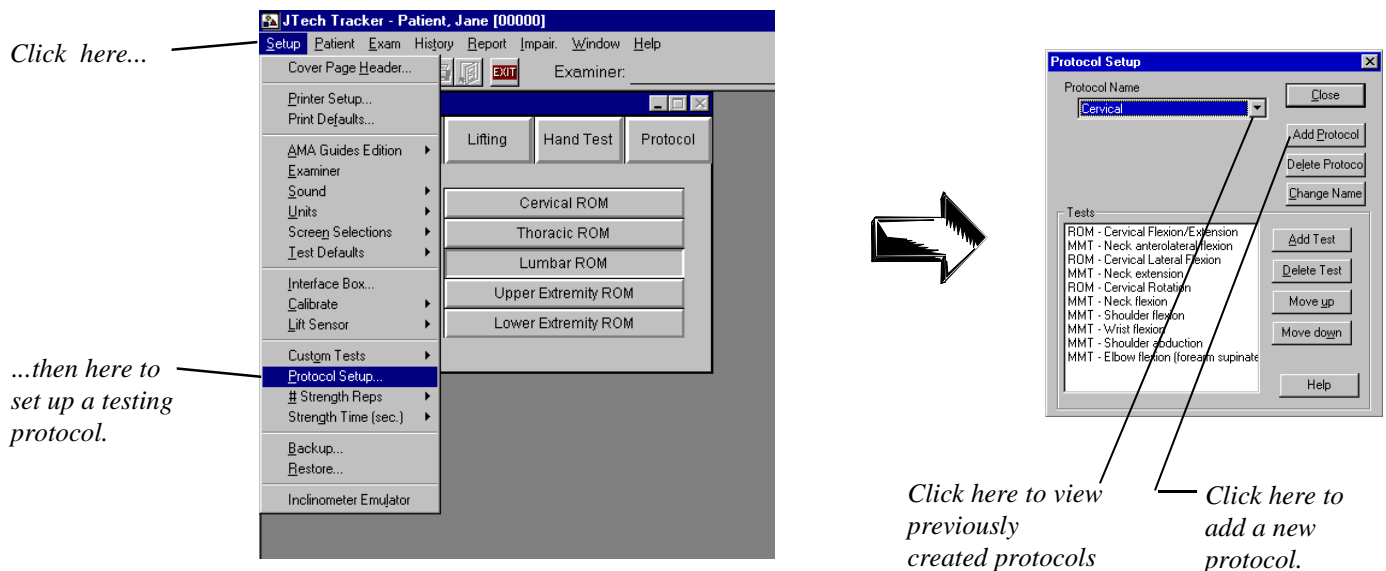
To edit an existing protocol, select it from the protocol name list. To make a new protocol, click on the "Add Protocol" button . After "Add" is selected, the software will prompt for the new protocol's name. Type the name of the new protocol and click " OK."

After the new protocol has been named (Lumbar in this ex - ample), select those tests which are to become part of the protocol. To view the list of available tests, click on the "Add Test" button. The screen below will appear.
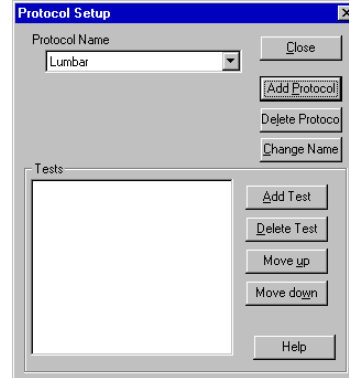
The test options appearing in the screens below depend upon the modules available in your Tracker software. Use the scroll bar if necessary to view all available tests.

As shown below, adjacent to each of the available modules, is a set of brackets containing a plus or a minus sign. A plus indicates the corresponding item contains additional tests that can be displayed with a double click of the mouse. A minus sign indicates that the heading has been completely displayed. Some tests can also be differentiated based on left or right side.

Highlighting a test indicates that the item has been selected for addition to the   protocol. To remove the highlight, click again on the item.

Highlighting a heading has the same effect as highlighting all of t   he individual tests under that heading. For example, selecting "Cervical ROM" is the same as selecting "Cervical Flex/Ext," "Cervical Lat. Flexion," and "Cervical Rotation."   Similarly, selecting MMT - Shoulder Flexion assumes that both right and left side   tests will be performed.

Only available modules are listed. A [+] designation in front indicates that the listing is a group from which you may select individual tests. Click on the group to see individual tests.
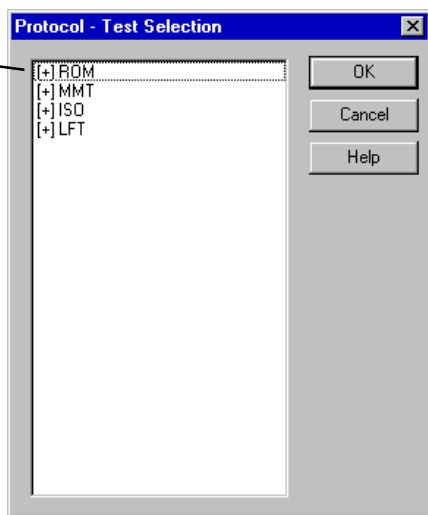
No designation means you have reached the last layer of the group and the test is
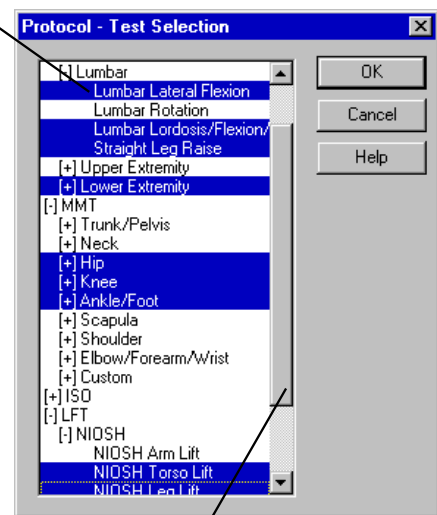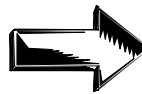
Click on the scroll bar to see additional tests.

Clicking on the "OK" button takes all tests highlighted in the Protocol Motion Selection screen and lists them in the Test Protocol window (pictured at right). Within this dialog, tests can be deleted, added, moved up, or moved down. This allows precise control of the order in which the tests are to be completed. The order of the tests in this window is the order the software will use to select test screens and prompts.

To delete a test, highlight the test and click the "Delete Test" button.

To move a test up the protocol list, highlight the test and click the "Move Up" button. Similarly, to move a test down the list, click the "Move Down" button. Only one test can be highlighted at a time.

After the order of the tests is defined, click the "Close" button to save the protocol.

After protocols have been defined, access them by pressing the "Protocol" button, and then "Test/Select" from the Test Selection window.
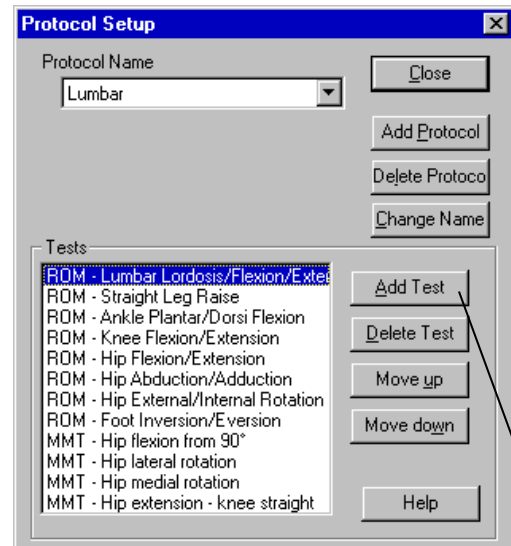
This button is selected to add tests to the protocol list.
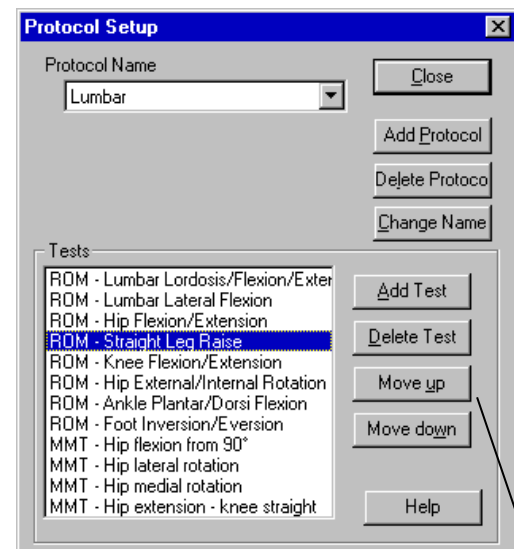
Highlight a test, and put it in the proper order with the "Move"
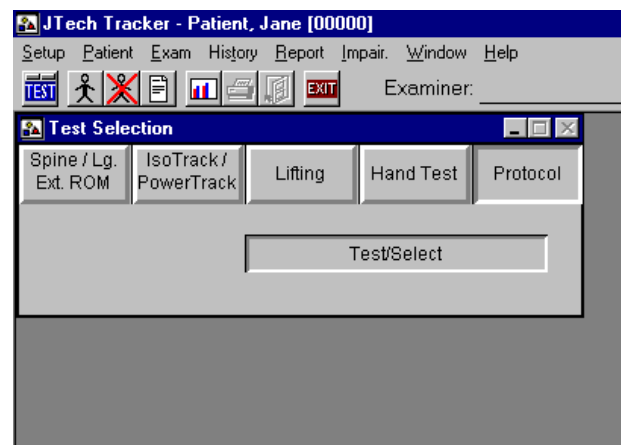
From the Protocol Selection wi n-dow, click on a protocol to display all tests associated with that prot o-col.   To automatically   complete every test associated with a selected protocol, click on "Test All."   Clic k-ing "Test" will only access the hig h-lighted test. After an individual test has been completed, clicking "Test All" will only activate those tests which have not been previously pe r-formed.
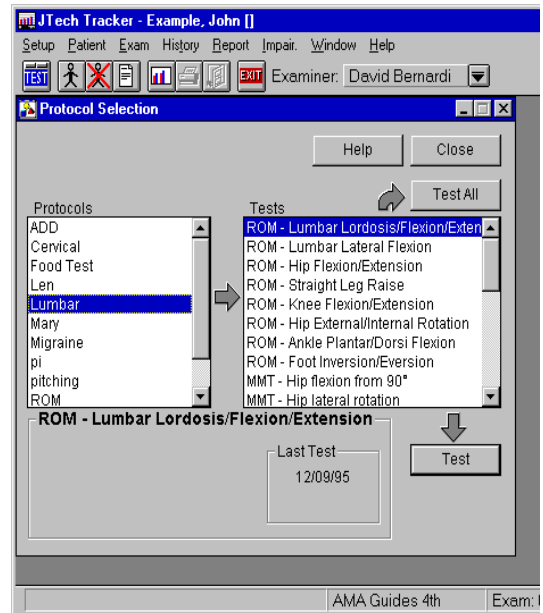
Chapter 1
Using Inclinometers

Inclinometry Principles

For purposes of evaluating spinal impairment, goniometers have been disallowed in court since 1989. Inclinometers are the prefer red method for measuring mobility of the spine. Quoting from the AMA's *Guides to the Evaluation of Permanent Impairment*:

> Regional spinal motion is a compound motion, and it is essential to measure simultan e-ously the motion of both the upper and lower extremes of that region. Therefore, mea s-urement techniques using inclinometers are more appropriate than those utilizing goniom e-ters for obtaining reliable spinal mobility measurements.

Tracker's dual inclinometry is much more accurate than a single inclinometer and is pr e-ferred when documenting spinal range of motion. The second sensor automatically su b-tracts out extraneous motion; therefore, the value displayed and entered into the software is the true motion.

Dual inclinometers are also useful for extremity ROM measurement. Protocols for mea s-uring the extremities are outlined later in this chapter.

Inclinometer Calibration

If you are turning the system on for the first time that day, a message indicating the need to calibrate the inclinometer sensor s appears in the middle of the computer screen. Typically, the software will prompt for calibration whenever it is warranted.

After the dialog appears, place the sensors on a flat surface, such as a tabletop. Make sure the graphics on both sensors face the same direction and that the sensors are in the same plane. When inclinometer sensors are correctly positioned, click on the   software's "Calibrate" button.

Ensure that the sensors are in the same plane and facing the same direction.

Select "Calibrate" after placing the sensors in the proper position.

Inclinometer Calibration

Place both inclinometers on a flat level surface then select "Calibrate".

Calibrate   Cancel   Help
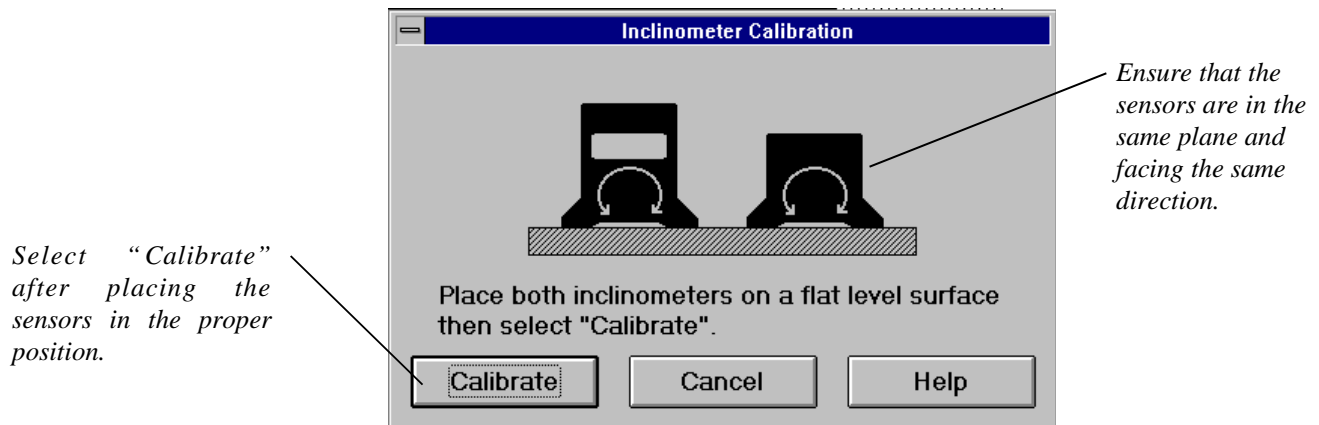
Inclinometer Features

Enter and Hold Buttons on the Master Inclinometer

An enter button is located on the top of the master inclinometer. This button   is used to enter neutral position and end range of motion angles into the software. An external "Enter" switch can also be use d.

The hold button on the side of the master inclinometer does not provide any function in the software. When the inclinometer s are used independent of the software, the hold button will freeze the display on the master unit. Upon release, the display r everts to normal operation.

Hand/Foot Switches

Enter switch: This switch is used to enter neutral position and end range of mot ion. To activate the switch, plug the red connector of the hand/foot switch into the interface box. The switch can be used on a table or on the floor as a foot switch.

Next/Skip switch: This switch can be used instead of the mouse for tabbing through ROM menu fields to select the proper joint. Plug the black connector of the hand/foot switch into the interface box to activate .

Master Inclinometer On/Off Button

The on/off button on the top of the master inclinometer should be "off" when used with the software because the interface box provides power to the master unit. The master unit battery (used for independent operati on) will have reduced life if the switch is left in the "on" position.

Straps

In some cases, straps can be used as indicated by the Help screens. To attach the inclinometers securely to the straps, twist the inclinometer back and forth on the strap so that more hook comes into contact with the loop.

If speed of the exam is important, the straps can be omitted. Firmly hold th e inclinometers on the body without any slippage. Make sure to maintain proper orientation during the entire movement.

Portable Non-computerized Inclinometer Use

The inclinometers can be used when a computer is unavailable. Detach the slave and master inclinometers from the coiled cables. Attach each end of the short (1") cable to both inclinometers. Turn on the master unit us ing the on/off switch located on the top of the master inclinometer. Consult the Dualer instruction manual for more information   on portable operation.

Inclinometer Accuracy Rules

Since inclinometers use gravity as the reference for rotation, proper orientation and use of the instruments is essential for ac curacy. The following five rules should be observed:

1. ORIENTATION: Always keep the Velcro faces of the master and slave inclinometers within 40 degrees of vertical and parallel to the plane of motion. All planes of motion should ideally be vertica l. For spine flexion/extension, spine lateral measurements, and most extremities, the patient should be seated or standing so t he sagittal and frontal plane are vertical. For spinal rotations, the patient should be supine or bent at the waist so the tran sverse plane is vertical (or within 40 degrees of

| correct | marginal | incorrect |
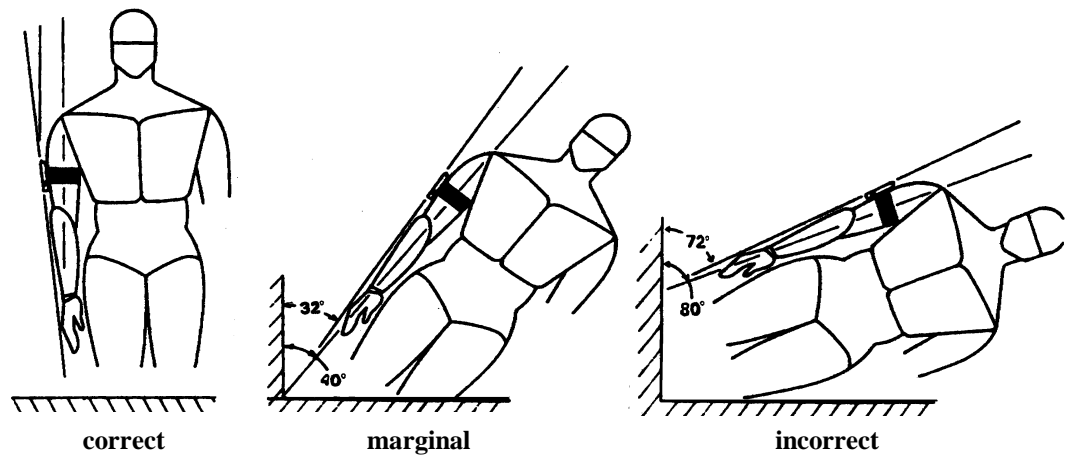
2. DIRECTION: When using both inclinometers always make sure that the printed side of both inclinometers face the same direction. Incorrect position will result in signif i-cant angle errors.

Printed sides of master and slave unit are

| correct | incorrect |
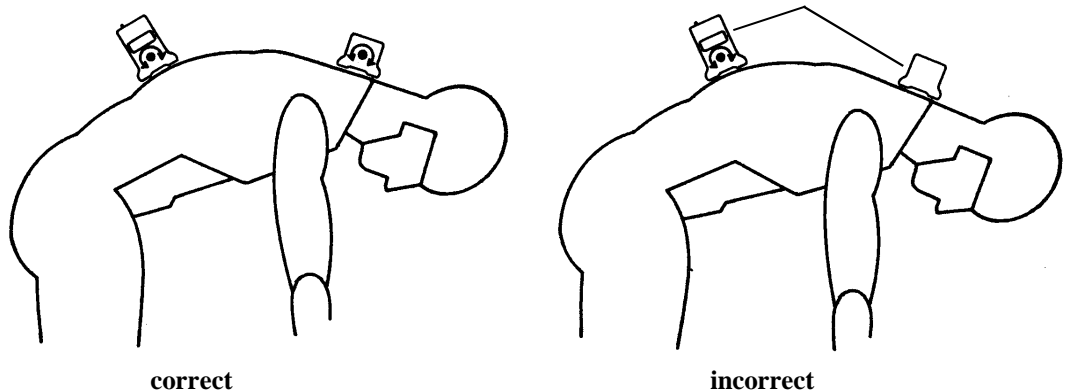
3. PRESSING BUTTONS: During spine or extremity measurements in inclinometer mode, gently press the "Enter" button on the master inclinometer to prevent mov e-ment of the inclinometer on the strap. Using the foot/hand enter switch is preferred and will prevent this problem. Further verify the accuracy of this step as follows: I m-mediately after entering a neutral position the display on the computer should read "0"

degrees. For the spine, if the number is greater than 3°, select the "Repeat Last Rep" button and rezero. For the extremities , reselect the measurement.

4. **MANUAL PRESSURE ON THE INCLINOMETERS** (inclinometer mode): Always apply equal pressure to the bases of the inclinometers dur ing the entire motion to prevent the inclinometers from tipping. Be especially cautious when measuring spinal flexion/extension s on obese patients as the soft tissue over the spine prevents firm contact with the spine.

5. **SLIPPING** (inclinometer mode): D o not allow the inclinometers to slide on the body during the movement. This is especially important during spinal lateral flex ion. Maintain the same orientation to the spine during the entire movement. When measuring cervical flexion/extension ensure t hat the inclinometer does not slip on the head.

Protocols for Range of Motion

Range of Motion Normative Data

Normal ranges of motion listed in reports and on test screens are based on the AMA's *Guides to the Evaluation of Permanent Impairment*. According to recent clinical testing, up to 10% of the normal population may be considered impaired. Therefore, comparing your patients to the norms should be done with caution. JTech is currently gathering data on more accurate "norms" based on age and gender. These norms will be included in future upgrades of this software as they become a vailable.

Neutral-zero Method

The range of motion protocols follow the neutral -zero method adopted by the AAOS, AMA *Guides*, ASHT, APTA, ASSH, and others. This method establishes a reference position at neutral position, which is defined as 0°. Angles in   degrees are documented from this reference position.

One of the most confusing aspects of this method is the ankylosis conditi on, or inability of a joint to reach neutral position. For instance, if a knee flexes to 80° but cannot attain neutral in exten sion (extension lag), the extension measurements should be changed to negative numbers with the right mouse button. This is very important for proper calcul a-tion of impairment ratings or interpretation of results.

Active/Passive Measurements

Active - The subject provides the effort t o move the joint.

Passive - The examiner moves the joint through the range of motion until resistance is felt or the patient ex periences pain.

Make sure the correct "active" or "passive" selections are used in the software. Impai r-ment calculations use the largest active or passive measurements of a joint when both are recorded.

Large Extremity Range of Motion

Goniometer Mode - Extremity

The software defaults to this mode for measurement of large extremities. The master unit is used as a goniometer in this mode. WHEN IN GONIOMETER MODE DO NOT USE THE SLAVE UNIT. Attach the rail to the base of the master unit as an alignment aid. Most of these measurements require two placements of the master inclinometer while the limb is stabilized . DO NOT ALLOW THE SEGMENTS TO THE JOINT TO MOVE DURING THE TWO-PLACEMENT PROCEDURE. This is important since the master unit m easures tilt from a gravity reference and any movement will cause errors.

The goniometer mode is usually not as accurate as th e inclinometer mode but should be used if:
> 1. The subject is unable to reach neutral or is ankylosed, or
> 2. An impairment ratin g is done, or
> 3. You are most comfortable using goniometers on the extremities, or
> 4. Very fast exams are important.

For accuracy, make sure of the following:
> 1. The rail is properly aligned to the segment.
> 2. The motion is in a plane within 45° of vert ical.
> 3. The joint is stabilized during the two -step process.
> 4. The inclinometer sweeps the proper angle.

When measuring knee flexion, for example, the knee is first flexed then stabilized in the proper position. The master inclinometer is aligned to th e femur and "zeroed." The master unit is then oriented on the tibia (as shown by the software Help screen). The angle is enter ed into the software by pressing the enter switch. In the example shown below, 140° is correctly measured. If the unit is plac ed incorrectly, as in the second example, it measures only 40°, an error of 180°! To correct the angle, select the angle and then select the "180 Degree Offset" button. Using this offset feature permits measurements without the need to follow correct pla cement procedures.
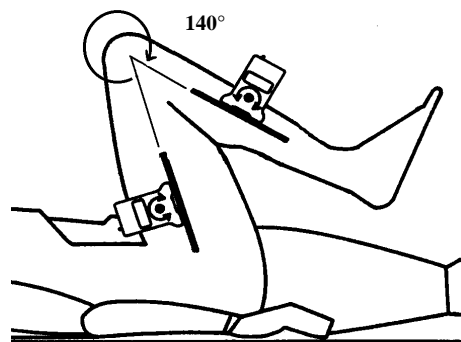
correct:
140° measured
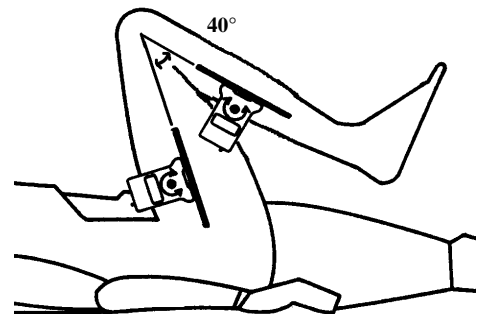
incorrect:
40° measured
Select "180° Offset" to correct

Inclinometer Mode - Extremity

The inclinometer mode for extremity measurements can be used if:
>   1. The subject can reach neutra l position, and
>   2. Very accurate results are needed, and
>   3. Speed of the exam is not as important.

This method is **STRONGLY** recommended if recruitment is occurring.

In most cases both inclinometers are used. This mode is usually more accurate than the goniometer mode since alignment to landmarks is not required and the measured segment can be isolated. Neutral can be verified by using either a flat surface (such as a yardstick) or other visual aids, depending on the joint.

When using a strap to affi x a sensor to an extremity, the inclinometer Velcro face can be oriented in any direction parallel to the plane of motion as sho wn in the following example:

correct   **correct**   **correct**

Ankylosis - Extremities

If the subject cannot reach neutral position, then a negative number m ust be assigned to the angle. Use the right mouse button to change angles to negative or select the "Ankylosis" button in the T est screen. For example, during elbow flexion the subject measures 120° and in extension the angle is 30° from the neutral posi tion. The angle should be changed to -30° since the elbow cannot attain neutral position or beyond into the extension region.

120° flexion   **-30° extension**

CAUTION: If a negative number is not assigned to the joint in this example, the impai r-
ment rating module assumes the joint can reach neutral and beyond, resulting in an inco r-
rect impairment calculation.

Spine Range of Motion

Spine Test - "Status" Column
This field indicates "ankylosis" if a joint is immobile, and either "lordosis" or "kyphosis"
in the thoracic minimum kyphosis and lumbar minimum lordosis tests.

Spine Test - "Valid" Column
This column indicates "yes" if at lea st three consecutive measurements are within +/ - 5°
of the average of the three. If the column indicates "no," the measurements   do not meet
this consistency criteria and are considered invalid for evaluating impairments.

Spine Test - Straight Leg Raise "Valid" Column
For a lumbar flexion/extension measurement to be considered valid, a straight leg test
should be completed. This validity test subtracts the sum of the sacral flexion and
extension angles from the tightest straight leg raise angle. (This is   calculated in the spine
test automatically.) If the resulting value is less than 15° (4th edition AMA   *Guides*) or
10° (3rd edit ion of the *Guides*) the lumbar flexion/extension measurements are
considered valid (negative numbers are also considered less tha n 10°) and the valid
column indicates "yes." If the measurement is invalid, or "no," you should elect to omit
(defer) the calcu lated impairment for lumbar flexion/extension in the impairment section
according to the *Guides*.

Spine Repetitions
At least thr ee consecutive measurements must repeat within +/ - 5° or +/- 10%,
whichever is greater, of the average to be considered valid fo r evaluating impairments.
The software will prompt for each repetition until this validity criteria is met. If the
validity criteria is not met after six repetitions, an impairment will not be rated. In this
instance, malingering should be suspected and the subject should be rescheduled.

In following the prompts, notice that you do not rezero the inclinometers at neutral after each repetition. Do not remove or alt er the position of the inclinometers during the three - to-six repetition procedure. If either inclinometer is moved during the t hree to six repetitions, select "Redo last rep," rezero at neutral per the prompt, and continue the repetitions.

Ankylosis - Spine

If a subject cannot reach the neutral position, the region is ankylosed. Select "ankylosis" in the appropriate spine test and follow the "Help" instructions. A negative angle will be assigned to the selected ankylosis spine regions. Always have the   subject try to attain neutral position during measurement. Measure all three planes of motion of a region.

Lordosis/Kyphosis of the Spine

The curvature of the thoracic region is normally kyphotic at neutral. This is the default selection in the test fo r thoracic flexion. In the rare case the thoracic spine is lordotic, select "Lordosis" in the test for thoracic "Minimum Kyphos is" and the angle will be assigned a negative number.

The curvature of the lumbar spine is normally lordotic at neutral. This   is the default in the test. In the rare case when the neutral lumbar spine is kyphotic in the test of lumbar "Minimum Lordosis, " select "Kyphosis" and the angle will be assigned a negative number.

This determination of the curvature of the spine at neutr al is necessary for proper impairment calculations.

Motion	Repetitions	Status	Valid	Max	Ave	Dev	Imp
Spinal Statistics							
Flexion	49 47 50		Yes	50	49	-2°	0
Extension	58 60 58		Yes	60	59	2%	0

The Statistics box, which appears by following the procedure outlined in Module 1, Chapter 7: *Displaying Patient History*, provides information on a specific test. The Spinal Statistics screen shows each repetition (a maximum of six) whether or not the tes t was valid, the average of the valid repetitions, the maximum value of the three valid tests, and the amount of deviation.

Deviation provides an indication of the spread of the data, and it is the value which is used to determine if a ROM test is valid.   If the average of the three repetitions exceeds 50°, the deviation is expressed as a percentage. If the average of the three r epetitions is below 50°, the deviation is expressed in degrees. Using the above data as an example, the average flexion value i s 49°, and the greatest deviation from average is trial 2 at 47°. Therefore, the deviation is expressed as 2°. Similarly, the   average for extension is 59°, and the greatest spread from average is 1° (all three trials). Therefore, the 1° deviation is expressed as a percentage difference, which is 1.67% rounded up to 2%.

Chapter 2
Performing a ROM Test

Spinal ROM Tests and Dialogs

Once the following screen has been accessed, cervical ROM testing can begin. Refer to Module 1, Chapter 4: *Starting a Test* for information on how to access this screen, or any other testing screen.
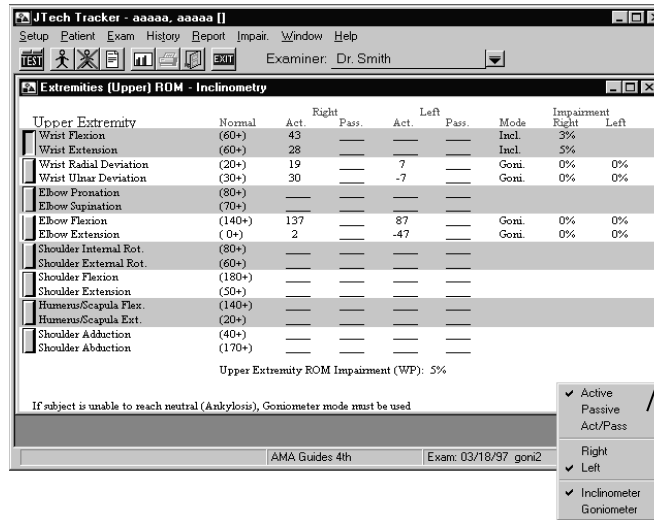
This drop-down menu is used to change ROM test defaults. Only those options available for a region will be displayed.

1. ROM tests can be performed as active or passive, some test also require left/right designations, and some can be performed in inclinometer or goniometer mode. To change the testing setup, click on the "Defaults" button.

2. ROM testing is completed in p airs, which are arranged by gray and white bands. Click anywhere within a band to begin testing the corresponding pair. After clicking on a band, the following standard ROM Testing screen appears.

"Cancel" deletes all repetitions completed and returns you to the previous screen.

Up to six repetitions can be used to meet AMA validity criteria.

Select "Ankylosis" if the patient is unable to reach neutral position.

Follow prompts in this box to complete the test.

Deletes all completed repetitions and returns to rep 1.

Deletes current repetition and starts it again.
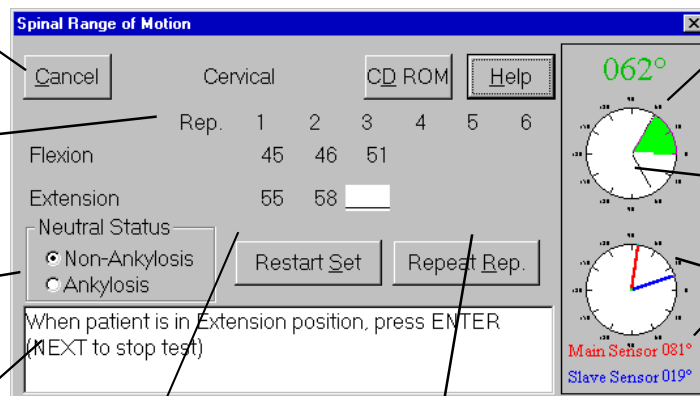
Numeric and graphic display of the differential angle between the main and slave sensors.

Normal value for this motion.

Numeric and graphical displays of the angle of both the main and slave sensors from neutral position.

Up to six repetitions of each pair may be prompted. When three consecutive repetitions are completed that meet the 5° or 10% re peatability criteria, the test is over. The current Testing screen is replaced by the Testing screen for the next plane of moti on of the same spinal region. If you need to end a test before three repetitions are completed, press the "Next" foot switch to save the data and continue to the next pair. The "Next" foot switch can also be used to "Tab" through these pop -up menus, free ing your hands from using the keyboard.

Helpful Hint for Impairment Exams: The fastest protocol for measuring multiple repetitions is to zero the sensors once at neutral and complete all repetitions. In some cases, a potential malingerer may be a ble to repeat the measurements within the 5° or 10% requirement giving a false impression of maximal effort. If malingering is suspected, you may wish to mix up the multiple repetitions. Complete only one repetition of each in the pair. Take a break or evaluate another component of the exam. **DO NOT EXIT THE TESTING SCREEN FOR THIS PLANE OF MOTION UNTIL ALL REPETITIONS ARE COMPLETED OR YOU WILL NOT BE ABLE TO GO BACK INTO THE TEST AND COMPLETE ADDITIONAL REPETITIONS.** After the break, select "Repeat Rep ." Follow the prompts, rezeroing the sensors on the patient for the next repetition and record the repetition.

Note: If you have a question about the testing protocol for a motion, click on the "Help" button. A screen with an illustrate d and written description will appear. If you have the CD -ROM option, click on "CD -ROM Help." If it is not available, contact JTech at 1-800-985-8324 to upgrade.
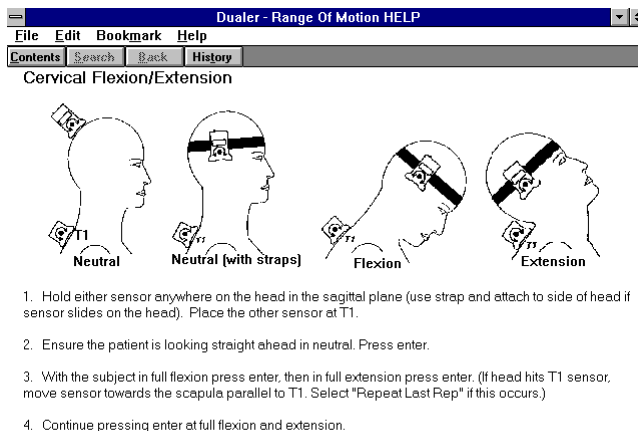
CD-ROM Help screen with full-motion video.
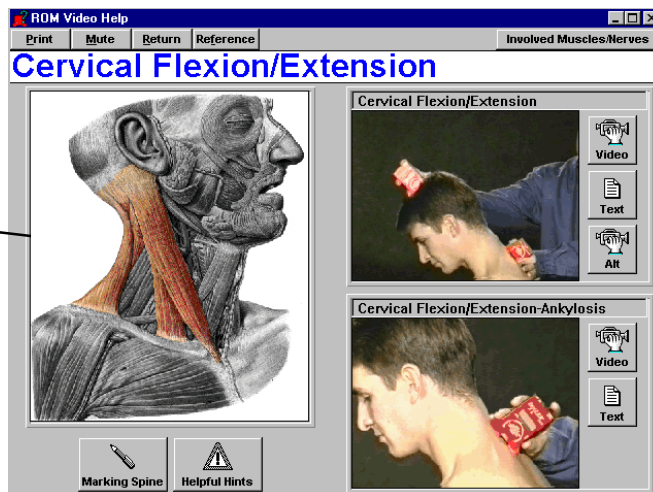
3. Once the desired tests for a region have been completed, the ROM Data screen appears with a summary of the results. For refe rence, a sample of each of the regional ROM Data screens has been included. To perform other tests as part of this exam, click on the Main menu button labeled "Test" to bring up the Test Selection screen.

Only the three valid trials are displayed in this screen.

Spinal (Cervical) ROM

Cervical	Normal				Status	Valid	Impair.
Flexion	(50+)	45	46	51		Yes	0%
Extension	(60+)	55	58	62		Yes	0%
Left Lateral	(45+)	42	41	45		Yes	0%
Right Lateral	(45+)	43	44	46		Yes	0%
Left Rotation	(80+)	81	82	84		Yes	0%
Right Rotation	(80+)	81	80	82		Yes	0%

Press right mouse button over ROM pair to delete [Defaults]

TEST

A negative sign here indicates the thoracic spine is lordotic at neutral. "Status" line would read "Lordosis" if this were the case.

Negative signs indicate an inability to reach neutral position (ankylosis).

Spinal (Thoracic) ROM

Thoracic	Normal				Status	Valid	Impair.
Minimum Kyphosis	(20)	23	20	24	Kyphosis	Yes	0%
Flexion	(40+)	36	32	34	N/A	Yes	1%
Left Lateral	(10+)	___	___	___			
Right Lateral	(10+)	- 12	___	___			
Left Rotation	(30+)	27	27	29		Yes	1%
Right Rotation	(30+)	24	24	30		Yes	0%

Spinal exams are valid if three consecutive repetitions repeat within ± 5º or ± 10% (whichever is greater) from the average of the three repetitions.

Impairments are not assessed if the test is invalid.

A negative sign here indicates the lumbar spine is kyphotic at neutral. "Status" line would read "Kyphosis" if this were the case.

Spinal (Lumbar) ROM

Lumbar	Normal				Status	Valid	Impair.
Left Lateral	(25+)	30	26	26		Yes	0%
Right Lateral	(25+)	27	25	27		Yes	0%
Left Rotation	(0+)	___	___	___			
Right Rotation	(0+)	___	___	___			
Minimum Lordosis	(15+)	14			Lordosis	N/A	
Flexion	(60+)	49	54	52	N/A	Yes	4%
Extension	(25+)	24	22	18	N/A	Yes	2%
Sacral Hip Flexion	(45+)	38	34	35	N/A	N/A	
Sacral Hip Extension	(5+)	7	6	6	N/A	N/A	

Validity

					Status	Valid	
Left Straight Leg Raise	(65+)	57	55	58	N/A	Yes	
Right Straight Leg Raise	(65+)	53	51	48	N/A	Yes	
Leg Raise Validity*		53 - (38 + 7) = 8				Yes	

[Defaults]

*d = deferred
*Tightest Leg Raise - (Sacral Hip Flexion + Sacral Hip Extension)

An "e" for exception is displayed if the examiner is taking exception to the AMA Guides. See Module 3, Chapter 1: Impairment Rating for details.

A "d" for deferred will be displayed here if the SLR test indicates invalidity. (The examiner can also elect to not defer the impairments.)

Check the AMA Guides to determine if SLR needs to be performed.

Extremity ROM Tests and Dialogs

This button changes the highlighted angle by 180°. Use only if angle was recorded with the sensor backwards or upside-down. Refer to "Help," Dualer manual, or Chapter 1 of this module for proper orientation.
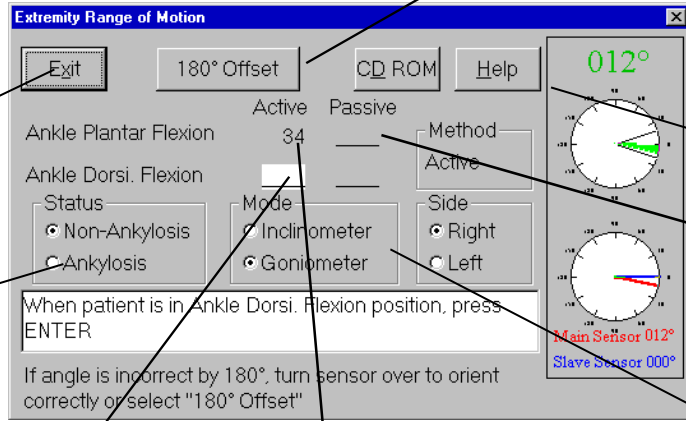
Click here to save the displayed angles and return to the Data screen.

Select "Ankylosis" if patient is unable to reach neutral. If joint is immobile, click "Exit" after first ROM value is recorded.

Use the "Help" button to see how to perform tests.

Click here to bypass the automatic prompt and select a measurement to be recorded.

"Inclinometer Mode" requires both sensors. "Goniometer Mode" uses just the main sensor and is used for ankylosis measurements.. See Help for more information.

Extremity Range of Motion

Exit   180° Offset   CD ROM   Help   012°

Active Passive

Ankle Plantar Flexion   34   ____

Ankle Dorsi. Flexion   ____

Method: Active

Status: Non-Ankylosis / Ankylosis

Mode: Inclinometer / Goniometer

Side: Right / Left

When patient is in Ankle Dorsi. Flexion position, press ENTER

If angle is incorrect by 180°, turn sensor over to orient correctly or select "180° Offset"

Main Sensor 012°
Slave Sensor 000°

Clicking on a recorded angle allows overwriting of existing data.

Clicking the right mouse button on the recorded angle toggles between negative and positive. Negative indicates ankylosis.

Extremities (Upper) ROM

Whole person impairment as a result of upper extremity ROM is listed here.

Upper Extremity	Normal	Right Act.	Right Pass.	Left Act.	Left Pass.	Mode	Impairment Right	Impairment Left
Wrist Flexion	(60+)	69	___	71	___	Goni.	0%	0%
Wrist Extension	(60+)	63	___	71	___	Goni.	0%	0%
Wrist Radial Deviation	(20+)	25	___	27	___	Goni.	0%	0%
Wrist Ulnar Deviation	(30+)	31	___	35	___	Goni.	0%	0%
Elbow Pronation	(80+)	59	66	79	81	Incl.	1%	0%
Elbow Supination	(70+)	54	64	66	77	Incl.	1%	0%
Elbow Flexion	(140+)	___	___	___	___			
Elbow Extension	(0+)	___	___	___	___			
Shoulder Internal Rot.	(80+)	___	___	___	___			
Shoulder External Rot.	(60+)	___	___	___	___			
Shoulder Flexion	(180+)	___	___	___	___			
Shoulder Extension	(50+)	___	___	___	___			
Humerus/Scapula Flex.	(140+)	___	___	___	___			
Humerus/Scapula Ext.	(20+)	___	___	___	___			
Shoulder Adduction	(40+)	___	___	___	___			
Shoulder Abduction	(170+)	___	___	___	___			

Upper Extremity ROM Impairment (WP): 1%

Defaults

If subject is unable to reach neutral (Ankylosis), Goniometer mode must be used

Extremities (Lower) ROM

Lower Extremity	Normal	Right Act.	Right Pass.	Left Act.	Left Pass.	Mode	Impairment Right	Impairment Left
Ankle Plantar Flexion	(40+)	___	___	___	___			
Ankle Dorsi. Flexion	(20+)	___	___	___	___			
Knee Flexion	(150+)	___	___	___	___			
Knee Extension	(0+)	___	___	___	___			
Hip Flexion	(100+)	___	___	___	___			
Hip Extension	(30+)	___	___	___	___			
Hip Abduction	(40+)	___	___	___	___			
Hip Adduction	(20+)	___	___	___	___			
Hip External Rotation	(50+)	___	___	___	___			
Hip Internal Rotation	(40+)	___	___	___	___			
Foot Inversion	(30+)	___	___	___	___			
Foot Eversion	(20+)	___	___	___	___			

Lower Extremity ROM Impairment (WP): 0%

Defaults

If subject is unable to reach neutral (Ankylosis), Goniometer mode must be used

3. From a ROM Data screen, ROM tests on other regions can be completed by accessing the Test Selection window through one of the   following:

a. Click on the "Test Selection" button.

b. Select "Window," then "Close All" from the menu item list.

c. Select "Window," then "Test Window."

To bring up the Test Selection window, so that you can test other regions, select one of these.
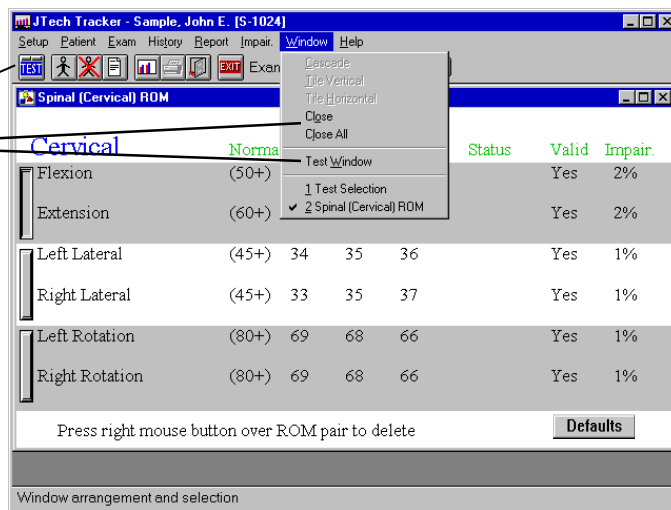
When the Test Selection window comes to the foreground, click on the button corresponding to the region to be tested next.

Click on one of these region buttons.
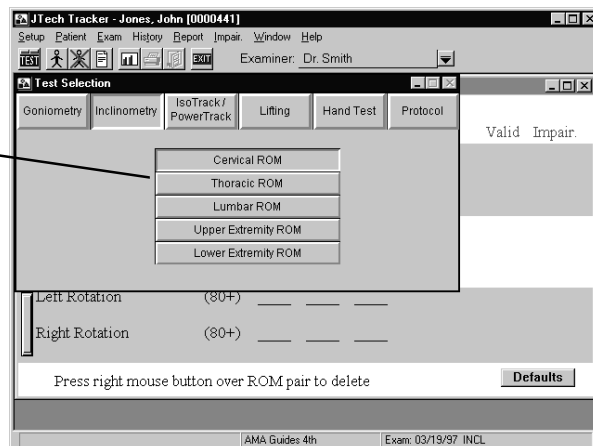
4. To attach notes to the exam, refer to Module 1, Chapter 6: *Adding Notes*.

To add other impairments to the patient's record, refer to Module 3, Chapter 1: *Impairments*.

To view a patient's ROM history, refer to Module 1, Chapter 8: *Displaying Patient History*.

Note: After a testing session is completed, JTech recommends selecting the "Patient Close" button to clear the screen. This p revents inadvertent testing of future patients in the currently selected patient file.

To exit the software, click on the "Ex it" button.

Manual ROM Data Entry

From the Setup menu drop -down list, "**Inclinometer Emulator**" allows the manual input of ROM data. For example, if the inclinome ter was used independent from the computer and the data was recorded on a chart, the chart data can be manually entered into the software using this feature. When "Inclinometer Emulator" is selected, the following image is placed in the bottom inch of your software screen.

To use the emulator function, select a patient and region for testing as if you were going to use the inclin ometers. When the ROM screen is displayed, select "Setup," then "Inclinometer Emulator" from the Main menu line. With the emul ator displayed, select the ROM pair for data entry and click on the bar. When the Test screen is displayed, click "Enter" on th e emulator bar to zero the display. After clicking "Enter" the first time, use the ">" buttons or manually type in the values a nd click "Enter." When your entries meet the validity criteria, the software will automatically advance to the next movement fo r the region. To skip a movement, click on "Next." Click on "Exit" to close the emulator.

Clicking < or > increments the corresponding inclinometer dial 1°.

Clicking << or >> increments the dial 10° per click.
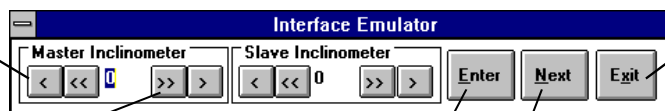
Clicking "Enter" button records displayed angle.

Clicking the "Exit" button exits the emulator option.

Clicking on the "Next" button tabs through the menu field.

Note: As an alternative to using the emulator, use the manual entry system available as a module in software versions 4.3 and higher. Refer to Module 14, chapter 2 for more information.

Chapter 1
Impairments

The Tracker M.E. Series automatically calculates impairment from ROM and strength test results. The impairment information can be view and printed for the appropriate test by selecting "Report" from the Main menu line, then "Patient Exam..." and the test from the resulting dialogs. To keep information current, Tracker software maintains a dynamic link to the ROM and strength testing results. Therefore, if you change or delete any test results, the corresponding impairment in this module is automatically updated. If you select "Exception" (which is explained later in this chapter) this link is not maintained. If you uncheck "Exception" later, the link is re-established and the impairment is again automatically calculated.

Note: Impairments are calculated based on the edition of the AMA *Guides* selected at the time of testing. Therefore, if the AMA *Guides* edition is changed afterwards, data cannot be updated to reflect the change.

Adding Other Impairments

In addition to deficits documented through ROM and strength testing, other restrictions can also affect a patient's impairment. The Tracker M.E. Series software allows the addition of other impairments by entering the actual impairment at the correct "Unit," such as finger, hand, upper extremity, lower extremity, spine, or other organ systems. Each value to the "whole person" level and then to final total impairment is calculated in the Impairment Summary report, which is viewed and printed through "Report," "Patient Exam...."

Note: The AMA publishes the *Guides to the Evaluation of Permanent Impairment*" that details the procedures used in evaluating a whole person injury in percentages from 0-100. These ratings are usually done in personal injury or worker's compensation cases after the patient has reached the point of maximum medical improvement. The *Guides,* however, are also useful in determining trends in injury assessment. To obtain a copy of the *Guides* contact the AMA or a medical book distributor. **YOU SHOULD BE FAMILIAR WITH THIS PUBLICATION BEFORE ENTERING OTHER IMPAIRMENTS INTO THIS MODULE.**

To access the impairment adding feature of the software, click on the "Impair..." menu item from the Main menu line. From the resulting drop-down menu, select "Details." The Impairment Details dialog will appear (see next page).

To add an impairment:

1. Click on the "Add" button.

2.   Select the region affected by the impairment from the "Unit" list.

3.   Use the "Tab" key or mouse to move the cursor to the "Details" box. Type in enough detail to sufficiently document the impairment.

4.   Press the Tab key or use the mouse to move the cursor to the appropriate impairment box. Type in the level of impairment corresponding to the injury.

5.   Use the Tab key or the mouse to go to the Table box and type the referenced table numbers from the *Guides*.

6.   If the impairment you entered is different from that prescribed by the AMA, place an "x" in the exception box.

7.   The impairment is automatically saved when you click "Add" to add another impairment, click "Close" to exit the window, or select "Item" to review an impairment.

8.   To review or modify impairment details, select the abbreviated description in "Item." If the list is long and the item does not appear in the box, click the up or down arrows to scroll the list. After the "Item" is selected, the details of the selected impairment will be displayed. To modify, select "Details" and type in the new data.

9.   To delete an impairment, select the "Item," then select "Delete."

Note: Some impairments exclude the use of the ROM impairment. For those cases, change the ROM impairment to 0% to prevent a double rating of impairment.

Important: Some states mandate the use of older publications of the *Guides* for worker's compensation exams. Before doing impairment ratings, determine the issue of the *Guides* that is required by your state and select "**Setup**" from the Main menu line. The 3rd edition as noted in the software refers to the 3rd edition, 2nd printing.

Some sections of the AMA *Guides* are not sufficiently detailed to prevent various interpretations. In these cases, JTech has contacted the authors of the applicable sections and has defined the calculation according to the authors' intent. For further details on these interpretations, consult Chapter 2: *ROM Impairment Rating Interpretation* in this module. Chapter 2 may also be copied without permission from JTech for the purposes of justifying the impairment rating when submitting the Impairment Summary report.

Chapter 2
ROM Impairment Rating Interpretation

The following describes the procedures used by the software to calculate impairments. Where procedures can be interpreted different ways, JTech has consulted various medical associations, worker's compensation commissions, and the authors of the applicable   sections of the *Guides* for clarification. You may copy the following without permission for use only in an impairment report to further clarify calculation of the numbers.

Spine ROM Charts

These charts use the threshold method from the applicable   *Guides* charts. For example, the cervical rotation chart lists the following:

0°	6% impairment
20°	4%
40°	2%
60°	1%
80°	0%

Therefore, ROM from 0-19 degrees is 6% impairment, 20-39 degrees is 4%, etc.

Extremity ROM Charts

Most measurements are rounded to the nearest 10° for lookup in the applicable charts. The one exception is radial/ulnar deviation, which is rounded to the nearest 5°. For   measurements that are at the 5° mark, the angle is always rounded to the larger value. For joints that are unable to reach the neutral position (angle is negative), the angle is rounded to the larger number. For example, if elbow extension is measured at -15° (15° of   extension lag), the angle is rounded to -10°.

Preferred Side (3rd edition only)

For the preferred side (handedness as selected in the Patient Information screen), the total upper extremity impairment is reduced as follows:

If impairment is between 5% and 50%, the value is reduced by 5%.
If impairment is between 51% and 100%, the value is reduced by 10%.

For example, if upper extremity impairment of the preferred side is calculated at 60%, the value is reduced to 54% as follows:

60% - (60% x 10%) = 54%

Combined Values

In accordance with the Combined Values Tables of the AMA *Guides*, values are combined using the formula A + B(1-A). The result is rounded off to the nearest whole number before being applied to the next value to combine.

Abnormal Motion Validity

This criteria has caused confusion, especially in states that use the 3rd edition of the *Guides*, such as Texas. Tom Mayer, MD from Austin, TX and one of the authors of the spine section has clarified this criteria. Additionally, the 4th edition of the *Guides* has been clarified to this same criteria.

The validity should be determined as follows:

When measuring spine abnormal motion, a minimum of three consecutive repetitions must fall within +/- 5° or 10% (whichever is greater) of the average of the three. The maximum angle of the three valid repetitions is used to determine impairment. A maximum of six repetitions is permissible. If consistency is not met after six repetitions, an impairment rating for that motion is not calculated.

Lumbar Flexion/Extension Validity Using Straight Leg Raise Test

Confusion occurs when interpreting the definition of "tightest leg raise." JTech has further clarified this issue with Tom Mayer, MD, spine section author as follows:

First the left leg, then the right leg, is measured to the three repetition validity requirement. For the left leg, the software determines the largest angle of the three valid repetitions. The same is done for the right leg. The two maximum readings are then compared, and the smaller of the two angles (called the "**tightest straight leg raise**") is used in the validity check.

Next, the largest sacral flexion angle, measured simultaneously with the last three valid lumbar flexion angles, is determined. Then the largest sacral extension angle, measured simultaneously with the last three valid lumbar extension angles, is determined. These two angles and the straight leg raise (SLR) are plugged into the following formula:

Tightest SLR - (Max. Sacral Flexion + Max Sacral Extension)

The lumbar flexion/extension impairments are valid if the result is less than or equal to 10° for all 3rd editions of the *Guides* or less than 15° for the 4th edition. (Negative numbers are not considered valid when using the 3rd edition.) If the validity criteria is not met, the software rates the impairment, but defers the value and does not use the rating in the final impairment calculations.

Note:

If either the lumbar flexion/extension or straight leg raise repetitions do not meet the 5° repeatability criteria, the straight leg validity check is not evaluated.

An example may help clarify the procedure:

The following data was recorded from lumber and straight leg ROM testing:

	rep 1	rep 2	rep 3	rep 4	rep 5	rep 6
Lumbar Flexion	45	44	32	44	45	46
Lumbar Extension	5	5	4	6	7	8
Sacral Hip Flex.	32	31	31	33	34	35
Sacral Hip Ext.	2	3	3	3	2	2
Left Straight Leg Raise (SLR)	22	23	24			
Right Straight Leg Raise (SLR)	19	20	21			

The software evaluates the data as follows:

1. Determines if three valid lumbar flexion/extension and SLR's were recorded. In this case the answer is yes.

2. Determines the maximum sacral hip flexion/extension angles corresponding to the LAST three valid lumbar flexion/extension angles. In this case, the maximums are 35° flexion and 3° extension.

3. Determines the last three valid SLR's for the right and left side.

   a. Of these valid readings, it determines the maximum for each side, which in this case are 24° right and 21° left.

   b. Determines the minimum of these two maximums, which is 21°.

4. Numbers are plugged into the formula:

   Tightest SLR - (Max. Sacral Flexion + Max Sacral Extension)
   21-(35+3) = -17

   Since this is less than 10° or 15° requirements, impairment for lumbar flexion/extension is valid for both the 3rd revised and 4th editions of the *Guides*. However, since the value is negative, the impairments are not valid using the 3rd edition.

Spine Impairment

The software adds all ROM impairments for a region (i.e. cervical) and combines the sum with other impairments of the same region. These regional whole person impairments at

combined to obtain the whole person contribution of the spine. If ankylosis is present in the region, the following criteria are used:

Ankylosis per 3rd edition, 3rd edition revised only

Ankylosis of a spinal region excludes impairment rating for abnormal motion of the same region. You will be able to measure normal motion, but a rating is not assessed.   Ankylosis for all three planes of motion for the region should be measured. The software will use the largest ankylosis impairment value in the final calculations.

Ankylosis per 4th edition

Ankylosis of a spinal region does not exclude ratings for abnormal motion. If more than one ankylosis measurement in a region is measured, the ankylosis impairment ratings are combined and then added to the other abnormal motion ratings for the region.

Upper Extremity Impairment

All wrist ROM impairments are added together, all elbow ROM impairments are added together, and all shoulder ROM impairments are added together. Then the resulting   values from the additions are combined according to the   *Guides'* Combined Values Chart. Finally, any other impairments are combined using the Combined Values Chart.

All ROM impairments of a digit are added together, then combined using the "Chart" with other impairments of the same digit to obtain the digit's total impairment. Digit impairment is converted to hand impairment, then each digit's total impairment at the hand level is added together, and finally this impairment is converted to upper extremity impairment.

The final upper extremity impairment is then converted to whole person impairment by multiplying by .6.

Lower Extremity Impairment

3rd edition, 3rd edition revised

At the lower extremity unit all ankle/foot ROM impairments are added together, all hip ROM impairments are added together, and all knee ROM impairments are added   together. The resulting values are then combined using the Combined Values Chart.   Finally, other impairments for the lower extremity are combined using the Chart.

The final lower extremity impairment is then converted to whole person impairment by multiplying by .4.

4th edition

All impairments are combined for final lower extremity impairment then multiplied by .4 for whole person impairment.

Chapter 1
Manual Muscle Testing - General Considerations

Manual Muscle Testing Precautions

The following are general guidelines to minimize risk of injury to the patient. Please note that these guidelines are not comprehensive and cannot cover all conditions. Final responsibility for the risk of injury lies with the examiner.

1. Force increase should be gradual.
2. Patient should be CLOSELY observed for any evidence of pain. The test should be stopped immediately if this occurs.

Manual Muscle Testing - General Information

Manual muscle testing or grading should be performed when neurological problems at the nerve root or peripheral nerve are suspected, or if disease or disuse affects the muscles. Manual muscle testing can help identify specific nerve motor function. Bilateral testing indicating a weakness in several muscles may further substantiate disease or injury involving nerve roots or peripheral nerves, as long as disuse or disease of the fibers of the muscle, or disorders of the higher levels of the central nervous system, are ruled out. Manual muscle testing should never be used alone to diagnose, but should be used in conjunction with other diagnostic testing tools such as the Tracker ROM (Inclinometer Range of Motion system) and the dynamic scan capabilities of the DynaTrack SEMG.

If a rehabilitation program is initiated, bilateral manual muscle testing should be completed at periodic intervals along with other diagnostic testing. Use the Tracker History module to graphically display the effectiveness of treatment when documenting grade 4 or 5 muscle strength tests using the PowerTrack II manual muscle tester.

Manual Muscle Testing Accuracy

Observation of the following general rules should be followed to help insure repeatability and accuracy when using the PowerTrack II manual muscle tester.

1. If testing bilaterally, the muscles and/or tendons that normally cause the motion should be palpated bilaterally to help identify substitution by muscles other than the prime movers. Adjust patient stabilization or position until substitution is eliminated. Consult the CD-ROM Help as necessary for proper setup. If substitution continues, document the nature of the substitution in the "Patient Notes" section of the software.

2. The lever arm length between the attachment point of the muscle and the PowerTrack II transducer must be the same between repetitions and sessions. Make sure the unit is placed at the same location for each repetition and test. For multiple repetitions, better

accuracy is achieved if the unit remains placed on the body during all repetitions.

3. Ensure the starting point for breaking action is at the same range of motion position for each test and repetition. This is necessary because of the wide variations in force the prime movers can oppose depending on the starting point of breaking action.

4. Determine the plane of motion of the segment and ensure that the PowerTrack II   transducer is not sideways or off axis to this motion. Additionally, apply force in the direction of motion.

5. Always build up resistance smoothly until the position is broken. In general the break should occur within 2-3 seconds. Prolonging the time to break may introduce fatigue. Shorter breaks are at higher risk of re-injury or may not allow for buildup of maximum contraction. For difficult to break segments, two hands may be required.

Impairment Ratings and Manual Muscle Testing

According to the AMA's *Guides to the Evaluation of Permanent Impairment*, a "Grade" must be completed to calculate a muscle strength impairment. (For more information on grading, see Module 6, Chapter 1: *Grading*.) First, complete a bilateral muscle strength test using the PowerTrack II. If the deficit is greater than 15%, select grade 4 as indicated by the software upon closing the test. If the patient is too weak for manual muscle testing, select a grade from 0-3 using standard protocols (see Help - Grading, select CD-ROM Help if available from the grade dialog, or see Module 6 of this manual). Finally, select the involved nerve. The impairment will automatically be calculated based on the grade and nerve selected.

Note: The nerve must be selected before an impairment is assessed. The exception is the lower extremity 4th edition AMA *Guides* which is based on grade only. The software will adjust for this exception automatically.

In many cases, problems with a nerve can weaken more than one muscle. If all the   affected muscles are graded against this same nerve, then multiple impairments will be   assessed for the nerve. According to the AMA *Guides*, only the maximum loss of function resulting from the nerve should be rated. To prevent this multiple rating of impairment, select "MMT Exclusions" from "Impair..." in the Main menu list.

The nerve with the highest level of involvement should be selected for impairment rating. For example, C5 nerve root injury has resulted in a weakness of the anterior deltoid   innervated by the axillary nerve, as well as weakness in the rhomboids innervated by the dorsal scapular nerve. The highest level of nerve involvement is C5.   **The peripheral nerves are not selected!**

Manual Muscle Test Grading

For detailed information about muscle test grading, see Module 6, Chapter 1: *Grading* in this manual.

CD-ROM Help

If PowerTrack CD-ROM Help has been installed, clicking on the "CD-ROM" button in a selected test will display an illustration of the affected muscles, the cited scientific references, nerve innervation and root, and four testing videos with complete voice dialog for each grade of the selected motion (176 videos). Use of this help increases accuracy through standardized procedures and increases the confidence of ancillary personnel doing the testing. Also, this help can be printed and inserted into reports.

Test Selection Methods

The Muscle/Motion selection dialog can be used to select the motion associated with a muscle group using one of five methods. The dialog is designed so that selections cascade to other choices all displayed simultaneously on the same screen. This provides instant feedback to assist in selection and determination of involved nerves or muscles. Also, other muscles and nerves that may be affecting the motion are displayed at the bottom of the dialog for possible alternate selections.

Myotome Testing

Myotome testing involves testing all muscles innervated by a selected nerve root or nerve root group, such as the brachial plexus. This method is considered reliable as long as disuse or disease of the fibers of the muscle or disorders of the higher levels of the central nervous system are ruled out. Myotome testing can be completed using one of two selection methods.

1. *Root to peripheral nerve* - This option lists all peripheral nerves innervated by the selected nerve root. When one of the displayed nerves is selected, the affected muscles are also displayed.

2. *Nerve Root* - This option lists all muscles innervated by the selected nerve root.

Additionally, using the *Peripheral Nerve* selection method, although not a myotome test, can sometimes eliminate a nerve root as the problem.

Never use myotome testing as the sole basis of a diagnosis, also include nerve conduction velocity tests, dynamic scan SEMG tests using the DynaTrack System, X-ray, etc.

Confirming Specific Nerve Injury/Disease Diagnosis

If all muscles innervated by a selected nerve root are weak, this may lend strong evidence to a diagnosis involving problems with the nerve root. However, in some cases additional testing of nerve roots above and below the affected nerve root may be necessary to determine if the problem is more extensive.

If only a few muscles innervated by a selected nerve root are weak, then the diagnosis may not be obvious. Determine if the problem stems from a partial injury to the nerve root or just to the peripheral nerve. Using the *Peripheral Nerve* selection method, determine if the weak muscles are innervated by only one peripheral nerve. If the answer is yes, this gives greater indication (but not absolute) that the injury is with the peripheral nerve. Further NCV and SEMG testing may confirm your suspicions.

What if only a few of the muscles associated with the peripheral nerve are weak? This could indicate a problem further down the nerve than the innervation point for the stronger muscles. The problem may also be injury or disease in specific muscles.

Determining Initial Specific Nerve Injury/Disease Diagnosis

If problems are suspected in a general area of the spine, then either the *Muscle Group* or *Motion to Muscle* selection method should be used for initial testing. For instance, if the upper extremity has some general weakness, test the entire upper extremity and print the reports. Study the selection method in each report that shows muscle weakness, then use the *Nerve Root* or *Nerve Root to Peripheral Nerve* selection method to display the muscles that could be affected by various peripheral or root nerves. After careful study, the problem area may be more apparent. Follow up with additional diagnostic testing or muscle testing using the *Nerve Root* or *Nerve Root to Peripheral Nerve* selection method as necessary.

Testing of Injured or Diseased Muscles

If injury, disease, or neurological problems are occurring near or in the muscle fibers, then the following selection methods should be used:

1.   *Motion to Muscle* - Lists all muscles associated with a selected motion.

or

2.   *Muscle Group* - Lists all muscles by group such as hip, knee, etc.

PowerTrack II Setup and Calibration

New Installations and First Time Setups

1. Install the hardware using the instructions in Module 1, Chapter 1 of the Tracker manual. Connect the phone jack end of the supplied cable to the PowerTrack II transducer. Plug the round end of cable into the Aux 2 receptacle on the Tracker Interface Box.

2. Install the software using the instructions in the Tracker Manual (Module 1, Chapter 2: *Software Installation)*. If the Power-Track II transducer and Tracker Interface Box were received in the same shipment, the transducer has been calibrated at the factory. If this is the case, a calibration diskette is included with your shipment. To utilize the factory calibration, install the calibration diskette as part of the Tracker software installation procedure.   If the diskette is not installed with the software, manual calibration must be performed before using the gauge.
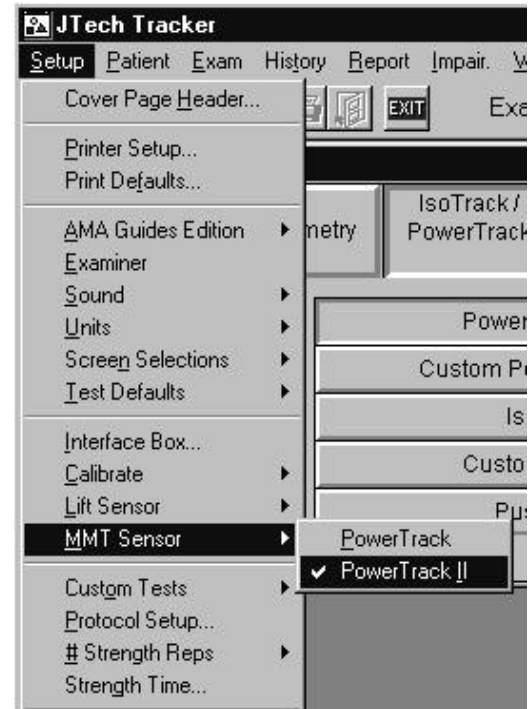
   If PowerTrack II was purchased as an upgrade to an existing system, the transducer must be calibrated manually. To manually calibrate the transducer, complete step 3, then use the instructions for *Maintenance Calibration* outlined below.

3. Set the sensor default for the Tracker Software by selecting "Setup," "MMT Sensor," and "PowerTrack II" (as shown in illustration) from the Main menu.

Maintenance Calibration

Every six months, or upon installing as an upgrade to a current Tracker system, the software will prompt for a maintenance calibration. However, if the gauge is dropped or mishandled, the calibration should be performed before the appearance of the software prompt. The PowerTrack II should be calibrated using the following steps:

1. Place the plastic calibration cradle on a flat, level surface. Install the flat pad in the PowerTrack II transducer and place it in the cradle with the pad up. Make sure the transducer is level.

2. From the Main menu, select "Setup," "Calibrate," and "PowerTrack II."

3 Make sure no external weight is applied to the transducer, then click the "Zero Calibrate" button. If a warning appears which indicates the values are out of range, click "no" and contact JTech Customer Service.

With flat pad installed, make sure device is level in all planes.

Placecradle on a flat, level surface.
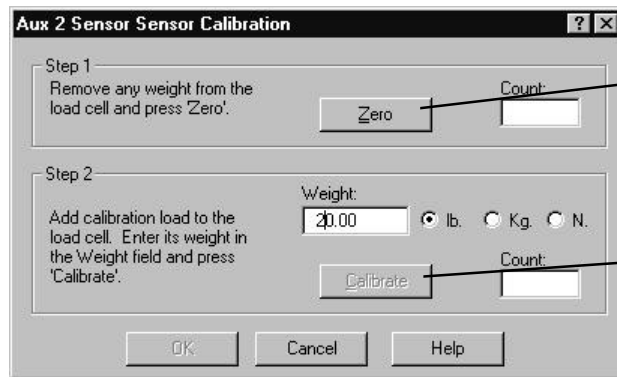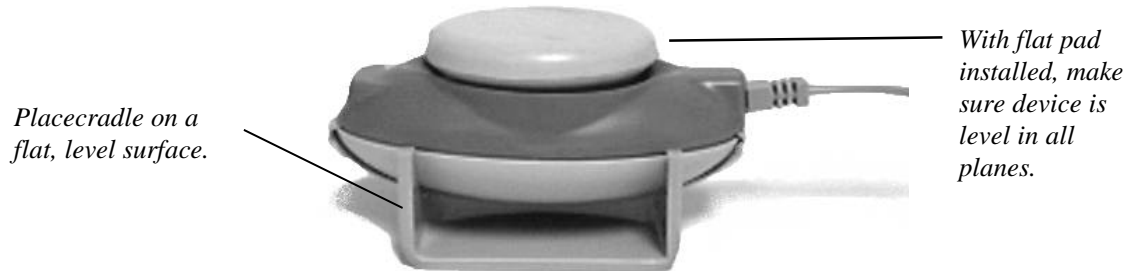
Click on "Zero" button with no weight applied to the transducer.

Apply known weight between 20-30 lb. to transducer, type value in box, and click the "Calibrate" button.

4. Apply a known weight between 20-30 lb. to the transducer. Make sure the weight is centered on the transducer pad. Type the value in the "Weight" box and click the "Calibrate" button.

Make sure weight is centered on pad and that the transducer is level.
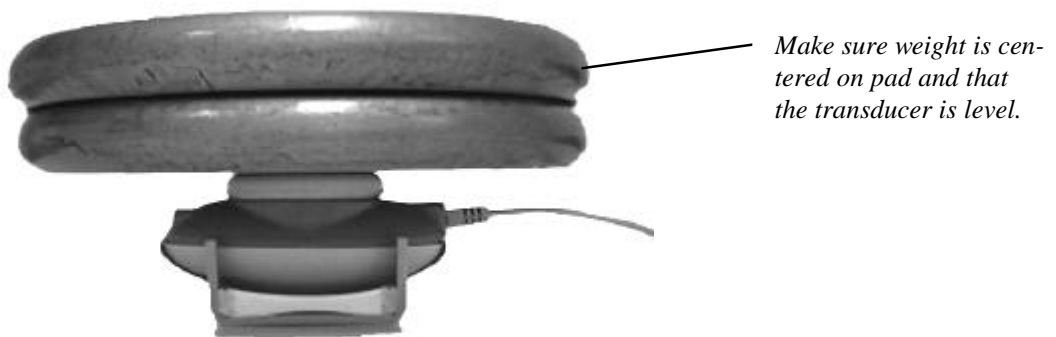
Daily Auto Calibration

The first time the transducer is used for the day, the software will prompt for a zero calibration. To perform a zero calibration, place the PowerTrack II transducer with the pad up. Make sure no force or weight is applied, and click "OK." Clicking on the "Postpone" button in the Calibrate prompt puts off the zero calibration until the next time the device is used. Failure of the software to respond when "Postpone" is clicked indicates that a full calibration must be performed.

Chapter 2
Using the PowerTrack Muscle Testing Software

To perform a standard manual muscle test, select a patient from the database, select the PowerTrack module button, then the "PowerTrack MMT" button. Custom muscle tests can also be performed by selecting "Custom PowerTrack MMT." Custom test setup is explained later in this chapter.

Select this button to perform ROM testing. (Contact JTECH if option is not available.)

This button is selected for PowerTrack and IsoTrack strength testing.

The top button is used to select standard PowerTrack MMT tests, and the second button allows you to test using custom tests you have created.
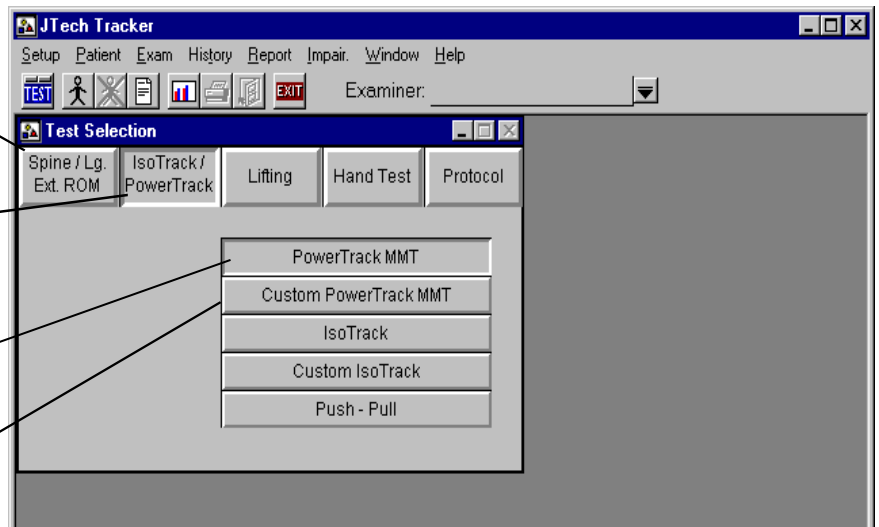
Muscle Selection Methods

Selecting "PowerTrack MMT" brings up the following screen, which is used to select tests. "Root to Nerve" is the default muscle selection methodology. (For more information about selection rationale, see Chapter 1 of this module.) The menu boxes instantly indicate the nerve roots that spawn peripheral nerves and which muscles are innervated by the selected peripheral nerves. As you highlight an item, notice how the lists "downstream" of the selection are affected. Select an item in the muscle list to dictate the muscle action to be tested.

The test to be completed for the highlighted muscle is displayed here.

Summary box indicates that other muscles and nerves may be involved during the test.
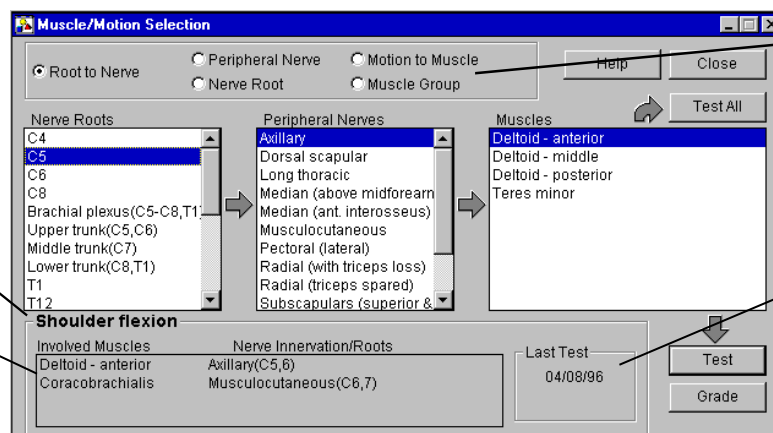
Click on any of these radio buttons to determine the test selection method.

This box indicates if the highlighted muscle was tested previously and when.

All of the Muscle Selection screens share a similar design. Once a muscle (or series of muscles) has been highlighted, the buttons at the top and bottom of the screen are used to dictate the next action. Selecting the "Test" button initiates the test sequence for the highlighted muscle. Selecting the "Grade" button brings up the Grade screen for the highlighted muscle, which allows you to denote if there is a deficit. (For more information on grading a strength test, see Module 6 of this manual.) The "Test All" button selects all muscles associated with a particular nerve root, peripheral nerve, etc. for testing. The "Help" button accesses the Help screens for assistance with the particular screen. The "Close" button returns you to the Test Selection screen.

Selecting "Peripheral Nerve" brings up the following dialog screen for selection of the muscles associated with a particular peripheral nerve.

Click here to test all of the muscles associated with the highlighted peripheral nerve.

Click on the scroll bar to see the entire list of options.

Click here to test just the highlighted muscle.
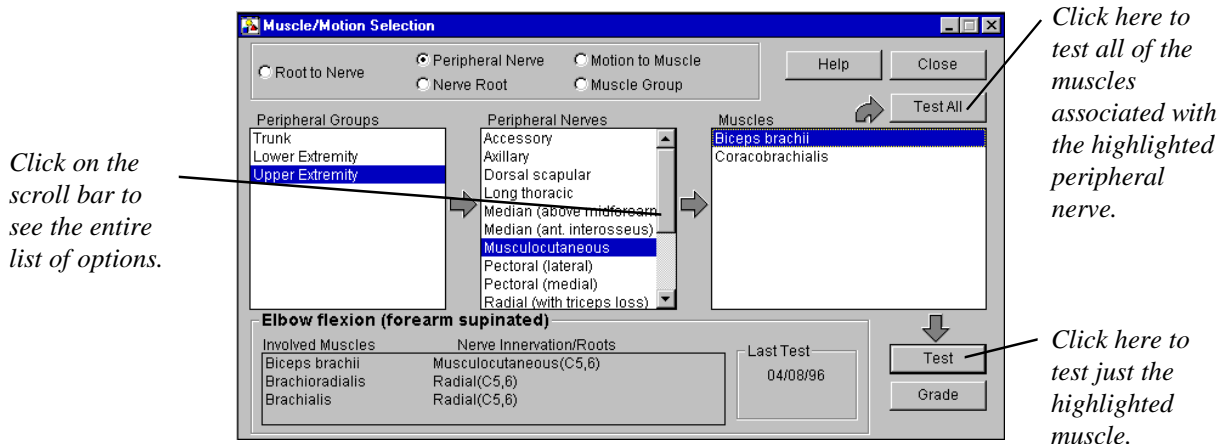
Selecting "Nerve Root" allows you to see (and test) all muscles associated with a particular nerve root. The screen below appears.
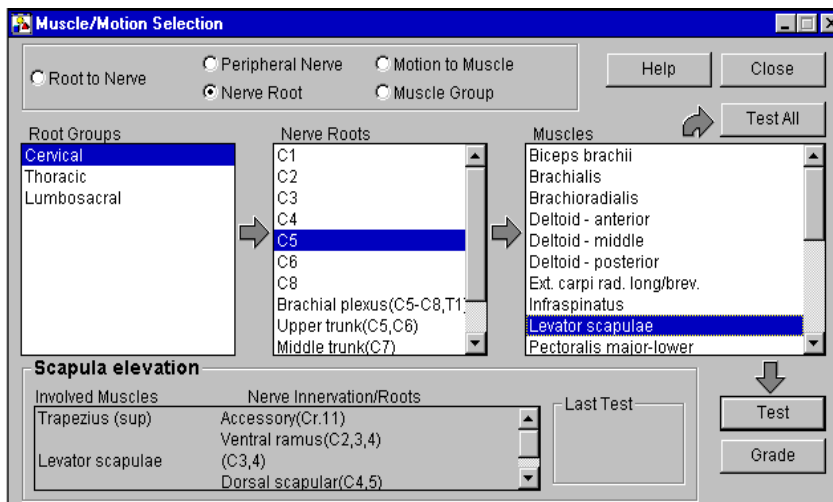
Clicking on "Motion to Muscle" allows you to see and select a list of motions associated with a selected joint.
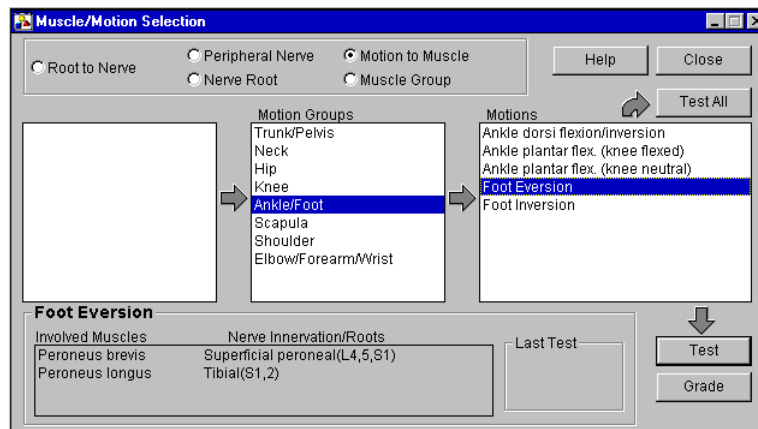
Clicking on "Muscle Group" enables you to directly select a muscle or group of muscles to be tested. A similar screen is pictured below.
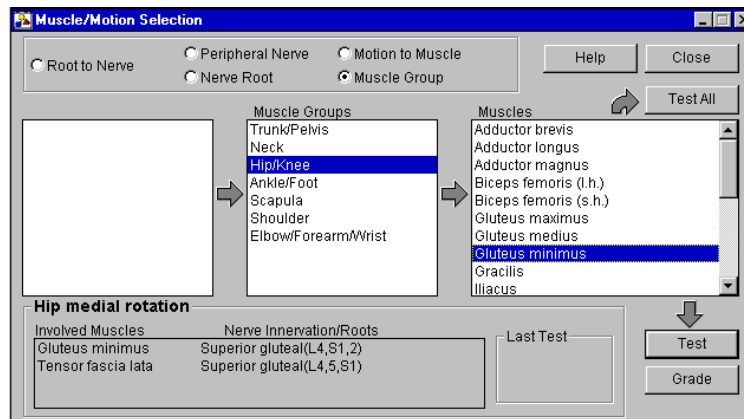
Testing

Highlight the first muscle to be tested and click on the "Test" button. Selecting "Test All" will highlight all the muscles or motions displayed in the list box furthest to the right. Selection of either of these two buttons will initiate the Testing screen. If your computer system has a 16-bit sound card and speakers, a voice prompt will begin with instructions about completing the test.

The Test screen is pictured on the next page. It features an autoscaling, force versus time split-screen graph that displays left and right side data separately. A Validity Status box in the lower left corner of the screen indicates if the recorded data meets the validity criteria. Six function buttons, which will be described later, are positioned below the graph. In the lower right-hand corner is a real-time display of load on the sensor. The "Threshold" button allows user-control of the load-level that must be exceeded prior to data being recorded. Just above the "Threshold" button is a key for distinguishing test repetitions. Above that is a box indicating the status of the current test. Lastly, there is a button to access the CD-ROM Help system, which has full motion video and narration

about the test, its positions, and its stabilization procedures. For more information about the CD-ROM Help System, contact JTECH at 1-800-985-8324.

WARNING: Prior to using the PowerTrack manual muscle tester to record data, ensure that the sensor is in the LOW Threshold Mode and that RESET is pressed. Inaccuracies of ½ pound or more may result if this step is not taken. **If there is no load on the transducer and the software indicates force, use the sensor's RESET button rezero the transducer** . Always keep the transducer in the OFF position when it is connected to the computer.

Click here for CD-ROM Help System.

Auto-scaling force and time axes for graphs.

Test Status box.

Switch to left or right side by clicking these

Force curve color key.

Validity Status box shows "Yes" or "No" after two repetitions have been completed.

Set the test threshold from 1-10 lb.

Real-time display of load on sensor.

Click here to close testing procedure.

Selecting the "Statistics" button displays a box containing statistical information regarding the tests over the graphs (shown below). The peak load for each repetition is displayed, as well as validity, CV, and percent deficit. Repetitions which have not been excluded are displayed in bold. To remove the "MMT Statistics" box, click on "Close."

Statistics box.

A set of unilateral repetitions is considered valid if the greatest difference between successive repetitions or the coefficient of variation is less than or equal to 15%. The coefficient of variation is determined with the n-1 method using the maximum of each repetition.

Deficit is calculated as the percent difference between the maximum repetition of the right side and the maximum repetition of the left side.

Selecting the " **Delete Rep**" button displays the following window on the Test screen. This option allows selective removal of repetitions that may not be indicative of the patient's true ability. Validity and statistics are recalculated each time a repetition is eliminated. Tests subsequent to the deleted repetition are moved up, so if rep 2 is deleted, rep 3 is renamed rep 2 and rep 4 is renamed rep 3.
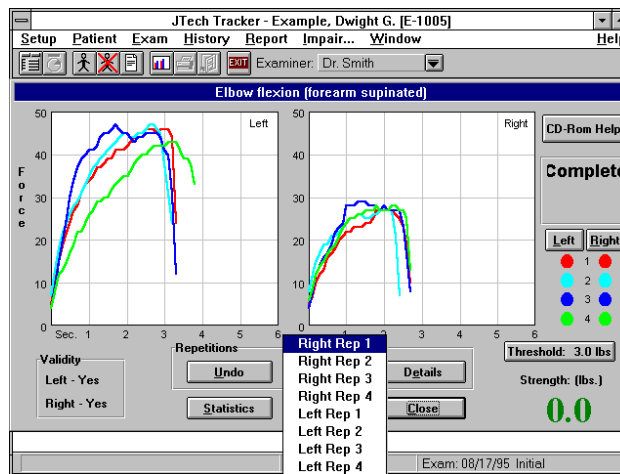
Clicking on the " **Undo**" button deletes only the last completed repetition.

Select the "**Details**" button to add information regarding a specific repetition. By clicking on the check box labeled "Ratchet" you can indicate if the respective force curve exhibits signs of "Cogwheeling" or "Ratcheting Response," which may be an indicator of sub-maximal effort. By clicking on the check box labeled "Exclude," you can elect to not use a curve as part of the statistical and validity calculations. Data input into this screen is displayed as part of the report writer.

If the deficit between the maximum values for left and right side tests is greater than 15%, a message will appear indicating such upon selecting either the "Close" or "Statistics" buttons. The prompt will recommend rating this muscle as a grade 4. The muscle test must be graded if it is to be used as part of an impairment. Consult your edition of the AMA's *Guides to Evaluation of Permanent Impairment* for more information. Click on "OK" to proceed with the function of the button that was originally selected.
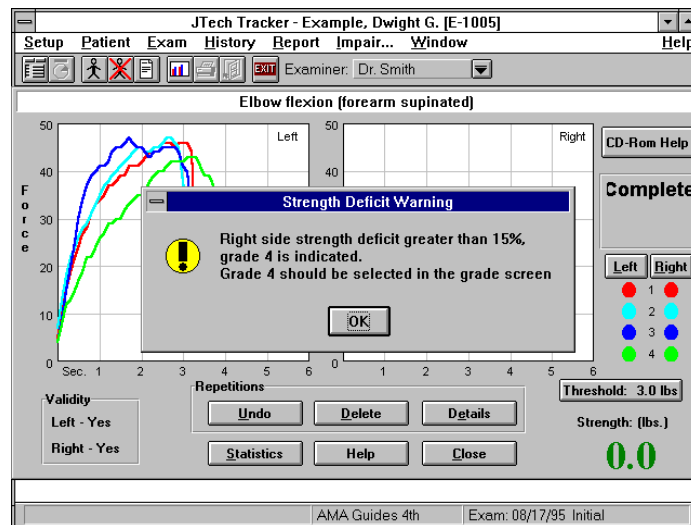
To go back to a Test screen, highlight the muscle or motion again from the Muscle/Motion Selection screen and select "Test." The graphs will be displayed for viewing. To perform additional repetitions of this test, or repeat a portion of the exam, select the "Continue" button as shown below.

Select "Continue" to add more repetitions or repeat a repetition.
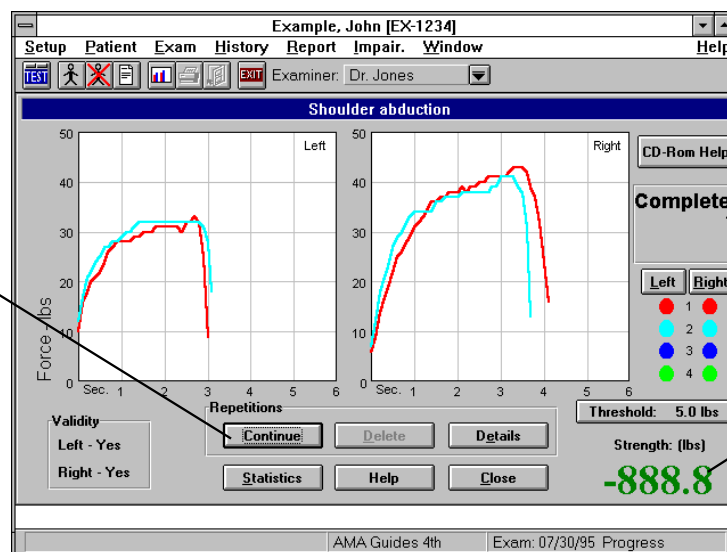
Software assumes testing is complete until "Continue" is selected.

The load cell is inactive until "Continue" is selected.

Grading

As noted earlier, if a muscle test is to be used as part of an impairment rating, the test must be graded. Selecting the the "Grade" button at the Muscle/Motion Selection screen enables you to grade the test. For more detailed information about grading, see Module 6: *Grading* of this manual.

Impairment Rating

By performing a grading procedure, the resulting impairment is linked to the extremity with the motor deficit. If the Impairment Summary is printed out, the motor deficit will be added or combined (as appropriate) with ROM impairments (or any other impairments which may have been added) on a regional basis, and then combined to calculate a Whole Person Rating.   For detailed information about impairment rating, see Module 3: *Impairments* of this manual.

In many cases, problems with a nerve will weaken more than one muscle. If all the affected muscles are graded against this same nerve, then multiple impairments will be assessed for the nerve. According to the AMA's *Guides,* only the maximum loss of function resulting from the nerve should be rated. To prevent this multiple rating of impairment, the software's "Auto-Exclusion" feature will select the greatest impairment for a particular nerve. This feature is accessed through the "Impair.." drop-down menu item. The resulting screen is illustrated below. The default setting is "yes," which means the auto-exclusion feature is turned on. Only the maximum graded impairment for a nerve will be displayed in the impairment dialog and on reports. Selecting "no" will result in an impairment being reported for each graded test of the same nerve.

Creating Custom Manual Muscle Tests

There are 44 muscle tests in the software and on the CD-ROM. These tests were all adapted from the standards outlined by Kendall as well as Daniels and Worthingham. Occasionally, clinicians must improvise their own methodologies based on their clinical experiences or a unique patient's needs. The Tracker software allows the creation of custom muscle tests, which can be used for any patient at any time. For example, the standard shoulder abduction test requires the arm be raised to 90° before the transducer is placed just above the elbow. The clinician, however, may need to test the arm at 0° of abduction. With Tracker's Custom Test feature, this can be accomplished.

To create a custom test, select "Setup," "Custom Tests," and "PowerTrack" as shown below.

First, select "Setup,"

then select "Custom Tests,"

and finally select "PowerTrack."
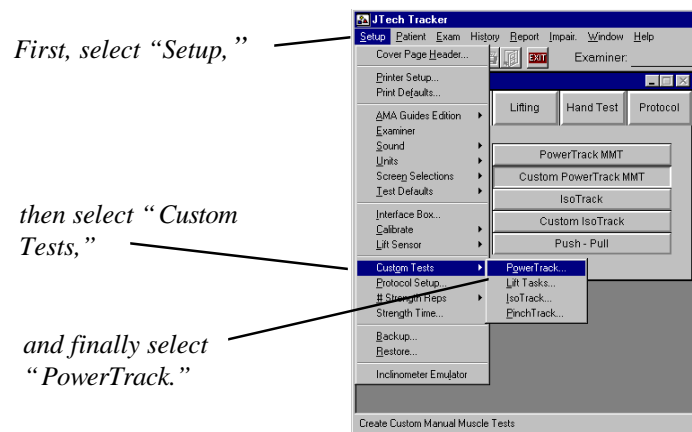
After making the above selections, the following dialog box appears. To add a new custom test, select the "Add Test" button. To modify an existing test, click on the downward pointing arrow and select the test from the resulting list.
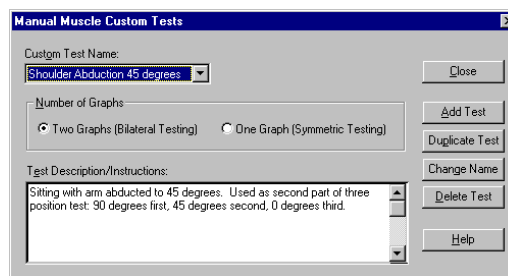
Selecting the "Add Test" button results in the following box. Choose a name for the custom test and type it into the New Test Name box. "OK" accepts the name and "Cancel" exits without saving the name.
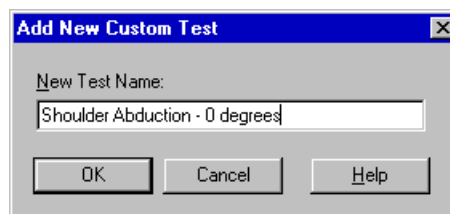
After providing a name for the custom test, select either "One Graph" if the test is a unilateral motion or "Two Graphs" if the test is bilateral. In the Test Description/Instruction box, type a description of the test or any special instructions to be observed during the test. Click "Close" when finished to save the test.

The information entered into this box is extremely important. It should include enough detail to insure repeatability of the test. The information can be displayed at the Testing dialog by using the "Test Setup" button.

Click on this button to add a custom test.

Click here to create a duplicate tests with a new name.

Click here to change the test's name.

Click here to delete the test displayed in the Custom Test Name box.

Performing a Custom Manual Muscle Test

From the Test Selection screen, select "PowerTrack," then the button labeled "PowerTrack Custom MMT." When the following dialog appears, you can perform a specific test or perform all the tests on the list. To perform a specific test, highlight the custom test from the list and click on the "Test" button. To perform all the custom tests on the list, select "Test All."

Once in the Test screen, all buttons function as they would for a standard muscle test with two exceptions: The "CD-ROM Help" buttons does not function and there is an

Clicking here initiates testing of all the tests in the list.

Clicking on this button initiates testing for the highlighted test only.

additional "Test Setup" button. Clicking on the "Test Setup" button displays a test description/information dialog. This dialog includes the details about the test that where entered when the custom test was created. This feature enables the examiner to verify patient position, transducer position, or any other information included in the test description.
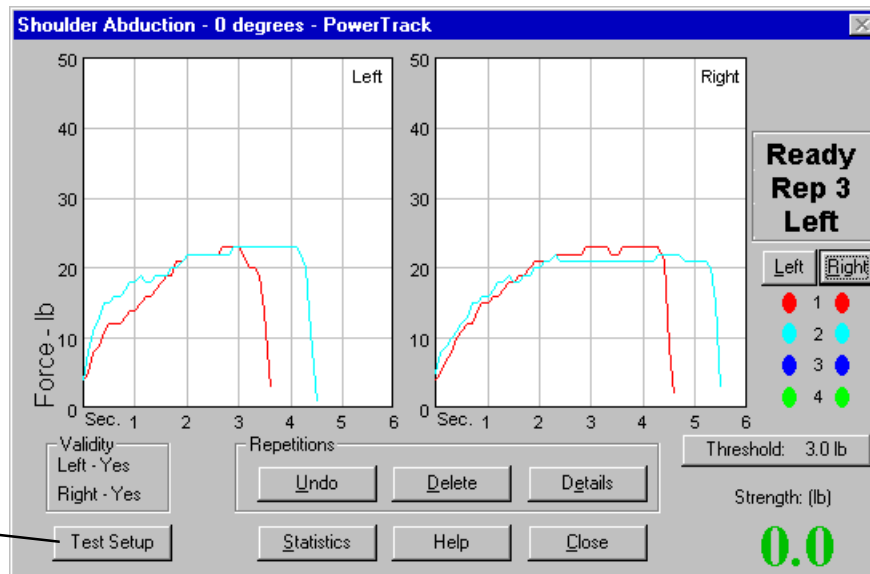
Clicking this button displays the dialog below.
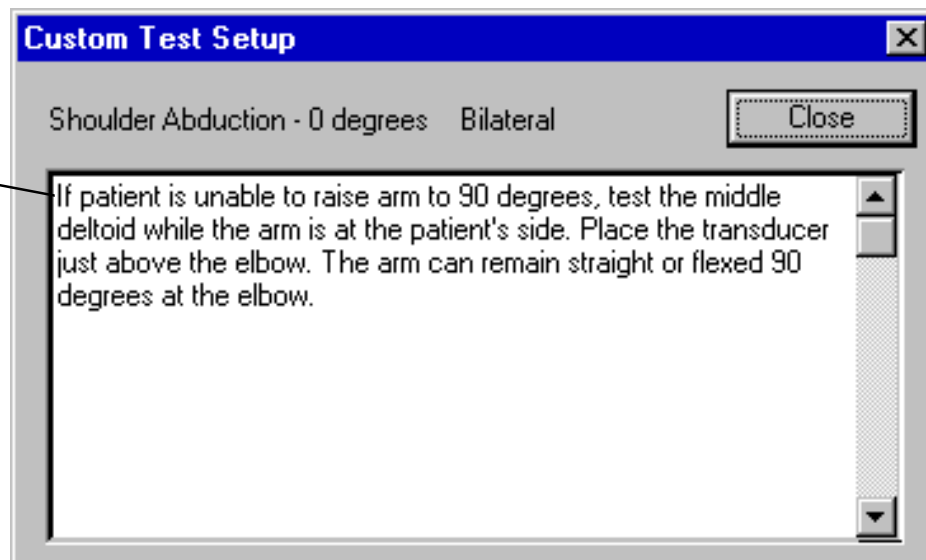
The information in this box, entered when the custom test was created, helps ensure accuracy and repeatability of custom tests.

Chapter 1
Isometric Muscle Testing - General Considerations

Isometric Muscle Testing Precautions

The following are general guidelines to minimize risk of injury to the patient. Please note that these guidelines are not comprehensive and cannot cover all conditions. Final   responsibility for the risk of injury to the patient lies with the examiner.

1. Force increase generated by the patient should be gradual, especially for testing of the spine, or in the presence of a musculoskeletal injury, instability, or recent surgery. A warm-up repetition consisting of 50% of maximum effort is recommended prior to maximum effort testing for each new test position.

2. The patient should be CLOSELY observed during testing for any evidence of pain or discomfort. The test should be stopped immediately if the patient reports pain,   shortness of breath, or dizziness.

3. Contraindications to testing include: uncontrolled hypertension, severe respiratory problems, herniated disk, severe osteoporosis, structural weakness of the abdominal or thoracic wall, unsplinted fractures, unhealed torn or sutured tendons, or any other condition that would be exacerbated by the performance of isometric contraction or valsalva maneuver.

4. Proper stabilization should always be provided to effectively isolate the muscle being tested, minimize substitution, and make the patient feel physically secure enough to generate a maximum contraction. For specific stabilization guidelines, follow the instructions of the IsoTrack CD-ROM Help system.

5. In the event the patient is illiterate or does not understand English, be sure the patient is made aware of all the inherent risks of testing and understands the content of the warning labels.

6. The IsoTrack software produces an informed consent form (a sample is provided in the Appendix) and requires that it is signed prior to testing.

Patient Instructions for Isometric Testing

Studies have shown that isometric strength testing results vary according the the   instructions given to the patient. Therefore, greater consistency will result if the instructions are standardized as follows:

Tell the patient: "We are going to measure your strength. These tests are isometric

strength tests, which means that you will be exerting force, but not moving anything. We will measure your average maximum force with this apparatus. For each test, please follow these instructions:"

1. The test will be demonstrated for you. If you do not understand, please ask questions.

2. For each test, we will give you at least three attempts. The first is practice, try it at 50% effort. This first attempt is a warm-up and will help you determine if you know what is expected.

3   Next you will be given a minimum of two attempts on each test. Try to do your best on each attempt as your score will be the average of the two measurements.

4. When a test is given, I will say, " **Ready ... set ... go**." For the period of the test, you should apply consistent, maximum effort. If at any time during the test you experience pain or discomfort, you should stop the test immediately. The computer will beep during the test and a double beep when the test is finished.

5. Let me demonstrate the test for you.

6. Are there any questions?

7. Let's begin the first test. " **Ready ... set ... go**."

Isometric Muscle Testing - General Information

Isometric muscle testing should be performed when neurological problems (due to injury or disease) at the nerve root or peripheral nerve level are suspected, or if injury, disease or disuse has affected the muscles or joint. Isometric muscle testing can help identify specific nerve motor function. Bilateral testing indicating a weakness in several muscles may further substantiate disease or injury involving nerve roots or peripheral nerves, providing disuse or disease of the fibers of the muscle or disorders of the higher levels of the central nervous system are ruled out. Isometric muscle testing should never be used alone to diagnose, but should be used in conjunction with other diagnostic testing tools such as the balance of the Tracker M.E. Series Systems and the dynamic scan capabilities of the DynaTrack SEMG.

As part of a rehabilitation program, bilateral isometric muscle testing should be completed at periodic intervals along with other diagnostic testing. The "History" feature of the IsoTrack software is used to graphically display and document the effectiveness of treatment at periodic intervals along with other diagnostic testing.

Isometric testing provides some advantages over dynamic testing. For example, isometric testing is typically faster and less costly than isokinetic testing, yet it can accurately predict dynamic strength at reasonable speeds. Stabilization is easier to achieve for motions where the joint's center of rotation drastically changes during the arc of motion (e.g. the spine). Isometric testing is preferred when movement causes pain, such as in a joint con-

tracture or during painful arcs of motion due to joint injury. Isometric testing is typically less fatiguing (systemically) than isotonic testing; therefore, more muscles can be tested in one session.

Isometric Muscle Testing Accuracy

Several general rules must be followed to insure repeatability and accuracy when using the IsoTrack System.

1. Determine the plane of motion of the segment being tested. Use the Multi-Vector Alignment System of the IsoTrack to correctly position the patient and transducer so the load is measured in the plane of motion (on-axis loading).

2. Prior to testing, the muscles and/or tendons that normally cause the motion should be palpated upon contraction to help identify substitution. If substitution is detected, stabilization or position should be adjusted until substitution is eliminated. Consult the CD-ROM Help as necessary for proper setup. If substitution continues, document the nature of the substitution in the "Patient Notes" feature of the software.

3. The lever arm length between the attachment point of the muscle and the IsoTrack transducer must be the same between repetitions and sessions. Ensure that the unit is placed at the same location for each repetition and test. For multiple repetitions, better accuracy is achieved if the unit remains placed on the body during all   repetitions.

4. Make sure the joint is at the same range of motion position for each test and   repetition. This is necessary because the muscle length/tension relationship and joint   mechanical advantage change throughout the range of motion.

5. Have the patient build force gradually until the maximum effort is achieved and held. In general, the maximum force should occur within two to three seconds. Prolonging the time to maximum effort may introduce fatigue. Based on the patient's condition and endurance level, use the "Test Time" feature of the software to select the   optimum duration of the test (up to six seconds). Standard protocols require at least three seconds of data collection after the maximum is achieved for valid statistical determinations.

6. When testing with cable attachments make sure the horizontal line of pull is directly in line with the transducer's center line as shown below.

Incorrect   Correct

Impairment Ratings and IsoTrack Muscle Testing

According to the AMA *Guides to the Evaluation of Permanent Impairment*, a "grade" must be completed to calculate a muscle strength impairment. First, complete a bilateral muscle strength test using the IsoTrack. Second, grade the test. If the deficit is greater than 15%, select grade 4 as indicated by the software. If the patient is too weak for isometric muscle testing, select a grade from 0-3 using standard protocols (see Module 6: *Grading* of this manual or select "CD-ROM," if available, from the Grade dialog). Finally, select the involved nerve. The impairment will automatically be calculated based on the grade and nerve selected. (For more information, see Module 3: *Impairments* and Module 6: *Grading* in this manual.)

The nerve must be selected before an impairment is assessed. The exception is the lower extremity in the 4th edition AMA *Guides,* which is based on grade only. The software will adjust for this exception automatically.

In many cases, problems with a nerve will weaken more than one muscle. If all the affected muscles are graded against this same nerve, then multiple impairments will be assessed for the nerve. According to the AMA *Guides*, only the maximum loss of function resulting from the nerve should be rated. To prevent this multiple rating of impairment, select "Exclusions" from "Impair..." in the Main menu list.

The nerve with the highest level of involvement should be selected. For example, C5 nerve root injury has resulted in a weakness of the anterior deltoid innervated by the axillary nerve as well as weakness in the rhomboids innervated by the dorsal scapular nerve. The highest level of nerve involvement is C5. **The peripheral nerves are not selected!**

Isometric Muscle Test Grading

Traditionally, muscle testing uses a grading scheme for documentation and standardization. Grading ranges from 4/5 "Good/Normal" to 0/1 "None/Slight Contraction." For more information on grading muscle tests and using Tracker software's grading capabilities, see Module 6 of this manual.

CD-ROM Help

If the IsoTrack CD-ROM Help has been installed, clicking on the "CD-ROM" button in a selected test will display an illustration of the affected muscles, the cited scientific references, nerve innervation and root, and four videos with complete voice dialog for each grade of the selected motion. Use of this help option increases accuracy through standardized procedures and increases the confidence of ancillary personnel doing the testing. CD-ROM Help pages can be printed and inserted into reports.

Test Selection Methods

The Muscle/Motion Selection dialog can be used to select the motion associated with a muscle group using one of five methods: *Root to Nerve*, *Peripheral Nerve*, *Nerve Root*, *Motion to Muscle*, and *Muscle Group*. The Muscles/Motion Selection dialog is designed so that selections cascade to other choices, which are all displayed simultaneously on the same screen. This provides instant feedback to assist in selection and determination of involved nerves or muscles. Also, other muscles and nerves that may be affecting the motion are displayed at the bottom of the dialog for possible alternate selections.

Myotome Testing

Myotome testing involves testing all muscles innervated by a selected nerve root or nerve root group, such as the brachial plexus. This method is considered reliable as long as disuse or disease of the fibers of the muscle or disorders of the higher levels of the central nervous system are ruled out. Myotome testing can be completed using one of two   selection methods:

1. *Root to Nerve* - This system lists all peripheral nerves innervated by the selected nerve root. When one of the displayed nerves is selected, the affected muscles are also displayed.
2. *Nerve Root* - All muscles innervated by the selected nerve root are listed with this system.

Additionally, using the *Peripheral Nerve* selection method, although not a myotome test, can sometimes eliminate a nerve root as the problem.

Note: Myotome testing should never be used as the sole basis of a diagnosis. Nerve conduction velocity tests, dynamic scan SEMG tests using the DynaTrack System, diagnostic   ultrasound, video fluoroscopy, etc. should also be included when making a diagnosis.

Confirming Specific Nerve Injury/Disease Diagnosis

The fact that all muscles innervated by a selected nerve root are weak may lend strong evidence to a diagnosis involving problems with the nerve root. However, in some cases, additional testing of nerve roots above and below the affected nerve root may be   necessary to determine if the problem is more extensive.

If only a few muscles innervated by a selected nerve root are weak, the diagnosis may not be obvious. To make the diagnosis clearer, first determine if the problem stems from a partial injury to the nerve root or just to the peripheral nerve. Use the *Peripheral Nerve* selection method to determine if the weak muscles are innervated by only one peripheral nerve. If the answer is "yes," there is a greater indication (but not absolute) that the injury

is with the peripheral nerve. Further NCV and SEMG testing may confirm the indications. What are the indications if only a few of the muscles associated with the peripheral nerve are weak? This could indicate a problem further down the nerve than the innervation point for the stronger muscles. The problem may also be injury or disease in specific muscles.

Determining Initial Specific Nerve Injury/Disease Diagnosis

If problems are suspected in a general area of the spine, then either the *Muscle Group* or the *Motion to Muscle* selection method should be used for initial testing. For instance, if the upper extremity has some general weakness, the entire upper extremity should be tested and reports printed. Study the selection method in each report that shows muscle weakness, then use the *Nerve Root* or *Root to Nerve* selection method to display the muscles that could be affected by various peripheral or root nerves. After careful study, the problem area may be more apparent. Follow up with additional diagnostic testing or muscle testing using the *Nerve Root* or *Root to Nerve* selection methods as necessary.

Testing of Injured or Diseased Muscles

If injury, disease, or neurological problems are occurring near or in the muscle fibers, the following selection methods should be used:

1. *Motion to Muscle* - All muscles associated with a selected motion are listed.
or
2. *Muscle Group* - This method lists all muscles by group such as hip, knee, etc.

Chapter 2
IsoTrack Testing Setup

First Patient Visit

The IsoTrack testing system has both hardware and software setup adjustments that must be made to conduct tests. In the software, a number of list boxes contain parameter information about standard tests that should not be changed. These are the default parameters required for accurate testing of the selected muscles. ***Do not change these parameters unless an exception to the standard test is required and the exception is documented in the "Notes" section.*** Additional list boxes for patient-specific settings are blank. These boxes are required to be filled before continuing to the next test.

The following steps should be used when testing a patient with IsoTrack for the first time:

1. Adjust the IsoTrack to the default parameters.
2. Position the transducer against the patient as instructed.
3. Complete all required repetitions.
4. Record parameters in the blank list boxes.

Note: Convenience and patient comfort should determine if the parameters are recorded before or after the IsoTrack test.

Wheelchair Option
If the wheelchair option is enabled, enter the positions of the right and left wheels on the platform. These positions will then be required to complete testing. If the patient does not require the wheelchair on subsequent follow up testing, disable this option.

Follow-up Visits

All list boxes should have been filled the previous visit. For accurate retesting, DO NOT change the parameters unless an exception is required and is documented in the notes. When retesting a patient:

1. Adjust the IsoTrack according to the displayed parameters and instructions.
2. Position the transducer against the patient as instructed.
3. Complete all required repetitions.

Platform Parameters

The IsoTrack testing platform has a number of adjustments to correctly position the patient for standard testing, custom isometric testing, NIOSH lift tasks, custom lift tasks and push/pull testing. The software includes general testing station adjustment parameters that apply to a wide population base. These parameters can be viewed using the "Test Setup" button at the IsoTrack Test screen (see Chapter 3 of this module). Parameters for standard tests should not be changed unless necessary to accommodate the patient's physical condition, and then they should be documented in the "Notes" section. For some tests certain parameters are patient-specific, such as the transducer height, and must be documented during testing.

Refer to the following for information about IsoTrack adjustments:
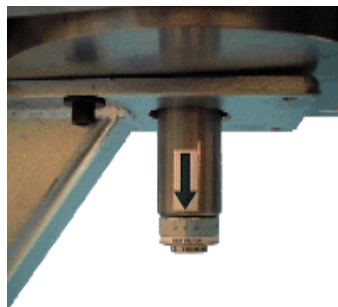
Seat Vector - This parameter indicates the direction the seat faces relative to the transducer. To set the seat vector, twist the lever on the right side of the seat until it indexes in the unlocked position. To lock the seat, rotate the seat to a mark on the Seat Vector Indicator and turn the lever to the locked position. If the seat does not lock, turn the seat slightly in both directions from the mark until the lever engages.

Height Indicator Strip.
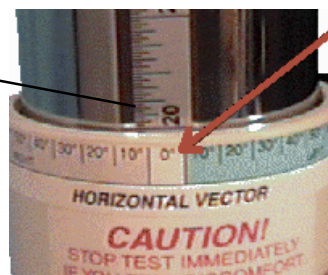
Horizontal Vector - This parameter is the degree of rotation of the transducer around the vertical pole. To set the Horizontal Vector, release the locking handle and rotate the transducer until the correct position on the Horizontal Vector Indicator is centered on the Height Indicator strip. In this example the horizontal vector is 0°.

Note: Before testing, make sure the vector locking handle is in the vertical position with the end of the handle against the stop.

Height - This setting indicates how high above the platform the transducer is positioned during a test. Height can be set from 6" to 97". To set the height, release the locking handle and move the transducer along the vertical tube until the top of the transducer is aligned with the mark on the Height Indicator. In this example the height is 20".

Height is often a patient-specific parameter and should be documented during testing.

Vertical Vector - This parameter indicates the rotation of the transducer around the horizontal axis. To set, twist the knob to release, then rotate the transducer housing until the indicator points to the correct vertical angle. Twist the knob as required to lock the vertical vector.

Note: For some tests the vertical vector is left unlocked so it is free to rotate during testing.
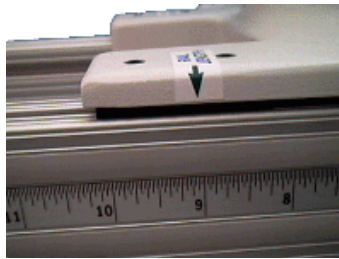
Rail Length - This parameter is the distance the transducer is moved out from the vertical pole. Rail Length can be set from 8 ½" to 20" with 1/8" resolution. To set, twist the small handle counterclockwise, then move the transducer horizontally until the indicator points to the correct length. Lock the rail length by twisting the small handle until the handle end rests against the vertical tube.
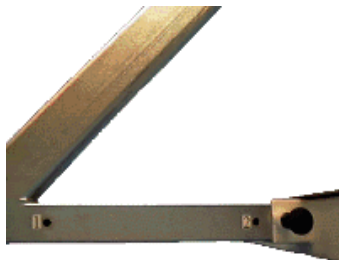
Seat Position - The seat position can be set from positions 1-4. The #1 setting indicates the seat is set closest to the transducer. To adjust, rotate the two seat stabilizer knobs (see below) counterclockwise until fully disengaged from the floor. Slide the seat until the indexer locks into one of the four seat position holes. As a rule of thumb, upper extremity testing is performed at seat setting 1, and lower extremity testing is performed at position 2 or 3.
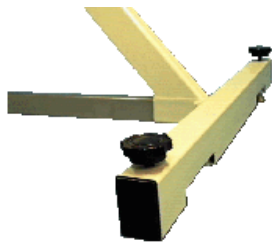
Seat Stabilizers - This hardware adjustment is not noted in the software. The stabilizers are used to keep the seat level and secure. To adjust the stabilizers, rotate the two seat stabilizer knobs an equal amount clockwise until the seat is stable.

IsoTrack Accessories

A number of testing accessories are included with the IsoTrack testing station for use with different types of testing. The default accessory is shown in the Accessory list box, and can be viewed by selecting the "Test Setup" button at the Test screen. Any changes to the default accessory should be documented in the "Notes" section.

Caution: **Always make sure the accessory is properly locked in position before beginning a test! Failure to lock the accessory in place could cause injury. As shown below, the black locking knobs are in the up position when locked.**
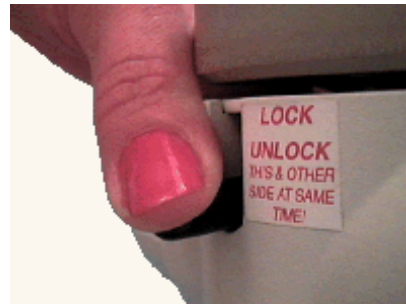
Locked   Unlocked

The following accessories are available to be used with the IsoTrack testing system:
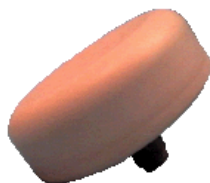
624 - curved pad.   *623 - round pad.*   *625 - curved pad/strap.*   *506 - cable handle.*
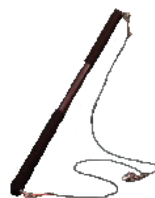
621 - handle.   *626 - long bar.*   *627 - short bar.*   *515 - eye hook.*

IsoTrack Calibration

New Installations and First Time Calibration

If the IsoTrack testing station and the Tracker Interface Box were received in the same shipment, then the transducer has been calibrated at the factory and a calibration diskette was included with that shipment. The calibration diskette should be installed during the software installation process according to the instructions in Module 1, Chapter 2.

The loadcell must be calibrated on site if the IsoTrack testing station was purchased as an upgrade to an existing system. To do this, follow the instructions below for maintenance calibration.

Maintenance Calibration

Every six months, the software prompts for a maintenance calibration. In the meantime, if the loadcell impacts a rigid surface or is mishandled, the calibration should be performed prior to the appearance of the software prompt. Adjust the Vertical Vector to the 180° position as pictured below and lock it. From the Main screen, select "Setup," then "Calibrate" and "IsoTrack" from the resulting lists. Make sure there is no externally applied weight on the gauge, and click the "Zero Calibrate" button in the IsoTrack Calibration dialog. Insert the eye-hook into the loadcell receptacle. Using a hook or rope, attach a known weight to the eye-hook as pictured below. Type the weight of the object into the dialog box, then click on the button labeled "Weight Calibrate." The minimum weight for calibration purposes is 50 lb. Any weight up to 400 lb. can be used.

Vertical Vector at 180°	*Weight calibrate*	*Zero calibrate*

Daily Auto Calibration

Daily, the software will prompt for a "Zero Calibration" to eliminate any drift inherent with load sensing devices. Remove all force from the gauge, position as above, and click "OK." If there is no time to perform the Zero Calibration, the calibration can be delayed until the IsoTrack is used again by clicking the "Postpone" button.

IsoTrack Push-Pull

This setup is used to simulate functional pushing and/or pulling.

Pull Test

To simulate pulling, set the rail length to 8½" and lock in place. The height is based on the functional pull being simulated. If a specific job task is not being simulated, the height should be adjusted to correspond to the patient's waist. The short bar accessory should be attached to the load cell. The vertical vector should be unlocked allowing the load cell to pivot freely. Document the foot position once the patient has adopted a comfortable pull posture.

Push Test

To simulate a push test, use the same Multi-Vector Alignment settings for the pull test above, but change the accessory to the long bar and three-foot cables. The vertical vector should remain unlocked. The patient stands inside the long bar and cables and pushes away from the post.

Chapter 3
Using the IsoTrack Software for Muscle Testing

Once a patient has been selected from the patient database and an exam description has been selected or defined (see Module 2, Chapter 2: *Starting a Test)*, select the "IsoTrack/PowerTrack" button from the Test Selection screen.

Select IsoTrack, or other buttons to use alternative testing modules. (Contact JTECH if options are not available.)

First select "IsoTrack/ PowerTrack," then the button corresponding to the type of test to be performed.
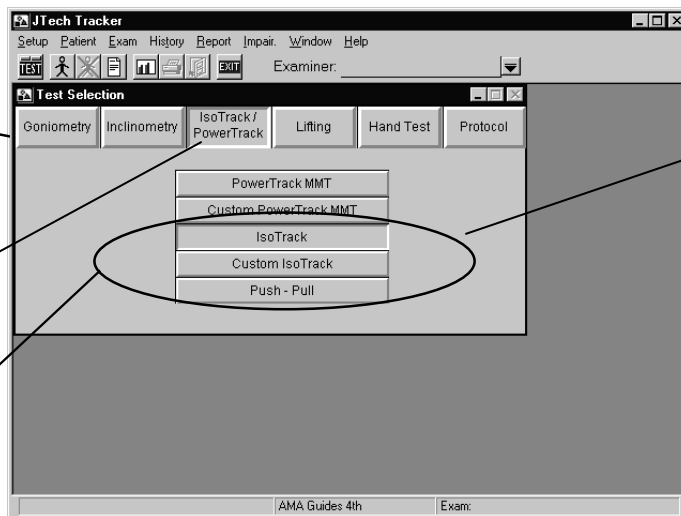
These three buttons are part of the IsoTrack software module. The "PowerTrack MMT" and "PowerTrack Custom MMT" buttons come with the PowerTrack manual muscle testing module.

Muscle Selection Methods

Select "IsoTrack" to bring up the Muscle/Motion Selection screen. The results of selecting "Custom IsoTrack" and "Push-Pull" are discussed later.   *Root to Nerve* is the default muscle selection methodology. The menu boxes instantly indicate the nerve roots that spawn peripheral nerves and which muscles are innervated by the selected peripheral nerves. As an item is highlighted, lists "downstream" to the right of the selection are affected. Selecting an item in the muscle list dictates the muscle action to be tested. For more information on muscle selection strategy and methodology, refer to Chapter 1 of this module.
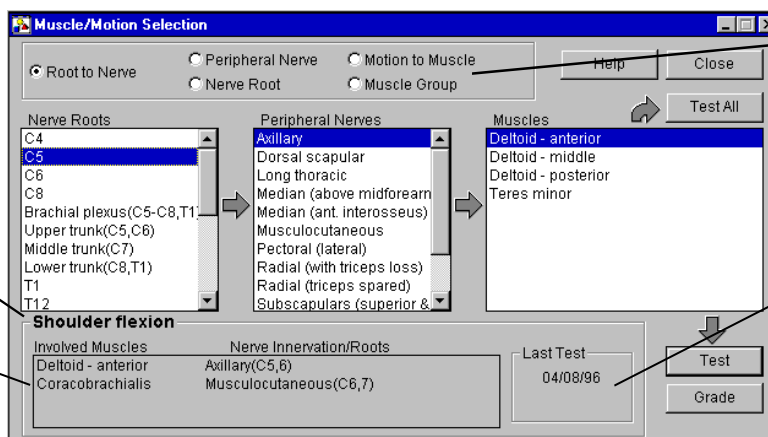
The test to be completed for the highlighted muscle is displayed here.

Summary box indicates that other muscles and nerves may be involved during test.

Selecting one of these methods determines the selection method for the muscles to be tested.

This box indicates whether the highlighted muscle was tested previously and when.

All of the IsoTrack Muscle Selection screens share a similar design. Once a muscle (or series of muscles) has been highlighted, the buttons at the top and bottom of the screen are used to dictate the next action. Selecting the "Test" button initiates the test sequence for the highlighted muscle. The "Grade" button is selected to grade the highlighted muscle if there is a deficit. The "Test All" button selects all muscles associated with a particular nerve root, peripheral nerve, etc. for testing. The "Help" button accesses the Help screens for assistance with the particular screen. The "Close" button returns to the Test Selection screen.

Selecting "Peripheral Nerve" brings up the following dialog for selection of the muscles associated with a particular peripheral nerve.

Click on the scroll bar to see the entire list of options.

Click here to test all of the muscles associated with a particular peripheral nerve.

Click here to test just the highlighted muscle.
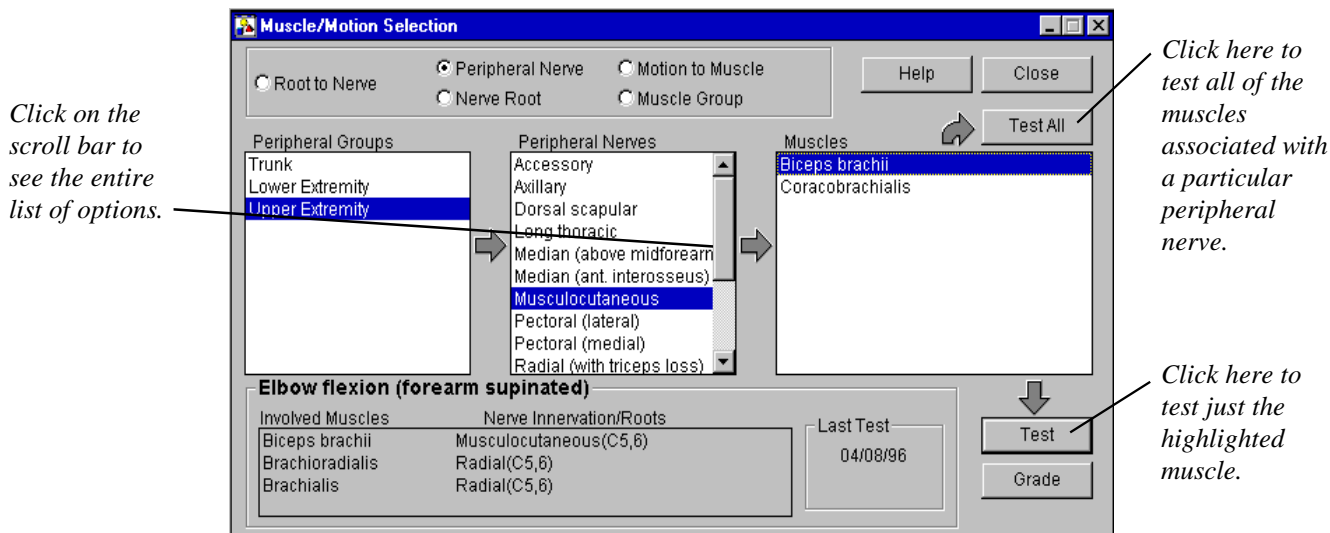
Selecting "Nerve Root" shows all the muscles associated with a particular nerve root. Once selected the Muscle/Motion Selection screen changes and appears with options like the dialog below.
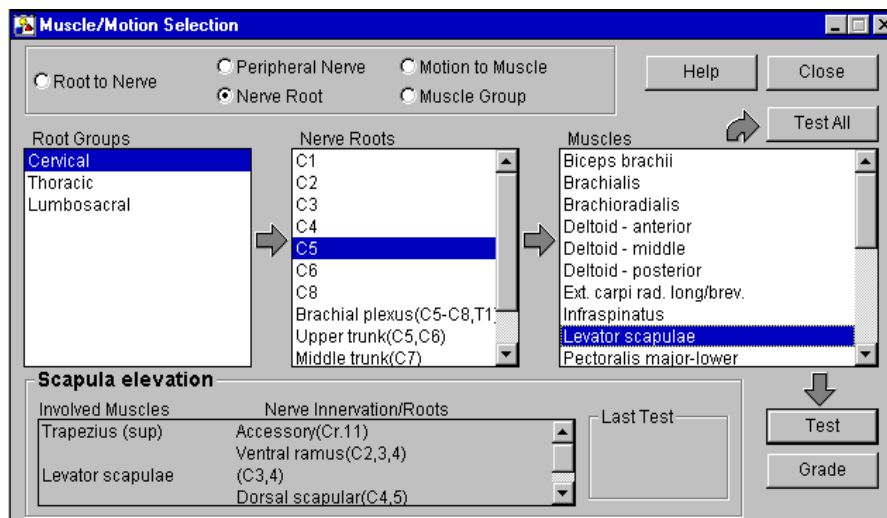
Click on "Motion to Muscle" to see and select a list of motions associated with a selected joint. An example of the results is shown below.
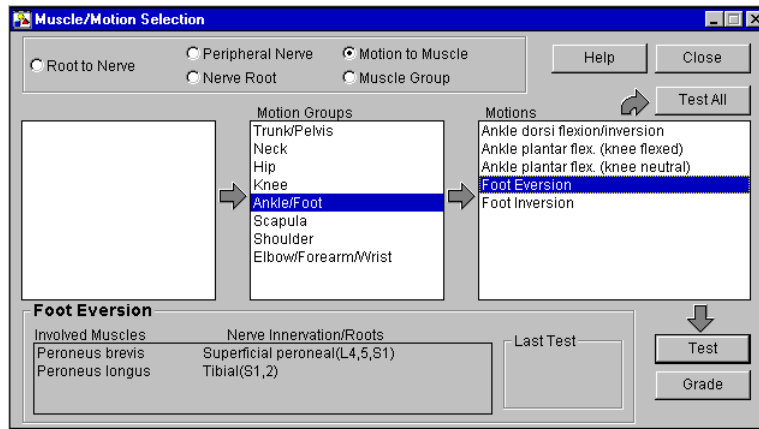
Click on "Muscle Group" to directly select a muscle or group of muscles to be tested. A similar screen is pictured below.
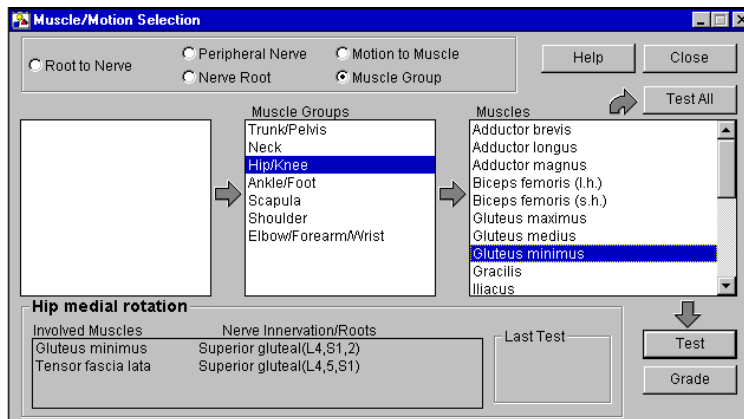
Testing

To test a specific muscle, highlight it and click the "Test" button. Selecting "Test All" will highlight all muscles or motions displayed in the list box furthest to the right. Selection of either of these two buttons will initiate the Testing screen. If a 16-bit sound card and speakers are part of your computer system, a voice prompt will begin with instructions about completing the test.

The Test screen is pictured on the next page. It features an autoscaling, split-screen graph of force versus time that displays left side and right side data separately. For a non-bilateral joint only a single graph appears. A Validity Status box in the lower left corner of the screen indicates if the recorded data is valid. Six function buttons are positioned below the graph. Their functions will be described later. In the lower right-hand corner is a real-time display of load on the sensor. The "Threshold" button allows user-control of the load-level that must be exceeded prior to data being recorded. Just above the "Threshold" button is a color key for distinguishing test repetitions. Above that is a box that indicates the status of the current test. Lastly, there is a button to access

the CD-ROM Help system, which has full-motion video and narration about the test, its positions, and its stabilization procedures. For more information about the Iso-Track CD-ROM Help System, contact JTech at 1-800-985-8324.

Click here to bring up the CD-ROM Help system.

Test Status box.

Autoscaling force and time axes for graphs.

Click these buttons to switch between left or right side.

Force curve color key.

Validity status box. "Yes" or "No" appears after two repetitions have been completed.

Real-time display of load on sensor.

Click here to set "test time" and "ready time."

Click here to see the hardware and software setup parameters for the test and to set parameters specific to the individual patient.

Click here to close the testing procedure.

Click here to set a threshold from 3-45 lb.

After clicking "Test Setup" the screen shown on the next page appears. Standardized parameters that apply to a broad population base are displayed in the appropriate list boxes. These parameters should not be changed unless necessary to accommodate the patient's physical condition. Patient-specific setup parameters, such as transducer height, should be entered in the blank list boxes. Unused parameters for the selected test are not displayed. If the test is competed without entering patient-specific parameters, a warning box will appear upon closing the Test screen.

Symmetrical Testing

If the test selected is a bilateral test, such as a shoulder test, the software displays right and left side parameter settings. Setting right-side parameters automatically sets corresponding opposite parameters for the left side. When a symmetrical test is selected the software does not display the right and left side options.
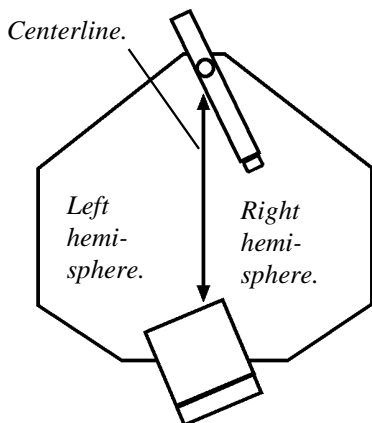
Right and Left Parameter Designations

Centerline.

Left hemi-sphere.

Right hemi-sphere.

"Right" and "Left" side parameter settings are based on a "hemisphere" system. From behind the seat facing the pole, the centerline of the platform, running from seat through the pole, divides the parameters between right and left. Therefore, any parameter that moves into the right hemisphere is designated as right and likewise for the left. (In example at left, seat parameter is left, transducer parameter is right.)

Information about the test used with the patient is displayed in

The parameter settings indicate direction of seat relative to the hemi-sphere centerline in 10° increments from 0°-180°.

This parameter shows direction of transducer rotation around the vertical pole in 5°

Left parameters automatically default opposite of right.

Scapula elevation - Test Setup

Test Description/Instructions

Patient Position: In the seat or wheelchair facing 90 degrees from the post.
Belts: Hip belt attached to isolate the upper torso.
Accessory Placement: Pad placed on the shoulder proximal to the joint.
Patient Action: Attempts scapula elevation.

OK
Cancel
Help
CD-ROM Help

Right Side Defaults
Seat Vector: 100°   L
Horizontal Vector: 10°   R

Left Side Defaults
Seat Vector: 100° R
Horizontal Vector: 10° L

Other Defaults
Seat Position: 1
Vertical Vector:
         ○ Locked   ● Unlocked
Rail Length:
Height:
Accessory: Curved Pad

☐ Wheelchair Option

Box indicates seat setting away

The transducer's vertical angle is set in 5° increments

Radio buttons show if Vertical Vector is locked or free to rotate.

This box shows the transducer distance out from vertical pole between 8½" to 20" with 1/8" resolution.

Transducer height above platform, this parameter is often patient-specific.

This setting is used if the patient is confined to a wheelchair. When it is checked, wheel placement boxes appear in "Side Defaults" sections.

This parameter designates the accessory attached to the transducer for the test.

The following list boxes are not shown in the above illustration, but are available for certain selected tests:

Foot Quadrant   Only available for standing tests.

Wheel Quadrant   Displayed when "Wheelchair Option" selected. To set position, click "Select" button, click on quadrant from resulting display, then click "OK." Parameter for left side does not automatically default when Right Wheel Quadrant is set.

Cable Length   This box is selected if cables are used with the accessory. Cable lengths are 1', 3', and 5'.

Testing Screen Function Buttons

The following sections describe the use of the six function buttons located at the bottom of the IsoTrack Testing screen.

Statistics
Selecting the "Statistics" button overlays the graphs with a box (shown on next page) containing statistical information regarding the tests. The peak load for each repetition is displayed, as well as validity, coefficient of variation, and percent deficit. Repetitions that have not been manually excluded through the Details dialog (see below) are displayed in bold. To remove the Statistics box, click on "Close."

A set of unilateral repetitions is considered valid if the greatest difference between successive repetitions or the coefficient of variation is less than or equal to 15%. The coefficient of variation is determined with the n-1 method using the maximum of each repetition.

Deficit is calculated as the percent difference between the maximum repetition of the right and the maximum repetition of the left side.

Isometric Statistics

Right Side

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	30 lb	28 lb	126 lb-sec	23%	No	Complete
Rep 2	45 lb	38 lb	172 lb-sec	36%	No	Complete
Rep 3	51 lb	44 lb	200 lb-sec	27%	No	Complete
Rep 4	58 lb	49 lb	222 lb-sec	34%	No	Complete

Ready Time:	1.5 sec	Max Difference:	36%
Max Average:	49 lb	CV:	23%
Deficit:		Valid:	No

Left Side

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	39 lb	32 lb	147 lb-sec	44%	No	Complete
Rep 2	36 lb	30 lb	138 lb-sec	44%	No	Complete
Rep 3	27 lb	24 lb	49 lb-sec	100%	No	Complete
Rep 4						Incomplete

Ready Time:	1.5 sec	Max Difference:	20%
Max Average:	32 lb	CV:	15%
Deficit:	35%	Valid:	Yes

[Close]   [Help]

Click here to close the Statistics box.

The following is a summary of the lift task statistics:

Repetition statistics are specific to each repetition.

Max ....Maximum force recorded from the end of ready time to the end of the test.

Ave ....Average force during from the end of ready time to the end of test.

Power ....Indicates the subject's ability to sustain force over time. The area under the curve from end of ready time to end of test.

Fatigue ....Percent difference between the maximum and the load value at the end of the test. If patient does not sustain a load until the end of the test, 100% fatigue will be reported.

Ratchet..................Checked in "Details" if the curve exhibits oscillations indicative of "ratchet response" or "cogwheeling," which may indicate submaximal effort.

Status ...."Complete" if test extends beyond ready time or "Incomplete" if test ends during ready time. "Exclude" is selected from "Details."

Overall statistics apply to the test as a whole.

Test Time..............The predetermined length of the test in seconds. Test time begins when the threshold is exceeded. Test time includes ready time.

Ready Time...........Examiner controlled time period usually dictated by how rapidly patient can build strength.

Max Average.........The maximum of the averages determined above.

Max Difference ....The maximum difference between successive repetitions. It is used as part of validity to determine consistency of effort.

CV ....Coefficient of variation, which is a statistical calculation indicating spread of data.

Valid......................Yes/No indicator. A test is valid ("Yes") if either the CV or Max Difference is 15% or less. "No" indicates both values are greater than 15%.

Delete Rep

Selecting the "Delete Rep" button brings up the following window on the Test screen. Tests that may not be indicative of the patient's true ability can be selectively removed using this screen. Validity and statistics are then recalculated each time a curve is eliminated. Tests subsequent to the deleted repetition are moved up, for example, if rep 2 is deleted, rep 3 is renamed rep 2 and rep 4 is renamed rep 3.
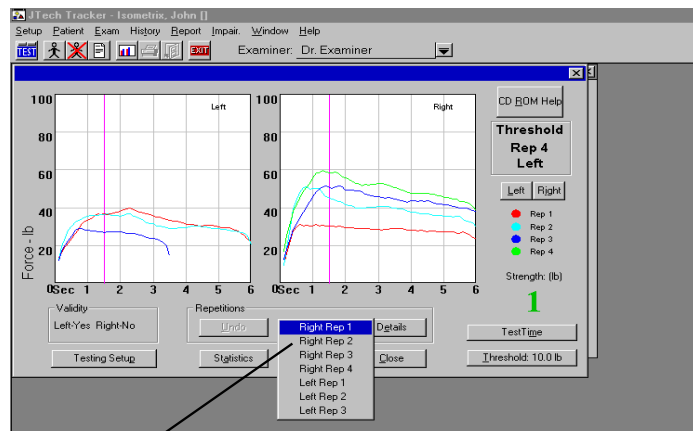
Highlight, then click on the rep to delete it.

Undo

Clicking on the "Undo" button deletes the last completed repetition.

Details

Selecting the "Details" button allows the adding of notes regarding a specific repetition. At the Details screen, clicking on the check box labeled "Ratchet" marks the respective force curve as exhibiting signs of "cogwheeling" or "ratcheting response," which may be an indicator of sub-maximal effort. Clicking on the "Exclude" check box permits the curve to be excluded from statistical and validity calculations. Repetitions excluded through the Details dialog appears in standard type (not bolded) in the Statistics dialog. Input into this screen is displayed as part of the report writer.

Test Time

The "Test Time" allows you to change the default time parameters for the test (see Module 1, Chapter 3). Test time is the overall length of the test. "Ready time" is used to provide the patient a time buffer at the beginning of the test to reach maximum effort. Only the data sampled from the end of ready time to the end of test ("sample time") is used for reports and statistical calculations. As a rule of thumb, the sample time should be at least three seconds.

To adjust the ready time, position the pointer on the right-hand edge of the red bar. Press the left mouse button and drag the edge of the bar to the desired value. To adjust the test time, position the pointer on the right-hand edge of the green bar and drag it to the desired position. Click "OK" when finished.

Click and drag here to adjust "ready time."

Click and drag here to adjust "test time." Adjusting test time after a test has been performed will erase the test information.

Warning which appears if test time is adjusted after a test has already been completed.

With some tests the effects of changing ready time from 1.5 seconds to one second can dramatically affect some calculations. Therefore, if comparisons are to be made for a patient using multiple test dates, the ready time and the test time should remain the same in each instance. The software automatically selects the ready time and test time according to the patient's previous exams using the test.

If the deficit (difference) between the maximum value for the left side and the maximum value for the right side is greater than 15%, a message will appear indicating such upon selection of either the "Close" or "Statistics" buttons. If this is the case, and the muscle test is to be used as part of an impairment, the software will recommend rating this muscle as a grade 4. Consult your edition of the AMA *Guides to Evaluation of Permanent Impairment* for more information. Click on "OK" to close the Warning box and proceed. To rate the muscle as part of an impairment, click on the "Grade" button in the Muscle/Motion Selection screen and use the instructions in Module 6:   *Grading* of this manual.
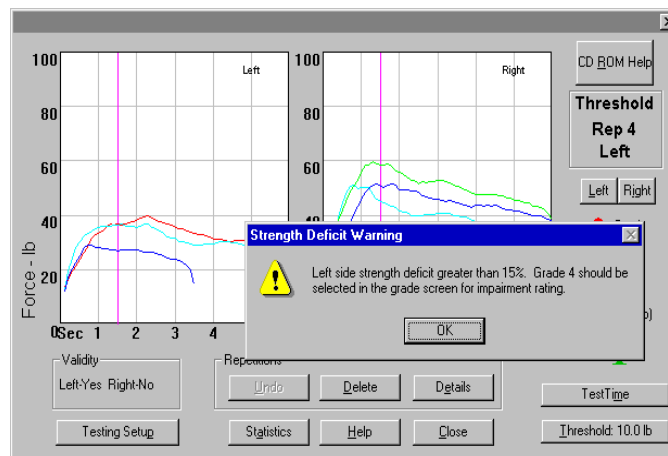
Continue

To go back to a Test screen, highlight the muscle or motion again from the Muscle/Motion Selection screen and select "Test."   The graphs will appear. To perform additional repetitions of this test, or repeat a portion of the exam, select the "Continue" button as shown below.

Select "Continue" to add more repetitions or repeat a repetition.
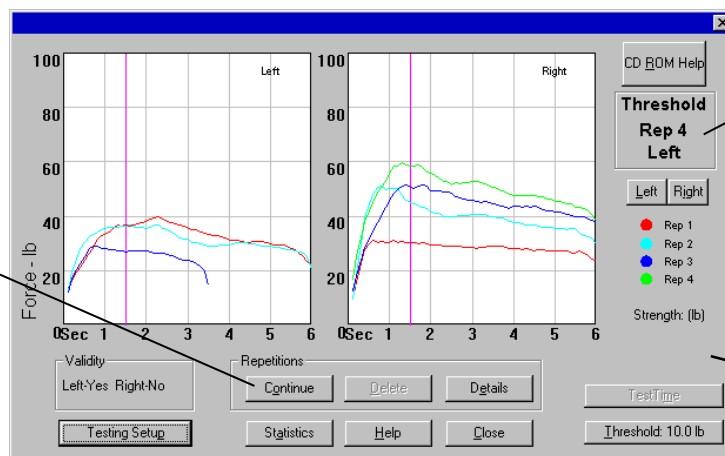
The software assumes testing is complete until "Continue" is selected.

The load cell is inactive until "Continue" is selected.

Grading

Muscle tests have traditionally been graded on a 0-5 scale, with zero being non to slight contraction and five being full contraction. Upon selecting the "Close" or the "Statistics" button, the software will prompt you to grade the test if a bilateral deficit greater than 15% exists. Grading the test is not necessary if it is only being used for things like screening or evaluation of progress. The test must be graded if it is to be used as part of an impairment rating. For more information about muscle test grading, see Module 6: *Grading* of this manual.

Impairment Rating

Performing a grading procedure links the resulting impairment to the extremity with the motor deficit. If the Impairment Summary is printed out, the motor deficit will be added or combined (as appropriate) with ROM impairments (or any other impairments that may have been added) on a regional basis and then combined to calculate a "Whole Person Rating." To view a listing of added impairments, select "Impair..." and "Details" from the menu items at the top of the screen. To see how the impairments were added or combined, preview the Impairment Summary on the screen by selecting "Report," "Patient Exam," and the appropriate test date. At the Print dialog box, use the mouse to place a check in the boxes next to "Impairment Summary" and "Print to Screen."

In many cases, problems with a nerve will weaken more than one muscle. If all the affected muscles are graded against this same nerve, then multiple impairments will be assessed for the nerve. According to the AMA *Guides*, only the maximum loss of function resulting from the nerve should be rated. To prevent this multiple rating of impairment, the software's "Auto-exclusion" feature will select the greatest impairment for a particular nerve. This feature is accessed be selecting "Impair..." from the Main menu list. The resulting screen is illustrated on below, and the default setting is "On." Only the maximum graded impairment for a nerve will be displayed in the Impairment dialog and on reports. Selecting "Off" will result in an impairment being reported for each graded test of the same nerve.

Default setting is "On." Clicking "Off" will report an impairment for each test of the graded nerve.

Auto-exclusion   ×

  ⦿ On   Auto-exclusion ensures that a nerve is not
                represented in more than one impairment
  ○ Off   for Muscle Testing.

        OK   Cancel   Help
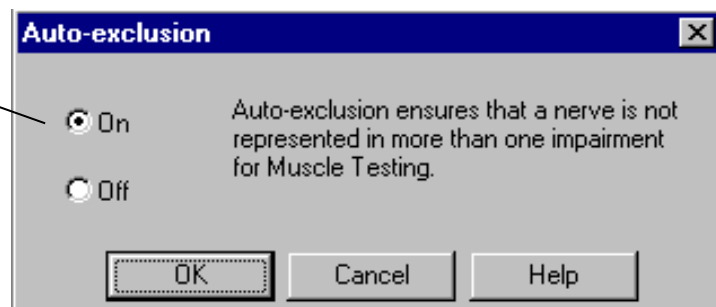
Creating Custom IsoTrack Muscle Tests

There is a wide range of muscle tests in the software and on the CD-ROM. These tests were all adapted from the standards outlined by Kendall as well as Daniels and Worthingham. Occasionally, clinicians must improvise their own methodologies based on their clinical experiences or a unique patient's needs. Tracker software allows the creation of custom muscle tests that can be used for any patient at any time. For example, the standard shoulder abduction test requires the arm to be raised to 90° for testing. The clinician, however, may want to test the arm at 0° of abduction. With IsoTrack's custom test capabilities the clinician can test the shoulder at any degree of abduction.

To create a custom test, select "Setup," then "Custom Tests," and then "IsoTrack."
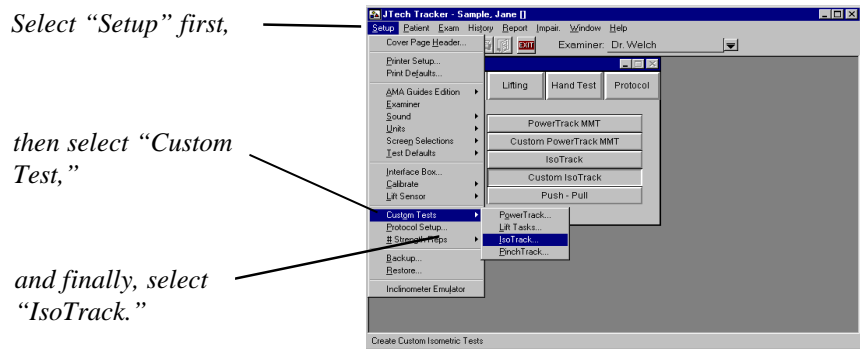
Select "Setup" first,

then select "Custom Test,"

and finally, select "IsoTrack."

After "IsoTrack" is selected, the following dialog box will result. To add a new test, select the "Add Test" button. To modify an existing test, click on the downward pointing arrow and select the test from the resulting list.

The custom test name is entered in this box.

The test description and any special instructions for the test are entered in this box.

These boxes are used to define the test parameters and patient positioning.
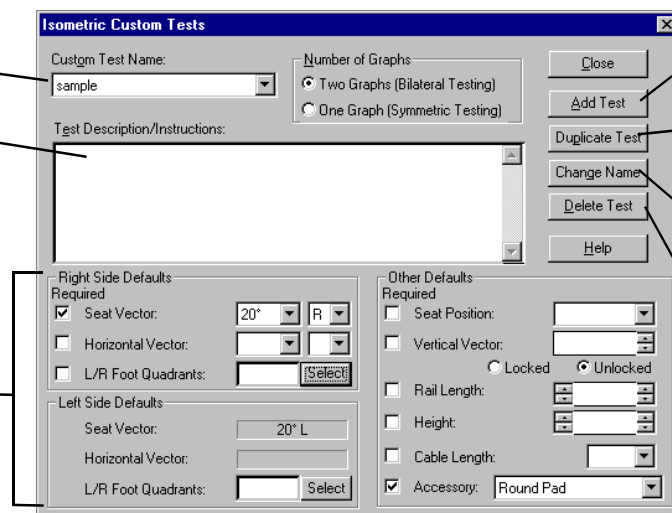
Click here to add a new custom test.

Click here to create a duplicate test with a new name.

Click here to change the name of an existing custom test.

Click here to delete the test highlighted in Custom Test Name box.

Selecting "Add Test" in the Custom Test dialog results in the following box. Type the name of the new custom test in the box and select "OK."
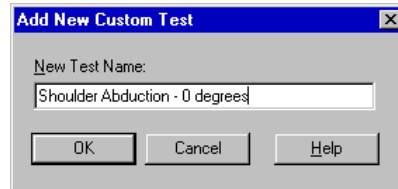
After the name of the test has been defined, select either "One Graph" if the test is a unilateral motion or "Two Graphs" if the test is bilateral. Click on Test Description/Instructions and type a description of the test or any special instructions to be observed during the test.

Select graph option according

Once all the test parameters are set, click on the "Close" button to exit and save the test.

Placing a check in these boxes turns the parameters on, removing the check turns them off. Unchecked parameters will not be visible at the Testing screen Setup dialog even if a value is

Feet placement for standing tests are entered by clicking "Select." At the Placement screen, select the left foot position with the left mouse button and the right position with the right mouse button.

Left side "Seat" and "Horizontal" vectors automatically default to the opposite of the right side settings.

Set the parameters for the test using the check and list boxes. Checking the parameter check box means that parameter will be displayed when "Test Setup" is selected at the Test screen. Standard parameters can be set beforehand, while patient-specific parameters (such as height) can be checked and left blank. Parameters checked and left blank, however, must be entered before closing the Test screen.

Performing a Custom Isometric Muscle Test

From the Test Selection screen, select "IsoTrack" and the button labeled "Custom Isometric." The dialog shown below will appear. Highlight the custom test to be performed from the list. After the test has been highlighted, select the "Test" button. To perform all custom tests on the list, select "Test All."

Select this button to test a patient using all the custom tests on the list.

Select this button to test using only the highlighted test.
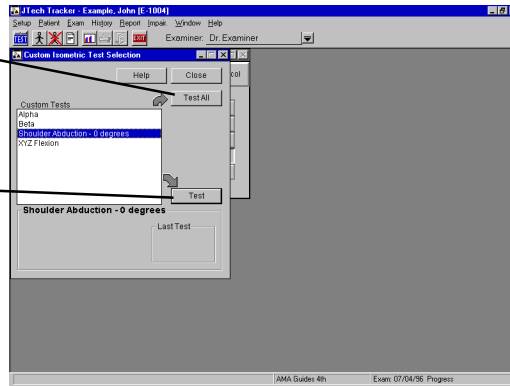
Once in the Test screen, all buttons, except for the "CD-ROM Help," function as they would for a standard muscle test.

Tip: To conveniently test a patient using multiple custom tests, create a test series using the protocol capabilities of the software. For more information on protocols, see Module 1, Chapter 8: *Creating and Using Protocols*.

Push-Pull Testing

Upon selecting the "Push-Pull" button the following dialog appears.

Clicking on "Test All" initiates both push and pull testing.

Clicking on "Test" initiates testing for just the highlighted test.
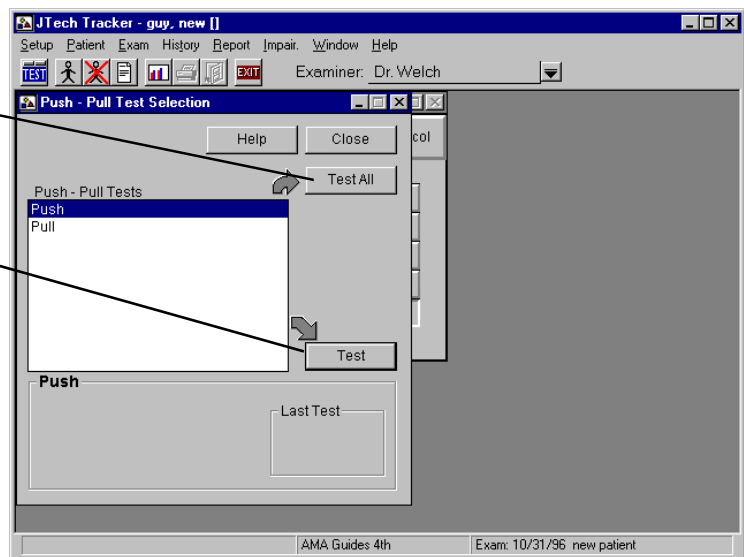
Standard test parameters are entered automatically in the Test Setup dialog by the software, but patient specific parameters must be entered manually by the examiner. All buttons and functions in the Push-Pull Test screen function the same as other IsoTrack Test screens.

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Chapter 4
Using the IsoTrack Software for Lift Task Testing

The lift strength measurement aspect of the software can receive input from different force transducers. A setting in the "Setup" pull-down menu dictates which sensor is enabled. For the software to recognize the IsoTrack force transducer, the "IsoTrack" option must be selected under the "Lift Sensor" heading (see the illustration below). If just the IsoTrack system was purchased, the default setting will be "IsoTrack," since "LiftTrack" would not be selectable.

Click on the "Setup" pull-down menu item,

then select "Lift Sensor,"

and finally select "IsoTrack."
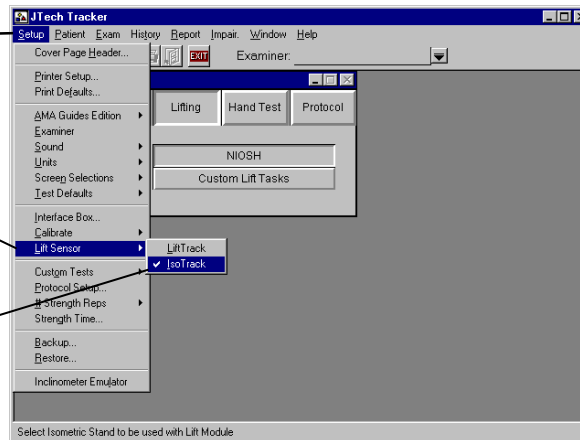
After a patient has been selected from the patient database and an exam description has been selected or defined (see Module 1, Chapter 4: *Starting a Test*), select a button from the Test Selection screen corresponding to the classification of lift postures to be tested.

For lift testing, select "Lifting" from the list of available modules. Contact JTECH at 1-800-985-8324 for information on additional modules.

After "Lifting" is selected, you can select "NIOSH" to use the six standard tests or "Custom Lift Tasks" to use tests you have created.
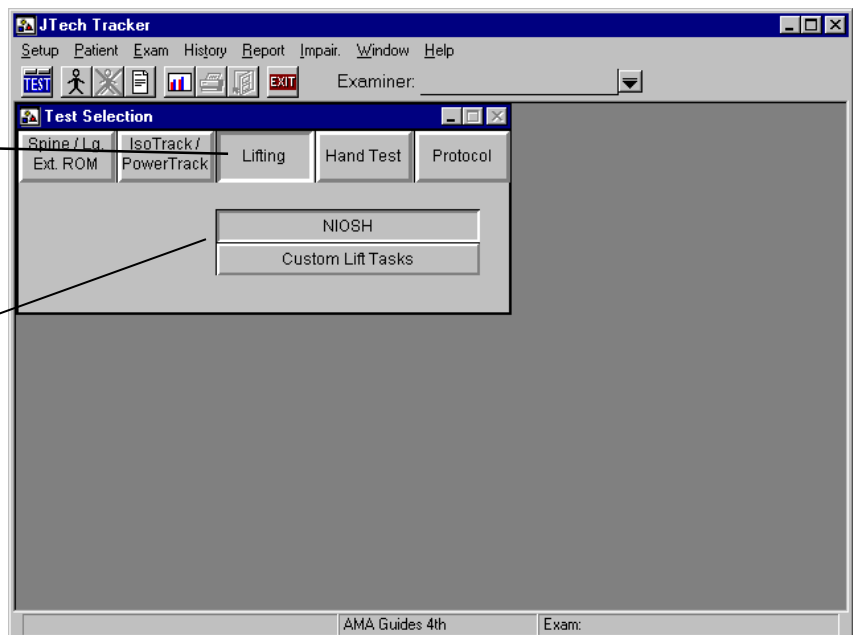
NIOSH Position Testing Screen

Selecting "NIOSH" displays a screen illustrating the six NIOSH test postures. The results of selecting "Custom Lift Tasks" will be discussed later on in this chapter.

To start testing, click the button depicting the desired test posture.

Select "Close" to return to the Main menu.

Click "Help" for detailed information on patient positioning and IsoTrack setup for test.

The last date a specific test was performed is listed below the corresponding NIOSH posture. Dates are only shown if the patient has performed the lift task test.

Patient Consent Form

Prior to any test the software displays a message to ensure a consent form has been signed by the patient. Static testing is a strenuous test which can lead to patient injury if proper protocol is not followed. The consent form is a waiver of liability if the patient is injured during testing.

A sample of the consent form is shown in the Appendix.

NIOSH Positions and IsoTrack Setup

When conducting NIOSH Lift Tasks with the IsoTrack, the apparatus should be adjusted as follows:

The rail length is set at 18½" and locked in place with the corresponding lever. The horizontal vector is set at 0° and locked. The vertical vector is set at 0°, but not locked. The seat must be slid back to position 4, so it is out of the way. The IsoTrack short bar is attached to the load cell.

To start a test, select the button corresponding to the posture to be tested. If a specific lift has been performed by the patient previously, the test date is shown under the   respective buttons.

Arm Lift

Height of the short bar and transducer is determined by positioning the patient such that the elbows are flexed to 90° with the shoulders in neutral position when holding the short bar. The patient's feet should be positioned so that short bar fits in palms of hands when the elbows are in the position described above. The patient's feet should also be shoulder width apart. Document the bar height above the platform, using the height indicator on the vertical tube, and the position of the medial malleoli on the platform for future testing. The patient lifts upward on the bar without swaying backward, raising up on the toes, or elevating the shoulders. This test primarily stresses the elbow.

Leg Lift

The height of the bar is set at 15 inches using the height indicator, and the medial malleoli are placed at 0 inches on the platform. Line the feet up with the teal-colored   diagonal line passing through 0 inches and quadrants "N" and "G" to prevent the patient's face from hitting the pole. The feet should be positioned far enough apart to allow the short bar to fit between the medial borders of the knees (as pictured). The trunk should be held as vertical as is   comfortable. The patient should use a leg lift technique,   emphasizing the quadriceps. This test primarily stresses the knee.

Torso Lift

The height of the short bar is set at 15 inches using the height indicator, and the medial malleoli are positioned at 15 inches on the platform. The patient flexes at the waist with minimal knee flexion. The bar is pulled upward in the direction of the arms. This test is stressful on the low back and, therefore, potentially the most dangerous for patients with low back pain. Exercise extreme caution with this test.

Floor Lift

The height of the short bar is set at 6 inches, and the medial malleoli are positioned at 10 inches on the platform. The patient flexes the trunk and the knees to reach the short bar. The patient lifts upward utilizing the hip, back, and leg extensors.

High Near Lift

The height of the short bar is set at 60 inches using the height indicator, and the medial malleoli are positioned at 10 inches on the platform. The patient grabs the bar with forearms supinated and lifts directly upward without raising up on the toes. This test primarily stresses the shoulder.

High Far Lift

The height of the short bar is set at 60 inches using the height indicator, and the medial malleoli are positioned at 20 inches on the platform. The patient grabs the bar with forearms supinated and lifts directly upward without raising up on the toes. This test primarily stresses the shoulder.

Patient Instructions

Before administering the first test, read the following instructions* or the equivalent to the patient.

"We are going to measure the strength of your legs, arms, and back. These tests are isometric strength tests, which means that you will be exerting force, but not moving anything. We will measure your average maximum force with this apparatus. For each test, please follow these instructions:

1.   The test will be demonstrated to you. If you do not understand, please ask questions.

2.   For each test, we will give you at least three attempts. The first is practice, try it at 50% effort. This first attempt is a warm-up and will help you determine if you know what is expected.

3.   Next you will be given a minimum of two attempts on each test. Try to do your best on each attempt as your score will be the average of the two measurements.

4.   When a test is given, I will tell you to begin when you are ready. For the period of the test, you should apply a consistent, maximum effort. The computer will beep when the test is finished. Do not attempt to jerk the handle to achieve maximum effort.

5.   Let me demonstrate the test for you.

6.   Are there any questions?

*Adapted from *Preemployment Isometric Strength Testing Methods,* Dr. Andrew Jackson FACSM, June 1990, p 37.

Lift Task Testing Screen

After the "Consent" dialog has been answered "Yes," a Test screen is displayed. The blue header indicates the type of test and the proper positioning of the patient. The dialog at the right indicates what repetition number is ready to be performed. After the patient is properly positioned and holding the lift bar, click "Start" to initiate the test. After the threshold value is crossed, data will be recorded in the form of a force curve. The patient should quickly build up to maximal force and hold it for the selected duration of the test. After two repetitions have been completed, the software will automatically determine if validity has been achieved. A maximum of four tests may be completed for any lift posture.

Header information includes type of test and proper patient position.

Autoscaling axis for best visualization of graphs.

Validity Status box shows "Yes" if validity criteria has been met.

Click " Undo" to delete last repetition performed.

Allows deletion of any of the repetitions already performed.

Click on"Close" when finished with test.

Click here to initiate each repetition.

Repetition status box.

Color key for distinguishing repetitions.

Real-time display of load on sensor.

Enables you to override defaults for test time and ready time.

Test Screen Function Buttons

Statistics

Clicking on the "Statistics" button displays a complete summary of data associated with the test.

NIOSH Arm Lift Statistics

Repetitions

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	68 lbs	63 lbs	282 lbs-sec	21%	No	Complete
Rep 2	71 lbs	62 lbs	276 lbs-sec	35%	No	Complete
Rep 3	71 lbs	66 lbs	297 lbs-sec	20%	No	Complete
Rep 4						Incomplete

Over All

Ready Time:	1.5 sec	Max Difference:	6%
Max Average:	66 lbs	CV:	3%
NIOSH Percentile:	23%	Valid:	Yes

Dynamic Rating

Occasional: 50 lbs	Frequent: 20 lbs	Constant: 10 lbs

The following is a summary of the lift task statistics:

Repetition statistics are specific to each repetition.

Max....................... Maximum force recorded from the end of ready time to the end of the test.

Ave....................... Average force during from the end of ready time to the end of test.

Power .... Indicates the subject's ability to sustain force over time.   The area under the curve from end of ready time to end of test.

Fatigue .... Percent difference between the maximum and the load value at the end of the test. If patient does not sustain a load until the end of the test, 100% fatigue will be reported.

Ratchet .... Checked in "Details" if the curve exhibits oscillations indicative of "ratchet response" or "cogwheeling," which may indicate submaximal effort.

Status.................... "Complete" if test extends beyond ready time or "Incomplete" if test ends during ready time. "Exclude" is selected from "Details."

Overall statistics apply to the test as a whole.

Test Time.............. The predetermined length of the test in seconds. Test time begins when the threshold is exceeded. Test time includes ready time.

Ready Time .... Examiner controlled time period usually dictated by how rapidly patient can build strength.

Max Average .... The maximum of the averages determined above.

NIOSH %............. A comparison based on Max Average to NIOSH database.

Max Difference .... The maximum difference between successive repetitions. It is used as part of validity to determine consistency of effort.

CV......................... Coefficient of variation, which is a statistical calculation indicating spread of data.

Valid .... Yes/No indicator. A test is valid ("Yes") if either the CV or Max Difference is 15% or less. "No" indicates both values are greater than 15%.

Dynamic Rating ... A rating based on published research and maximum average. The theoretical load a patient may be able to lift dynamically on an occasional, frequent, and constant basis in the tested posture. These numbers should be confirmed using dynamic testing.

Details

The graph on the following page shows that the patient's fourth repetition (for whatever reasons) exhibited signs of cogwheeling (inconsistent effort during the repetition) and the maximum was much lower than previous repetitions. The Validity Status box indicates validity was not achieved as a result of this fourth repetition. By clicking on the "Details" button the fourth repetition can be eliminated from the statistical calculations and notes can be recorded indicating the rationale for such a decision.

Fourth repetition shows inconsistency.
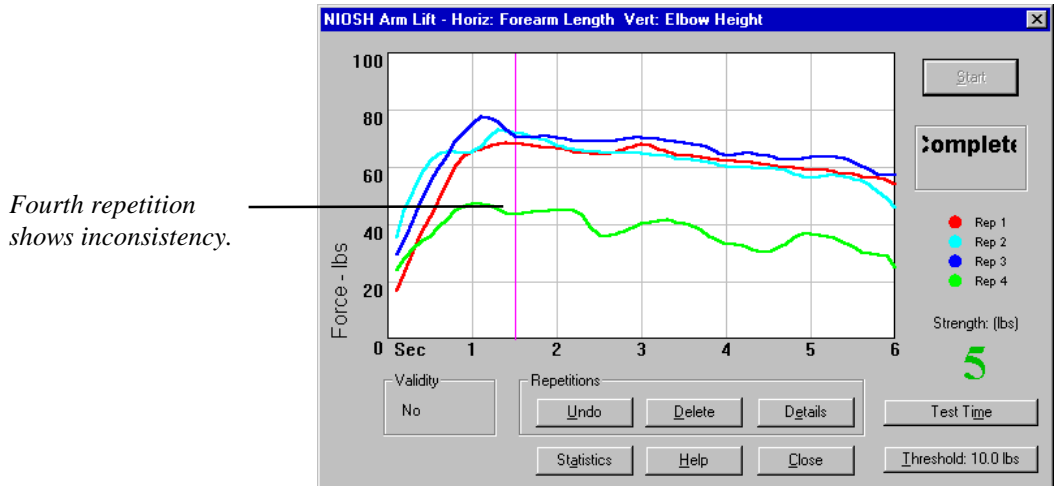
Clicking on "Details" displays the following Repetition Details dialog.

Click these boxes to indicate ratcheting.

Click on these check boxes to exclude a repetition from statistical calculations.

These boxes allow you to enter comments about individual repetitions.

Reviewing the Statistics box (below) illustrates that the fourth repetition was not used for statistical calculation. Notice that the fourth repetition is greyed out, the status field reads "Exclude," and validity has been achieved.

NIOSH Arm Lift Statistics

Repetitions

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	68 lbs	63 lbs	282 lbs-sec	21%	No	Complete
Rep 2	71 lbs	62 lbs	276 lbs-sec	35%	No	Complete
Rep 3	71 lbs	66 lbs	297 lbs-sec	20%	No	Complete
Rep 4	45 lbs	37 lbs	166 lbs-sec	44%	Yes	Exclude

Over All

Ready Time:	1.5 sec	Max Difference:	6%
Max Average:	66 lbs	CV:	3%
NIOSH Percentile:	23%	Valid:	Yes

Dynamic Rating

Occasional: 50 lbs   Frequent: 20 lbs   Constant: 10 lbs

Test Time

The "Test Time" button is used to override the default test time setting. Test time define the length of the test using two components: test time and ready time. Test time represents the overall length of the test in seconds. Ready time is used to provide the patient with time at the beginning of the test to reach maximum effort. The data sampled during ready time is not used in reports or statistical calculations. Data recorded from the end of ready time to the end of the test ("sample time"), on the other hand, is used for reports and statistical calculations. As a rule of thumb, the sample time should be at least three seconds.

Ready time serves as a buffer for any transient occurrences during the load initiation phase of the lift. For instance, if the patient "jerks" the handle, ready time excludes this phenomena. (Patients should be encouraged to proceed cautiously when initiating a test.) Ready time allows the patient's body to adapt to the stresses being placed on it and recruit additional muscle fibers and generate maximum force.

In summary, ready time is best defined as the time it takes the patient to reach a steady state. Based on the force curves generated, the examiner can evaluate what is the best ready time for the patient, such that no transient phenomena enter the calculation of statistical parameters associated with the test.

Test time can vary from a ½ second to six seconds in ½ second increments. Ready time is required to be at least a ½ second less than test time.

Changing the ready time after a test has been performed can affect the statistical calculations. Changing the test time after tests have been performed results in the loss of all data associated with that test. A Warning screen requiring confirmation will indicate the ramifications of the proposed change in test time.

Test Time dialog.

Line on graph shows current ready time setting.

Click here to see the Test Time dialog.

To adjust ready time, click and grab edge of red color bar.

Click and grab edge of green bar to adjust test time.

To adjust the ready time, position the pointer on the right-hand edge of the red bar. Press the left mouse button and drag the edge of the bar to the desired value. To adjust the test time, position the pointer on the right-hand edge of the green bar and drag it to the desired position. Click "OK" when finished.

Warning which appears if test time is adjusted after a test has already been completed.

The example below demonstrates the effects of changing ready time from 1.5 seconds to one second. With this particular test, the change dramatically affects the power calculation and has a slight effect on Max, Ave, Fatigue, Max Average, NIOSH Percentile, Max Difference, and CV. If comparisons are to be made for a patient using multiple test dates, the ready time and the test time should remain the same in each instance. The software automatically selects the ready time and test time according to the patient's previous exams for this test.

NIOSH Arm Lift Statistics

Repetitions

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	68 lbs	63 lbs	316 lbs-sec	21%	No	Complete
Rep 2	73 lbs	62 lbs	311 lbs-sec	37%	No	Complete
Rep 3	77 lbs	67 lbs	335 lbs-sec	26%	No	Complete
Rep 4	47 lbs	38 lbs	189 lbs-sec	47%	Yes	Exclude

Over All

Ready Time:	1.0 sec	Max Difference:	8%
Max Average:	67 lbs	CV:	4%
NIOSH Percentile:	24%	Valid:	Yes

Dynamic Rating

Occasional: 50 lbs	Frequent: 20 lbs	Constant: 10 lbs

Close   Help

NIOSH Arm Lift Statistics

Repetitions

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	68 lbs	63 lbs	282 lbs-sec	21%	No	Complete
Rep 2	71 lbs	62 lbs	276 lbs-sec	35%	No	Complete
Rep 3	71 lbs	66 lbs	297 lbs-sec	20%	No	Complete
Rep 4	45 lbs	37 lbs	166 lbs-sec	44%	Yes	Exclude

Over All

Ready Time:	1.5 sec	Max Difference:	6%
Max Average:	66 lbs	CV:	3%
NIOSH Percentile:	23%	Valid:	Yes

Dynamic Rating

Occasional: 50 lbs	Frequent: 20 lbs	Constant: 10 lbs

Close   Help

Threshold

The point at which the strength generated by the patient causes the recording of data is called the "threshold." Once the threshold is crossed, the test begins, and real-time strength data is displayed on the screen. The threshold should prevent a repetition from being falsely recorded as a result of the patient making any adjustments prior to the test. The threshold is adjusted by clicking on the button marked "Threshold" in the lower corner of the Data Acquisition screen. The limit and the increments are dependent upon the test being performed.
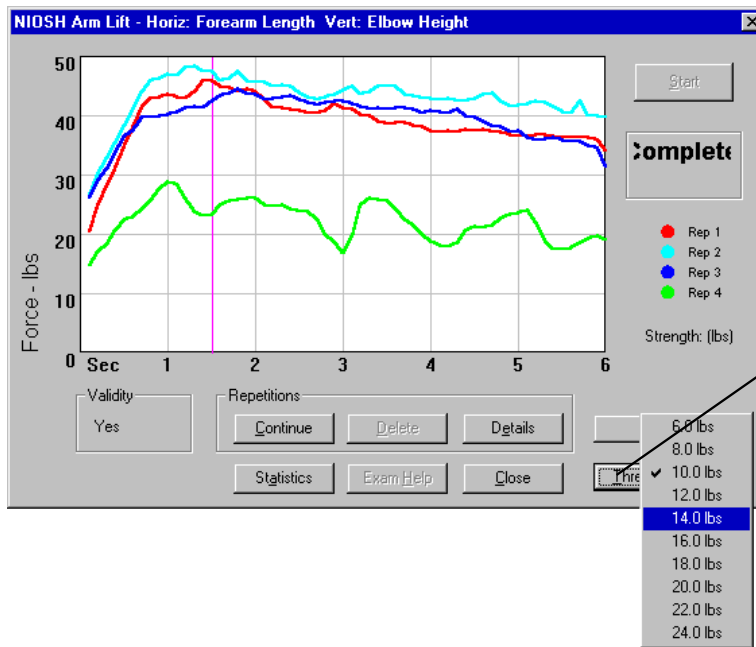
Click here to adjust the threshold. Once the threshold scale is visible, highlight the new value with the mouse.

Delete and Undo

If a repetition needs to be removed for any reason, click "Delete" button, and highlight the appropriate repetition. If the most recent repetition needs to be deleted, select "Undo."
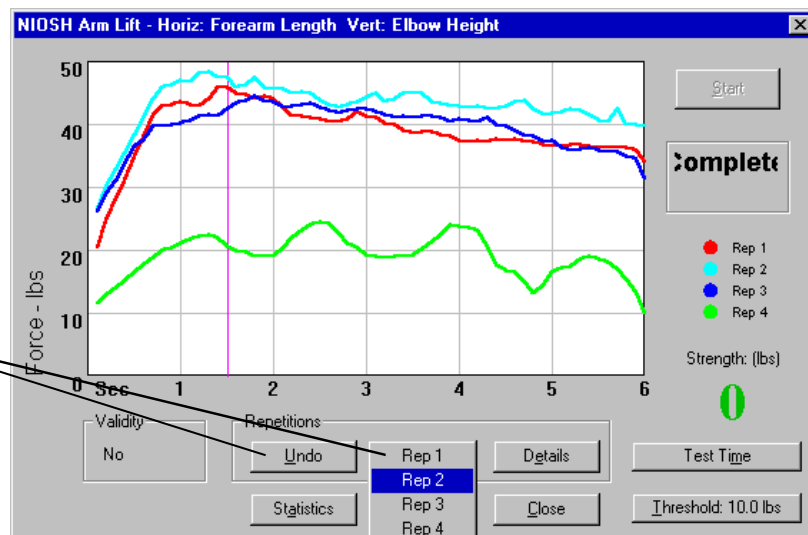
Use "Delete Rep" or "Undo" to remove force curves.

Creating Custom Lift Task Tests

In addition to the NIOSH tests, the IsoTrack software will allow an examiner to model any static lift task posture. To create a custom lift test, select "Setup," "Custom Tests," and "Lift Tasks." The selections are illustrated below.
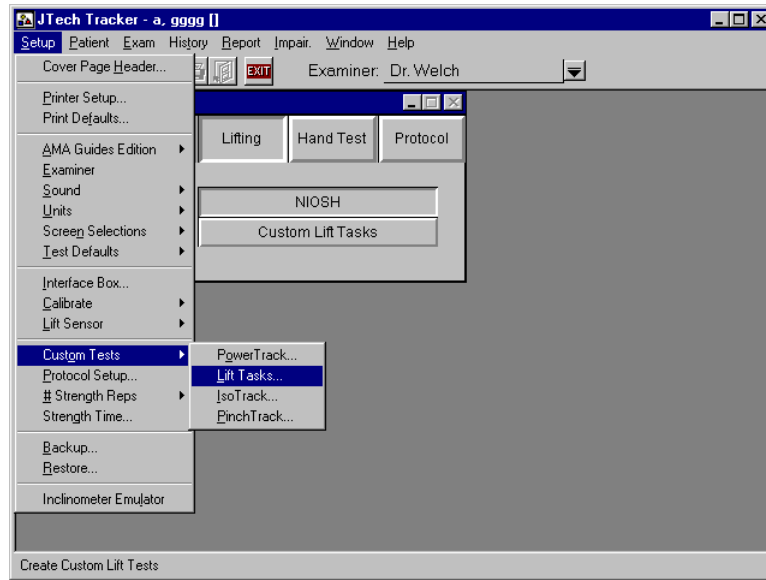
A dialog box (pictured below) will indicate if any custom tests already exist. Click on the downward arrow to see the complete list. If an existing custom test is to be deleted, renamed, or duplicated, highlight the test and click the appropriate button. To add a test, click on "Add Test." Another dialog will ask what the name of the new test is. Type it in and click "OK." The new test's name will appear in the box below. Position the cursor in the respective fields under "Platform Position" and type in the Horizontal Distance corresponding to foot placement, Vertical Distance corresponding to the height from the top of the platform to bottom of the handle (the value shown by the Height indicator on the vertical pole). Use the Test Description/Instruction field to document the things like the test's purpose, the patient's posture, or any special instructions. The test is saved when the "Close" button is clicked.
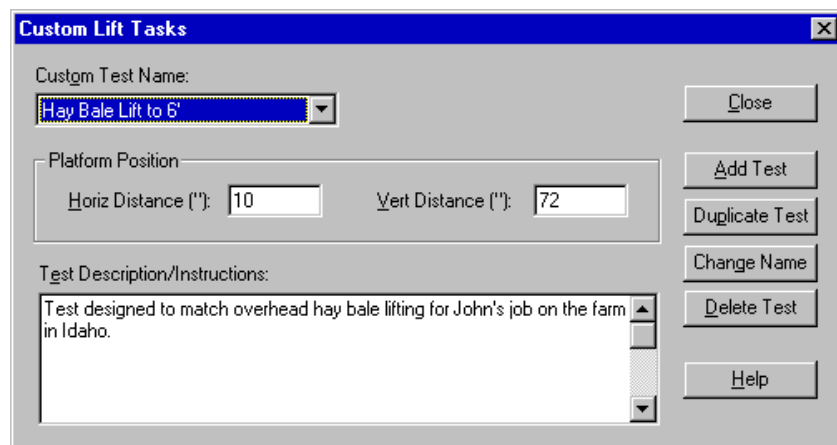
To initiate a test, select the "Lifting" module button and "Custom Lift Tasks" from the test button at the Test Selection screen. The following screen will appear.

Click here to see only the tests previously performed by the selected patient. If no previous tests exist for the current patient, the check must be empty before continuing.

Custom Lift Tasks

☐ Patient Specific

Description	Horiz	Vert
Eye Level Shelving	10	64
Hay Bale Lift to 6'	10	72
Stocking Job Lift	15	32

Test

Close

Help
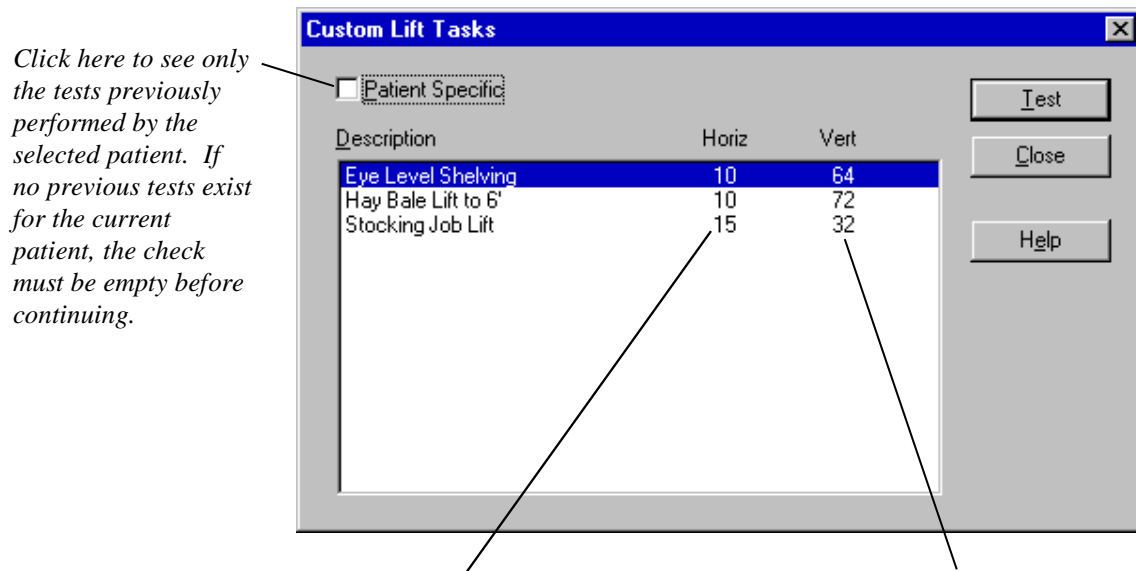
The "Horiz" value indicates the horizontal placement of patient's medial malleoli on the platform.

The "Vert" value is the distance in inches from the platform to the bottom of the handle (shown by the Height indicator on the vertical pole).

Highlight a test and click the "Test" button. The functionality of the Data Acquisition screen is the same as the screen for NIOSH tests. In the Statistic screen, however, there will be no dynamic rating or NIOSH percentile comparisons.

Click on the "Patient Specific" check box to show only those particular custom lift tests that this specific patient has performed. If you click "Patient Specific" and no previous tests exist for the patient, you must remove the check before the software will allow you continue.

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Chapter 5
Using IsoTrack for Functional Position Testing

The IsoTrack testing platform with its Multi-Vector Alignment System and Tracker™ software are versatile enough to perform a wide range of functional position testing. These tests can be used for functional capacity evaluations, post-offer testing, athletic training, job task evaluations, and more.

The software does not include any custom position tests, since each is specific to the position or task being tested. Therefore, each custom functional position test must be created prior to testing. The following information outlines one approach to creating a custom functional position test.

Functional Position Evaluation

The first part of creating a custom functional position test is evaluating the demands of the task. The following example is applicable to post-offer testing. However, the same instructions could apply to athletic training, functional capacity evaluations, or rehabilitation.

Step 1: Evaluate the Task On Site

A clinic provides post-offer testing for several concrete removal companies. The workers are to be tested in a simulated sledge hammer chopping pattern. After consultation on the job site, the best simulated position is determined to be standing erect, feet shoulder width apart, both hands holding the end of the long bar, and pulling downward and across the body. On-site job testing when using a sledge hammer to break concrete established the average force exerted in this position at 90 pounds.

Step 2: Determine the Limit

Based on the frequency of the test and consultation with the employer, the examiner has decided employees must exert at least 45 pounds isometrically in order to qualify for the position.
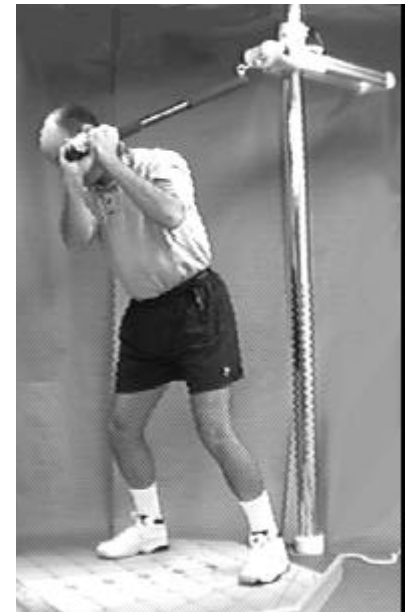
Test position.

Note: To determine the qualification level in a real case, clinical articles relevant to isometric testing should be consulted.

Step 3: Set Up the IsoTrack Custom Test Screen

Once the test position has been determined, the platform setup parameters are entered into the software list boxes. The parameters will then be the default settings displayed during testing. These values, in most cases, should not be changed during a test.

Using the Software to Create Functional Position Tests

To access the Custom IsoTrack Setup screen, select "Setup" from the Main menu line, then "Custom Tests" and "IsoTrack" from the resulting menus. The Isometric Custom Tests screen shown below will appear. The information displayed in the dialog below is based on the previous example.

Test Description / Instructions box is used to ensure accuracy and repeatability by providing detailed information about test.

Click on this button to create a new test.

Click here to make a copy of an existing test with a new name.

Click here to change the test's name.

Test parameter are entered into these boxes based on the patient positioning required by the test. Checking a list box and entering values makes that the default. For patient specific parameters, place a check in the list box without entering a value. The values then must be entered at the Test screen.

Click here to delete the test displayed in the Custom Test Name box.

Checks next to the blank list boxes require the value to be entered during a test. In this example, the "Height" parameter for the transducer varies according to the patient's height, so "Height" is checked, but left blank. (Note the information about setting the transducer height in the Test Description/Instructions box.) The "Height" parameter should be entered during testing. Any parameter check box left unchecked will not appear in the "Test Setup" dialog.

Bilateral versus Symmetric Testing

In this example, symmetric testing is required since left-handed concrete breakers are being tested only on the left side. For right-handed concrete breakers, another custom test would be created for the right side. If a custom test requires comparing right side and left side bilateral deficits, then "Bilateral Testing" would be selected.

Chapter 1
Grading Muscle Tests

Traditionally, muscle testing uses a grading system for documentation and standardization. In the traditional system muscle test grades range from 4/5 "Good/Normal" to 0/1 "None/Slight Contraction." With the introduction of the PowerTrack manual muscle tester and the IsoTrack isometric testing station, the system has been modified slightly to encompass the additional diagnostic data available.

When Should a Muscle Test Be Graded?

Using the traditional subjective method of muscle testing, every test needed to be graded just for the purpose of documentation. With Tracker muscle testing systems, the actual force curves and peak force values are automatically recorded, so the need to grade every test is greatly reduced. As a result, tests conducted for purposes like initial screenings and monitoring progress are not required to be graded. In addition, tests not graded during the examination, or immediately after, can be graded at a later date if necessary with Tracker software.

According to the AMA *Guides*, a muscle test must be graded if it is to be used as part of an impairment rating. Tests where the patient cannot exert force against the transducer or where the use of a force gauge is disallowed should also be graded to provide documentation of the test.

Grading with the Muscle Testing Transducer

Grade 4 or 5:

These grades are assigned if the patient can provide slight to full resistance against the transducer.

1. Patient moderately resists against the examiner. If any resistance occurs, then the patient has enough strength to provide resistance against the muscle testing transducer. If the patient is too weak to provide any resistance, grades 0/1, 2, or 3 should be assigned through the "Grade" module and the following steps should be skipped.

2. Place the patient in the recommended position and conduct a test using the transducer. (Use the CD-ROM Help for assistance with patient positioning.) Repeat

for a minimum of three repetitions to ensure accuracy and repeatability. (Follow the respective rules of accuracy listed in the modules for the device you are using.)

3. Repeat the test for the opposite side.

4. If a strength deficit greater than 15% exists bilaterally, the software will suggest "grading" the test when you click on either the "Close" or the "Statistics" button. As noted earlier, a grade is required if the test is to be included in an impairment report. For more information on using the software to grade the test, see Chapter 2 of this module. Grading may be skipped if all that is needed is the bilateral strength comparison for showing progress, justifying treatment, or determining the injured/diseased nerves.

Note: Some tests are not allowed using a force gauge. For those cases only a grade can be assessed. Additionally, some tests are not bilateral; therefore, a more in-depth analysis using standard grading procedures is required to determine a grade 4.

Grading without the Muscle Testing Transducer

If the subject does not have sufficient strength to resist against the force gauge or a force gauge test is not allowed, then the following grading system can be used in the software's Grade module: Use the CD-ROM Help for detailed information about positioning the patient to conduct tests without the transducer.

Grade 4/5 - Good/Normal: Moderate to full resistance against the examiner.
Grade 3 - Fair: Partial to complete motion against gravity.
Grade 2 - Poor: Partial to complete motion with gravity removed.
Grade 0/1- Zero/Trace: No contraction to slight contraction.

Additionally, the sliding scale in the grade module should be used to further define the selected grade. For instance, selecting a grade 3 indicates partial to complete motion against gravity. Using the sliding scale, some motion against gravity would be assigned a grade 3, complete motion against gravity might be a grade 3+, and little motion against gravity might be a 3-. Also, some overlap does occur in the grading scheme. For instance, a grade 2+ may be nearly equivalent to a 3-. (See Chapter 2 of this module for more information about using the grading feature in the software.)

Chapter 2
Using the Software to Grade Tests

Manual muscle testing has traditionally used a scale system of 0-5, where 5 is normal and 0 is a muscle which does not contract. Grades 0-4 are impairment ratable, and this aspect of the software is accessed by clicking on the "Grade" button from the Muscle/Motion Selection screen. After selecting the "Grade" button, the following screen appears and is the foundation of the grading option. For more information about grading muscles, refer to Chapter 1 of this module.

A muscle test does not have to be conducted with the transducer to use the "Grade" function of the Tracker software. This allows you to assign a grade when the use of a force gauge is disallowed or the patient cannot provide resistance against it. To grade a test without using the transducer, highlight the muscle in the Muscle/Motion Selection dialog and click the "Grade" button. Tests where a force gauge is disallowed can be graded 0-5. Tests where the patient is unable to provide resistance against the force gauge should be graded 0-3 using the guidelines outlined in Chapter 1 of this module.

The Grade Dialog

Click here to exit without assigning a grade.

Grades 0-5 are selectable using the "Grade" buttons.

The definition of each grade and differentiation within the grade is displayed in this area.

The sliding scale allows differentiation within the grade.

Muscle Test Grade: Elbow flexion (forearm supinated)

No Grade

CD-Rom Help

Grade

| 0 - Zero | 1 - Trace | 2 - Poor | 3 - Fair | 4 - Good | 5 - Normal |

Close

Strength Loss

| Some resistance against transducer (-) | Moderate resistance against transducer | Almost full resistance against transducer (+) |

Help

Side

25%   20%   15%   10%   5%   1%

○ Right
○ Left

Involved Nerve

C5

Strength Loss	13%
Max Nerve Impairment	× 30%
Upper Extremity Impairment	4%

CD-ROM Help defines how to test the various grades.

Select the right or left side for grading. For tests without the transducer, right is the default.

Drop down menu for selection of the involved nerve. A nerve must be selected to complete the grading.

Impairment is automatically calculated per the AMA guidelines based on the grade and percent of strength loss selected using the sliding scale.

Within a each grade, there is a sliding scale corresponding to the allowable motor loss range according to the AMA *Guides*. The allowable ranges within the grades are as follows:

Grade 4 - Good is 1-25%
Grade 3 - Fair is 26-50%
Grade 2 - Poor is 51-75%
Grade 1 - Trace is 76-99%
Grade 0 - Zero is 100%

To change the strength loss percentage, use the mouse to adjust the sliding scale to the appropriate number. Notice that the strength loss percentage in the bottom box changes. For upper extremities, changing the strength loss percentage in most cases also changes the impairment. For lower extremities, the impairment percentage is based solely on the grade, with grades 0-2 typically receiving the same impairment rating. The "Max Nerve Impairment" percentage (if allowed) is entered automatically according to the AMA *Guides* based on the nerve selected. Consult the AMA *Guides* for more information about grading muscles.

Additional Grade Dialogs

The following illustrations indicate the resulting software screens that appear as each of the remaining grade buttons (0-3) are selected. The grade 4 screen is shown on the preceding page.

Grade 3

Grade 2

Grade 1

Grade 0

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Chapter 1
LiftTrack Lift Task Testing

The LiftTrack testing station and Tracker software can be used to perform the six standard isometric lift task tests outlined in the NIOSH *Work Practices Guides for Manual Lifting,* as well as custom tests you create.

Lift Task Precautions

The following are general guidelines to minimize risk of injury to the patient. Note that these guidelines are not comprehensive and cannot cover all conditions. Final responsibility for the risk of injury to the patient lies with the examiner.

1. Force increase generated by the patient should be gradual, especially for testing of the spine, and in the presence of a musculoskeletal injury, instability, or recent surgery. A warm-up repetition consisting of 50% maximum effort is recommended prior to each test.

2. The patient should be CLOSELY observed during testing for any evidence of pain or discomfort. The test should be stopped immediately if the patient reports pain, shortness of breath or dizziness.

3. Contraindications to testing include: uncontrolled hypertension, severe respiratory problems, herniated disk, severe osteoporosis, structural weakness of the abdominal or thoracic wall, unsplinted fractures, unhealed torn or sutured tendons, or any other condition that would be exacerbated by the performance of isometric contraction or valsalva maneuver.

4. In the event the patient is illiterate or does not understand English, be sure the patient is made aware of all the inherent risks of testing and understands the content of the warning labels. The software produces an informed consent form (a sample is provided in the Appendix) and requires that it is signed prior to testing.

Lift Task Accuracy

Several general rules must be followed to insure repeatability and accuracy when using isometric lift task testing.

1. Have the patient build force gradually until the maximum effort is achieved and held. In general, however, maximum force should occur within two to three seconds. Prolonging the time to maximum force may introduce fatigue. Based on the patient's condition and endurance level, use the "Test Time" feature of the software to select the optimum duration of the test (up to six seconds). Standard protocols require at least

three seconds of data collection after the maximum force is achieved for valid statistical determinations.

2. Studies have shown that isometric strength testing results vary according the the instructions given to the patient. Therefore, greater consistency will result if standardized instructions are given to patients.

Patient Instructions

Studies have shown that isometric strength testing results vary according the the instructions given to the patient. Therefore, greater consistency will result if the instructions* are standardized as follows:

Tell the patient: "We are going to measure your strength. These tests are isometric strength tests, which means that you will be exerting force, but not moving anything. We will measure your average maximum force with this apparatus. For each test, please follow these instructions:"

1. The test will be demonstrated for you. If you do not understand, please ask questions.

2. For each test, we will give you at least three attempts. The first is practice, try it at 50% effort. This first attempt is a warm-up and will help you determine if you know what is expected.

3 Next you will be given a minimum of two attempts on each test. Try to do your best on each attempt as your score will be the average of the two measurements.

4. When a test is given, I will say, " **Ready ... set ... go**." For the period of the test, you should apply consistent, maximum effort. If at any time during the test you experience pain or discomfort, you should stop the test immediately. The computer will beep during the test and a double beep when the test is finished.

5. Let me demonstrate the test for you.

6. Are there any questions?

7. Let's begin the first test. " **Ready ... set ... go**."

*   Adapted from *Preemployment Isometric Strength Testing Methods* Dr. Andrew Jackson FACSM, June 1990, p 37

NIOSH Test Positions

The six static lifting postures pictured were used to compile an isometric strength database and are summarized in the *Work Practices Guide for Manual Lifting* (NIOSH 1981).

Arm Lift

Height of the lift bar is determined by positioning the patient such that the elbows are flexed to 90° with the shoulders in neutral position. The position of the patient's feet should be such that the lift bar fits in palms of hands when the elbows are in the position described above. Feet should be shoulder width apart. Document the bar height above the platform and the position of the medial malleoli for future testing. The patient lifts upward without swaying backward, raising up on toes, or elevating shoulders. This test primarily stresses the elbow.

Leg Lift

The height of the bar is 15", and the medial malleoli are placed at 0". The feet are far enough apart such that the lift bar fits between the medial borders of the knees. The trunk should be held as vertical as is comfortable. The patient should use a leg lift technique, emphasizing the quadriceps. This test primarily stresses the knee.

Torso Lift

The height of the lift bar is 15", and the medial malleoli are positioned at 15". The patient flexes at the waist with minimal knee flexion. The bar is pulled upward in the direction of the arms. This test is stressful on the low back and, therefore, potentially the most dangerous for patients with low back pain. Exercise extreme caution with this test.

*Clip is used to
attach handle to
platform for this
lift position.*

Floor Lift

One of the "c" clips provided is used to attach the lift handle to the platform. The height of the lift bar is 6", and the medial malleoli are positioned at 10" on the platform. The patient flexes the trunk and the knees to reach the lift bar. The patient lifts upward utilizing the hip, back and leg extensors.

High Near Lift

The height of the lift bar is 60", and the medial malleoli are positioned at 10" on the platform. The patient grabs the bar with forearms supinated and lifts directly upward without raising up on the toes. This test primarily stresses the shoulder.

High Far Lift

The height of the lift bar is 60", and the medial malleoli are positioned at 20" on the platform. The patient grabs the bar with forearms supinated and lifts directly upward without raising up on the toes. This test primarily stresses the shoulder.

Custom Testing

LiftTrack module software provides the capability to create custom tests based on your testing needs. Custom test are created through the software, using postures you define. For more information about creating custom test, see Chapter 2 of this module.

Chapter 2
Using the LiftTrack Testing Software

Tracker software can receive input from two lift task devices: LiftTrack and IsoTrack. If you only have the LiftTrack module, the software will automatically default to the LiftTrack sensor, and you can to patient selection. If you have both IsoTrack and LiftTrack make sure the LiftTrack sensor is selected before starting a test. Do this by selecting "Setup" from the top menu list, then select "Lift Sensor" and "LiftTrack" from the resulting menus as shown below.
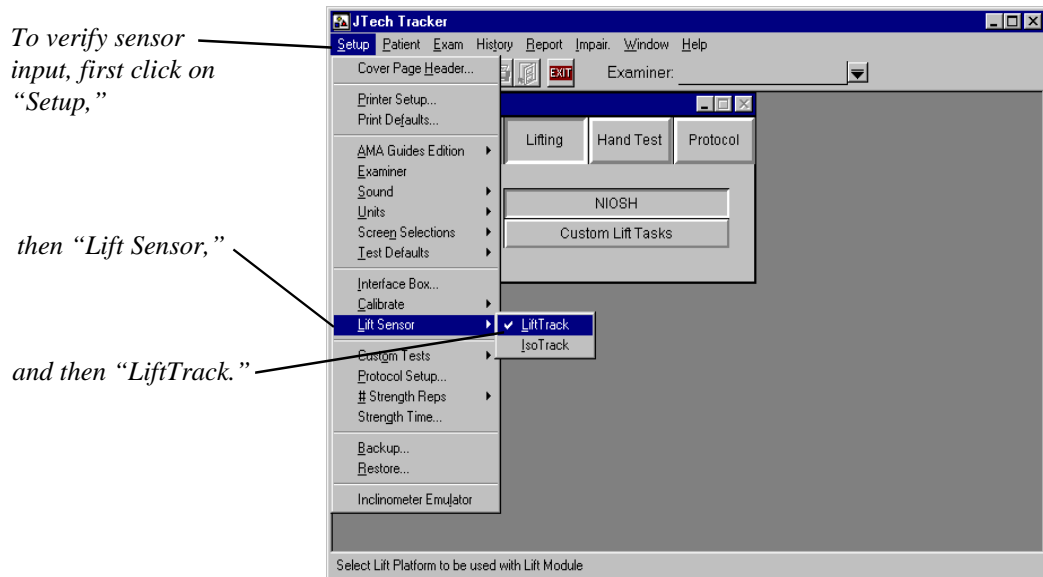
To verify sensor input, first click on "Setup,"

then "Lift Sensor,"

and then "LiftTrack."

After a patient has been selected from the patient database and an exam description has been selected or defined (see Module 1, Chapter 4: *Starting a Test*), select a button from the Test Selection screen corresponding to the classification of lift postures to be tested.
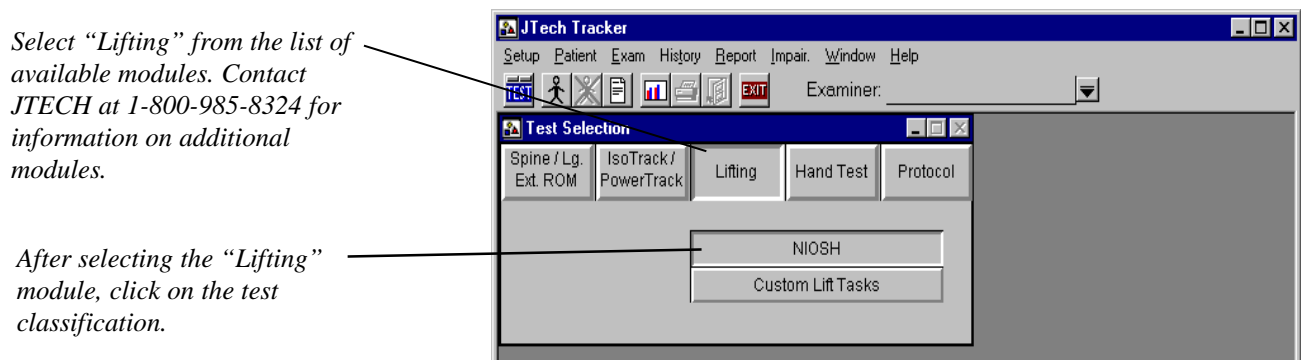
Select "Lifting" from the list of available modules. Contact JTECH at 1-800-985-8324 for information on additional modules.

After selecting the "Lifting" module, click on the test classification.

Selecting "NIOSH" displays a screen illustrating the six NIOSH test postures. The results of selecting "Custom Lift Tasks" are discussed later on in this chapter.

To start testing, click the button depicting the desired test posture.

The last date a specific test was performed with the selected patient is listed below the corresponding NIOSH posture.

Select "Close" to return to the Main menu.

Click "Help" for more information (such as for patient positions) on each test.
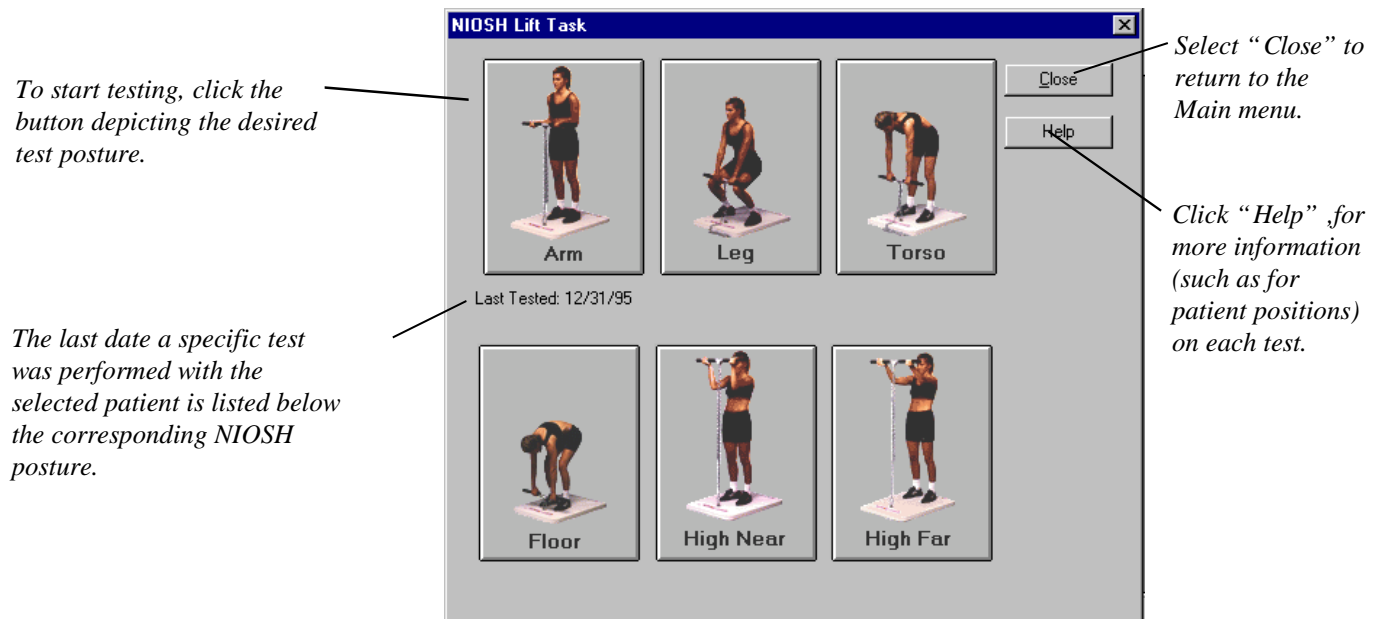
Select the "Help" button or refer to Chapter 1 of this module for information about the test postures.

LiftTrack Calibration

If the system has not been previously calibrated (such as the first time system is used), or the calibration diskette was not used during the software installation, the following dialog box will appear. (If a calibration diskette came with the system, it can only be used by re-installing the Tracker software.) At this point the lift sensor should be manually calibrated using the instructions on the following page.
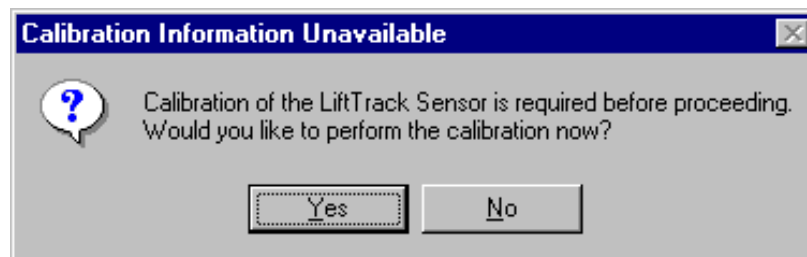
Answering "Yes" at the above dialog box displays the Lift Platform Calibration screen illustrated on the next page. The lift sensor must be calibrated before a test can be conducted, so answering "No" will result in a return to the NIOSH Lift Task screen.

The "Count" values are only used by JTech Customer Service if you have a calibration error.

The exact weight used for calibration should be entered here.

These radio button select the weight system being used for calibration.
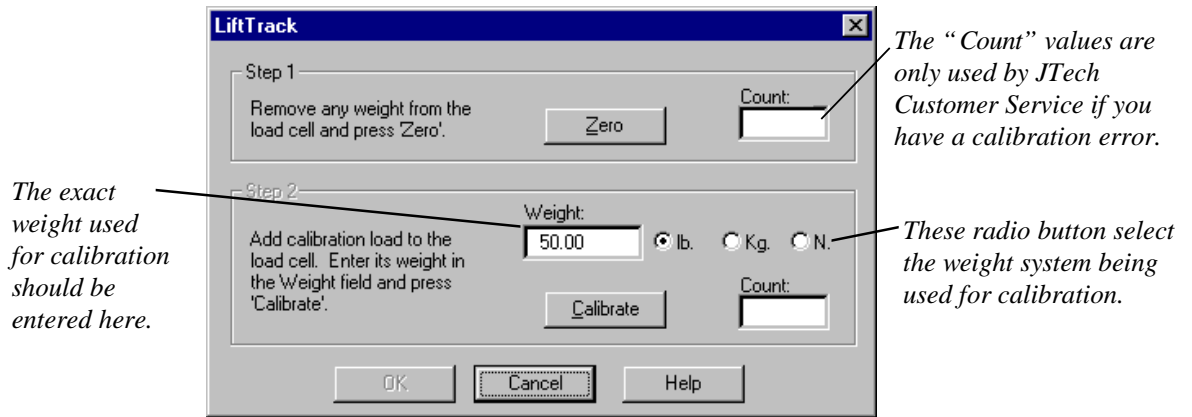
To "Zero Calibrate" the LiftTrack sensor, position the lift bar between two objects with no weight on the sensor as shown below left. Click on the "Zero Calibrate" button or type "Z" on the keyboard. To perform a weight calibration, hang a known weight on the handle (as pictured below right), enter the value in the Weight box, and click on the "Calibrate" button or press "W" on the keyboard. The minimum recommended weight for calibration is 25 lb. The optimum calibration weight is the midpoint of the anticipated load range.
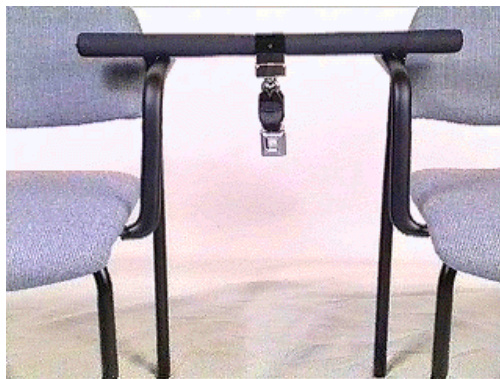
Zero calibration
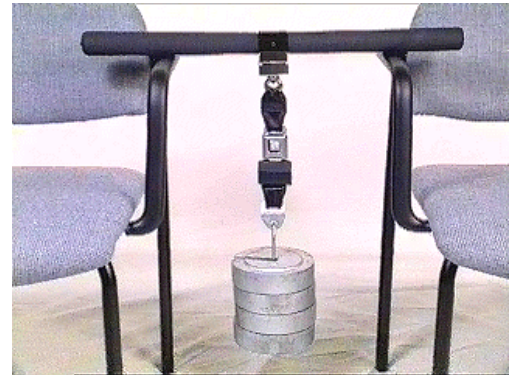
Weight calibration

If the following warning appears during calibration, call JTech Customer Service for assistance with calibrating your system. Selecting "Yes" will accept the values and allow you to conduct tests, but test values may not be accurate.
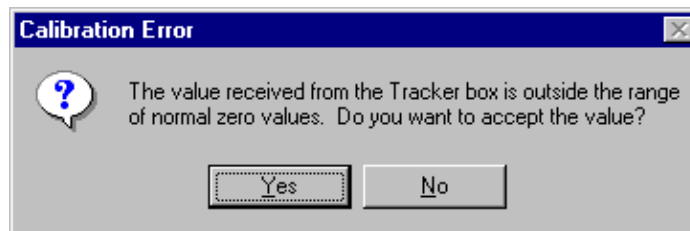
Daily Calibration

The first time any day the LiftTrack is used the software will automatically prompt for a zero calibration. Remove the weight as instructed and click "OK" to perform the calibration. Once the calibration is complete the software will take you to the next screen.

If there is no time to perform a calibration, clicking "postpone" will take you to the next screen.

Click "OK" to perform a zero calibration.

Clicking here puts off the calibration and takes you to the next screen.
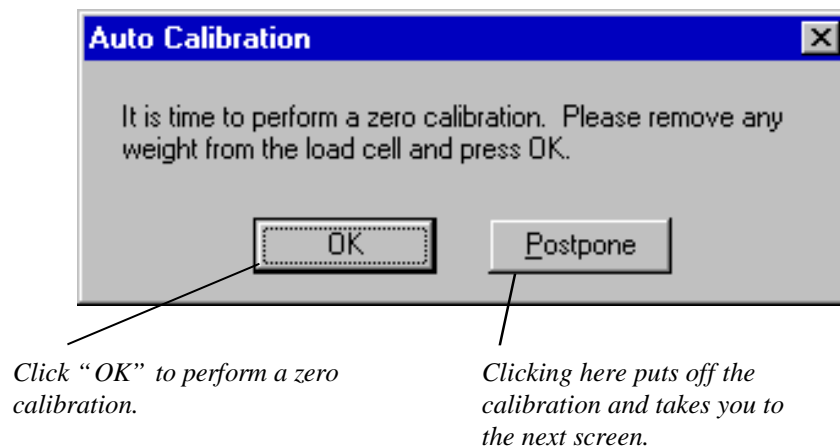
Patient Consent

Prior to any lift task test, the software displays a message ensuring that a consent form has been signed by the patient. Static testing is a strenuous test which can lead to patient injury if proper protocols are not followed. The consent form is a waiver of liability if the patient were to be injured during testing. You must enter "Yes" to the consent form prompt to go to the Data Acquisition screen. Selecting the "Print Consent Form" will produce a printed consent form for the patient to sign.
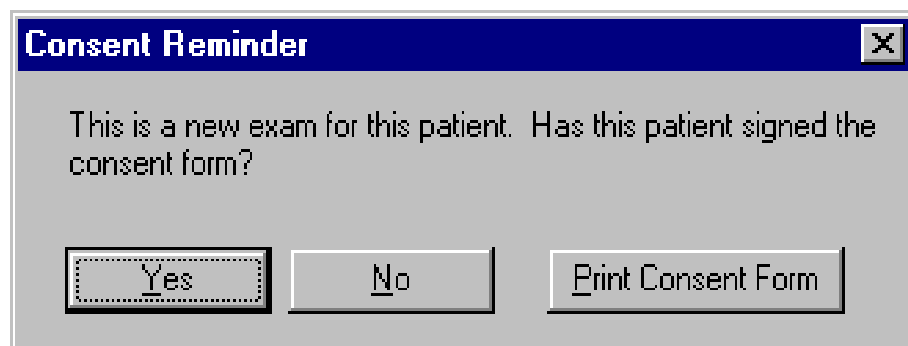
A sample of the consent form is shown in the Appendix.

Test Screen

After the consent dialog has been answered "Yes," a Test screen is displayed. The blue header indicates the type of test and the proper positioning of the patient. The box below the "Start" button indicates what repetition number is ready to be performed. After the patient is properly positioned and holding the lift bar, click "Start" to initiate the test. After the threshold value is crossed, data will be recorded in the form of a force curve. The patient should quickly build up to maximal force and hold it for the selected duration of the test. After two repetitions have been completed, the software will automatically determine if validity has been achieved. A maximum of four repetitions may be completed for each lift posture.

Header information includes type of test and proper patient position.

Graph automatically scales axis for easier viewing.

Validity Status box.

Press "Undo" to delete last repetition

Shows statistical information about test.

Used to "Delete" completed repetitions.

Enables examiner input about repetitions.

Press "Close" when finished with the test.

Sets force point where data collection begins.

Click here to initiate each repetition.

Repetition Status box.

Color key for distinguishing repetitions.

Real-time display of load on sensor.

Allows control of test time and ready time.

Test Screen Function Buttons

The buttons at the bottom of the Test screen provide a variety of functions, from controlling the test time to showing detailed information about the test data. The function of the buttons is described on the following pages.

Statistics

Clicking on the "Statistics" button displays a complete summary of data associated with the respective repetitions.

The following is a summary of the statistics displayed:

Repetition statistics are specific to each repetition.

Max............... Maximum force recorded during the period from the end of ready time to the end of the test.

Ave .... Average force from the end of ready time to the end of test.

Power............ Indicates the subject's ability to sustain force over time. The area under the curve from the end of ready time to the end of the test.

Fatigue.......... Percent difference between the maximum and the load value at the end of the test. If patient does not sustain a load until the end of the test, 100% fatigue will be reported.

Ratchet .... Examiner determined and noted using "Details" button.

Status .... "Complete" if test extends beyond ready time or "Incomplete" if test ends during ready time. "Exclude" is selected from "Details."

Overall statistics apply to the test as a whole.

Test Time.............. The predetermined length of the test in seconds. Test time begins when the threshold is exceeded. Test time includes ready time.

Ready Time.......... Examiner controlled, usually dictated by how rapidly the patient can build strength.

Max Average........ Maximum of the averages determined above.

NIOSH % .... Based on **Max Average,** this value is a comparison to the NIOSH normative database.

Max Difference .... The maximum difference between successive repetition, it is used as part of validity to determine consistency of effort.

CV........................ Coefficient of variation is a statistical calculation indicating spread of data.

Valid .... Displayed as "Yes" or "No." Yes validity means the **CV** or **Max Difference** values are less than 15%.

Dynamic Rating ... Based on published research, these values use **Max Average** to formulate ratings that indicate the theoretical load a patient **may be able** to lift dynamically on an *occasional* basis (Blankenship, 1990) and on *frequent* and *constant* bases (*Dictionary of Occupational Titles*, 1991) in the tested posture. These numbers should be confirmed using dynamic testing.

Details
Selecting the "Details" button enables the examiner to indicate if repetitions showed signs for "ratcheting" (oscillations that may indicate submaximal effort), should be excluded from statistics calculations for any reason, and to enter comments. Clicking on "Details" displays the following dialog.

Check boxes are used to indicate if the repetition showed signs of ratcheting or if it should be excluded.

These boxes are used to enter comments. These comments are especially helpful when a repetition is excluded.

The following is an example of how the above "Details" dialog might be used. The graph below shows that the patient's fourth repetition (for whatever reasons) exhibited signs of ratcheting (inconsistent effort during testing) and the maximum was much lower than previous attempts. The validity status box indicates overall validity was not achieved as a result of this fourth repetition.

Notice difference in fourth repetition.
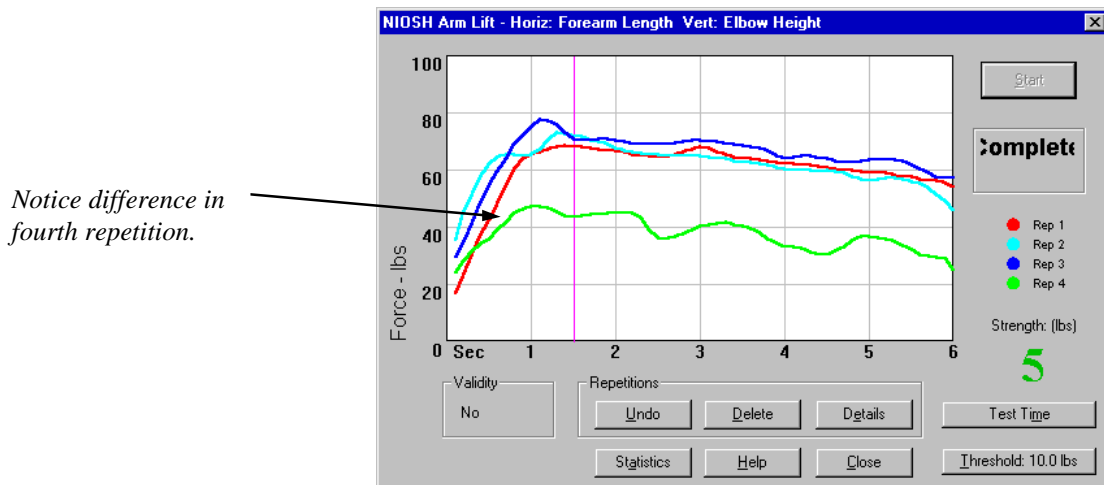
By clicking the "Details" button, the fourth repetition can be eliminated from the statistical calculations and notes can be recorded indicating the rationale for such a decision. (See Details dialog on previous page.) In this example, the fourth repetition has been marked as showing signs of ratcheting, excluded from the statistic, and commented upon.

The results of the above actions can be seen by reviewing the Statistics box below. Note that the fourth repetition is greyed-out, indicating that it was not used for statistical calculation. The status field reads "Exclude" and the overall validity has been achieved.
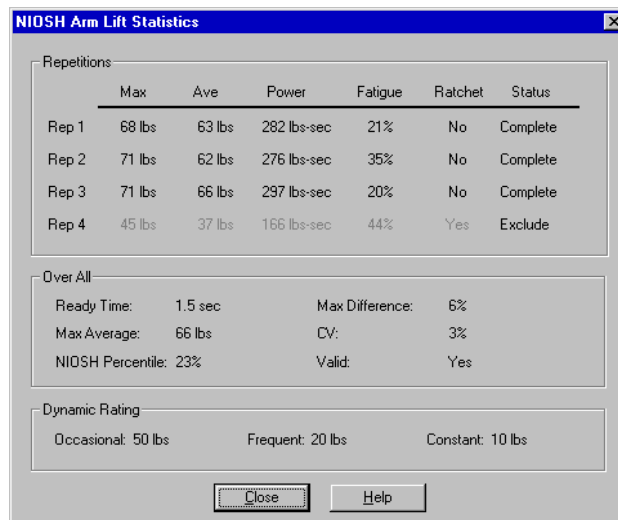
Undo and Delete

The "Undo" button deletes the most recent repetition, which can be useful following a practice repetition. The "Delete" button allows removal of any completed repetition. To remove a repetition, click on "Delete" and highlight the appropriate repetition. All subsequent repetitions will move up (rep 3 becomes rep 2, and rep 4 becomes rep 3 in the example below).

Use "Delete" or "Undo" to remove data and force curves for repetitions.
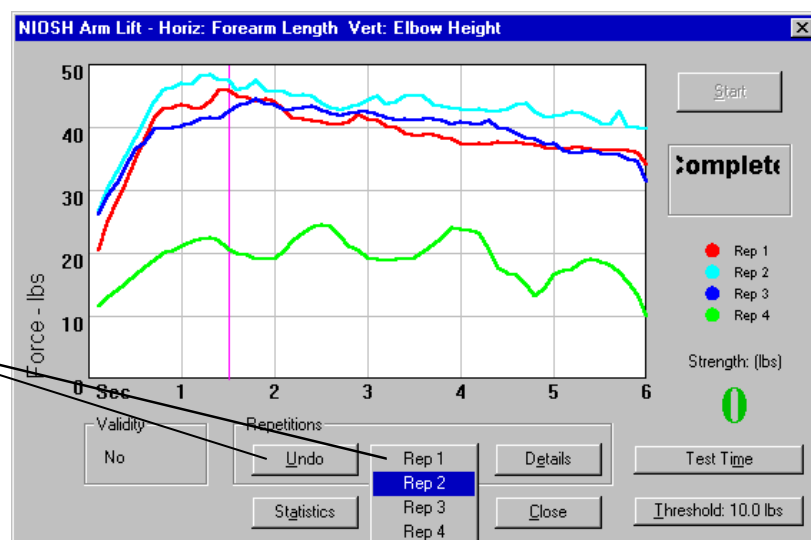
Test Time

The "Test Time" button allows you to override the default test time settings (see Module 1, Chapter 2). Test time is the overall length of the test, or the period of time the subject must sustain a lift. This button is also used to set the "ready time," which provides a time buffer at the beginning of the test for reaching maximum effort before data is collected. The data sampled between the end of ready time and the end of the test ("sample time") is used for the reports and statistical calculations. As a rule of thumb, the sample time should be at least three seconds. For example, if the test time is set at five seconds and the ready time is set at two second, the sample time will be three seconds.

Ready time also serves as a buffer for any transient occurrences during the load initiation phase of the lift. For instance, if the subject "jerks" the handle, ready time excludes this phenomena. (Subjects should be encouraged to proceed cautiously when initiating a test.) Ready time allows the subject's body to adapt to the stresses being placed on it and recruit additional muscle fibers, which allows the generation maximum force.

In summary, ready time is best defined as the time it takes the subject to reach a steady state. Based on the force curves generated, the examiner can evaluate what is the best ready time, such that no 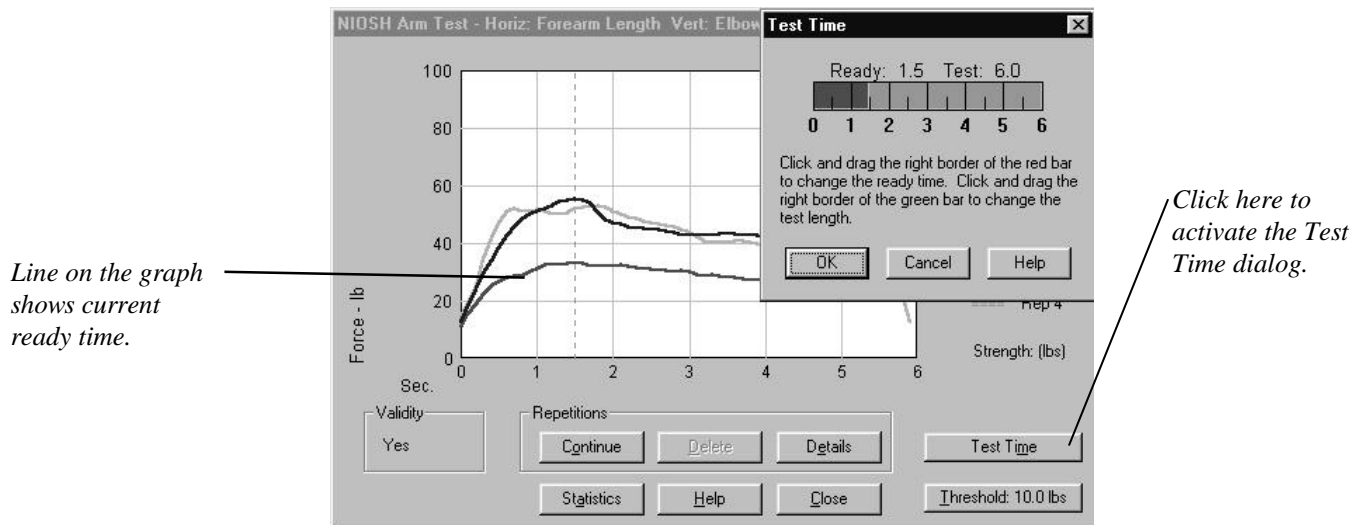transient phenomena enter the calculation of statistical parameters associated with the test. Test time, on the other hand, is the total length of the test (ready time plus sample time).

Test time can vary from a ½ second to six seconds in ½ second increments. Ready Time is required to be at least a ½ second less than the test time. Both parameters are adjusted by clicking on the "Test Time" button in the lower right-hand corner of the Data Acquisition screen (see instructions below). Changing the ready time after tests have been performed will affect the statistical calculations. Changing the test time after tests have been performed results in the loss of all data associated with that test. A Warning screen requiring confirmation will appear before changes to test time are made by the software.

Line on the graph shows current ready time.

Click here to activate the Test Time dialog.

To adjust the ready time, position the pointer on the right-hand edge of the red bar, press the left mouse button, and drag the edge of the bar to the desired value. To adjust the test time, position the pointer on the right-hand edge of the green bar, press the left mouse button, and drag the edge of the bar to the desired position. Click "OK" when finished.

Click and grab the red edge to adjust ready time.
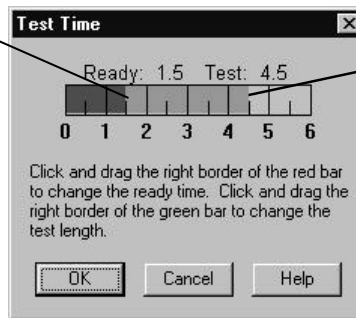
Click and grab edge of green bar to adjust test time.
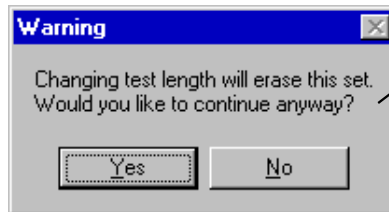
Warning that appears if the test time is adjusted after a test has already been completed.

The example below demonstrates the effects of changing ready time from 1.5 seconds to one second. With this particular test, the change dramatically affects the power calculation and has a slight effect on Max, Ave, Fatigue, Max Average, NIOSH Percentile, Max Difference, and CV. If comparisons are to be made for a subject using multiple test dates, the ready time and the test times should remain the same in each instance. The software automatically selects the ready time and test time according to the subject's previous exams for this test.

NIOSH Arm Lift Statistics

Repetitions

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	68 lbs	63 lbs	282 lbs-sec	21%	No	Complete
Rep 2	71 lbs	62 lbs	276 lbs-sec	35%	No	Complete
Rep 3	71 lbs	66 lbs	297 lbs-sec	20%	No	Complete
Rep 4						Incomplete

Over All

Ready Time: 1.5 sec	Max Difference: 6%
Max Average: 66 lbs	CV: 3%
NIOSH Percentile: 23%	Valid: Yes

Dynamic Rating

| Occasional: 50 lbs | Frequent: 20 lbs | Constant: 10 lbs |

NIOSH Arm Lift Statistics

Repetitions

	Max	Ave	Power	Fatigue	Ratchet	Status
Rep 1	68 lbs	63 lbs	316 lbs-sec	21%	No	Complete
Rep 2	73 lbs	62 lbs	311 lbs-sec	37%	No	Complete
Rep 3	77 lbs	67 lbs	335 lbs-sec	26%	No	Complete
Rep 4	47 lbs	38 lbs	189 lbs-sec	47%	Yes	Exclude

Over All

Ready Time: 1.0 sec	Max Difference: 8%
Max Average: 67 lbs	CV: 4%
NIOSH Percentile: 24%	Valid: Yes

Dynamic Rating

| Occasional: 50 lbs | Frequent: 20 lbs | Constant: 10 lbs |

Threshold

The point at which the strength generated by the subject triggers recording of data is called the threshold. Once the threshold is crossed, the test begins and real-time strength data is displayed on the screen. The threshold is used to help prevent a repetition from being falsely recorded as a result of the subject making any adjustments prior to the test.

The current threshold setting is displayed on the "Threshold" button. The threshold value is adjusted by clicking on the "Threshold" button. The limit and the increments are dependent upon the test being performed. The higher the threshold, the greater the force the subject must produce to begin recording data.
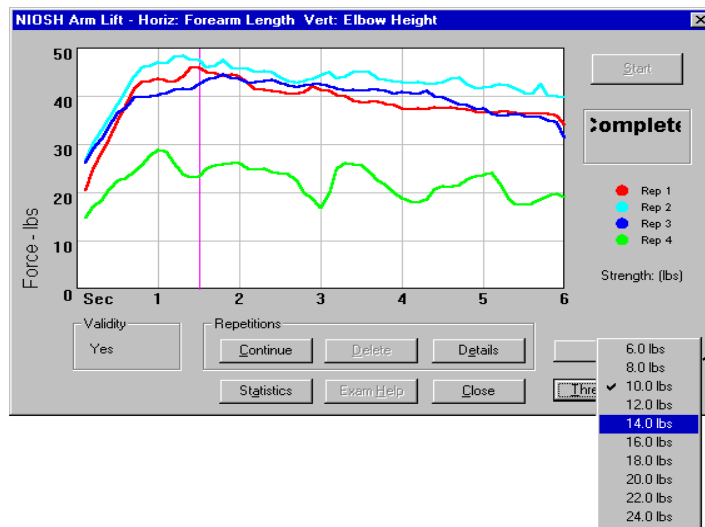
Click here to adjust the threshold. Once the threshold scale is visible, highlight the new value with the mouse.

Creating Custom Lift Task Tests

In addition to the NIOSH tests, Tracker software allows any static lift task posture to be modeled. To create a custom lift test, select "Setup" from the Main menu, then "Custom Tests" and "Lift Tasks" as illustrated below.
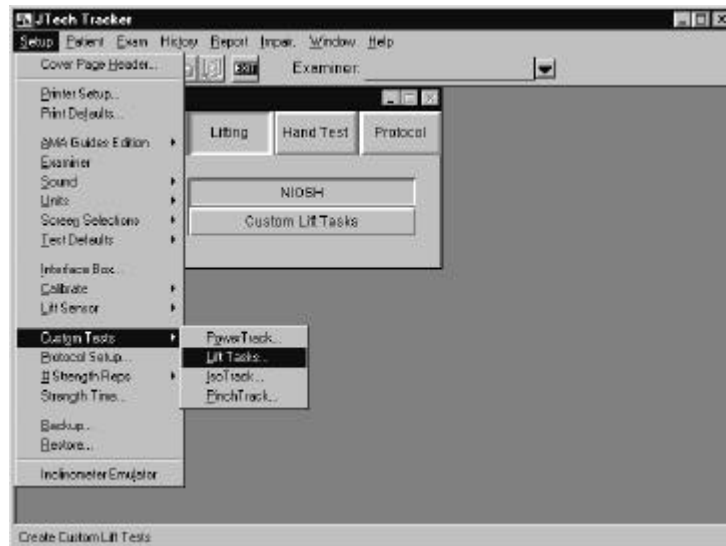
The Custom Lift Tasks dialog is pictured below. If any custom tests have already been created, they can be accessed by clicking on the downward arrow beside the Custom Test Name box.

To create a test, click on "Add Test." Another dialog will ask for the name of the new test. Type a name into the box and click "OK." The new test's name will appear in the Custom Test Name box. After the test is named, position the cursor in the respective fields and type in the Horizontal Distance corresponding to foot placement, Vertical Distance corresponding to the height of the handle above the platform, and a test description or any special instructions. The test is saved when the "Close" button is clicked.

The additional dialog buttons function as follows:

"Duplicate Test"	Creates a duplicate of the displayed test under a different name.
"Change Name"	Simply changes the name of the displayed test.
"Delete Test"	Removes the currently displayed test.

Click on arrow to see list of custom

"Horiz Distance" indicates the placement of the medial malleoli on the platform. "Vert Distance" is the measurement in inches from the top of the platform to the bottom of the handle.

This box is used to enter particulars about posture, instructions, etc. to insure accuracy and repeatability of custom tests.

Once a custom test has been created, it can be used for a specific subject or multiple subjects. Custom tests are accessed through the "Custom Lift Tasks" classification button. After making the selection, the following screen appears.

Clicking on "Patient Specific" displays only those tests performed by the current patient.

To perform a test, highlight the test from the list and click on "Test."

To perform a custom test, highlight it test and click the "Test" button. The functionality of the Data Acquisition screen is the same as for NIOSH tests with two exceptions: the statistics will provide no dynamic rating or NIOSH percentile comparisons.

The Patient Specific check box in the upper left-hand corner functions after a subject has been tested using a custom test or tests. After a subjects has performed a custom test, clicking on the Patient Specific check box shows only the custom lift tests the currently selected patient has performed.

Note:

If the Patient Specific box is checked and the current patient has not performed a custom test, the check must be removed before the software will allow you to continue.

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Chapter 1
Grip Testing General Information

When, Why, and How Often

There are many reasons to measure a patient's grip strength. In worker's compensation cases, it may be necessary to establish if the patient can return to work. Grip strength can also be used to determine the nature of injury (organic versus psychological) or the patient's sincerity of effort, as in a functional capacity evaluation. As part of a screening, comparing a subject's strength relative to a normative database may be desirable. As part of a post-offer, grip strength may be used to determine an employee's predisposition to repetitive motion disorders. With insurance companies requiring documentation of improvement, grip testing new patients to establish a baseline from which to assess treatment effectiveness (surgical, chiropractic or otherwise) may also be helpful.

As part of a functional capacity evaluation, the 5 position grip test is the minimum grip strength testing that should be performed. The rapid exchange grip (REG) test and the sustained grip test should be performed if there is any question about sincerity of effort resulting from the 5 position test.

A recently published rehabilitation protocol for patients with carpal tunnel syndrome suggests that grip strength testing should occur as part of an initial exam, which also includes orthopedic and neurological tests, nerve latency tests, range of motion, and X-ray. This test could be as simple as a position 2 maximum effort test or a complete 5 position test. The article also suggests that after two weeks of intensive care treatment the patient's grip strength should be re-tested. After 6-8 weeks of rehabilitation care, the grip strength should again be tested. Upon discharge of the patient, or release to pre-injury status, a final grip strength should be performed.

5 Position Grip Test

The software gives the user the flexibility to perform a test at any or all of the 5 positions available with the dynamometer. The two most common test methodologies are: 1) a complete 5 position test to be used as a validity check as part of a functional capacity evaluation, and 2) a simple position 2 or position 3 maximum grip test, as part of a routine musculoskeletal evaluation.

According to the American Society of Hand Therapists (1981) and Mathiowetz et al. (1984), the proper positioning of the patient for this test is as follows:

Seated, with the shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and the wrist between 0 and 30° extension and between 0 and 15° ulnar deviation.

In all cases, the arm should not be supported... The dynamometer is presented vertically and in line with the forearm to maintain the standard forearm and wrist positions.

Use the following standard instructions and verbal prompts developed by Mathiowetz and associates (1984) for performing the test:

1. Tell the patient, "**I want you to hold the handle like this and squeeze as hard as you can**."

2. Demonstrate position and procedure, then give the dynamometer to the patient.

3. After the patient is positioned appropriately, say " **Are you ready? Squeeze as hard as you can**."

4. As the patient begins to squeeze, say " **Harder!...Harder!....Relax!**"

5. Repeat the test two more times, then move on to the other hand.

Note: Ensure that the tests are started on the hand indicated by the software. The default is to start on the right hand. To start on the left, click "Restart L." If a mistake is made, there is no way to switch data without retesting!
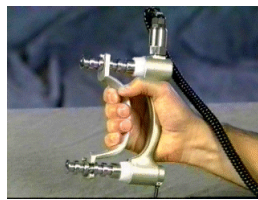
| Position 1 | Positon 2 | Position 3 | Position 4 | Positon 5 |

Stokes (1983) and Janda et al. (1987) reported that a patient giving maximum effort at all five settings should produce a bell-shaped curve. This applies to injured and uninjured populations alike and is based on the mechanical advantage unique to each test position. Use the "Graph" button at the Data Acquisition screen to get an indication of the patient's performance on the 5 position test. If the data is indicative of the characteristic curve (such as on the next page), the patient can be said with reasonable certainty to have given valid effort. The test should then be labeled as such.

Note: Hamilton et al. report that curve shape is a function of strength and that the curve will be flatter for subjects with a weaker grip. Hamilton cautions that clinicians should be careful about using a flattened curve to imply the lack of sincere effort by the subject.
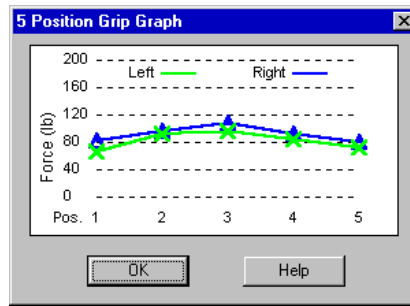
This validity check is for the overall 5 position test and should not be confused with the validity associated with the individual position tests. Coefficient of variation (CV) is used to determine the validity of the individual tests.

Rapid Exchange Grip Test

Hildreth et al. (1989) showed that the rapid exchange grip (REG) test could be used as another validity check to supplement the 5 position grip test. In the event that the bell-shaped curve generated by a maximally-performing injured hand is somewhat flat, or an uncooperative patient produces a mildly bell-shaped curve, the REG can serve as a distinguishing test.

According to Hildreth, a patient should be suspected of submaximal effort if the greatest force recorded during the REG exceeds the maximum force seen in the 5 position test. The reason for this is theorized to be the short period of time the patient has to process the complex feedback of signals sent to the central nervous system involving frequency of neuronal firing and number and types of motor units required.

The REG test is performed at the position in which the patient achieved maximum load during the 5 position test.

The proper positioning of the patient for this test is as follows:

Seated, with both shoulders adducted and neutrally rotated, elbows flexed at 90°, forearms in neutral position, and the wrists between 0 and 30° extension and between 0 and 15° ulnar deviation.

In all cases, the arms should not be supported. The dynamometer is presented vertically, and held by the examiner equidistant between the patient's hands at a height to maintain the standard forearm and wrist positions.

The examiner should the hold the grip dynamometer with one hand by the pressure transducer as shown below.

Proper starting position.

Use the following standard instructions for performing the test:

1. Tell the patient, "**Starting with your right hand, grasp the dynamometer and squeeze as hard as you can. Switch your hands as rapidly as possible, and squeeze maximally with your left hand. We will repeat this ten times. Remember to exert maximal force and alternate you hands as quickly as possible.**"

2. Demonstrate and then give the dynamometer to the patient.

3. After the patient and dynamometer are positioned appropriately, say " **Are you ready ? Begin."**

4. As the patient begins to squeeze, say " **Quickly!...Quickly!"**

5. A minimum of five repetitions is required for a validity determination. The software prompts for 10, but the test can be ended anytime after five.

Note: Ensure that the test is started with the right hand. If a mistake is made, there is no way to switch the data without retesting!

Sustained Grip Test

In order for the sustained grip test to be used as a validity check for an FCE or other purpose, a minimum of two repetitions must be performed bilaterally. The test time for each repetition must be at least three seconds. Validity is determined based on the coefficient of variation (CV) of the completed repetitions.

For proper documentation purposes, ensure that the grip position denoted in the software coincides with the position used in the actual test.

According to the American Society of Hand Therapists (1981), the proper positioning of the patient for this test is as follows:

> Seated, with the shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and the wrist between 0 and 30° extension and between 0 and 15° ulnar deviation.

> In all cases, the arm should not be supported... The dynamometer is presented vertically and in line with the forearm to maintain the standard forearm and wrist positions.

Use the following standard instructions for performing the test:

1. Tell the patient, "**I want you to hold the handle like this and squeeze as hard as you can.**"

2. Demonstrate position and procedure, and then give the dynamometer to the patient.

3. After the patient is positioned appropriately, say " **Are you ready ? Squeeze as hard as you can.**"

4. As the patient begins to squeeze, say " **Harder!...Harder!....Harder!**" until the computer's double beep indicates the entire test time has elapsed.

5. Repeat the test at least one more time, and then repeat the procedure on the other hand.

Grip Dynamometer Calibration

New Installations and First Time Calibration

If the grip dynamometer and the Tracker Interface Box were received in the same shipment, the transducer has been calibrated at the factory. If this is the case, a calibration diskette should have been included with the shipment. To utilize the factory calibration, the calibration diskette must be installed as part of the initial Tracker software installation. For more information, see the installation instructions in Module 1, Chapter 2: *Software Installation*.

If the grip dynamometer was purchased as an upgrade to an existing system, then the dynamometer must be calibrated manually. To do this, follow the instructions listed under maintenance calibration.

If the following screen appears upon entering the GripTrack testing module, a   mainte-
nance calibration must be performed.
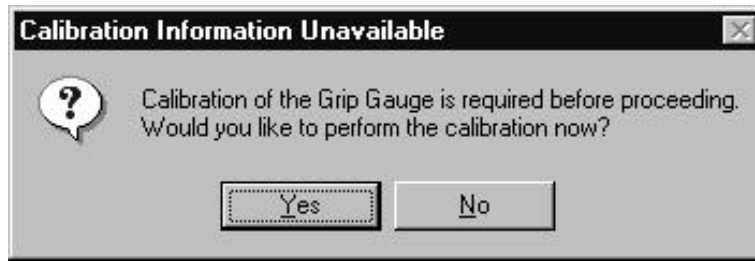
Maintenance Calibration

Every six months, the software will prompt for a maintenance calibration. In the   mean-
time, if the gauge is dropped or mishandled, the calibration should be performed prior to
the appearance of the software prompt. To perform a maintenance calibration use the
following steps:

Step 1
Place the adjustable dynamometer handle in position #2 (counting out from the gauge).
Position the grip dynamometer flat on a table with a spacer under each end to lift   trans-
ducer cover off the surface. From the main screen, select "Setup," then "Calibrate," and
"GripTrack" from the drop-down menus.
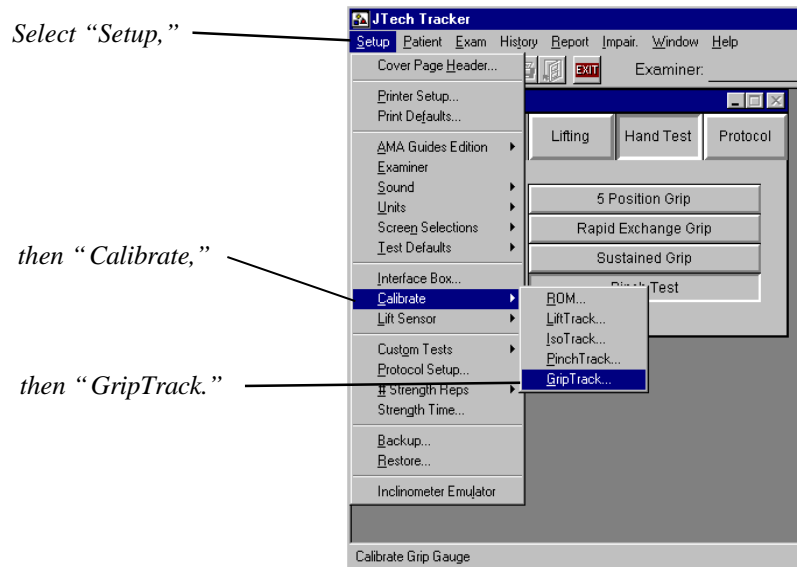
Step 2
Make sure no external weight is applied to the gauge, and click the "Zero Calibrate"   but-
ton in the Grip Gauge Calibration dialog (shown on the next page). Once the zero   calibra-
tion is performed successfully, a confirmation dialog is displayed. If the following warning
appears, we recommend that you click on "No" and contact JTech Customer Service.
Clicking "Yes" will allow you to accept the values and continue, but the data collected
may not be accurate.

If this screen appears, con-tact JTech Customer Service. Clicking "Yes" will accept the values and allow you to perform tests, but the values may not be accurate.

Calibration Error

? The value received from the Tracker box is outside the range of normal zero values. Do you want to accept the value?

Yes   No
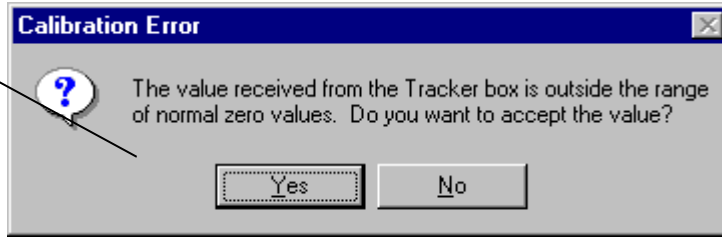
Grip Gauge

Click this button to zero calibrate the grip gauge.

Step 1
Remove any weight from the load cell and press 'Zero'.   Zero

Count:

Count boxes are used to assist Customer Support should calibration problems occur.

After zero calibration, place a known weight on the gauge, enter its value here, and click on "Calibrate."

Step 2
Add calibration load to the load cell. Enter its weight in the Weight field and press 'Calibrate'.

Weight:
50.00   ⦿ lb. ○ Kg. ○ N.

Calibrate

Count:

The weight unit is designated using these radio buttons. The default is pounds.

OK   Cancel   Help

Step 3

Using the enclosed cable, attach a known weight to the gauge as shown below. The ideal weight is 100 lb. and the minimum is 50 lb. Type the weight of the object into the Weight box and click on the "Weight Calibrate" button. (If you entered the Calibration dialog from the Testing dialog, you will automatically return to the testing screen when the calibration is complete.)
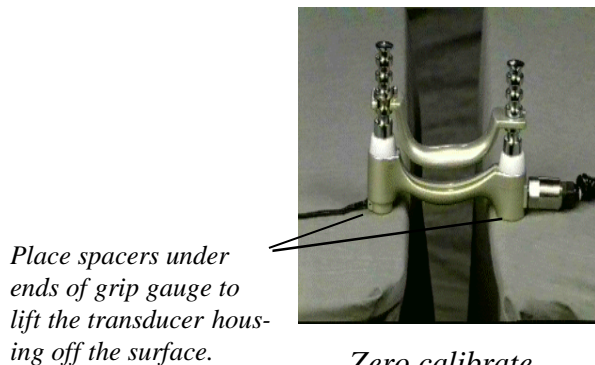
Place spacers under ends of grip gauge to lift the transducer hous-ing off the surface.
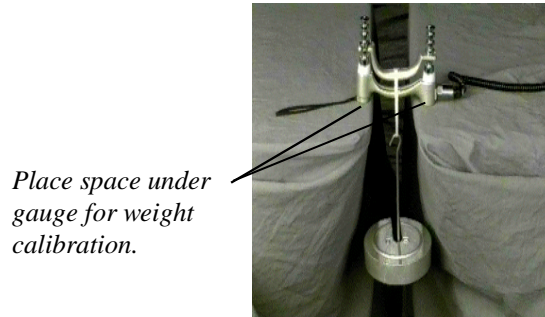
Place space under gauge for weight calibration.

Zero calibrate.

Weight calibrate.

Daily Auto Calibration

The software will prompt for a "Zero Calibration" every day the first time the device is used. To perform a zero calibration, place the handle in position #2, remove any force from the gauge, position the gauge with the spacers as above, and click "OK." Clicking on the "Postpone" button in the Calibrate prompt puts off the zero calibration until the next time the device is used. Failure of the software to respond when "Postpone" is selected indicates that a full calibration must be performed.

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Chapter 2
Using the GripTrack Software

5 Position Grip Test

After a patient has been added or selected from the patient database, and an exam description has been defined (see Module 1, Chapter 4: *Starting a Test*), click on the button labeled "Hand Test." From the resulting menu of buttons, click "5 Position Grip" to initiate the test sequence.

All other enabled Tracker modules appear in this row of button. Contact JTech to upgrade your system at 1-800-985-8324.

Click on "Hand Test" to view the hand testing protocol selections.

These three tests come with the GripTrack system. Click on "5 Position Grip" to initiate the test sequence.
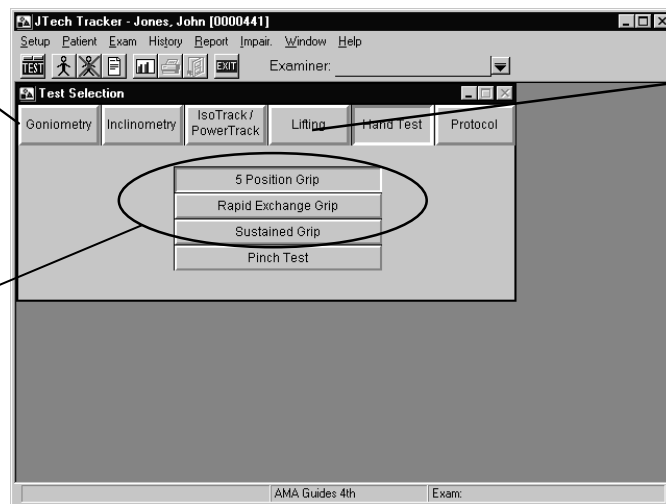
After selecting "5 Position Grip," the following dialog appears.

Locate the button corresponding to the grip gauge handle position for the test. Use either the mouse or the Tab and arrow keys to select.

The "Position" buttons correspond to the adjustable handle position on the sensor. The handle position closest to the gauge is position 1 and farthest from the gauge is position 2 (see illustrations on the next page). The software provides the flexibility to perform all of the position tests in any order, or in any combination. The industry standard, however, is to test all five positions, starting at position 1 and ending at position 5. Select the button corresponding to the position to be tested.
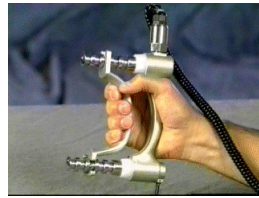
Position 1   *Positon 2*   *Position 3*   *Position 4*   *Positon 5*

Refer to Chapter 1 of this module for more information regarding test procedures, or use the Help screen in the software.

Note: Make sure the dynamometer position corresponds with the test selected. The test must be deleted and repeated correctly if a mistake is made!

After a position test is selected, the Data Acquisition screen pictured below will appear. Refer to the captions for a complete description of the screen's elements.

Restart deletes all repetitions performed on the selected side and prompts for new data.

Right maximum labeled with blue marker and left maximum labeled with green marker.

Test position is indicated here.

When the load on the dynamometer exceeds the value displayed here, data is recorded. Threshold can be set to 1,3,5,7, or 10 lb. using this

Current repetition indicator.

" Undo" deletes most recent repetition.

"Next" closes current test and advances to next test (in this case the position 2 test). The "Next" foot switch provides the same functionality.

Real-time display of load on the grip dynamometer.

Dial gauge with real-time moving pointer. Gauge can be displayed in pounds, kilograms, or newtons.

Click here for details on test procedure or more information on button features.

Closes current test.

Note: The software default starts testing with the right hand. To start with the left hand, click on "Restart L." If a mistake is made, there is no way to switch data without retesting!

After a position test has been completed, you can either click on "Next" to test the next position or use the "Close" button to return to the 5 Position Grip Test screen. At the 5 Position Grip Test Screen you can view the test data, statistics, and database comparisons.

If after viewing the data you want to test another position or retest the previous position, click on the corresponding "Position" button.

All completed test data is displayed on the 5 Position Grip Test screen. A summary of the displayed data is as follows:

Rep 1, Rep 2, Rep 3: Raw data of the position test.

Ave: Average force of the repetitions performed.   The maximum average for all positions tested is bolded for both the right and left side. The largest of these two numbers is the criterion the software uses to determine the position at which the rapid exchange test should be performed.

CV: Coefficient of variation of the performed repetitions. At least two repetitions are required for calculation. If the CV for any position test exceeds 15%, the specific test is considered invalid, highlighted in red, and should be repeated.

Val: If the CV is 15% or less for a position test, validity is "Yes."   At least two repetitions are required for validity determination.

Deficit: This value is a comparison of the left average vs. the right average if performed bilaterally. A reading of -20%L would indicate the left side was 20% weaker than the right.

The single highest repetition for all tests performed is highlighted in red.

Left\Right Side Strength: Using only the 2nd position grip data, a comparison is drawn to a normative database of age- and gender-based maximum grip strengths (Mathiowetz et al. 1985, 1986). The number of standard deviation units (SD) above or below the mean is calculated assuming normal distribution. Using this number, the patient is grouped into either a "Normal," "Mild Deficit," or "Moderate to Severe Deficit" category. "Normal" is defined as -2 SD below the mean or better (assumes 97.7% of sample are normal). "Mild Deficit" is defined as -2 SD to -3 SD below the mean (assumes 2.2% of the sample have a mild deficit). "Moderate to Severe Deficit" is defined as greater than -3 SD below the mean (assumes the lowest .1% of the sample

Note: If data does not appear in this field, either the patient's birthday has not been entered in the personal data section of the software, or a position 2 test has not been performed.

Indicates an 11% difference between left and right hand strength at position 1.

The maximum repetition of all tests performed is displayed

Maximum average of all tests performed with the left hand is in bold. (The position where the maximum of the two bolded numbers occurs is used for REG test.)

Maximum average of all tests performed with the right hand is in

5 Position Grip Test

Pos	Left Side (lb) Rep1	Rep2	Rep3	Ave	CV	Val	Deficit	Right Side (lb) Rep1	Rep2	Rep3	Ave	CV	Val
1	78	81	89	83	7%	Yes	-11% L	92	98	91	94	4%	Yes
2	105	104	104	**104**	0%	Yes	-7% L	117	117	105	**113**	6%	Yes
3	90	96	98	95	5%	Yes	-13% L	108	107	113	109	3%	Yes
4	87	87	82	85	3%	Yes	-9% L	92	92	99	94	5%	Yes
5	69	70	70	69	1%	Yes	-7% L	77	75	73	75	3%	Yes

Left Side Strength
Pop. 42%   -0.2 SD   Normal

Right Side Strength
Pop. 38%   -0.3 SD   Normal

Graph   Defaults   Delete   Notes   Validity   Help   Close

Only data from the 2nd position grip test is used for population comparisons.

Results of clicking on these buttons are summarized on the following pages.

Patient's right hand grip is stronger than that of 38% of same-sex people in age group. Patient is only -.3 SD units from mean for age group (i.e. 50th percentile). This classifies the patient as normal.

Data Acquisition Screen Buttons

Defaults
The "Defaults" button at the bottom of the 5 Position Grip Test screen controls the testing parameters, such as number of repetitions, side to be tested, and threshold. The Defaults dialog appears below. Click on the white circle next to the desired setting and then "OK."

These buttons control the number of repetitions and side or sides for testing.

Click "OK" when finished.
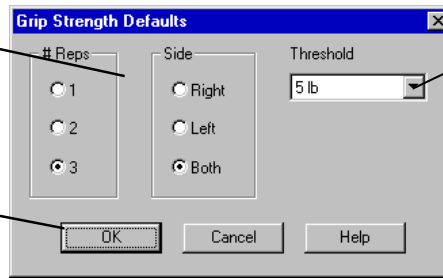
Click on the downward arrow and select the new threshold level.

Delete
The "Delete" button enables you to remove either the left or right side repetitions for any position test. To remove a data set, click on the test from the drop-down menu and click on "Yes" at the Warning prompt. Clicking "No" leaves the test data unchanged.
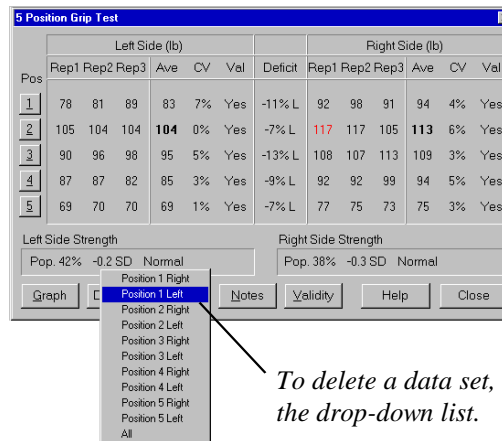
To delete a data set, highlight it from the drop-down list.

Notes
To add a note regarding the testing, click on the "Notes" button. A flashing cursor will appear in the field of the following dialog, entitled "5 Position Grip Notes." Type the note, up to 250 characters, as you would with a word processor. Click on "OK" when finished. The note will appear on the "5 Position Grip" report page.
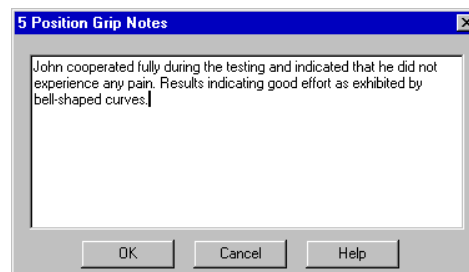
Graph

Janda et al (1987) and Stokes (1983) reported that a patient giving maximum effort at all five settings should produce a bell-shaped curve. This applies to injured and uninjured populations alike and is based on the mechanical advantage unique to each test position. Use the "Graph" button to get an indication of the patient's performance on the 5 position test. If the data is indicative of the characteristic curve (such as below), it can be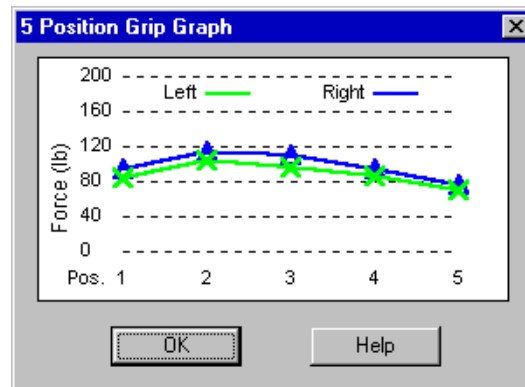 said with reasonable certainty that the patient gave maximum voluntary effort. The test should then be labeled as valid using the "Validity" button.

Note: Hamilton et al. report that curve shape is a function of strength and that the curve will be flatter for subjects with a weaker grip. Hamilton cautions that clinicians should be careful about using a flattened curve to imply the lack of sincere effort by the subject.

Validity

To quantify the overall test as "valid," close the Graph dialog by clicking "OK," and click on the "Validity" button. The default setting is "Undetermined," which results in a blank on the report in the Validity Status section. Click on the "Yes" radio button to label the test as valid and "No" for invalid. The left and right sides are independent.

Note: The 5 position graph validity check is for the overall 5 position test, and should not be confused with the validity associated with the individual position tests. CV is used to determine the validity of the individual tests.

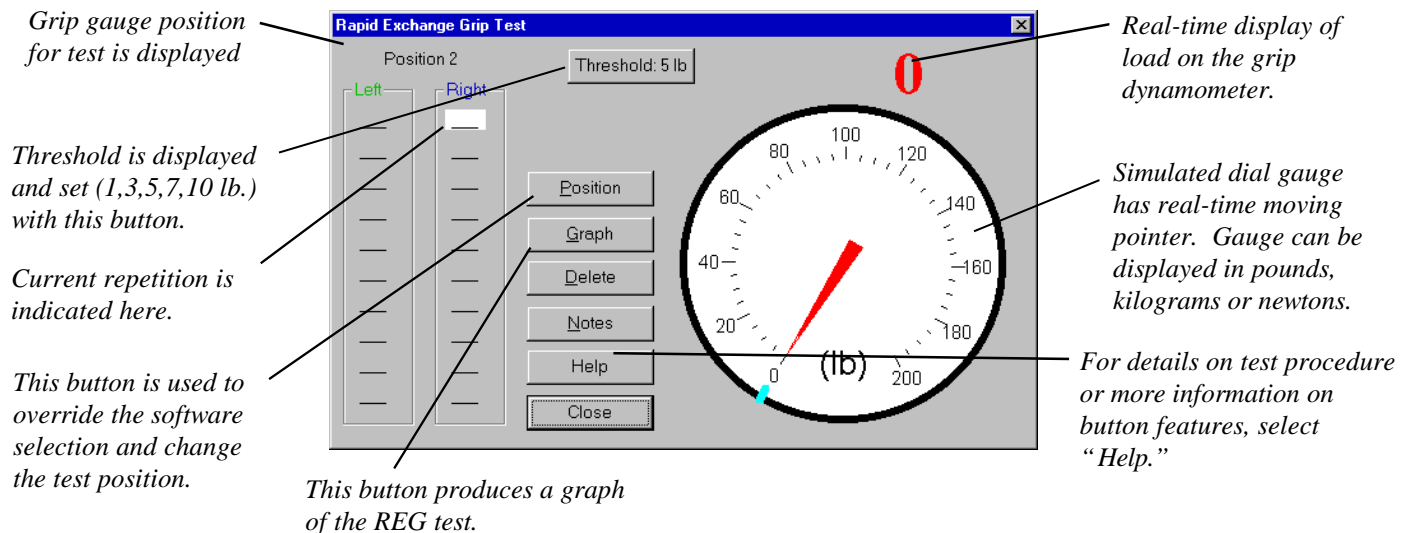*Validity for the right and left sides are assigned independently.*

After notes have been entered and validity has been assigned for the 5 position test, click the "Close" button in the 5 Position Grip Test screen to return to the main Test Selection screen. The rapid exchange grip (REG) test is typically performed next. To perform the test, select the button corresponding to that menu item.

Rapid Exchange Grip Test

Hildreth et. al (1989) showed that the rapid exchange grip test (REG) could be used as another validity check to supplement the 5 position grip test. In the event that the bell-shaped curve generated by a maximally-performing injured hand is somewhat flat, or an uncooperative patient produces a mildly bell-shaped curve, the REG can serve as a distinguishing test. Refer to chapter 1 or the appropriate Help screen for more information on the rationale for this conclusion.

If "Rapid Exchange Grip" is selected from the main Test Selection screen, the following dialog appears.

Grip gauge position for test is displayed

Threshold is displayed and set (1,3,5,7,10 lb.) with this button.

Current repetition is indicated here.

This button is used to override the software selection and change the test position.

This button produces a graph of the REG test.

Real-time display of load on the grip dynamometer.

Simulated dial gauge has real-time moving pointer. Gauge can be displayed in pounds, kilograms or newtons.

For details on test procedure or more information on button features, select "Help."

Note: At least one position of the 5 position test protocol must be tested before the REG test can be performed. The following warning appears if no 5 position test was performed.
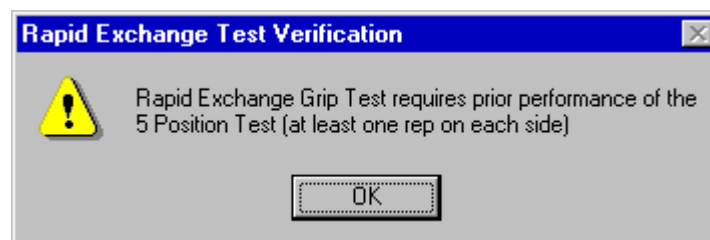
The REG test is usually performed at the grip gauge setting where the highest 5 position test value was recorded. Tracker software automatically defaults to this position for the REG test. The software also allows you override the selected REG test position by using the "Position" button. The following dialog appears. Click on the selection corresponding to the desired position. A graph of the 5 position results is displayed for reference.
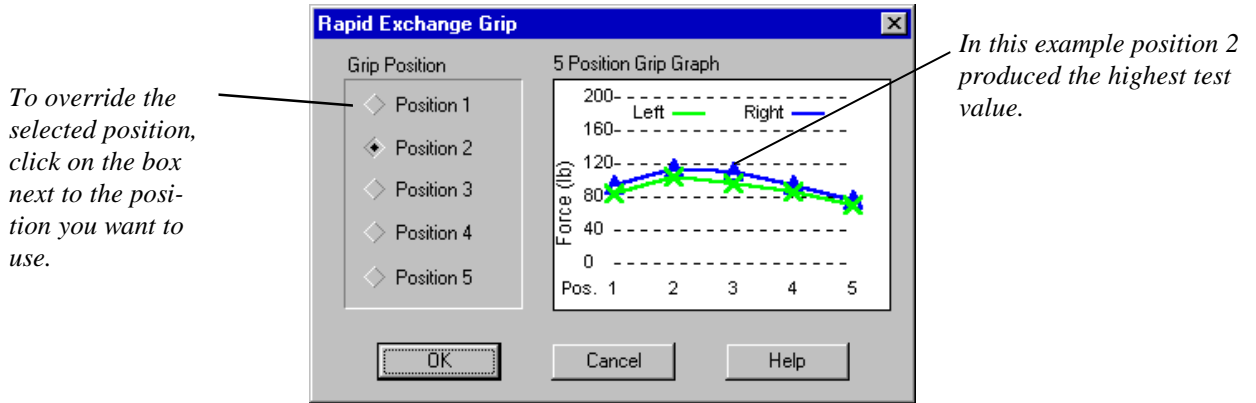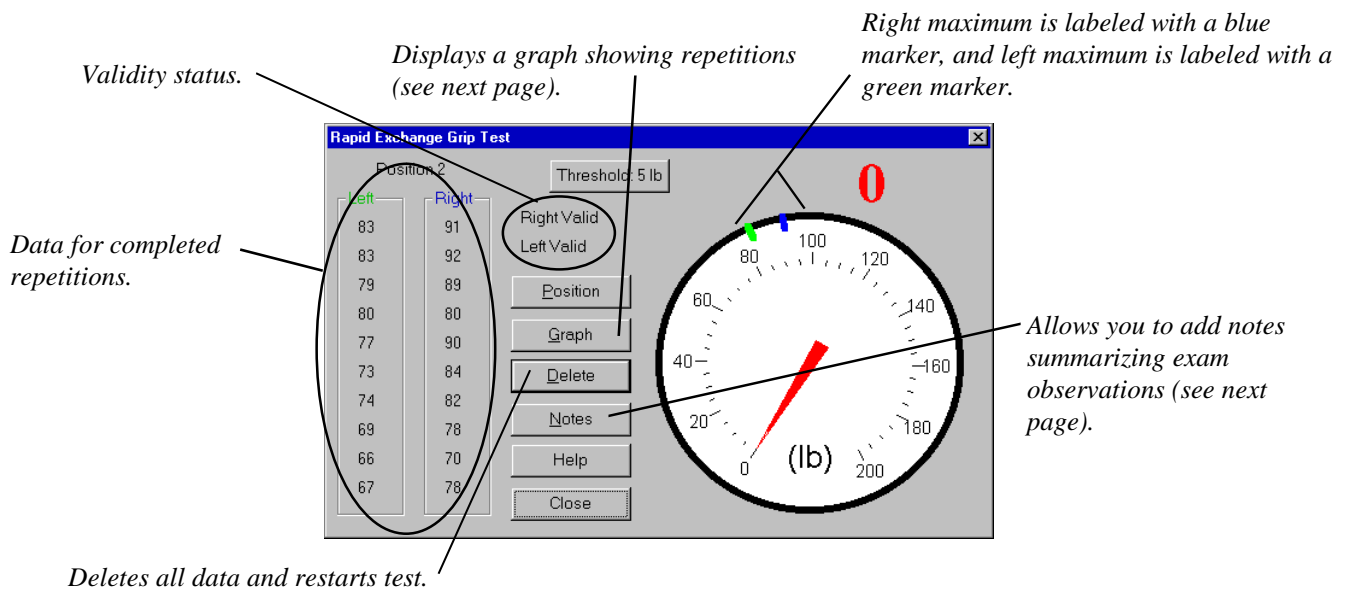
To override the selected position, click on the box next to the position you want to use.

In this example position 2 produced the highest test value.

At this point, the grip dynamometer is active and the software is ready to receive data. As soon as the threshold value is exceeded, the test will begin. Refer to Chapter 1 or click on "Help" for the test procedure and/or instructions to be given to the patient. The test is stopped upon the completion of 10 repetitions, or a delay of three seconds in the data acquisition.

The software requires a minimum of five repetitions to determine validity. If the test is stopped prior to the minimum required repetitions, the reminder is displayed on the computer screen.

The completed test data is displayed as follows:

Validity status.

Displays a graph showing repetitions (see next page).

Right maximum is labeled with a blue marker, and left maximum is labeled with a green marker.

Data for completed repetitions.

Allows you to add notes summarizing exam observations (see next page).

Deletes all data and restarts test.

The following dialog results from selecting "Graph."
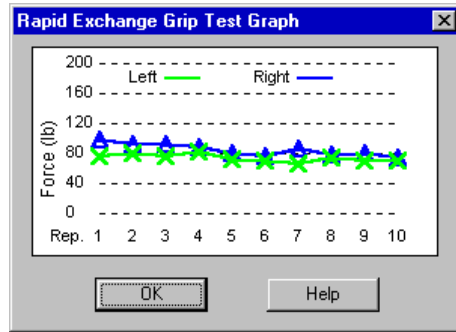
The Notes dialog allows you to enter information about the REG test. To enter notes, simply begin typing after the dialog is activated.
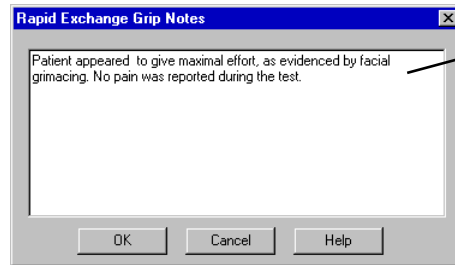
With the cursor in the box, begin typing to enter notes about the REG test.

Sustained Grip Strength Test

Similar to isometric testing, the sustained grip test can provide information on a patient's endurance, fatigue, consistency, and level of effort. Real-time force curves for up to four repetitions are displayed bilaterally. If available, voice prompts will lead you through the test protocol.

Test Status box.

These buttons switch between left or right side testing.

Auto-scaling force axis for graphs.

Force curve color key.

Validity status box. "Yes" or "No" appears after a two repetitions have been completed.

Real-time display of load on sensor.

Click on "Testing Setup" to define test position and instructions.

Controls threshold, which can be set from 3 to 45 lb.

Click here to close testing

Sustained Grip Function Buttons

Details

Selecting the "**Details**" button to mark and to add notes regarding a specific repetition. By clicking on the check box labeled "Ratchet," the respective force curve can be marked for exhibiting oscillations indicative of "cogwheeling" or "ratcheting response," which may be an indicator of sub-maximal effort. By clicking on the check box labeled "Exclude," the corresponding force curve is excluded from statistical and validity calculations. Notes about repetitions can be typed into the Comment boxes. Input into this screen is displayed as part of the report.

Delete Rep

By selecting the "**Delete Rep**" button, the following window appears on the Test screen. Tests which may not be indicative of the patient's true ability can be selectively removed. Validity and statistics are then recalculated each time a curve is eliminated. Tests subsequent to the deleted repetition are moved up, e.g. if rep 2 is deleted, then rep 3 is renamed rep 2 and rep 4 is renamed rep 3.

Undo

Clicking on the "Undo" button deletes the last completed repetition.

Statistics

Selecting the button labeled "Statistics" displays a box containing statistical information regarding the tests over the graphs (see next page). The peak load for each repetition is displayed, as well as average, percent deficit, and validity calculations. To remove the Statistics box, click on "Close."

Isometric Statistics

Right Side

	Max	Ave	Ratchet	Status
Rep 1	46 lb	37 lb	Yes	Exclude
Rep 2	87 lb	67 lb	No	Complete
Rep 3	89 lb	67 lb	No	Complete
Rep 4	92 lb	67 lb	No	Complete
Max Average:	67 lb			

Ratio Difference   6.88%
Peak-Ave root diff   0.91%
Validity   Valid (96.7%)

Ready Time: 0.0 sec   Deficit: -11% R

Left Side

	Max	Ave	Ratchet	Status
Rep 1	96 lb	79 lb	No	Complete
Rep 2	84 lb	74 lb	No	Complete
Rep 3	89 lb	71 lb	No	Complete
Rep 4	79 lb	64 lb	No	Complete
Max Average:	79 lb			

Ratio Difference   -6.88%
Peak-Ave root diff   0.36%
Validity   Valid (96.7%)

Close   Help

Three types of statistics are calculated for the sustained grip test: statistics unique to a specific repetition, statistics that apply to the side, and statistics that apply to the test as a whole. Values are calculated based on data occurring after the "ready time" has elapsed to the end of the test.

Repetition statistics are specific to each repetition.

Max	Maximum force recorded during test time, from the end of ready time to the end of the test.
Ave	Average force during test time.
Power	The area under the curve from the end of ready time to the end of the test.
Fatigue	Percent difference between the maximum and the load value at the end of the test. If patient does not sustain a load until the end of the test, 100% fatigue will be reported.
Ratchet	Examiner determines from the graph if the force curve exhibits rapid oscillations sometimes called "ratchet response" or "cogwheeling" and which may indicate submaximal effort. "Ratchet" is selected under "Details."
Status	"Complete" if the subject maintains force beyond ready time or "Incomplete" if force is released before end of ready time. "Exclude" can be selected through "Details" if a repetition should not be included in the statistical calculations for any reason.

Side statistics calculations are based on the completed repetitions for that side.

Max Average	Maximum of the averages determined above.
Max Difference	Maximum difference between successive repetitions. Used as part of validity to determine consistency of effort.
CV	Coefficient of variation (n-1 method) using the maximum of each repetition.
Valid	Yes/No. Valid if the CV or Max Difference numbers are less than 15%.

Overall statistics apply to the test as a whole.

Test Time	Length of time for the repetition, set through the software by the examiner.
Ready Time	Examiner-controlled and usually dictated by how rapidly the patient can build strength.
Deficit	Percent difference between the right and left Max Averages.

Testing Setup

By clicking "Testing Setup," you can control and document the position in which the sustained grip test is performed. The following dialog appears when "Test Setup" is clicked. Typically, position 2 or 3 is used for this test. Use the size of the patient's hand to dictate the position.
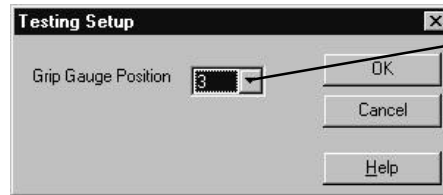
Click here to see other test positions available.

Test Time

The "Test Time" button allows you to override the default test time settings (see Module 1, Chapter 2). Test time is the overall length of the test, or the period of time the subject must sustain a grip. This button is also used to set the "ready time," which provides a time buffer at the beginning of the test for reaching maximum effort before data is collected. The data sampled between the end of ready time and the end of the test ("sample time") is used for the reports and statistical calculations. As a rule of thumb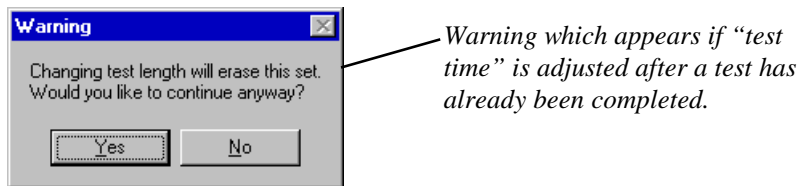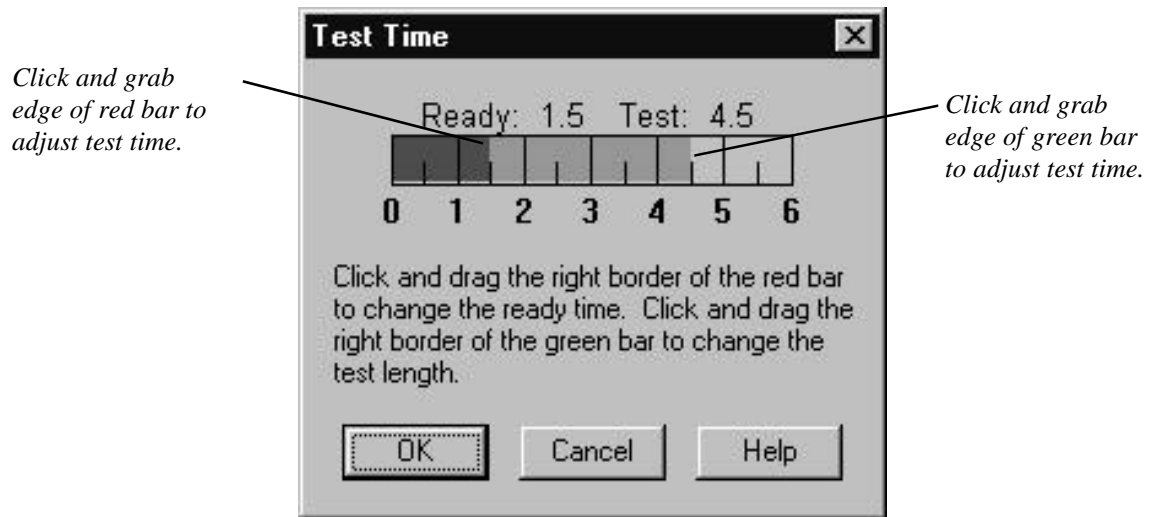, the sample time should be at least three seconds. For example, if the test time is set at 3½ seconds and the ready time is set at a ½ second, the sample time will be three seconds.

Ready time also serves as a buffer for any transient occurrences during the load initiation phase. For instance, if the subject "jerks" the handle, ready time excludes this phenomena. (Subjects should be encouraged to proceed cautiously when initiating a test.)

In summary, ready time is best defined as the time it takes the subject to reach a steady state. Based on the force curves generated, the examiner can evaluate what is the best ready time, such that no transient phenomena enter the calculation of statistical parameters associated with the test. Test time, on the other hand, is the total length of the test (ready time plus sample time).

Test time can vary from a ½ second to six seconds in ½ second increments. Ready time is required to be at least a ½ second less than the test time. Both parameters are adjusted by clicking on the "Test Time" button in the lower right-hand corner of the Data Acquisition screen (see instructions below). Changing the ready time after tests have been performed will affect the statistical calculations. Changing the test time after tests have been performed results in the loss of all data associated with that test. A Warning screen requiring confirmation will appear before changes to test time are made by the software.

To adjust the test time, position the pointer on the right-hand edge of the green bar, press the left mouse button, and drag the bar to the desired position. To adjust ready time, click and drag the right-hand edge of the red bar. Click "OK" when finished.

Click and grab edge of red bar to adjust test time.

Test Time

Ready: 1.5   Test: 4.5

0   1   2   3   4   5   6

Click and drag the right border of the red bar to change the ready time. Click and drag the right border of the green bar to change the test length.

OK   Cancel   Help

Click and grab edge of green bar to adjust test time.

Warning

Changing test length will erase this set. Would you like to continue anyway?

Yes   No

Warning which appears if "test time" is adjusted after a test has already been completed.

Chapter 1
Pinch Testing Background Information

When, Why, and How Often

There are many reasons to measure a patient's pinch strength. In worker's compensation cases, it may be necessary to establish if the patient can return to work. As part of a functional capacity evaluation, pinch strength testing can give an indication of sincerity of effort through coefficient of variation data, as well as an indication of the patient's ability to perform job-related tasks requiring manual dexterity or fine motor skills. As part of a screening, comparing a subject's strength relative to a normative database may be desirable. In the case of a post-offer, pinch testing may be used to help determine an employee's predisposition to repetitive motion disorders. With today's insurance companies requiring documentation of outcomes, testing new patients and establishing a baseline from which to assess treatment effectiveness (surgical, chiropractic or otherwise) may be extremely helpful.

When used as part of a functional capacity evaluation, the pinch strength testing portion of the exam should include, as a minimum, the three basic pinch tests: tip, key, and palmar.

A recently published rehabilitation protocol for patients with carpal tunnel syndrome suggests that pinch strength testing should occur as part of an initial exam that also includes orthopedic and neurological tests, nerve latency tests, range of motion and x-ray. This test could be as simple as a single tip pinch or a complete test including custom tests. The article indicates that after two weeks of intensive care treatment, the patient's pinch strength should be re-tested. After 6-8 weeks of rehabilitation care, the pinch strength should again be tested. Upon discharge of the patient, or release to pre-injury status, a final pinch strength evaluation should be performed.

Tracker software can also be used to create custom pinch tests. This is especially useful in testing function in special populations who may have had amputations, surgical reattachments, or congenital defects.

Tip Pinch Test

The software provides the flexibility to perform a test at any or all of the three standard positions: the tip (two-point), the key (lateral), and the palmar (chuck or three-point).

According to the American Society of Hand Therapists (1981) and Mathiowetz et al. (1984), the proper positioning of the patient for the pinch test is as follows:

Seated, with the shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and the wrist between 0 and 30° extension and between 0 and 15° ulnar deviation. In all cases, the arm should not be supported...

For the tip pinch, the pinch dynamometer is presented on its side and at a   45° angle to the forearm to maintain the standard forearm and wrist positions.

The pinch gauge should be held at the distal end (by the examiner)...
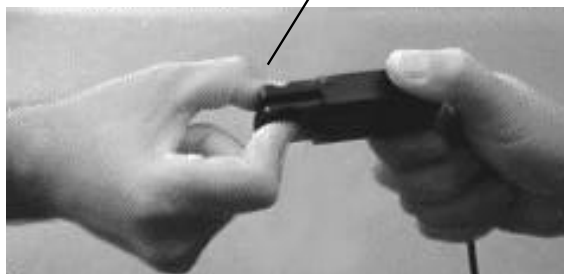
Use the following standard instructions developed by Mathiowetz et al. (1984) for performing the test:

1.   Tell the patient, "**Place the tip of your thumb on this side, and the tip of your index finger on this side as if to make an "O." Curl your other fingers into your palm as I am doing and pinch as hard as you can.**"

2.   Demonstrate the test, then give the pinch meter to the patient.

3.   After the patient is positioned appropriately, say " **Are you ready? Pinch** as **hard as you can**."

4.   As the patient begins to squeeze, say " **Harder!...Harder!....Relax!**"

5.   Repeat the test two more times, then move on to the other hand.

Note:

Make sure that the tests are started on the hand indicated by the software. The default is to start with the right hand. To start with the left hand, click the "Restart L" button. If a mistake is made there is no way to switch data without retesting!

Presented at 45° angle.

Key Pinch Test

The proper positioning of the patient for the key pinch test is as follows:

> Seated, with the shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and the wrist between 0 and 30° extension and between 0 and 15° ulnar deviation. In all cases, the arm should not be supported...

> For the key pinch, the pinch dynamometer is presented horizontally in line with the forearm to maintain the standard forearm and wrist positions.

> The pinch gauge should be held at the distal end (by the examiner) and placed on the middle phalanx of the middle finger.

Use the following standard instructions developed by Mathiowetz et al. (1984) for performing the test:

1. Tell the patient, "**Place your thumb on top and your index finger below as I am doing and pinch as hard as you can**."

2. Demonstrate and then give the pinch meter to the patient.

3. After the patient is positioned appropriately, say "**Are you ready? Pinch as hard as you can**."

4. As the patient begins to squeeze, say "**Harder!...Harder!....Relax!**"

5. Repeat the test two more times, and then move on to the other hand.

Note:

Make sure that the tests are started on the hand indicated by the software. The default is to start with the right hand. To start with the left hand, click the "Restart L" button. If a mistake is made there is no way to switch data without retesting!

Palmar Pinch Test

The proper positioning of the patient for the palmar pinch test is as follows:

Seated, with the shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and the wrist between 0 and 30° extension and between 0 and 15° ulnar deviation. In all cases, the arm should not be supported...

For the palmar pinch, the pinch dynamometer is presented on its side and at a 45° angle to the forearm to maintain the standard forearm and wrist positions.

The pinch gauge should be held at the distal end (by the examiner)...

Use the following standard instructions for performing the test:

1. Tell the patient, " **Place your thumb on this side, and your first two fingers on this side as I am doing and pinch as hard as you can."**

2. Demonstrate and then give the dynamometer to the patient.

3. After the patient is positioned appropriately, say " **Are you ready ? Pinch as hard as you can**."

4. As the patient begins to squeeze, say " **Harder!...Harder!....Relax!**"

5. Repeat the test two more times, and then move on to the other hand.

Note:

Make sure that the tests are started on the hand indicated by the software. The default is to start with the right hand. To start with the left hand, click the "Restart L" button. If a mistake is made there is no way to switch data without retesting!

Presented at 45° angle.
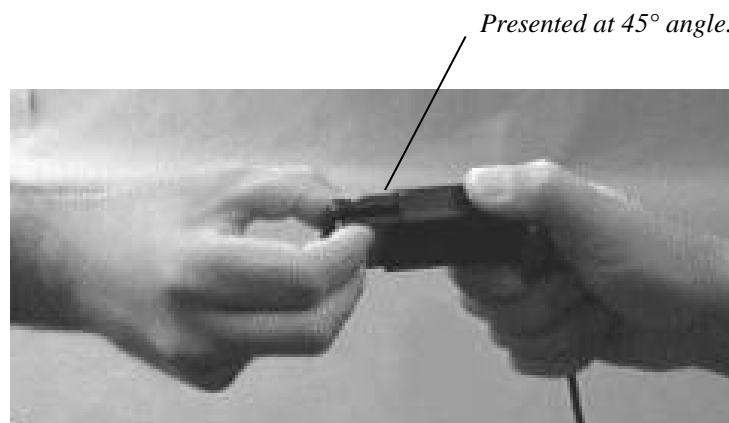
Pinch Dynamometer Calibration

New Installations and First Time Calibration

If the pinch dynamometer and the Tracker Interface Box were received in the same shipment, then the gauge has been calibrated at the factory. A calibration diskette should have been included with that shipment and installed with the program software. If the calibration diskette was installed, then only the daily calibration will be necessary to begin using PinchTrack.

If the pinch dynamometer was purchased as an upgrade to an existing system, or the diskette was not installed, the dynamometer must be calibrated in your office. To do this, follow the instructions below for a maintenance calibration.

Maintenance Calibration

Every six months, the software prompts for a maintenance calibration. In the meantime, if the gauge is dropped or mishandled, the calibration should be performed prior to the appearance of the software prompt. Place the pinch dynamometer flat on a table as pictured below. From the Main screen, select "Setup" and then "Calibrate" from the resulting menu. Select "Pinch Gauge" from the resulting list of devices. Ensure there is no externally applied weight on the gauge, and click the "Zero Calibrate" button in the Pinch Gauge Calibration dialog. After zero calibration is complete, place the enclosed weight on the dynamometer as pictured below. Insure the marks on the weight line up with the edges of the pinch dynamometer. Type the weight (stamped on the weight) into the dialog box, and click on the button labeled "Weight Calibrate."

Zero calibrate.

Weight calibrate.

Daily Auto Calibration

The first time the pinch gauge is used any day the software will prompt for a "zero calibration." Remove any force from the gauge, position as above, and click "OK." If there is no time to perform the zero calibration, you may elect to put off the calibration until the next time the gauge is used by clicking on the "Postpone" button.

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Chapter 2
Using the PinchTrack Software

After a patient has been added to or selected from the patient database, and an exam description has been defined (see Module 1, Chapter 4: *Starting a Test*), click on the button labeled "Hand Test." From the resulting menu of buttons, click "Pinch Test" to initiate the test sequence.

All other enabled Tracker modules appear along the top row of the Test Selection screen. Contact JTech to upgrade your system at 1-800-985-8324.

Click on "Hand Test" to view the available hand testing protocols.

Click on "Pinch Test" to initiate the test sequence.

Tip, Key, and Palmar Pinch Tests

After "Pinch Test" has been selected, the following Pinch Test dialog appears. The software gives you the flexibility to perform any or all of the tests, and in any order. Select the button for the pinch test you want to perform.

Locate the button corresponding to the test to be run. Use either the mouse or the Tab and arrow keys to select.

Tip Pinch Test   *Key Pinch Test*   *Tip Pinch Test*

Refer to Chapter 1 of this module for more information on pinch test procedures, or use the "Help" button in the software.

After a test has been selected, the Data Acquisition screen pictured below will appear. Refer to the captions for a complete description of the screen's features.

Threshold control button. After the load on the dynamometer exceeds the threshold (1,3,5,7, or 10 lb.), data is recorded.

Change the units of the dial gauge, and therefore the test ,with this button.

Right maximum is labeled with a blue marker, and the left maximum is labeled with a green marker.

The test position is indicated here.

Restart deletes all repetitions performed on the respective side and prompts for new data.

Current repetition is indicated by the white box.

"Undo" deletes most recent repetition.

"Next" closes current test and advances to the next test, (in this case the key pinch). The "Next" footswitch can also be used to perform the same function.
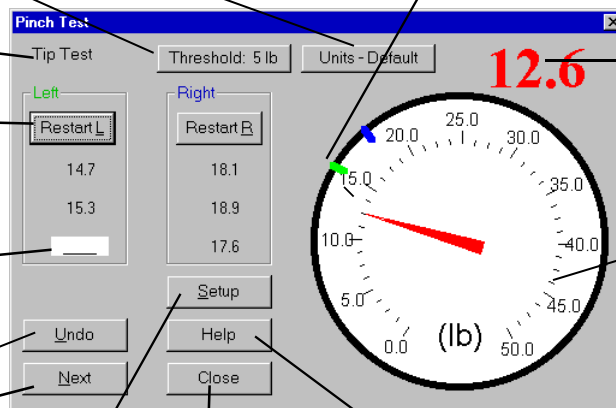
Real-time display of load on the pinch dynamometer.

Dial gauge with real-time moving pointer. Gauge can be displayed in pounds, newton or kilograms.

For details on test procedure or more information on button features, select "Help".

Closes current test.

This button is active for custom pinch

Note: Make sure that the tests are started on the hand indicated by the software. The default is to start with the right hand. To start with the left hand, click the "Restart L" button. If a mistake is made, there is no way to switch data without retesting!

All completed test data is displayed on the Pinch Test dialog screen. A summary of the displayed data is as follows:

Ave: Average of the reps performed.

CV: Coefficient of variation of the performed repetitions. A minimum of two repetitions is required for calculation.

Valid: Status is indicated by Yes or No. If the CV for any position test exceeds 15%, the specific test is considered invalid (No) and should be repeated.

Deficit: A comparison of left average vs. right average is displayed for each position test if performed bilaterally. A reading of -20%L would indicate the left side was 20% weaker than the right.

Indicates a 6% difference between left and right strength for the tip pinch.

Custom tests which have been added by the user. See page 5 of this chapter.

Clicking on the "Norms" button yields the following dialog box.

Dates that respective tests were last performed.

Patient's right hand tip pinch is stronger than that of 54% of same sex people in his/her age group. Patient is .1 SD units above mean for age group (i.e. 50th percentile). This classifies him/her as normal.

Left\Right Pinch Norms: Using the averages, a comparison is drawn to a normative database of age- and gender-based maximum pinch strengths (Mathiowetz et al. 1985, 1986). The number of standard deviation units (SD) above or below the mean is calculated assuming normal distribution. A population percentile is calculated, and the patient is grouped into either a "Normal," "Mild Deficit," or "Moderate to Severe Deficit" category. "Normal" is defined as -2 S.D. below the mean or better (assumes 97.7% of sample are normal). "Mild Deficit" is defined as -2 SD to -3 SD below the mean (assumes 2.2% of the sample have a mild deficit). "Moderate to Severe Deficit" is defined as greater than -3 SD below the mean (assumes the lowest .1% of the sample have a moderate/severe deficit).

If data does not appear in this field, then the patient's birthday has not been entered in the personal data section of the software, or the test has not been performed.

The "Defaults" button at the bottom of the Pinch Test screen controls the testing parameters, such as number of repetitions, side to be tested, and threshold. The Defaults dialog appears below. To change default settings, click on the white circle next to the desired settings, then click on "OK."

To change the threshold, click on the downward arrow and highlight the new threshold level.

Click "OK" when finished to save changes or "Cancel" to exit screen without saving.
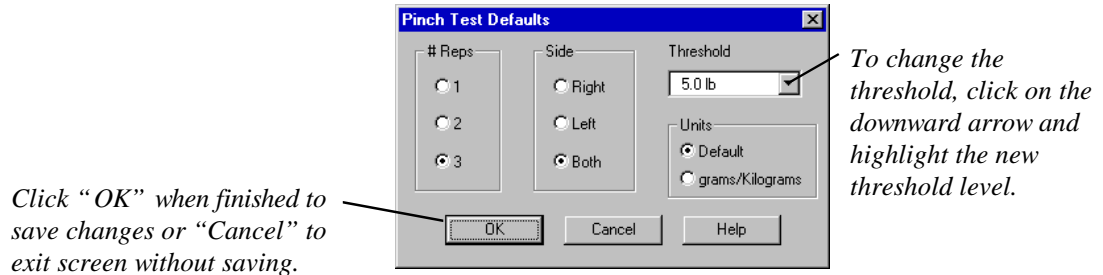
The "Delete" button at the Pinch Test screen is used to delete all repetitions for one side of a test as a group (data set). For example, if you delete "Tip Right" all repetitions performed for the right-hand tip pinch test will be deleted. To delete a data set, click on "Delete" and highlight the data set from the resulting menu. A Warning prompt will verify your action before the data set is deleted.


From the list, highlight a data set to be erased.
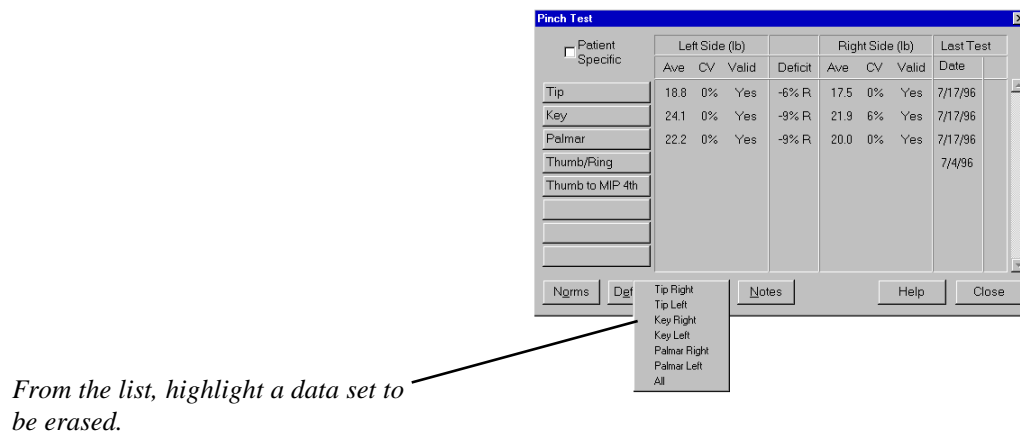
To add a note regarding the testing, click on the "Notes" button. The Pinch Test Notes dialog will appear with a flashing cursor the text field. Type the note, up to 250 characters, as you would in a word processor. Click "OK" when finished. The note will appear on the Pinch Test report page.
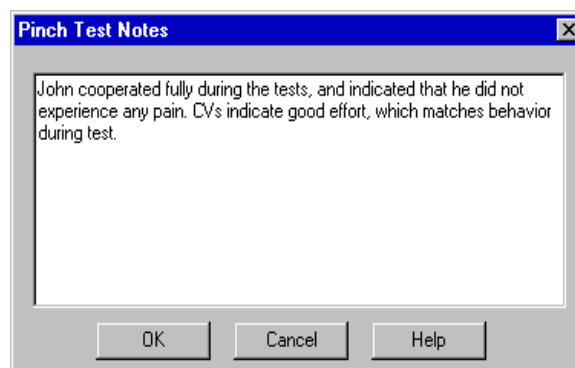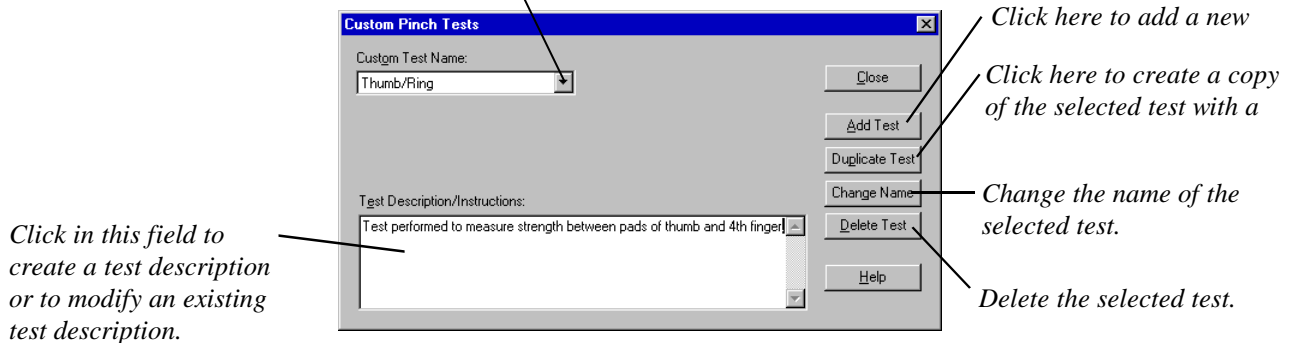
Creating Custom Pinch Tests

To create a custom pinch test begin by selecting the "Setup" drop-down menu. Then select "Custom Tests" and "PinchTrack" from the resulting menus.

Select "Setup,"

then "Custom Tests,"

and "PinchTrack."
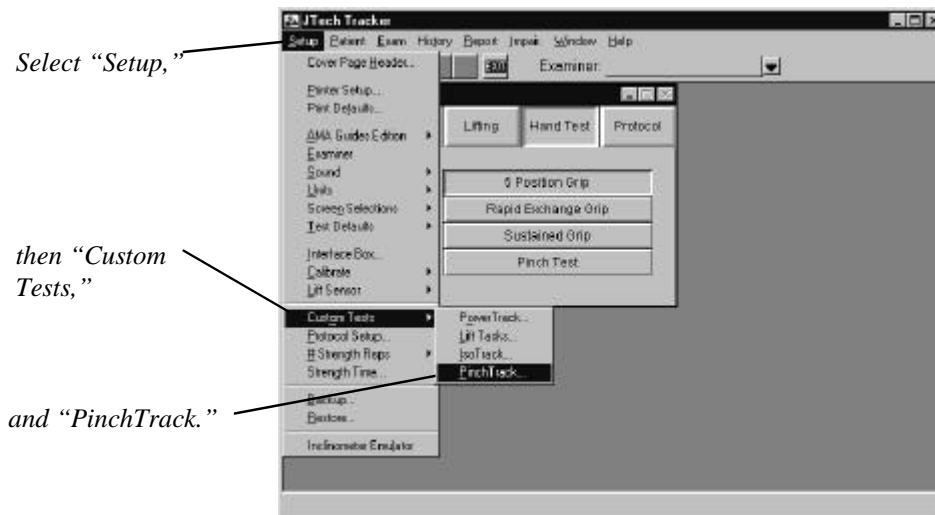
The resulting dialog is the basis for creating and displaying custom pinch tests. Click "Add" to create a custom test. To edit or delete a custom pinch test, click on the Custom Test Name downward arrow and highlight the test from the resulting list.

Click the downward arrow to show all previously defined custom tests.

Click here to add a new

Click here to create a copy of the selected test with a

Change the name of the selected test.

Click in this field to create a test description or to modify an existing test description.

Delete the selected test.

After clicking on "Add Test," the dialog on the next page appears.

If the cursor is not present, click in this field, then type in the name of the new custom test. A similar box will appear for naming a test when "Duplicate" is

Add New Custom Test

New Test Name:

Thumb to Amputation

OK   Cancel

Type a name for the new test and click "OK." This will save the name and return you to the previous screen, where the test description/definition can be created. "Cancel" exits the dialog without saving the new custom test name.

Once created the custom test is assigned a button in the Pinch Test Selection screen. If more than five custom pinch tests have been defined, the scroll bar on the right side of the screen can be used to see the other tests. Up to 15 custom pinch tests can be created.

Click here to display "Patient Specific" tests only.

Up to 15 custom tests can be created. Each is assigned a button for future selection.

Pinch Test

Patient Specific	Left Side (lb)				Right Side (lb)			Last Test
	Ave	CV	Valid	Deficit	Ave	CV	Valid	Date
Tip	18.8	0%	Yes	-6% R	17.5	0%	Yes	7/17/96
Key	24.1	0%	Yes	-9% R	21.9	6%	Yes	7/17/96
Palmar	22.2	0%	Yes	-9% R	20.0	0%	Yes	7/17/96
Thumb/Ring								7/4/96
Thumb to MIP 4th								
Thumb to Amputati								

Norms   Defaults   Delete   Notes   Help   Close

If more than five custom tests have been created, use the scroll bar to view additional tests.

The Patient Specific check box changes the display to show only those tests which have been performed on a specific patient during the course of treatment and testing. Click on the white square to activate the check (√). If the patient has not been tested previously, the Patient Specific box serves no function and should not be checked.

Chapter 1
Using Goniometers

Goniometry Principles

According to Norkin and White (1995), "Goniometry is used to measure and document the amount of available active and passive joint motion," as well as to "accurately describe abnormal fixed joint positions."

A goniometer consists of two arms which pivot about a common point called the "fulcrum" or pivot point The fulcrum is typically placed over the axis of joint rotation, and the arms are aligned on the proximal and distal segments of the joint. The goniometer measures the rotational angle one arm is able to travel relative to the other arm.

Range of motion (ROM) test data, along with data from muscle strength and neurological function tests can be used to:
  ♦ Determine the presence or absence of dysfunction
  ♦ Establish a diagnosis
  ♦ Develop treatment goals
  ♦ Evaluate progress (or lack thereof) toward rehabilitative goals
  ♦ Modify treatment
  ♦ Motivate the patient
  ♦ Research the efficacy of specific therapeutic techniques or regimens
  ♦ Fabricate orthoses or adaptive equipment

Advantages of the Tracker RangeTrack electrogoniometer versus conventional goniometers include time savings and elimination of inaccuracies, which may occur due to misreading the scale divisions or parallax resulting from not reading the goniometer at eye level.

RangeTrack uses a 0-180° notation system to report ROM values. For all motions, except rotation in a transverse plane, 0° is defined as the position of an extremity in anatomical neutral position. The American Medical Association and the American Academy of Orthopedic Surgeons, among others, support this measurement system.

Goniometric measurement for extremity joints has been found to be both valid and reliable. However, reliability depends upon the joint being measured (upper extremity joints generally produce greater reliability). Movement of the joint axis, poor alignment to bony landmarks, variations in manual force application by the examiner, and the patient's level of effort can also affect reliability. See Norkin and White for more details.

When performing ROM measurements on joints, aligning the fulcrum of the goniometer with the axis of rotation of the joint is the accepted practice. As stated earlier, the arms of the goniometer should align with the axes of the bones of the proximal and distal segments of the joints respectively. For wrist flexion and extension, however, dorsal and volar

placement of the goniometer has been shown to be more reliable. Dorsal placement of the goniometer for finger range of motion is the accepted protocol. The AMA has adopted these techniques for ROM measurements performed in conjunction with impairment ratings.

RangeTrack Features

Hand/Foot Switches

Enter switch: This switch is used to enter the end range of motion. To activate the switch, plug the red connector of the switch into the "Enter" receptacle on the back of the interface box. The switch can be used on a table or on the floor as a foot switch.

Next/Skip switch: This switch is used to tab through ROM menu fields and select the joint for testing. Plug the black connector of the hand/foot switch into the "Next" receptacle on the back of the interface box to activate.

Alignment Rails

These acrylic extension arms are attached to the goniometer via a press fit for large extremity joint ranges of motion. They can be easily removed for finger ROM measurements. Simply align the holes with the tabs on the goniometer arm and press into place. Make sure the groove on the acrylic rail aligns with the painted line on the RangeTrack goniometer.

Note: *The button head screw on the goniometer's side is a necessary stop for the electronic potentiometer. Removing the screw may cause damage to the potentiometer.*

Goniometer Calibration

If the calibration diskette was not included with your system and installed with your Tracker software, the software will prompt you to perform the following calibration procedure before taking measurements.

To calibrate the RangeTrack, select "Setup" from the items at the top of the Main screen, then "Calibrate," and "Goniometer" from the resulting menus. After the Calibration dialog appears, open the goniometer, place it on a flat surface as pictured in "A," and click on the "Zero" button. Then close the the goniometer, place it on a flat surface as pictured in "B," and click on the "Calibrate" button.
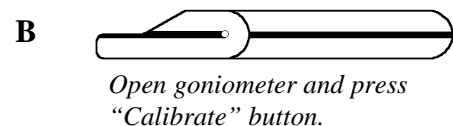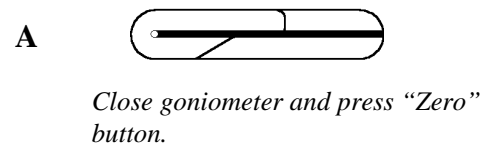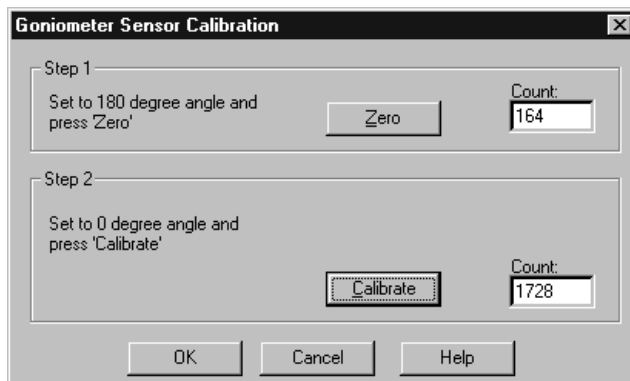
A

Close goniometer and press "Zero" button.

B

Open goniometer and press "Calibrate" button.

Protocols for Range of Motion

Range of Motion Normative Data

Normal ranges of motion listed in reports and on test screens are based on the AMA's *Guides to the Evaluation of Permanent Impairment*. According to the *Guides*, a normal rating for a given range of motion is considered as the point at which the corresponding impairment is zero. However, other associations and clinicians have established norms other than those used in the *Guides* (see references at end of chapter). Therefore, bilateral comparison is usually the best determination of "normal" for a patient, and as result could be considered a reasonable rehabilitative goal.

Neutral-zero Method

Range of motion protocols follow the neutral-zero method adopted by the AAOS, AMA *Guides*, ASHT, APTA, ASSH, and others. This method establishes a reference position at anatomic neutral position, which is defined as 0°. The lone exceptions are rotational movements performed in the transverse plane, such as internal/external rotation of the shoulder.

One of the most confusing aspects of this method is the ankylosis condition, or inability of a joint to reach neutral position. For instance, if a knee flexes to 80° but cannot attain neutral in extension (extension lag), adjustments must be made to the calculations. With RangeTrack the extension measurement should be changed to a negative number by   clicking the right mouse button or selecting the "Ankylosis" radio button in the Test dialog. Making this adjustment is very important for proper calculation of impairment ratings or interpretation of results.

Active/Passive Measurements

Active (AROM) - The subject provides the effort to move the joint.

Passive (PROM) - The examiner moves the joint through the range of motion until   resistance is felt or the patient experiences pain.

Typically, an active movement is performed first. If abnormalities are found, passive   motions are performed in the hope that the examiner can determine reasons for joint   limitation, and palpate joint end-feel. For a complete synopsis of physiologic and pathologic "end-feels," refer to Norkin and White.

Make sure to use the correct "Active," "Passive," or "Act/Pass" (both) selections in the software. Impairment calculations use only the largest active measurement of a joint. To set a testing default in the software, select the "Defaults" button in the Goniometer Test Selection screen and check the settings from the resulting menu. Test defaults can also be set using "Setup," "Test Defaults" from the Main menu when the   Goniometer Test Selection screen is active.

Set test defaults for active, passive or both motion. Testing for the left side or right side is also selected from this menu.
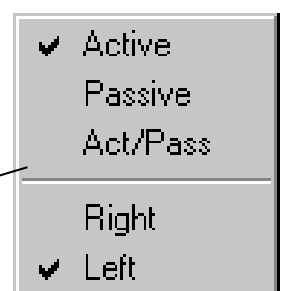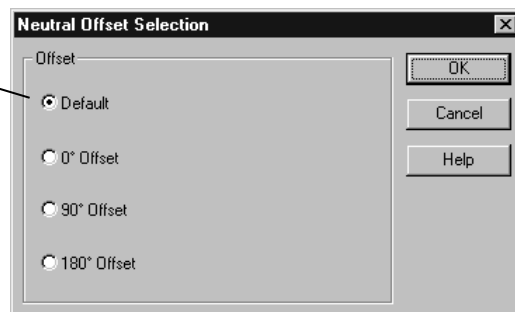
Goniometer "Offset" Button

"Offset" refers to the orientation of the goniometer in relation to the joint in anatomical neutral. Therefore, if the goniometer is opened straight out (as for wrist flexion) the offset is 180°, or if it is closed the offset is 0°. "Offset" selections are "Default," "0°," "90°," and "180°." The software automatically sets the goniometer offset for standard tests.
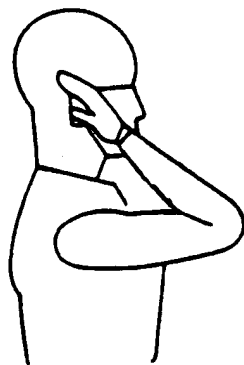
Variations to standard tests can be performed by utilizing the "Offset" button in the Test dialogs. For example, if a patient cannot abduct the shoulder while supine to the 90° neutral position for internal/external rotation measurements, the test may be conducted in a seated position with the shoulder at 0°. The "offset" should then be set to 180° to correct for the altered frame of reference of the new measurement position. If internal/external rotation is measured using the standing position described in the AMA *Guides*, the offset would likewise be set to 180°.

Click on the radio button to change the goniometer "neutral offset."
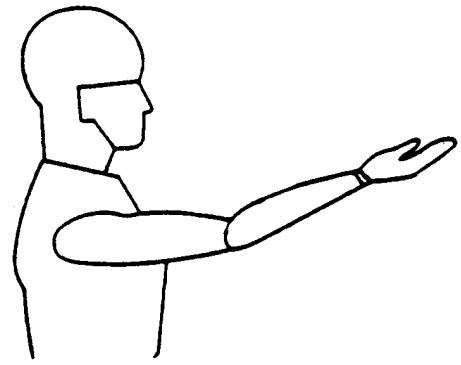

Ankylosis - Extremities

If the subject cannot reach neutral position, then a negative number must be assigned to the angle. Use the right mouse button to change angles to negative or select the "Ankylosis" button in the Test screen. For example, during elbow flexion the subject measures 120° and in extension the angle is 30° from the neutral position. The angle should be changed to -30° since the elbow cannot attain neutral position or beyond into the extension region.

120° flexion   **-30° extension**

CAUTION: If a negative number is not assigned to the joint in this example, the impairment rating module assumes the joint can reach neutral and beyond, resulting in an incorrect im-pairment calculation.

Joint Immobility

If the joint is immobile only a single measurement is necessary for the joint pairs (agonist/antagonist movements) and is recorded as a negative number. If desired, however, both pairs can be completed. For example, assume that a patient's elbow is immobile at 30° flexion. In this case ROM can be recorded as either:

|						
1)	Elbow Flexion	-30	or	2)	Elbow Flexion	30
	Elbow Extension				Elbow Extension	-30

Both of the above examples will yield the same impairment rating.

Large Extremity Range of Motion

Refer to the following pages for protocols for measuring specific joint ranges of motion.

IMPORTANT: If the patient cannot reach neutral position, change the angle to negative using the right mouse button or by selecting the "Ankylosis" button.
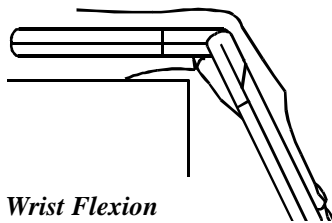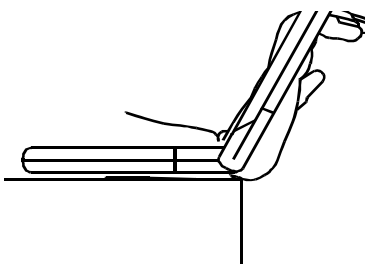

Wrist Flexion

Wrist Flexion

Patient is positioned with the forearm resting on a table and the wrist over the table edge. The shoulder is abducted to 90°, and the elbow is flexed to 90°. The goniometer pivot point is over the lateral aspect of the wrist over the triquetrum. One goniometer centerline is over the lateral midline of the ulna using the olecranon and ulnar styloid processes as references. The other goniometer centerline is over the lateral midline of the 5th metacarpal.

Wrist Flexion Alternate Placement

This placement is recommended by the AMA *Guides*. With the RangeTrack extension arms attached, place the goniometer's pivot point over the wrist joint aligning the long arm with the dorsal midline of the forearm and the short arm along the dorsal aspect of the 3rd metacarpal. Use care to place the short arm on the metacarpal and not on the surface area above the capitate. Remove the extension arm from the goniometer's long arm if the forearm muscles interfere with placement.
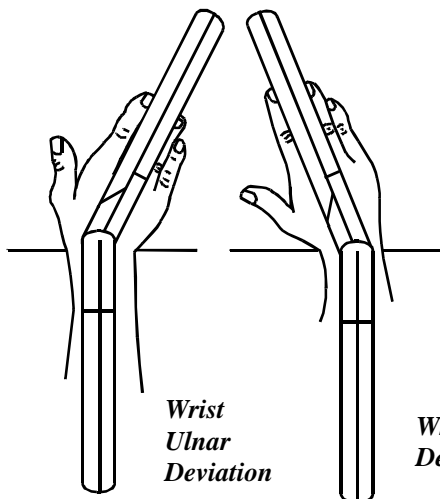

Wrist Extension

Wrist Extension

Positioning is the same as wrist flexion.

Wrist Extension Alternate Placement

Alternate placement as recommended by the AMA *Guides*. With extension arms attached, pivot point below the wrist joint, with the long arm aligned with the volar midline of the forearm and the short arm along the volar aspect of the 3rd metacarpal.

Wrist Radial/Ulnar Deviation

Patient is positioned with the forearm resting on a table and with the wrist over the table edge. The shoulder is abducted to 90°, and the elbow is flexed to 90°. The goniometer pivot point is over the middle of the dorsal aspect of the wrist over the capitate. One goniometer centerline is over the dorsal midline of the forearm using the lateral epicondyle as a reference. The other goniometer centerline is over the dorsal midline of the third metacarpal.
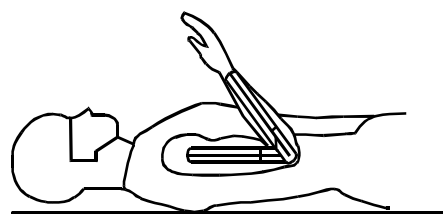
Wrist Ulnar Deviation

Wrist Radial Deviation
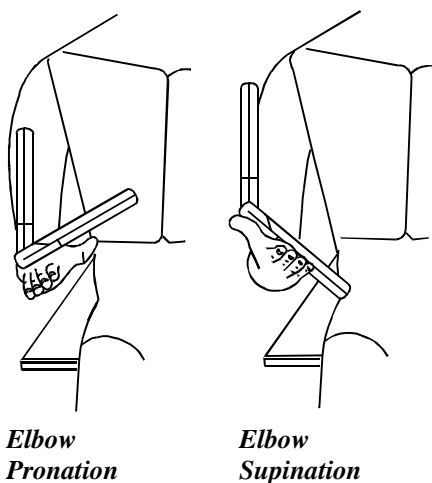
Elbow Pronation

Patient is seated with shoulder neutral and elbow at 90°. The goniometer pivot point is lateral and proximal to the ulnar styloid process. One goniometer centerline is parallel to the anterior midline of the humerus. The other centerline is across the dorsal aspect of the forearm, proximal to the styloid processes of the radius and ulna.

Elbow Supination

Patient is seated with shoulder neutral and elbow at 90°. The goniometer pivot point is medial and proximal to the ulnar styloid process. One goniometer centerline is parallel to the anterior midline of the humerus. The other goniometer centerline is across the ventral aspect of the forearm, proximal to the styloid processes.

Elbow Pronation

*Elbow Supination*

Elbow Flexion/Extension

Patient positioning and stabilization are the same for both flexion and extension. Patient is supine with a towel under the upper arm to ensure unrestricted extension. The goniometer pivot point is over the lateral epicondyle of the humerus. One goniometer centerline is over the lateral midline of the humerus using the center of the acromial process as a reference. The other centerline is over the lateral midline of the radius using the radial head and radial styloid process as a reference.
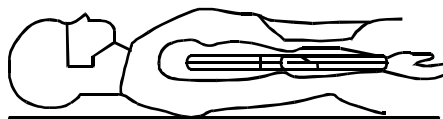
Elbow Flexion

Elbow Flexion/Extension Alternate Position

The AMA *Guides* suggest that this measurement can also be performed while the patient is standing. Alignment of the goniometer is identical for both supine and standing measurements, so no change to the "offset" is required.

Elbow Extension
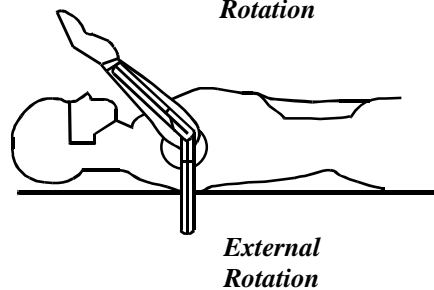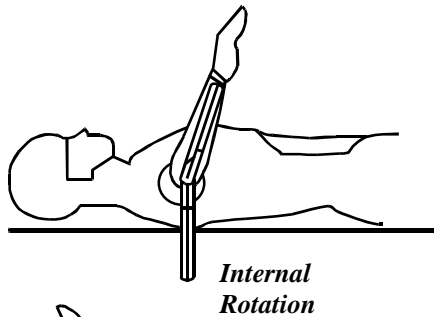
Shoulder Internal/External Rotation

Patient is supine with the shoulder abducted to 90° with a pad under the humerus. The goniometer pivot point is over the olecranon   process. One goniometer centerline is over the ulnar styloid process with the other goniometer centerline hanging vertically.

Internal Rotation

Shoulder Internal/External Rotation Alternate Position

The AMA *Guides* employs an alternate position for measuring internal/external rotation. The *Guides* have the patient standing with the arm abducted to 90°, which necessitates the use of a horizontal   reference. (See the Guides for exact placement and positioning.) If you adopt this method select the "Offset" button in the Testing dialog and click on 0°. If the patient is unable to abduct the arm to 90°, measure internal/external rotation with the shoulder in neutral and the patient either sitting or standing. With the shoulder in neutral the "offset" must be switched to 0°.

External Rotation

Tip: I*nstead of turning the goniometer over between measurements, move one arm to measure internal rotation and the other for external.*
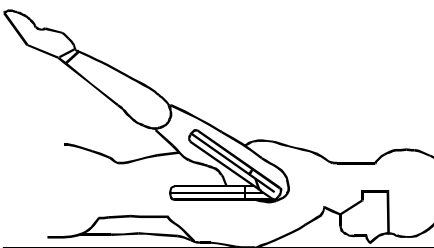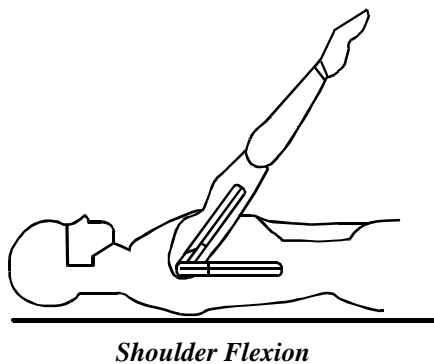
Shoulder Flexion

Patient is supine with the goniometer pivot point over the acromion process. The goniometer centerlines are over the lateral epicondyle of the humerus and over the lateral midline of the thorax.

Shoulder Flexion

Shoulder Extension

Patient is prone with the goniometer pivot point over the acromion process. The goniometer centerlines are over the lateral epicondyle of the humerus and over the lateral midline of the thorax.

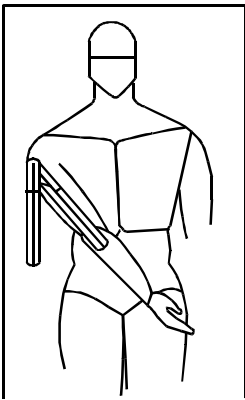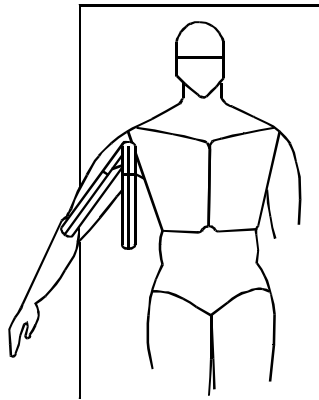### Shoulder Flexion/Extension Alternate Position

AMA *Guides* indicate that flexion/extension can be tested while patient is standing. Goniometer alignment is identical and no offset changes are required.

Shoulder Extension

Shoulder Adduction and Abduction

Supine Measurement

Positioning is the same for both shoulder adduction and abduction. The goniometer pivot point is over the anterior aspect of the acromiom process. The goniometer centerlines are over the anterior midline of the humerus and parallel to the sternum.
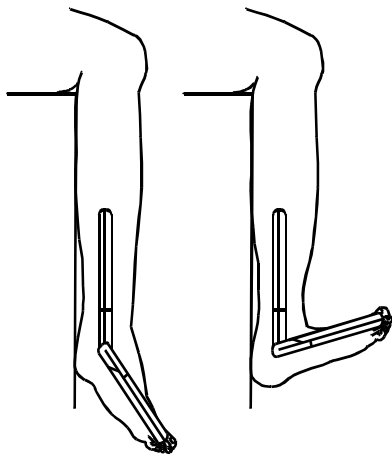
Seated Position

As an alternate, measurements can be made in the seated position. In this case the goniometer pivot point is over the posterior aspect of the acromion process and the centerlines are over the lateral midline of the humerus and parallel to the spine.

Standing Position
The AMA *Guides* indicates ROM can be tested while the patient is standing. Goniometer alignment is identical to supine and no "offset" changes are required.

Shoulder Adduction   *Shoulder Abduction*

Ankle Plantar Flexion / Dorsiflexion
Patient is seated with the lower leg over the edge of a table. Patient may also be positioned supine with the knee flexed to at least 30°. The goniometer pivot point is over the lateral aspect of the lateral malleolus. One goniometer centerline is over the lateral midline of the fibula using the head of the fibula as a reference. The other goniometer centerline is parallel to the lateral aspect of the 5th metatarsal.
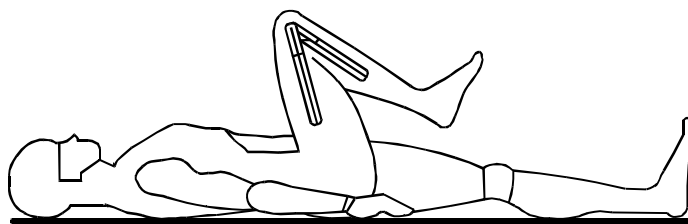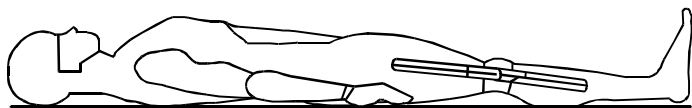
Plantar Flexion   *Dorsiflexion*

Knee Flexion
Patient is supine with the pivot point over the lateral epicondyle of the femur. One centerline is over the lateral midline of the femur referenced by the greater trochanter. The other centerline is over the lateral midline of the fibia referenced by the lateral malleolus and fibular head.

Knee Flexion

Knee Flexion Alternate Position
An alternate position for knee flexion is with the patient prone, the hip in neutral, and the foot hanging off the edge of the table. No change in the offset angle is required for this position. Despite the greater stability the prone position affords, it may show restricted ROM if the leg muscles or buttocks are bulky. For this reason, the AMA endorses the supine portion.
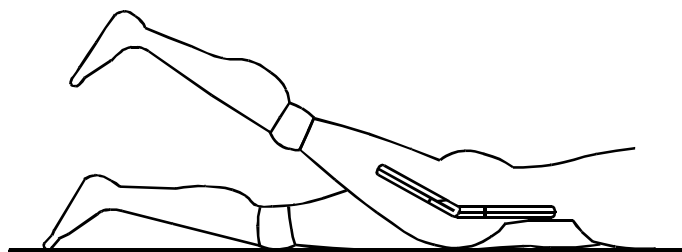
Knee Extension

Knee Extension

Patient is supine with a towel under the ankle to allow unrestricted knee extension. Placement is the same as knee flexion.

Hip Flexion

Hip Flexion

Patient is supine. The goniometer pivot point is over the lateral aspect of the hip joint using the greater trochanter as a reference. One goniometer center-line is over the lateral midline of the pelvis. The other goniometer centerline is over the lateral mid-line of the femur referenced from the lateral epi-condyle.


Hip Extension

Hip Extension

For the 3rd ed. of the *Guides* and most exams, patient is prone with the same alignment as hip flexion.

For the 4th ed. of the *Guides*, patient is supine and opposite knee is flexed until all lordosis of the lumbar spine is removed. With the patient attempting to keep upper leg on the table, align the goniometer the same as in hip flexion. Change angle to negative by using the right mouse button.
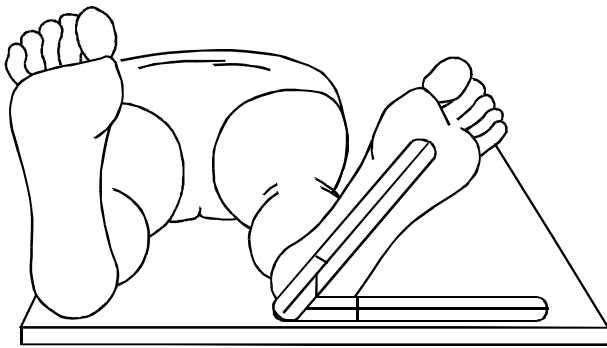

Hip Extension
4th Edition
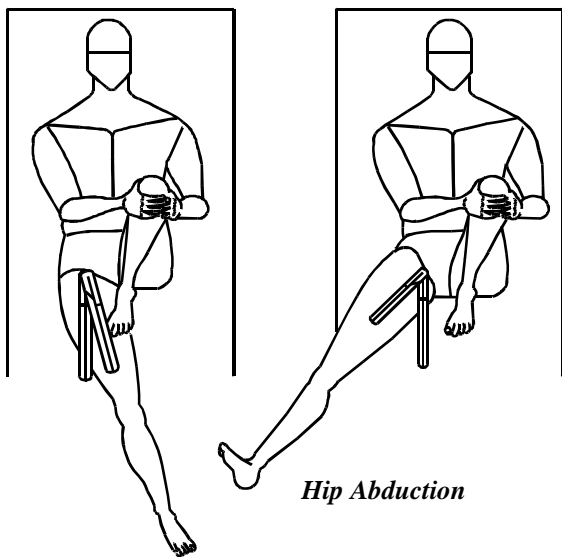
Hip Abduction

Hip Adduction

Hip Abduction/Adduction

Patient is supine. The goniometer pivot point is over the anterior superior iliac spine. One goniometer centerline is parallel to the midline and the other goniometer centerline is over the anterior midline of the femur using the midline of the patella for a reference.

Hip External and Internal Rotation
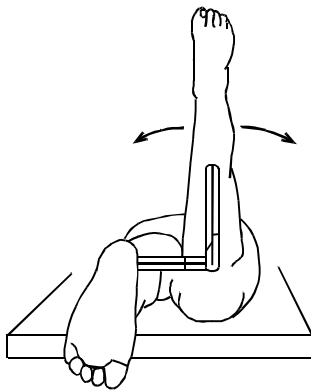
Hip Rotation
*4th Edition*

Hip External/Internal Rotation

3rd ed. of the AMA *Guides***:** Patient is supine with one goniometer centerline over the midline of the foot and the other goniometer centerline parallel to the table surface.

4th ed. of the AMA *Guides***:** Patient is prone with the knee flexed 90°. One goniometer centerline is along the anterior midline of the lower leg, referencing the crest of the tibia and midway between the two malleoli. The other goniometer centerline is parallel to the table surface.

Orthopedic exams: Patient is seated with one goniometer centerline along the anterior midline of the lower leg, referencing the crest of the tibia and midway between the two malleoli. The other goniometer centerline is parallel to the table across both patellas.
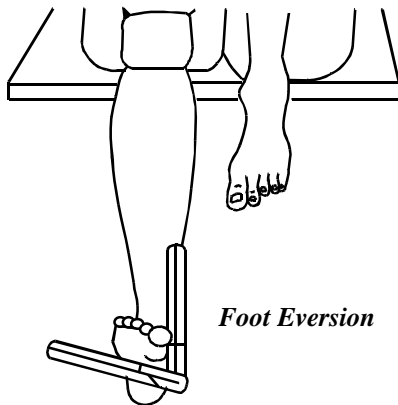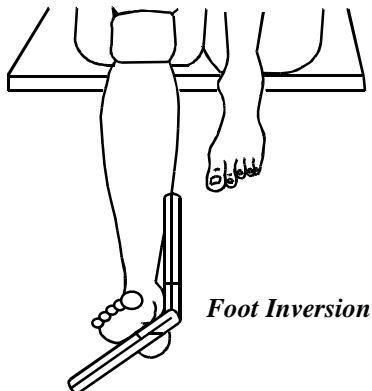
Foot Eversion

Foot Inversion/Eversion

Patient is seated with the lower leg over the edge of a table. One goniometer centerline is parallel to the anterior midline of the lower leg. The other goniometer centerline is placed over the plantar foot on a level with the heads of the metatarsals.

Foot Inversion

Finger ROM - General Information

Reliability and Validity
Gajdosik and Bohannon have shown a goniometer to be a valid tool for measuring range of motion. However, several variables affect the reliability of finger ROM measurements. Those variables which are applicable to RangeTrack include the measurement recording method, the type of ROM being measured (i.e AROM, PROM, TROM), the amount of force applied during measurement, the placement of the goniometer, and the proximal joint posture. Consistency of placement and goniometer usage will enhance both intra- and inter-tester reliability. Tracker software allows you to document any deviations from the standard techniques outlined in this manual and software Help screens.

When standardized testing techniques were utilized, Hamilton and Lachenbruch found a significant level of reliability among therapists measuring finger ROM, specifically MP, PIP, and DIP joints. They concluded that intra-tester reliability was higher than inter-tester reliability, and that inter-tester error could be reduced by defining more specific protocols.

As a reliability check for finger ROM, make sure that the goniometer reads 0° when the arms are placed on a flat surface, and 180° degrees when the arms are together. If readings deviate from this, the instrument should be recalibrated through the Setup" menu.

Goniometer Placement
The American Society of Hand Therapists (ASHT) recommends that finger ROM measurements be performed dorsally. In the presence of edema, significant scar tissue, bony malformations, or long or deformed fingernails, lateral measurements should be taken and a notation made to that effect. Hamilton and Lachenbruch showed equal reliability for lateral and dorsal goniometer placement techniques. Whichever method you choose, make sure to use it consistently so that subsequent trials on a patient may be accurately compared.

If lateral placement is necessitated, place the goniometer so that the arms are parallel to the long axis of the bones which form the joint, and the pivot point is in line with the joint axis of motion.

Measurement Conventions
JTECH uses the conventions adopted by the American Medical Association (AMA) and the ASHT, which use plus and minus signs to denote hyperextension and extension lag respectively.

If the joint's extension exceeds the anatomical neutral position of the joint, then it is referred to as hyperextension and represented with a plus (+) symbol. Incomplete extension, on the other hand, from the flexed position towards anatomical neutral is defined as extension lag, and represented by a minus (-) sign. Tracker software per-

forms this function automatically for thumb and finger ROM measurements.

For proper impairment ratings when ankylosis is present in a finger joint, both   measurements of the pair (agonist/antagonist) should be completed. If the joint is   immobile, select the "immobile" button in the Test dialog. Clicking on "Immobile" will record a negative and corresponding positive measurement for both joint motions with only one entry. The same result can be achieve when certain testing sequences are selected by recording both motions at the same position. In either case the   impairments are calculated the same.

Active/Passive Measurements
Active range of motion (AROM) is defined as that motion achieved by a joint under a patient's own muscle power. Passive range of motion (PROM) refers to the joint motion available upon application of an external force.

According to Gajdosik and Bohannon, a joint that has full active range will have full passive range as well. Therefore, passive measures should only be taken when either the patient exhibits restricted active ROM or contraindications to active ROM exist. During PROM measurements, the patient should relax muscles surrounding the joint being measured. The force exerted on a joint during PROM measurements should be minimized and as consistent as possible from test to test.

Total Active Motion (TAM) / Total Passive Motion (TPM)
AAOS defines TAM for a finger as the sum of active flexion and active extension occurring at the MP, PIP and DIP joints. Extension lag values are treated as negative numbers and hyperextension values are treated as positive numbers.

AAOS defines TPM for a finger as the sum of passive flexion and passive extension occurring at the MP, PIP and DIP joints. Extension lag values are treated as negative numbers and hyperextension values are treated as positive numbers.

Clinically, the importance of the TAM and TPM calculations is limited. The   calculations are used statistically to show progress (or lack thereof) for an entire finger, or to compare to the corresponding normal digit on the opposite hand. According to the American Society for Surgery of the Hand (ASSH), values should not be used to determine functional loss or impairment since the system is not weighted and certain finger joints are more important than others to total hand function. Recognized sources disagree about the validity of TAM/TPM comparison to normal. Cambridge and ASSH indicate comparisons are erroneous and should not be made, whereas ASHT and AAOS endorse comparison. TAM norms from AAOS are as follows:

	Index		**Middle**	**Ring**		**Little**
Male	284°		288°	294°	297°	
Female	305°		311°	318°	323°	

TAM and TPM values are included in the printed reports. They are not used in impairment calculations.

Impairment Rating as a Result of Finger ROM Restrictions
For determination of impairment resulting from restrictions in finger range of motion, the recorded value is rounded to the nearest 10º, and compared to the corresponding figure in chapter 3 of the AMA *Guides to the Evaluation of Permanent Impairment*.

For fingers, impairments resulting from loss of flexion and loss of extension in the same joint are added together. If more than 1 joint is involved, the joint impairments are combined, moving distal to proximal, using the combined values chart. Impairments also affecting the involved finger such as amputation or sensory loss, are combined with the range of motion restrictions. Finger impairment is then converted to hand impairment, upper extremity impairment, and then whole person impairment using AMA *Guides* Tables 1-3 respectively.

For the thumb, impairments resulting from loss of flexion and loss of extension occurring in the same joint are added together. If both the IP and MP joints are involved, the respective joint impairments are added together. If two or more abnormal joint motions are present, impairments due to each motion are added. Amputation or sensory loss impairments affecting the thumb are combined with the thumb's range of motion impairment value. Thumb impairment is then converted to hand impairment, upper extremity impairment, and then whole person impairment using Tables 1-3 respectively in the AMA *Guides*.

If multiple digits are involved, each digit is converted to a hand impairment, these numbers are then added together and expressed as upper extremity impairment, and finally converted to whole person values.

Finger Range of Motion Measurements

When performing finger range of motion tests with RangeTrack, the goniometer's long and short arms must be positioned correctly. The long arm is the one with the rounded end, the short arm is the one with the cutout end. Refer to the illustration below to identify the long and short arms
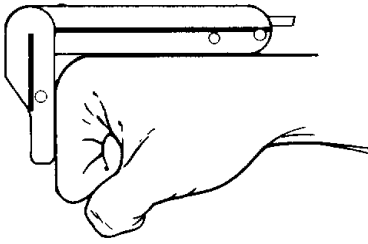
Note: In the presence of edema, significant scar tissue, bony malformations, long or deformed fingernails, measurements should be performed laterally, and a notation made. Lateral placement guidelines are included with the following protocols.

Important: Make sure to place the RangeTrack goniometer in the same position and orientation as the illustrations.
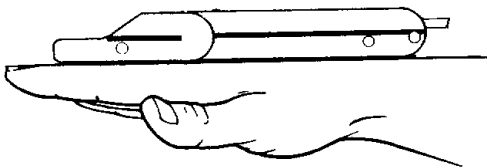
MP Flexion

Position the wrist and forearm in neutral position. Place the long arm of the goniometer along the dorsal surface of the metacarpal, the pivot point superior to the MP joint, and the short arm along the dorsal   surface of the proximal phalanx.

Note: If measuring AROM, IP joints should be flexed. If measuring PROM, IP joints should be relaxed.

MP Flexion

Lateral Placement for MP Flexion and Extension

If lateral measurements of MP flexion for the index or middle fingers are necessary, align the goniometer pivot point with the lateral aspect of the index MP joint, the long arm with the longitudinal axis of the 2nd metacarpal, and the short arm with the longitudinal axis of the proximal phalanx of the finger being measured. The index finger should be slightly extended when measuring middle finger MP flexion, and slightly flexed when measuring middle finger MP extension.

If lateral placement is required for measuring MP flexion of the ring or little fingers, align the goniometer pivot point with the lateral aspect of the little finger MP joint, the long arm with the longitudinal axis of the 5th metacarpal, and the short arm with the longitudinal axis of the proximal phalanx of the finger being measured. The little finger should be slightly extended when measuring ring finger MP flexion, and slightly flexed when measuring ring finger MP extension.
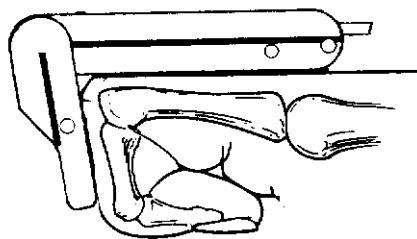
MP Extension

Position wrist and forearm in neutral position. Place the long arm of the goniometer along the dorsal surface of the metacarpal, the pivot point superior to the MP joint, and the short arm along the dorsal surface of the proximal phalanx.

Note: If measuring AROM, IP joints should be extended. If measuring PROM, IP joints should be relaxed.
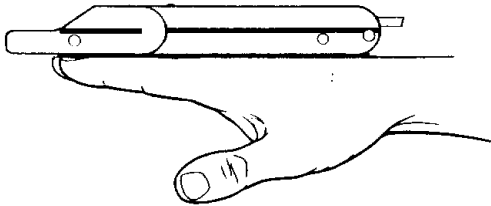
MP Extension

PIP Flexion

With the wrist and forearm in neutral position, place the   goniometer's long arm along the dorsal surface of the proximal   phalanx with the pivot point superior to the PIP joint, and the short arm along the dorsal surface of the middle phalanx.

Note: If measuring AROM, MP and DIP joints should be flexed. If measuring PROM, MP and DIP joints should be relaxed.

PIP Flexion

Lateral Placement for PIP Flexion and Extension

If lateral placement is required for measuring PIP flexion of the fingers, align the goniometer pivot point with the lateral aspect of the joint, the long arm with the longitudinal axis of the proximal phalanx, and the short arm with the longitudinal axis of the adjacent distal phalanx of the finger being measured.
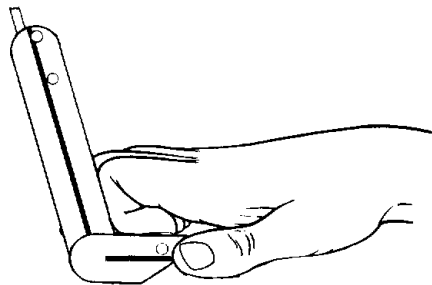
PIP Extension

PIP Extension

With the wrist and forearm in neutral position, place the goniometer's long arm along the dorsal surface of the proximal phalanx with the pivot point superior to the PIP joint, and the short arm along the dorsal surface of the middle phalanx.

Note: If measuring AROM, MP and DIP joints should be extended. If measuring PROM, MP and DIP joints should be relaxed.
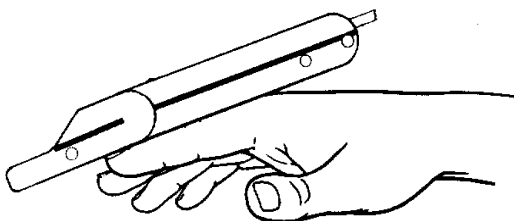
DIP Flexion

DIP Flexion

Place the wrist and forearm in neutral position. Position the goniometer's long arm along the dorsal surface of the middle phalanx with the pivot point superior to the DIP joint, and the short arm along the dorsal surface of the distal phalanx.

Note: If measuring AROM, MP and PIP joints should be flexed. If measuring PROM, MP and PIP joints should be relaxed.

Lateral Placement for Dip Flexion and Extension

If lateral placement is required for measuring DIP flexion of the fingers, align the goniometer pivot point with the lateral aspect of the joint, the long arm with the longitudinal axis of the proximal phalanx, and the short arm with the longitudinal axis of the adjacent distal phalanx of the finger being measured.

*DIP Extension*

DIP Extension

With the wrist and forearm in neutral position, place the goniometer's long arm along the dorsal surface of the middle phalanx with the pivot point superior to the DIP joint, and the short arm along the dorsal surface of the distal phalanx.

Note: If measuring AROM, MP and PIP joints should be extended. If measuring PROM, MP and PIP joints should be relaxed.
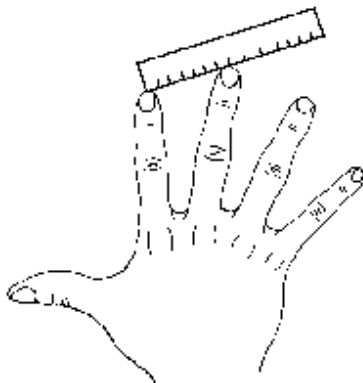
MP Abduction (angular measurement)

Place wrist in neutral position with the forearm pronated. Patient abducts MP joints. Align the centerline of the goniometer's long arm along the   dorsal midline of the metacarpal with the pivot point over the MP joint. The centerline of the short arm is aligned along the dorsal midline of the proximal phalanx. *For all MP abduction measurements the RangeTrack logo must be up.*
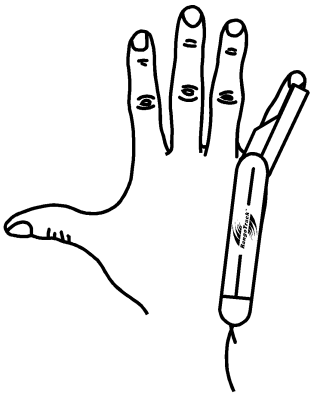
MP Abduction Right Index
(angular measurement)

MP Abduction (linear measurement)

Place wrist in neutral with the forearm pronated. Patient abducts MP joints. Use a centimeter ruler to measure the distance between two   adjacent fingertips. You will have three measurements per hand.

MP Abduction
(linear measurement)

Fingertip to Distal Palmar Crease

Place the wrist in neutral position with the forearm supinated. With a ruler, measure the distance from the fingertip of the 2nd digit to the distal palmar crease with the hand fisted.
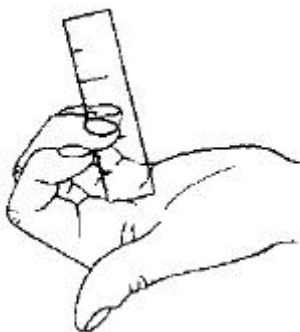
Tip to DPC

Thumb MP Flexion

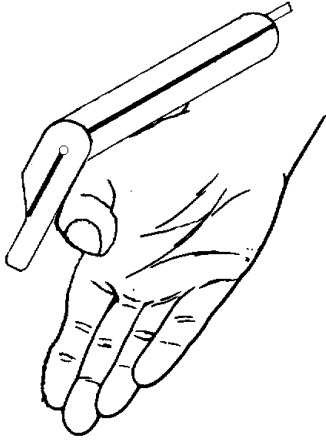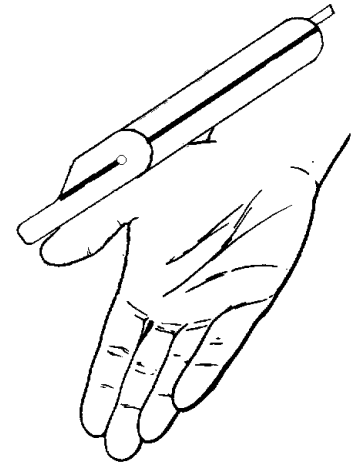With the wrist and forearm in neutral position, place the goniometer's long arm along the dorsal surface of the 1st metacarpal with the pivot point superior to MP joint, and the short arm along the dorsal surface of the proximal phalanx.

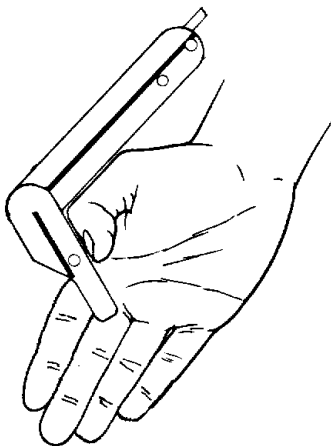*Thumb MP Flexion*

Thumb MP Extension

With the wrist and forearm in neutral position, place the goniometer's long arm along the dorsal surface of the 1st metacarpal with the pivot point supe- rior to MP joint, and the short arm along the dorsal surface of the proxi- mal phalanx.

Thumb MP Extension

Thumb IP Flexion

With the wrist and forearm in neutral position, place the goniometer's long arm along the dorsal surface of the proximal phalanx with the pivot point superior to IP joint, and the short arm along the dorsal surface of the distal phalanx.
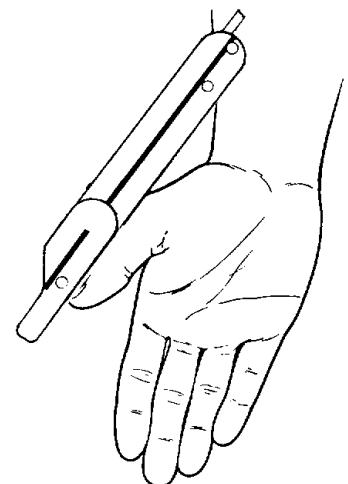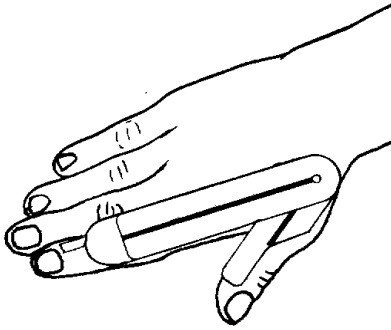
Thumb IP Flexion

Thumb IP Extension

With the wrist and forearm in neutral position, place the goniometer's long arm along the dorsal surface of the proximal phalanx with the pivot point superior to IP joint, and the short arm along the dorsal surface of the distal phalanx.

Thumb IP Extension

Right Thumb Radial Abduction

Thumb Radial Abduction

With the wrist in neutral position and the forearm pronated, align the centerline of the goniometer's long arm parallel to the 2nd metacarpal on the dorsal aspect. Align the short arm parallel to the centerline of the 1st metacarpal on the dorsal aspect of the thumb. The pivot point should align over the intersection of the lines parallel to the 1st and 2nd metacarpals. *Note the change in goniometer orientation for left and right measurements.*

IMPORTANT: If the thumb is immobile, indicate such by clicking the radio button in the Test dialog.
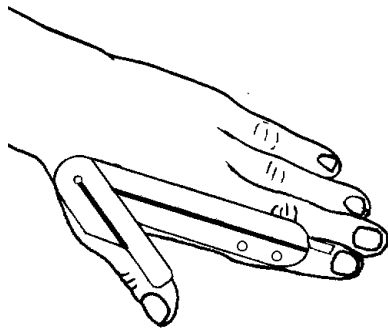
Left Thumb Radial Abduction

Thumb Adduction

Place wrist in neutral position with the forearm supinated. With a centimeter ruler record the smallest possible distance from the volar surface of the thumb IP joint to the distal palmar crease over the MP joint of the little finger.

IMPORTANT: If the thumb is immobile, indicate such by clicking the radio button in the Test dialog.

Thumb Adduction

Thumb Opposition

Thumb Opposition
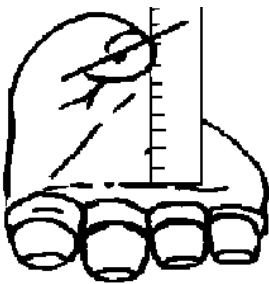
Place wrist in neutral position with the forearm supinated. With a centimeter ruler, record the largest possible distance from the volar surface of the thumb IP joint to the distal palmar crease directly over the 3rd MP joint. The thumbnail should remain parallel to the plane of the palm.

IMPORTANT: If the thumb is immobile, indicate such by clicking the radio button in the Test dialog.

References

1. Cambridge, CA. Range-of-motion measurements of the hand, In Hunter JM, Sneider LH, Mackin EJ, Callahan AD, (eds) *Rehabilitation of the Hand, 3rd edition*. St Louis, LV Mosby Co. 1990: 82-92

2. American Society of Hand Therapists: *Clinical Assessment Recommendations. 2nd edition*, 1992: 64-69

3. *AMA Guides to the Evaluation of Permanent Impairment, 4th edition*, AMA 1993: 25-35

4. Norkin CC, White DJ. *Measurement of Joint Motion: A guide to Goniometry, 2nd edition*. FA Davis Co., 1995: 92-116.

5. Greene, WB., Heckman, JD. (eds), *The Clinical Measurement of Joint Motion,* American Academy of Orthopedic Surgeons, Rosemont, Illinois 1994: 43- 61

6. American Society for Surgery of the Hand. *The Hand: Examination and Diagnosis. 3rd edition*, Churchill Livingstone, 1990; 122-127

7. Gajdosik RL, Bohannon RW. Clinical Measurement of Range of Motion. Review of Goniometry Emphasizing Reliability and Validity. Phys Ther 1987; 67(12):1867-72.

8. Hamilton GF, Lachenbruch PA. Reliability of Goniometers in Assessing Finger Joint Angle. Phys Ther 1969; 49:465-469.

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Chapter 2
Performing a Goniometer ROM Test

As with all Tracker modules, a patient and an exam must be selected to access the Range-Track Data Acquisition dialog. The Select Patient dialog can be opened in a number of ways:

    1) Click on "Patient," then "Select" from the drop down menu, or

    2) Click on the patient icon, or

    3) Click "Goniometry ROM," then select the region button.

After using one of the above methods, either choose a patient from the Select Patient dialog list or add a new patient. (See Module 1, Chapter 4, *Starting a Test* for more information about opening and adding patient files.) At the next dialog, select an existing exam for review or click on the "New Exam" button to start a new test.

Use "Patient" drop-down or icon to open a patient file and begin testing, or...

select "Goniometry" and a region button and the Patient Selection dialog will appear.
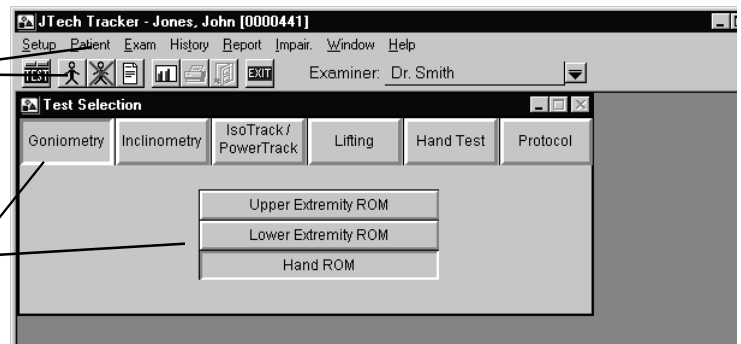
Upper and Lower Extremity ROM Tests and Dialogs

After a patient file is opened and either the "Upper Extremity ROM" or "Lower Extremity ROM" region button is selected, a screen like the one below is displayed for selecting tests and viewing data. (The example below is for upper extremity ROM.)

This screen is used to initiate tests either for all the pairs in the list, or for specific tests from the list. It also displays test results and impairments based on the results.
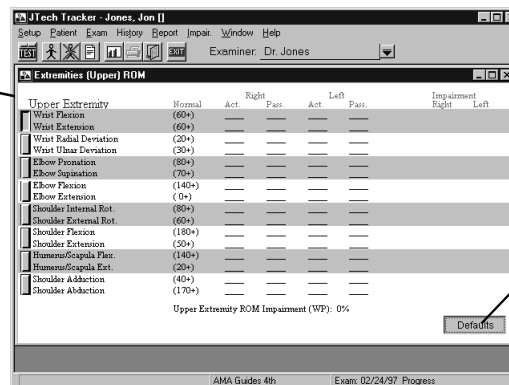
This button is used to select the side for testing and to choose active, passive, or both motions.

"Defaults" Button
The defaults button controls the side that is tested and whether the test is active, passive or both. The software automatically progresses through the testing list for the side that is

turned on. To change sides for testing, either at the beginning of a test or after testing of the first side is completed, select "Defaults" and click on the appropriate side. The side being tested is displayed in the Testing dialog.

To test active motions, passive motions or both, click on the "Defaults" button and select the desired test method. The motion method selected is displayed in the   Testing dialog.

Select the type of motion and the side for testing using the "Defaults" button, then clicking on the settings in this menu.

> ✔ Active
> Passive
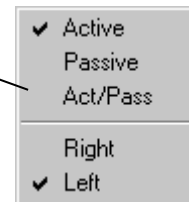> Act/Pass
>
> Right
> ✔ Left

Test defaults can also be set when the ROM Test Selection dialog is open using "Setup," "Test Defaults" from the Main menu.

Extremity Test Selection and Sequences

1. ROM testing is completed in pairs, which are arranged by gray and white bands. Click anywhere within a band to begin testing the corresponding pair. The pairs consist of agonist/antagonist movements, which enables you to test both opposite movements of the joint. Clicking on the first band will move automatically through all the tests on the list. To begin at a different point or to test a specific pair (or a single movement), click on the corresponding band. After clicking on a band, the following standard   Extremities Range of Motion Testing screen appears.

This button is used to change the goniometer

The "Help" button shows you how to perform tests.

Numerical display of the goniometer angle.

Click here to save the displayed angles and return to the Data screen.

If patient is unable to reach neutral, change the angle to negative by selecting "Ankylosis" or placing the cursor on the angle and clicking the right mouse button. If joint is immobile, click "Exit" after first ROM value is recorded and click "Yes" when warning box appears.

This box displays method default selected through the "Defaults" button.

Green area in dial shows angle of goniometer, dark lines show normal

Click here to bypass the automatic prompt and select a measurement to be recorded.

Click here to change the side to be tested for this test pair. To change the side for a sequence of tests, change the default using the "Defaults" button in the previous Data screen.

"Neutral Offset" Button

Variations to the test protocols described in Chapter 1 of this module and the Help screens can be performed utilizing the Test dialog's "Neutral Offset" button. ("Offset" refers to the angle of goniometer's arms at neutral or "zero." Tracker software designates the open, straight goniometer position as 0° and the closed position as 180°.) For example, the standard shoulder internal/external rotation measurement shows the patient supine with the shoulder abducted to 90° and the goniometer vertical in the open position. (The software automatically sets the "default" offset for standard tests.) In contrast, the Guides show the patient upright with the shoulder abducted to 90° and the goniometer parallel to the floor with arms closed. Therefore, the offset needs to be set to 180°.

Click on the radio button corresponding to the initial position (reference) of the goniometer.
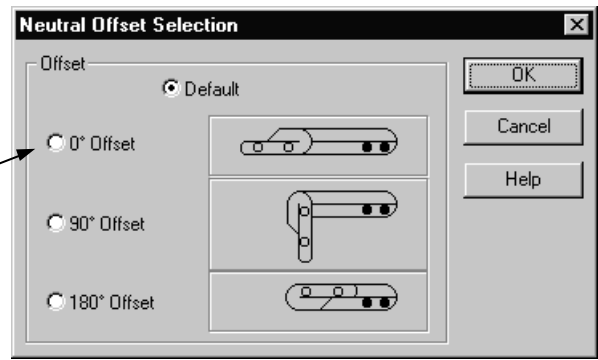
2. Once you complete all the desired tests for a region and select click on "Exit" or you complete the sequence for a region, the ROM Data screen appears with a summary of the results. For reference, samples of both the upper and lower extremities regional ROM Data screens have been included. To perform other tests as part of this exam, click on the Main menu button labeled "Test" (shown on left) to bring up the Test Selection screen.

Range of motion impairment for the joint is shown here.

Normal range values are shown in parenthesis.

Details of test results are shown under headings.

Whole person impairment as a result of upper extremity ROM is listed here.

Extremities (Upper) ROM

Upper Extremity	Normal	Right Act.	Right Pass.	Left Act.	Left Pass.	Impairment Right	Impairment Left
Wrist Flexion	(60+)	50	65	61	72	0%	0%
Wrist Extension	(60+)	55	55	60	70	0%	0%
Wrist Radial Deviation	(20+)	17	17	19	29	1%	0%
Wrist Ulnar Deviation	(30+)	22	23	29	36	1%	0%
Elbow Pronation	(80+)						
Elbow Supination	(70+)						
Elbow Flexion	(140+)						
Elbow Extension	(0+)						
Shoulder Internal Rot.	(80+)						
Shoulder External Rot.	(60+)						
Shoulder Flexion	(180+)						
Shoulder Extension	(50+)						
Humerus/Scapula Flex.	(140+)						
Humerus/Scapula Ext.	(20+)						
Shoulder Adduction	(40+)						
Shoulder Abduction	(170+)						

Upper Extremity ROM Impairment (WP): 1%

Defaults

Clicking on a recorded angle brings up the Test dialog allowing you to overwrite existing data. Clicking on the right mouse button deletes all data associated with this motion.

Range of motion impairment for the joint is shown here.

Notice how only one joint in the "Active" mode has been tested in this example

Use the "Defaults" button to change the test setting between active, passive or both..

3. To move from one of the ROM Data screens above to either test or view data from another region, do one of the following:

   a. Click on the "Test Selection" button.

   b. From the Main menu item list, select "Window," then "Close" or "Close All."

   c. Select "Window," then "Test Window."

When the Test Selection window comes to the foreground, click on the button corresponding to the region to be tested or viewed next.

4. To attach notes to the exam, refer to Module 1, Chapter 5: *Adding Notes*.

   To add other impairments to the patient's record, refer to Module 3, Chapter 1: *Impairments*.

   To view a patient's ROM history, refer to Module 1, Chapter 7: *Displaying Patient History*.

Note: After a testing session is completed, JTech recommends selecting the "Patient Close" button to clear the screen. This prevents inadvertent testing of future patients in the currently selected patient file.

To exit the software, click on the "Exit" button.

Finger ROM Tests and Dialogs

To initiate the Hand testing sequence, click on the button labeled "Goniometry" and then "Hand ROM" from the resulting region menu.
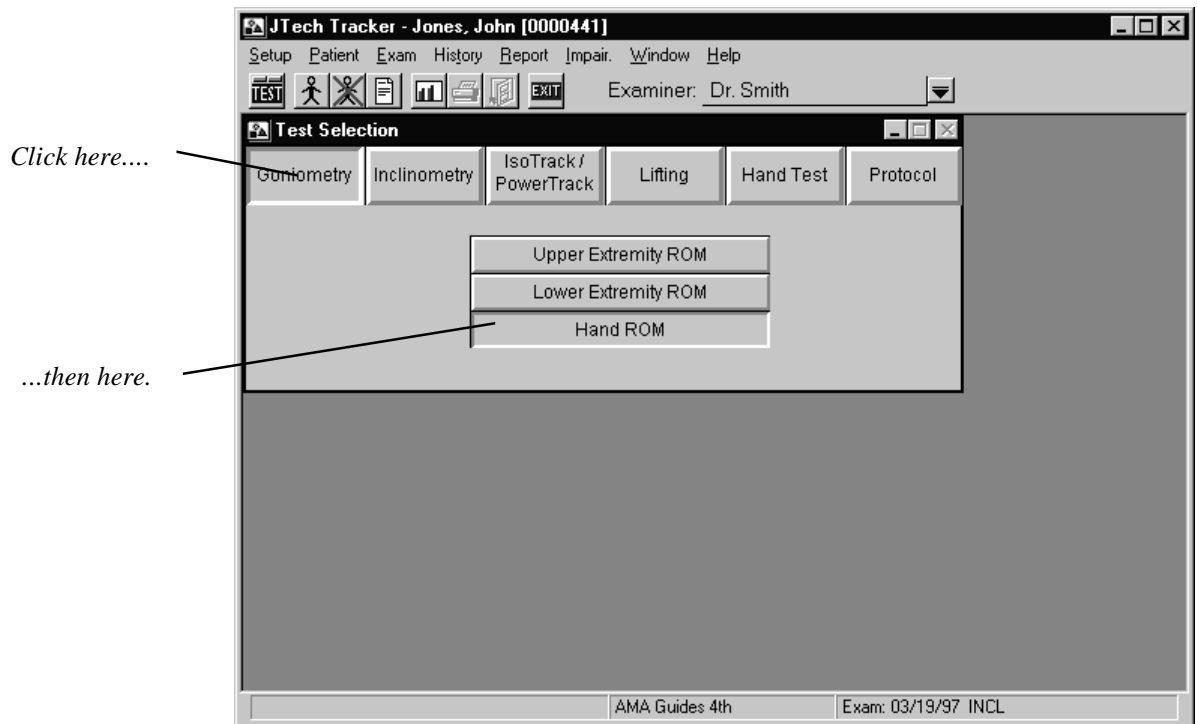
From the dialog, Hand ROM tests are selected by any of four methods or "Types": "Fingers Complete," "Fingers by Joint," "Fingers by Motion," and "Thumb." Each "Type" is further differentiated by "Group" and then by "Measurement."

To perform a complete ROM evaluation for digits 2-5, select "Fingers Complete," and then "Test All." This will walk you through all tests associated with a particular motion group. Measurement of Abduction/Adduction and Tip-to-DPC can only be accessed through the "Finger Complete" selection.

To perform testing on a specific ROM pair (e.g. flexion/extension) for a particular finger, select "Finger by Joint."

To test a single finger, flexions followed by extensions, select "Finger by Motion."

To test any motions associated with the first digit, select "Thumb."

This button is used to designate measurements as active, passive, or both, and to select the side for testing.

Click on one of these to select test "type."

After the test "type" is selected, click on the group to be tested.
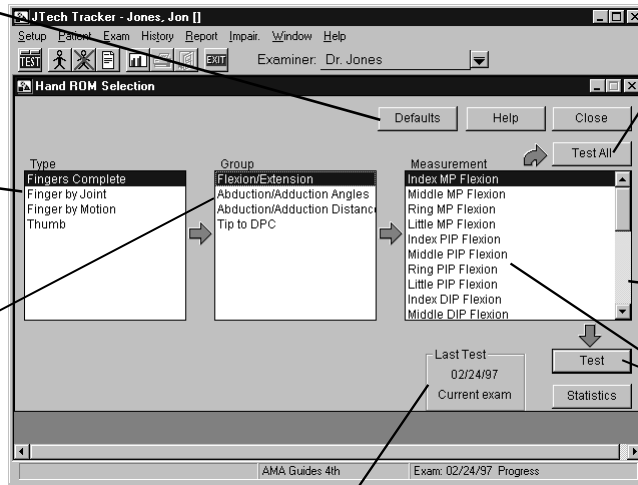
To perform all the measurements in the list, click on "Test All." (For "Fingers Complete", all flexion measurements are completed, then extension measurements are per-

Use the scroll bar to see additional tests.

To select an individual movement for measurement, highlight it from the list and click on "Test."

This box shows date of last test.

Selecting "Thumb" results in the following dialog. To access flexion/extension tests for the MP and IP joints, select "Thumb by Joint," or "Thumb by Motion." Click "Test All" to test all motions listed in the right-hand box. Use the "Test" button to select the highlighted test.
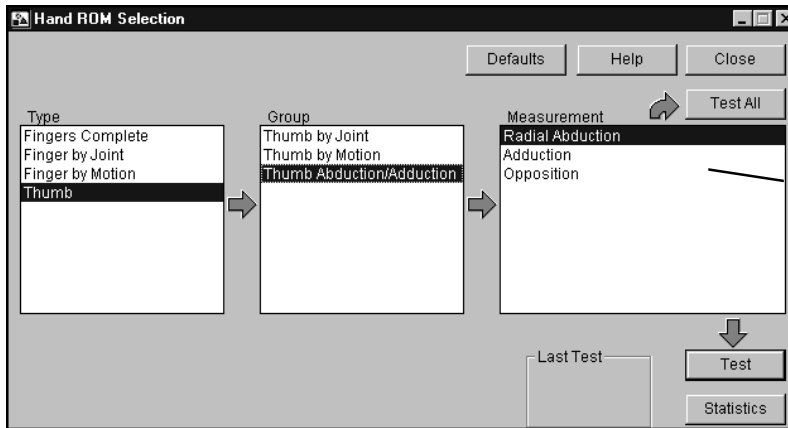
To test all the measurements in the list, click on "Test All."

Selecting a test(s) which requires goniometer input initiates a Data Acquisition screen such as the one below. Tests can be performed as "Active," "Passive," or both. Tests can also be performed for both the "Left" and "Right" sides. The default settings that control the tests can be set in the "Setup" menu of the Main screen, or by using the "Defaults" button found in the previous dialog. Prior to entering data, ensure the goniometer is properly calibrated by placing it in the "0°-open" and the "180°-closed" positions. Check to see that the proper angles are being displayed, respectively. If not, recalibrate the goniometer by exiting this dialog and clicking on "Setup," "Calibrate," and "RangeTrack."

When the goniometer is properly aligned with the joint being measured, press the "Enter" switch (not the keyboard key) to record the data. The software will then automatically prompt for the next motion to be measured (if there is one). If multimedia sound is not activated, read the dialog in the white box for instructions.

When measuring extension, the software automatically treats a finger's inability to reach neutral or "extension lag" as a negative value. Motion beyond neutral or "hyperextension" is denoted as a positive number. For more discussion on measurement conventions, refer to Module 10, Chapter 1.
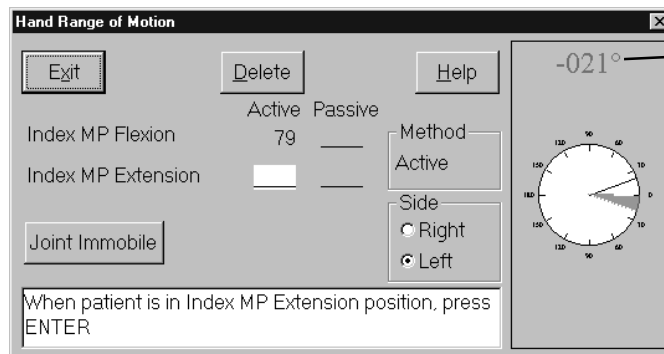
Inability to reach neutral in extension is automatically assigned a negative number.

After the first motion has been entered and the data entry indicator has advanced, the "Immobile" button becomes accessible. If the finger joint is immobile, click the button and a value corresponding to the previously measured angle, opposite in sign, is automatically input into the software. An indication of the joint's immobility will be added to the "Finger ROM" report. If the impairment module has been purchased, the software will automatically calculate and record the proper impairment as well.

Note: If you are using the "Test All" sequence and click on the "Joint Immobile" button, use the "Next" switch instead of the "Enter" switch to record the data and move to the next test.

Click on the button labeled "Joint Immobile" to indicate that a finger is rigid.
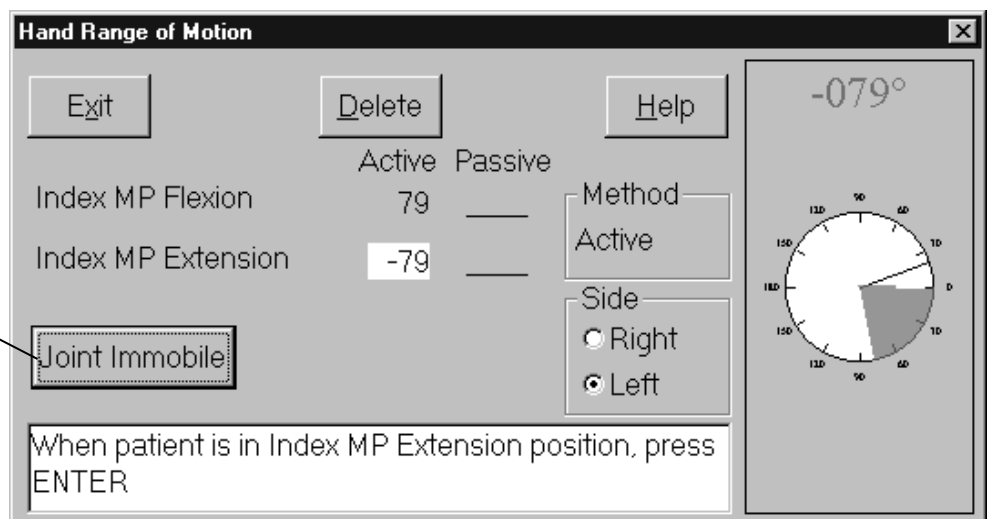
Distance Measurement Dialogs

Some hand testing range of motion measurements, such as thumb opposition, require measurement of the distance between the fingers. Distance ROMs are measured in decimal centimeters and input through the keyboard. Test dialogs requiring keyboard input, are similar to the one pictured below. The cursor should be in the default box upon entering the dialog. If it is not click within the white box, and type the measured value.

If Act/Pass is selected as the method default, type in the "Active" value, then press the Tab key to move to the "Passive" box.

Select "Ankylosis" if the patient is unable to achieve neutral position. The measurement of ankylosis should be recorded at the position of maximum possible ROM.

ROM Distance Measurement

Exit   Help

Active Passive

Index to Middle   [5.4] [6.7]   Method
                                    Active

Status   Side
○ Non-Ankylosis   ○ Right
○ Ankylosis   ● Left

After entering the Index to Middle Abduction measurement(s), press ENTER

Finger Test Statistics

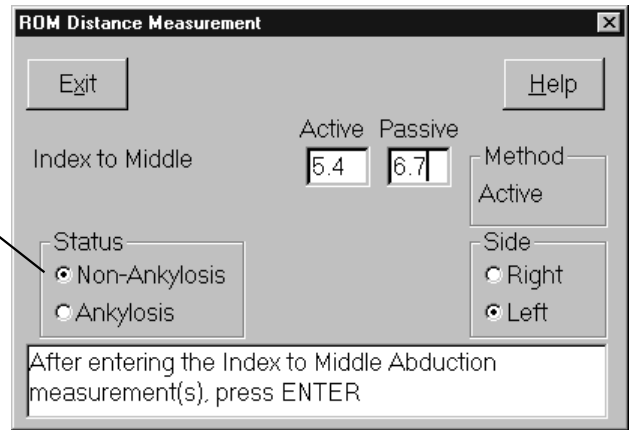Once the tests have been completed, clicking on the "Statistics" button in the Test Selection screen displays test results. Click on the radio button corresponding to the digit of interest. If the impairment rating module is available, the joint and whole finger impairments are displayed in addition to the ROM data.

Click on the radio button corresponding to the finger of interest to see its respective statistics.

Hand ROM Statistics

○ Thumb   ● Index   ○ Middle   ○ Ring   ○ Little

		Left			Right			Impair	
	Normal	Active	Passive	Status	Active	Passive	Status	Left	Right
MP Flexion/Extension	90°/20°	77/-12			93/28			13%	0%
PIP Flexion/Extension	100°/0°	84/-8			107/1			15%	0%
DIP Flexion/Extension	70°/0°	58/-3			69/-9			5%	2%
MP Abduction/Adduction	20°/0°								
Abduction (cm)	N/A	3.5			5.0				
Tip to DPC (cm)	0	1.0			0.0				
Total Motion	284°	196			289				

Whole Finger   30% 2%

Help   Close

Total motion is the sum of MP, PIP, DIP flexions minus the extension lags . Hyperextension values are added. Total Active and Total Passive motions are not calculated unless all six measurements are performed.

Status column shows "Ank" (ankylosis or extension lag) if patient is unable to reach neutral in extension, or "Imm" if joint is immobile and "Immobile" button was clicked in the Test dialog.

Impairment values are the sum of impairments due to flexion/extension restrictions. Abduction distance is not used in impairment calculations.

Whole finger values are determined by either the combination or addition (thumb only) of joint impairment values.

Tracker for Functional Capacity Evaluations

Background Information

When performing an FCE, determining more than just physical strength, or making comparison to a normative population in order to ascertain an individual's ability to perform work tasks or functional capability is important. Not until an individual's abilit ies are compared to a work standard can the questions of work performance be answered. For this reason alone, the FCE is the best tool for evaluating human performance as it applies to work demands. It is also the best tool since it requires the tested ind ividual to demonstrate functional abilities in terms of competence to negotiate weight, grasp, handle, move the body in space, a chieve dynamic and static postures, and perform work tasks. Contact JTECH for more information on products and services designed to assist you in becoming involved with Functional Capacity Evaluations.

Definitions of Related Terms

Critical Demands- The associated physical properties that must be performed in order to complete the essential functions.

Essential Functions-The tasks that must occur in order for a given job task to be completed.

Americans with Disabilities Act (ADA)- Legislative bill enacte d to protect individuals with disabilities from discrimination against opportunity to pursue a position that they are capable (with or without reasonable accommodation) of performing.

Reasonable Accommodation- Provisions such as accessibility or reasonabl e modifications to a job task such that an individual with a disability can perform the expected duties.

Dictionary of Occupational Titles (DOT)- Created by the U.S. Department of Labor, provides a description of the nature of work for a given industry or job duty, required skills and education, and identifies the physical demand level of the job position. The first publication   was in 1939 and contained 17,500 concise job definitions. (Ref: Work in Progress, by AOTA.)

Physical Demand Level (PDL)-As defined by the DOT, is a level that describes the weighted demand or frequency of a task. The demand levels are:

Sedentary:	That which requires exerting up to 10 pounds of force occasionally (0 -33% of an 8 hour workday) or primarily seated work.
Light:	Exerting 20 pounds of force occasionally or negligible weight frequently (34% - 66% of an 8 hour workday), and may also involve standing and walking to a significant degree.
Medium:	Exerting up to 50 pounds of force occasionally, 20 pounds frequently or up to 10 pounds constantly (67% to 100% of an 8 hour workday).
Heavy:	Exerting up to 100 pounds occasionally, 50 pounds frequ ently or 20 pounds constantly.
Very Heavy:	That which requires exerting greater than 100 pounds of force occasionally, greater that 50 pounds frequently and 20 pounds constantly.

Job Analysis- A method used to analyze a position in terms of its required tasks and the associated human performance requireme nts needed to perform those tasks. A typical job analysis will examine work postures, work activities, required lifting or weigh ted negotiation, task duration, frequencies, forces, weights, work heights, distances and ranges, tools, grasp, mental factors, stress factors, work environment, ergonomics and etc.

Job Description- A formal document that details the aspects of a job posi tion in terms of administrative provisions, expectations, abilities, and physical requirements.

What Questions Need Answering ?

In an ideal world, the evaluator will have a specific set of work task criteria, i.e. critical demands, that have been standa rdized either specifically for the given individual via a job analysis or work site evaluation or to the population performing t he given job via an American with Disabilities Act (ADA) compliant job description. These critical demands should form the foca l point of an FCE. Testing should be directed at determining an individual's ability to perform the critical demands in a comp etent and safe manner. This is evaluated by observing the individual demonstrate the physical ability to meet or exceed the hi ghest expected critical demand.

An FCE can also be performed if no critical demands exist or are not known in terms of identification and quantification of weighted or repetitive work task requirements. Both of these situations present themselves quite frequently. If the individual to be tested has a job opportunity but the critical demands are not available, an FCE can b e performed to determine the individual's Physical Demand Level (PDL). Job simulation tasks can also be evaluated to the best knowledge of the evaluator. Information as to the individual's ability can then be qualified and quantified and provided to the r eferral or employer for their interpretation as to whether the individual presents with the physical attributes and competence t o perform the assigned work tasks or ADL.

There are also situations where a job opportunity does not even exist for the indivi dual. Typically, some form of case resolution is in progress. The referral source is usually looking for a given individual's functional capacity or impairment to assist with the global efforts of determining the degree of disability by comparing curren t capacity to that of the person's most recent employment or pre -injury status. Another situation may be that of vocational e xploration and retraining. In this case the FCE serves as a reference point based on the individual's PDL to begin actual job searches or vocational exploration.

The FCE can also be used to demonstrate the effectiveness of treatment and intervention strategies. An abbreviated form of an FCE can be performed along with a typical physical evaluation as baseline data. Further a bbreviated FCE's can be performed weekly to demonstrate improved functional ability in response to treatment or intervention. Th is can be an effective tool for identifying treatment goals, plans and effectiveness. It can also help support the need for further care or outside referral, as well as facilitating reimbursement for care. Also note, that if your clientele is not speci fic to work related injury, the FCE can be tailored to correlate to Activities of Daily Living (ADL), sports medicine, or orthop edic medicine frames of reference.

Summary

When performing an FCE, always try to keep in mind that you are looking for an answer to a question. "What is this indi vidual's ability to perform a given work task or function?" If you are able to keep this question at the front of your mind, you will be able to efficiently and concisely perform the appropriate evaluational processes and answer the question. Even if the   individual does not offer his/her best effort, you will be able to identify if issues exist that are biasing the individuals' de monstration of effort regardless of whether they out of fear or are deliberate in nature. However, if you lose track of this qu estion, you can get caught in the quagmire of over testing, not testing specifically to the work demands, or engage on a chase t o "catch" an individual who is not giving forth best effort, which is not the purpose of this evaluational tool and often beyon d the scope of our clinical practice. Simply answer the question to the best of your ability, identify any evident issues if pr esent, suggest appropriate intervention strategies as appropriate and refer the question onto other appropriate parties if the a nswer falls beyond the scope of the FCE.

Integral Components of the Functional Capacity Evaluation

What makes an FCE an FCE?

The answer falls back to what is the question you (or the referral source) need answered in terms of an individual's ability t o perform given work tasks or demand level. There is no specific list of activities, lift procedures, hand use, work postures or standardized protocols that must be completed or performed in order for an FCE to be an FCE. **The proper length of evaluation or number of tests will always depend on what critical demands are expected of an individual or if no job exists, what physical demand level does a given individual possess in terms of work capacity.**

Example

If all you need to know is whether an individual   can negotiate a 35 -pound box from floor level to counter level, then your FCE could potentially be concluded in about 15 minutes . A cursory physical evaluation, a floor level static lift, and one job simulation lift test from floor to counter height would be a reasonable FCE for this individual.

The objective is to perform as many related movement, posture, and lift tests as needed to assure yourself ,as the evaluator, that the individual <u>can or cannot</u> perform the desired job duties based on actual demonstrated performance. You can also utilize accepted validity checks associated with objective tests such as the corresponding NI OSH Static Lifts, consistency of effort data, maximum voluntary effort tests, and observation of distracted movement patterns. Cardiovascular demand may also be an important part of your evaluation if significant aerobic As a general rule, the types of t ests that are typically performed as part of an FCE fall under the following headings:

> **Physical Exam**
> **Posture and Activity Tests**
> **Lifting**
> **Job Simulation**
> **Dexterity**
> **Cardiovascular**
> **Reliability of Effort**

To serve as a guideline for further narrowing of an appropriate battery of tests, consider the critical demands of the job:

What kind of lifting is expected?
What kind of work tasks?
What kind of work postures?
What kind of hand use is needed?
What are the aerobic considerations?

Work Assessment versus an FCE

A traditional FCE will be of little use in determining an individual's ability to perform SEDENTARY work, since the issues are less of determining a physical demand level   and more on determining activity tolerance. In situations like this, a Work Assessment should be performed because it focuses more on tolerance to repetitive activities such as lifting light mail or files, keyboard entry, etc. It is performed in a subje ctive manner utilizing one's clinical skills to determine an individual's tolerance through the demonstration of ability and   quality. One will typically set up a worker in a circuit made up of job simulation sedentary work tasks and note tolerance in t erms of performance. Record the time for the following events: onset of discomfort,   change in dexterity quality or activity pe rformance,   onset of symptom relief behaviors, and the request of the worker to end the circuit. The longest single duration of activity that was without discomfort should be noted and identified as the individual's tolerance time and whether normal quali ty or tolerance is demonstrated. Additionally, any pertinent clinical findings, any functional limitations and/or relevant inte   rvention strategies such as task adaptation, alternate work methods or adaptive work practices should be noted. Energy conservation techniques or work practices that will enhance the individual's performance, such as interspersed breaks or a chang e to alternate work tasks that are restful for the injured extremity, less physically demanding, or uses different muscle grou ps for their performance should be identified.

What Equipment Do I need to do an FCE ?

The tools required for performing a bare-minimum, generic FCE include:

Heart Beat Monitor
Stop Watch
Lifting Box
Shelving (or stack boxes)
Weights
Grip Dynamometer

The minimum tools which would provide you the flexibility to perform complete generic and custom FCEs include:

Heart Rate Monitor
Stopwatch
Lifting Boxes (general purpose, carry)
Shelving system with m ovable shelves

at least 200 lb of weight
Dexterity sample
Adjustable height steps
Inclinometer
Grip dynamometer
Static lifting system
On-site force gauge

The Tracker FCE Manual, the JTECH FCE Seminar (held four times per year), and the Track er FCE CD-ROM all address these issues and procedures in much greater detail. For more information any of these products, contact your JTECH representative at 800-985-8324 or 435-657-2500.

Chapter 1

PulseTrack Setup

PulseTrack provides continuous automatic monitoring of the patient's heart rate during Tracker testing. This feature is especial ly useful when performing functional capacity evaluations (FCEs), static and dynamic lift tasks, and isometric tests. PulseTrac k data can be transferred into Tracker FCE and EventTrack software modules. (See those modules for specific information about using PulseTrack data.)

The PulseTrack system inputs data collected from a Polar™ Heart Rate Transmitter attached around the pat ient's chest directly into your Tracker software program, where it is displayed in real time on screen.

PulseTrack Receiver

The PulseTrack Receiver is very sensitive piece of electrical equipment. It is designed to pick up the electrical pulses emitte d by a Polar™ Heart Rate sensor. Its active range from the Polar Heart Rate sensor is about three feet. The PulseTrack Receiv er should not be dropped, misused, immersed in water, or opened. Other electronic devices can cause interference during use, so the receiver should be kept away from objects like other Tracker devices, the Tracker box, and your computer.

The Receiver's 15 foot cord allows you to mount the receiver in a central location that will be within the 3 ft. range of the patient being test ed. The PulseTrack Receiver can also be attached to the patient, but you must use extreme caution to ensure the patient does no t trip on the cord, extend beyond the cable length, or knock the Receiver off.

Installing the Receiver and Software

1. Make sure the Tracker Interface Box is turned off and the Tracker program on your computer is closed..

2. Plug the PulseTrack Receiver into the port labeled "Heart Rate" on the back of the Tracker Interface Box.

3. Install the PulseTrack Software

    With new Tracker System

    If you purchased PulseTrack as part of a new Tracker system, PulseTrack software will install automatically with your Tracker software (see Module 1, Chapter 2: *Software Installation)*. For information about using PulseTrack software, see Chapter 2 of this module. If you purchased PulseTrack but it is not available when you open your Tracker software, contact JTech Customer Service.

With Existing System
> Install new Tracker software using the instructions in the Tracker Manual (Module 1, Chapter 2: *Software Installation)*.

4. Turn on the Interface Box and start your Tracker software.

The Polar™ Heart Rate Transmitter

Follow these instructions when using the Polar™ Heart Rate Chest Transmitter:

1. Connect the elastic strap to the Polar™ Trans mitter.

2. Adjust the strap length to fit snugly and comfortably around the patient.

3. Wet the grooved electrode areas on the back of the Polar™ Transmitter.

NOTE: The transmitter functions best when the electrodes are in direct contact with the skin. Ho w-ever, the transmitter can be worn over a light shirt. The areas of the shirt that will be directly under the transmitter electr odes must be well moistened to insure contact.

4. Place the transmitter around the patient's chest, below the breasts, so the Polar™ logo is in the center of the chest and up right.

5. Make sure the grooved electrode areas are against the patient's skin or wet portions of the shirt.

NOTE: The wrist receiver can be used to for monitoring heart rate, but it does not interface or send data to Tracker software.

Precautions for PulseTrack Hardware

Use the following precautions to help ensure extended use of your Polar™ Heart Rate Transmitter:

- Do not stretch or bend the tr ansmitter, especially when storing it.

- Do not store your Polar™ Heart Rate transmitter in any kind of non -breathable material, such as plastic.

- Keep you transmitter out of extreme cold (below -10ºC/14ºF), extreme heat (above 50ºC/122ºF), and direct sunlight.

- Do not immerse the receiver in water.

- Do not open the PulseTrack receiver. (Doing so voids your warranty.)

- Keep the receiver away from electrical sources (Tracker box, devices, computers, mon i-
  tors, etc.) during operation.

Care and Maintenance

Cleaning the Transmitter
Clean the transmitter after use with mild soap and water. Do not use abrasives, such as steel wool, chemicals, or alcohol as they can permanently damage the electrodes. After washing, carefully wipe the transmitter dry, never stor e it wet.

Cleaning the Receiver
The plastic surfaces of the PulseTrack receiver can be wiped clean with a damp cloth. Never immerse your PulseTrack receiver in water.

Transmitter Battery
The battery in the Polar™ Heart Rate transmitter is not replaceable. The battery's est i-mated average life is 2,500 hours of use. When the battery is depleted, contact JTech Cu s-tomer Service to purchase a new transmitter and recycle the old one.

Receiver
Do not open or attempt to service the PulseTrack receiver. In the event that it fails to fun c-tion properly, contact JTech Customer Service. Breaking the seal around the receiver voids your warranty.

Troubleshooting

No Heart Rate Reading
1. Make sure receiver is within three -foot range of transmitter.

2. Make sure elastic strap is tight enou gh

3. Make sure the electrodes of the transmitter are moistened and if a shirt is worn that it is wet beneath the electrodes.

4. Make sure the transmitter is being worn properly.

5. Make sure the transmitter electrodes are clean.

6. Make sure the Tracker Interface box is turned on.

Heart Symbol Flashes Irregularly

1. Make sure receiver is within three -foot range of transmitter.

2. Check that the elastic stra p has not become loose from movement.

3. Make sure transmitter electrodes are moistened.

4. Make sure receiver is within close p roximity to a potential interference source.

Extremely High Heart Rate Readings

The PulseTrack receiver is especially sensitive to electromagnetic signals given off by other electronic devices. Contact with or close proximity to electronic devices, such as the Tracker Interface box, Tracker devices, computers and monitors, can cause heart rate readings to rise to abnormal levels.   Signals from more than one Polar transmitter within the three-foot range can also cause elevated readings. Check the surround ings and move the receiver away from the source of interference.

Chapter 2

Using PulseTrack Software

Once the PulseTrack module has been installed (see Module 1, Chapter 2: *Software Installation*), the Heartbeat Monitor dialog app ears in the upper right -hand corner of the main Tracker dialog. The PulseTrack dialog may be minimized (run in the background) o r moved into a more convenient position. To minimize, click on the small bar icon at the top of the Heartbeat Monitor dialog (se e illustrations below). Once minimized, the dialog may be re -expanded by clicking "Tracker Communications" on the status bar. Tr acker remembers the status (expanded or minimized) and location of the PulseTrack dialog when the software is closed and will us e these settings as the default until the settings are changed again.
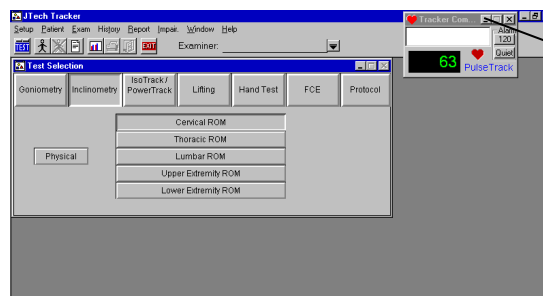
Click here to minimize the PulseTrack dialog.

Warning: **Do not close the TRACKER Heart Beat Monitor dialog during testing. A COM error will result, all communications will be lost and a restart of the software will be necessary.**

At the center of the Heartbeat Monitor dialag is a scrolling box that shows the start and close of all communication processes.   Refer to the following illustration for a summary of the features of the PulseTrack dialog.

To move this dialog out of the way, click here and it will be minimized and moved to the task bar.

Communications log which keeps a tally of all starts and stops, and scrolls as entries are added. Click on the up and down arrows to see the communications history for the corresponding Tracker session.

This button displays the current setting for maximum permissible heart rate. Clicking the button yields a dialog which is used to define this value.

The " Quiet" button silences the audible alarm which sounds when the maximum permissible heart rate is exceeded.

Numeric display of heartbeat, in beats per minute (bpm).
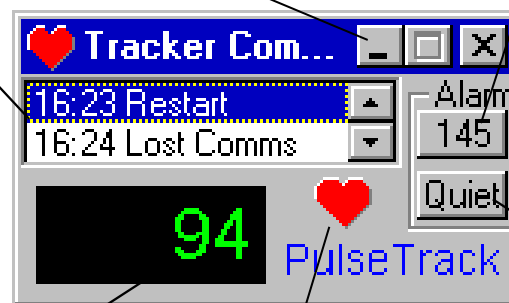
Heart image appears to beat if heart rate signal is being sensed by the receiver.

PulseTrack runs simultaneously with other Tracker data acquisition modules, as evidenced by the illustration below.
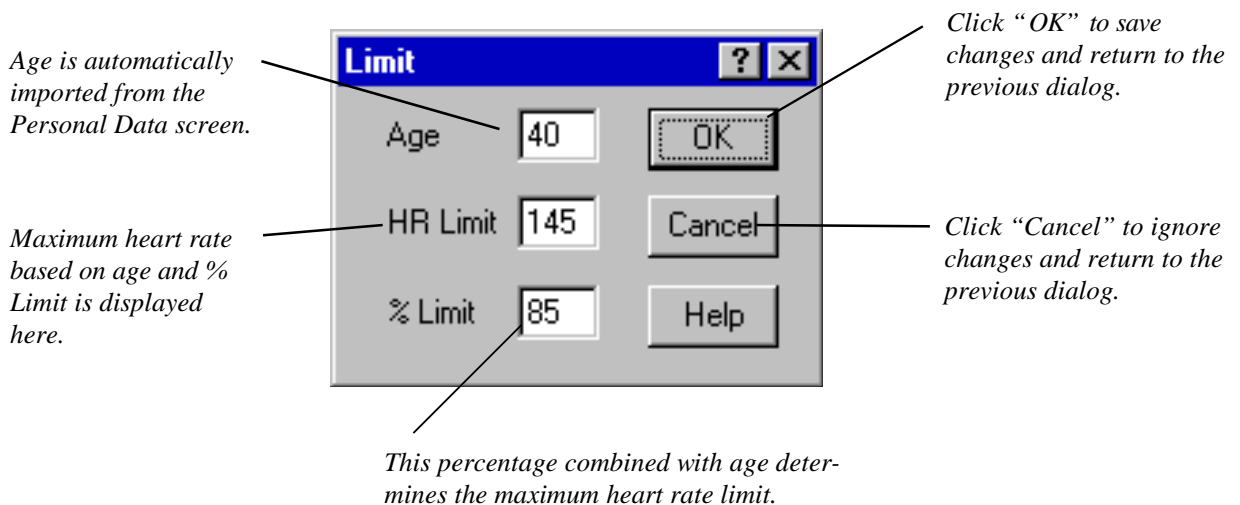
PulseTrack monitoring heartbeat while GripTrack data is being collected.
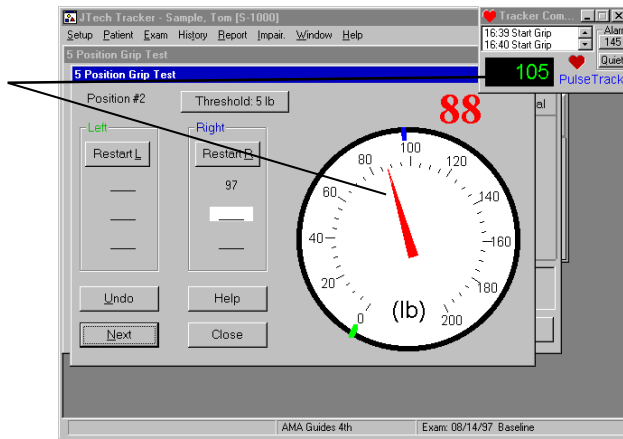
Setting the Maximum Heart Rate Limit

The maximum heart rate setting is used to define the upper limit for the patient's hear rate during testing. If the heart rate limit is reached or exceeded the alarm will sound (see illustration below). The "HR Limit" is automatically determined by multi plying the "% Limit" value by (220 - "Age"). The age data is imported from the Tracker Personal Data screen, and the "% Limit" i s user-controlled. The initial default is 75%. When you change the % Limit value, the new percentage is the value PulseTrack u ses until you manually change it again.

To change the heart rate limit, click on the button in the PulseTrack dialog below the "Alarm" heading. This will activate the dialog shown below. Each field is editable by simply clicking on the white box and typ ing a new value. The "HR Limit" field will be recalculated as either the "Age" or "% Limit" field is edited. Likewise, the "%   Limit" field is updated if the "HR Limit" field is edited.

Age is automatically imported from the Personal Data screen.

Click "OK" to save changes and return to the previous dialog.

Maximum heart rate based on age and % Limit is displayed here.

Click "Cancel" to ignore changes and return to the previous dialog.

This percentage combined with age deter- mines the maximum heart rate limit.

PulseTrack Alarms

PulseTrack provides both visual and audible alarms to notify you if the patient's heartbeat exceeds the maximum permissible valu e. The audible alarm beeps when the heart rate limit is reached or exceeded. It can be silenced by clicking the "Quiet" button . The visual alarm turns the heart value box red when the heart rate limit is reached or exceeded. The box automatically retur ns to white when the heartbeat drops below the alarm level.

Visual alarm appears as a red background.
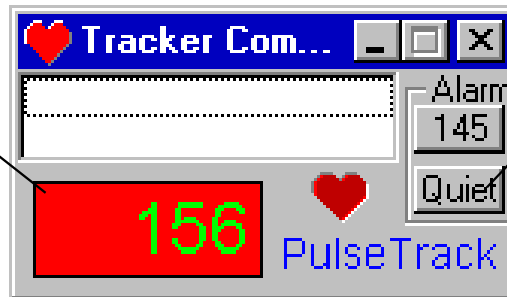
Click "Quiet" to silence audible alarm.

Chapter 1
Sensory Testing General Information

Light Touch / Deep Pressure Threshold

Indications for Testing

According to the results of several researchers:

> "*Semmes-Weinstein monofilaments are recognized as one of the most accurate quantitative tests for acute compression and more sensitive than two-point discrimination in assessing sensibility in chronic compression neuropathies*"[1]

They are also used for quantifying the effect of nerve lacerations and nerve repair surgeries, as well as mapping sensory deficits resulting from chronic diseases (e.g. diabetes) and burns. The monofilaments can also be used to map dermatomal sensory loss over the entire body, however the JTECH software is currently only used to map sensory loss for the hands.

Test Procedure

Patient is seated with hand supinated and supported with a towel or putty to avoid any movement which could vary contact force. Examiner should avoid supporting patient's hand to prevent transmission of heat or vibration, thereby skewing the results. Testing should be conducted in a quiet, distraction-free environment. The patient's vision of his/her hand should be occluded.

To begin testing, select a monofilament that is within normal limits (1.65 - 2.83 for the full kit, 2.83 for the minikit). Hold the monfilament perpendicular to the surface being tested. Apply enough force to bend the monofilament slightly. The monofilament should remain in contact with the patient's skin for a period of 1 to 1.5 seconds. The patient should indicate the feeling of sensation by saying "Touch" or "Yes". Non-verbal patients can indicate "Touch" by tapping on the table with his/her opposite hand. Testing typically begins on the volar surface of the fingertips and proceeds proximally. It is best to map nerve distribution within the hand by first finding all areas of normal sensation. If the monofilament is not sensed in a region, progress to a higher pressure monofilament and retest that region. Continue this process until all areas of the involved hand are mapped. Use the TRACKER software to document results during testing, or use colored pens to document the results on the hand, then use the software to create the report after testing has been completed. See Chapter 2 of this module for more information regarding the use of the software.

Apply the filament perpendicular to the skin with enough force to cause the filament to slightly bend.

Support the patient's hand in putty or with a towel to avoid any movement which may vary contact force.
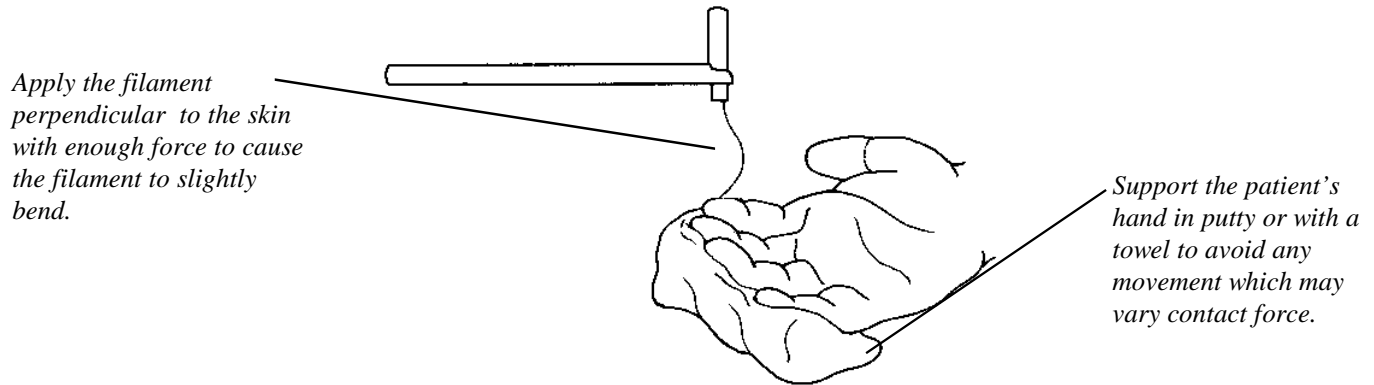
Note: Monofilament sizes 1.65 to 4.08 should be applied up to three times to the same spot to insure the proper amount of threshold is reached. A period of 1.5 seconds should elapse before the monofilament is reapplied. The 4.17 to 6.65 filaments are applied onl y once.

Scoring / Norms[2]

Category	Filaments	Calculated Force (g)	Summary
Normal	1.65-2.83	.0045 - .068	Indicates a recognition of light touch, and therefore deep pressure that is within normal limits.
Diminished Light Touch	3.22 - 3.61	.166 - .408	Diminished recognit ion of light touch, probably indicating fair use of the hand. Graphesthesia and stereognosis may be close to normal. Able to recognize temperature with good protective sensation. May not even be aware of sensory loss.
Diminished Protective Sensation	3.84 - 4.31	.697 - 2.06	Diminished use of the hand, difficulty manipulating objects, and/or tendency to drop some objects. May complain of weakness in hand. Some sense of pain and temperature may help keep patient from inj ury.
Loss of Protective Sensation	4.56 - 6.65	3.63 - 447	Little use of the hand. Will not be able to manipulate objects outside of vision angle. Perhaps no temperature sensation. May injure self further because of deficit. Not totally asensory.
Untestable	> 6.65	> 447	A pinprick test should be performed and results documented to determine if hand is tot ally asensory. Instructions should be given for protective care of the asensory hand.

Reliability and Validity

Research indicates good reliability and reproducibility as long as the monofilament lengths and diameters are correct. [3] Light touch-deep pressure testing with monofilaments has also been de-scribed as one of the most objective tests for determining cutaneous sensibility. [2] Proper storage of the instruments helps faci litate the accuracy of testing.

Static Two-point Discrimination

Indications for Testing

Two-point discrimination is sometimes recognized as the classic test of functional sensibility and for determining tactile gnosis [4], however researcher's opinions differ on the functionality of the tests[6]. Dellon reports that 2PD does correlate with the hand's ability to perform various grips, but not with function as demonstrated on Moberg's pick-up tests.

ASHT recommends repeating tests every 4 to 6 weeks until results indicate normal 2 point discrimination has been achieved, or no further progress has been demonstrated.

Test Procedure

Patient is seated with hand supinated and supported with a towel or putty to avoid any movement which could vary contact force. Examiner should avoid supporting patient's hand to prevent transmission of heat or vibration, thereby skewing th e results. Testing should conducted in a quiet, distraction -free environment. The patient's vision of his/her hand should be occ luded.

Using a device such as the Disk -Criminator, Boley gauge, or dull -pointed caliper, set a distance of 5 mm between the two points, orienting the points parallel to the longitudinal axis of the finger. Randomly apply either one or two points to the zo ne being tested. This allows testing of the respective digital nerves. The point(s) should be applied perpendicular to the skin   with a pressure that stops just at the point of blanching the skin. [4,5] Dellon reports the point(s) should be held in contact wit h the skin for a minimum of three seconds. Testing should begin at the distal

Apply the point(s)
perpendicuar to the finger
with enough force just short
of blanching. the skin.
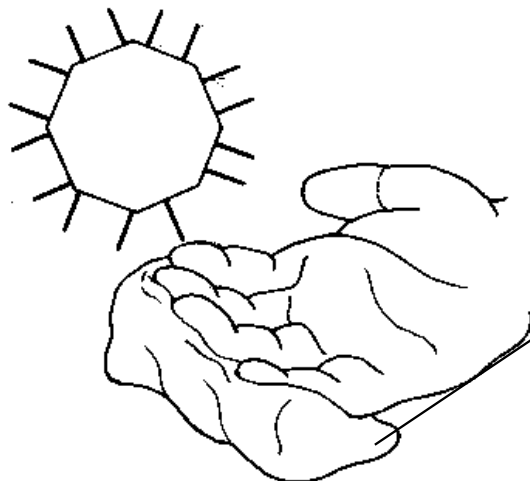
Support the patient's
hand in putty or with a
towel to avoid any
movement which may
vary contact force.

fingertip and proceed proximally.   Instruct the patient to respond "one" or "two" depending upon the number of points felt. ASHT protocol suggests 7 of 10 correct responses are required before the distance is recorded. [1] AMA protocol requires 2 of 3 correct responses[5]. If the correct number of accurate responses is not achieved, the distance is increased until the patient can accurately discern one versus two -point discrimination. The maximum testable distance is 15mm.

ASHT reports testing should be performed on flexor zones I and II (i.e. from the fingertips to the distal palmar crease). The AMA *Guides to the Evaluation of Impairment*, however, rates impairment only upon the results of testing on the fingers.

Reliability

The reported reliability and validity of the two -point discrimination test is poor due to the wide variation in the applied force[1]. Dellon et al. reported that using a standard protocol with the Disk-Criminator resulted in interexaminer variab ility of 1mm in 87% of the cases tested [7]. Dellon used a stimulus intensity equivalent to the minimum force required for the pati   ent to recognize whether the 2 points were moving or static.

Scoring / Norms

The American Society for Surgery of the Hand (AS SH) has summarized normative data for the two-point discrimination test [8].

Normal:	Less than 6mm
Fair:	6mm - 10mm
Poor:	11mm - 15mm
Protective:	One point perceived
Anesthetic:	No points perceived

According to the AMA's *Guides* two-point values less than 7mm are considered normal. Those between 7mm and 15mm suffer from a partial loss, and values greater than 1   5mm are considered a total loss.

Moberg has stated that a two-point discrimination value of at least 6 mm is required for wind ing a watch, 6mm-8mm for sewing, and 12mm for handling precision tools.   [4]

Impairment Rating

Sensory impairments are based only upon the sensory quality of the palmar aspect of the digits. Dorsal sensory loss is not considered an impairment.

Note: If the sensory deficit affects the entire dermatome, the impairment should be rated as a function of a peripheral nerve disorder, not as separate digit sensory losses.

According to the AMA's *Guides to the Evaluation of Permanent Impairment,*

> "If a patient has normal two -point discrimination, i t is not necessary to test
> sensory submodalities; rather, they are assumed to be present." [5]

The AMA defines several concepts in order to perform impairment rating based on sensory testing.

Total Sensory Loss -   Two-point discrimination values greater t han 15mm
Partial Sensory Loss - Two-point discrimination values of 7mm through 15mm.
Normal Sensibility -   Two-point discriminat ion values equal to or less than 6mm.
Transverse Sensory Loss - Involvement of both digital nerves.
Longitudinal Sensory Loss - Involvement of only one digital nerve.

For convention sake, the digital nerves are referred to as the radial digital nerve and   ulnar digital nerve.

Note: The fingers are divided into zones based on percent of digit length. The DIP joint is designated as 45% of digit length, the PIP joint is 80% of the digit length, and the MP joint corresponds to 100% of digit length. The IP joint of t he thumb corresponds to 50% of the thumb length, and the MP joint is 100% of the thumb length.

If the finger is amputated, the impairment value assigned that finger corresponds to the digit length. For example, if the index finger was amputated at the PIP   joint, the impairment would be 80%. This would correlate to a 16% hand impairment based on Table 1 of the   *Guides*.

Total sensory loss receives 50% of the impairment value associated with an amputation at the same digit length level. Partial sensory loss r eceives 25% of the impairment value associated with an amputation at the same digit length.

Relative importance of the involv ed side for longitudinal sensory loss is also defined by the AMA's *Guides*. For the thumb and little finger, the ulnar side of th e digit is weighted more than the radial side (60% vs 40%). For the index, middle, and ring fingers, the radial side is weighted 60%, while the ulnar is 40%.

All of the above data is summarized numerically in Tables 8 & 9 within the AMA   *Guides*

Based on the results of testing, the TRACKER software will automatically calculate the sensory impairment based on the aformentioned tabl es, and then combine or add with other impairments as appropriate.

Special Considerations :

If a patient has total sensory los s associated with the ulnar digital nerve and a partial sensory loss for the radial digital nerve of the same finger (or vice ve rsa), then the two respective impairment values are added to determine the impairment for the whole finger.

If a patient has a total sensory loss distal to a joint and a partial sensory loss proximal to that joint, the impairment due to the total loss is calculated normally. The partial loss is then calculated based on the remaining affected digit length. These   two impairment values are then added to give an impairment for the whole finger.

Moving Two-Point Discrimination

Indications for Testing

The moving two -point discrimination test overcomes many of the criticisms of the static two -point test. The static two-point test primarily stimulates the slowly adapting fiber receptor system, yet quick adapting fiber -receptor systems make up approximately 90% of the touch receptors in the fingertip. Therefore, the ability to discern a moving stimulus prov ides information about the density of functioning quick adapting fiber receptors. The test is a better indicator of function si nce most hand activities require the fingertips to move over an object. Moving touch sensation is recovered quicker than static touch following nerve repair, so the moving 2 point test can yield information regarding the success of treatment sooner.   [6]

ASHT recommends repeating tests every 4 to 6 weeks until results indicate normal moving two   -point discrimination is achieved or no f urther progress is demonstrated.

Test Procedure

Patient is seated with hand supinated and supported with a towel or putty to avoid any movement which could vary contact force. Examiner should avoid supporting patient's hand to prevent transmission of heat or vibration, thereby skewing th e results. Testing should conducted in a quiet, distraction -free environment. The patient's vision of his/her hand should be occ   luded.

Using a device such as the Disk -Criminator, Boley gauge, or dull -pointed caliper, set a distance of 5 mm between the two points. With the points perpendicular to the longitudinal axis of the finger, drag (proximal to distal) the points through the   zone being tested . Randomly alternate between one and two points. The point(s) should be applied perpendicular to the skin with   a pressure that stops just at the point of blanching the skin. Testing is typically performed only on the fingertips. Instruct the patient to respond "one" or "two" depending upon the number of

Apply the point(s) perpendicuar to the finger with enough force just short of blanching. the skin. Drag the point(s) distally.
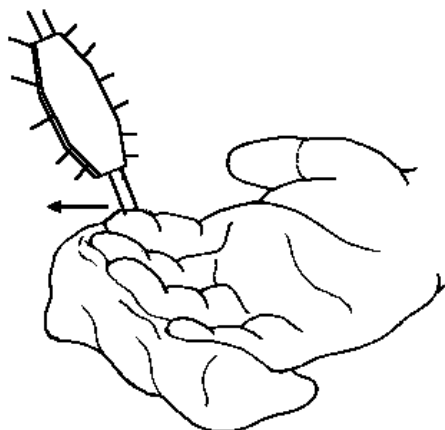
Support the patient's hand in putty or with a towel to avoid any movement which may vary contact force.

points felt. ASHT protocol suggests 7 of 10 correct responses are required before the distance is recorded. If the correct numbe r of accurate responses is not achieved, the distance is increased until the patient can accurately discern one versus two -point discrimination. If the correct response is achieved, reduce the distance between the points by 1 mm, gradually proceeding down to the normal value of 2 mm. The maximum testable distance should be no more than 8 mm.

Reliability

The reported reliability and validity of the moving two -point discrimination test is poor due to the wide variation in the applied force. However, Dellon reported that using a standard protocol with the Disk -Criminator resulted in interexamine r variability of 1mm or less in 93% of the cases tested[7]. Dellon used a stimulus intensity equivalent to the minimum force requi red for the patient to recognize whether the two points were moving or static.

Scoring / Norms

Dellon reports that "virtually e very normal fingertip has a m2PD (moving 2 point discrimination) of 2mm"[6]. The normal does not significantly decrease with age,   as the mean m2PD values of 80 - 90 year olds tested as part of Dellon's normative study was 3 mm. Dellon's normative study also indicated that there is no influence of sex or dominance on moving two   -point values[6].

Patel presented data in 1994 showing the   percentage of normals at each level of m2PD [9].

mm	% of normals (n=125)
2	30
3	46
4	17
5	5
6	0
7	2

References

1. Clinical Assessment Recommendations, 2nd Edition American Society of Hand Therapists, 1992

2. Bell-Krotoski, JA: Light touch -deep pressure testing using Semmes -Weinstein monofilaments. In: Hunter JM, Schneider LH, Mackin EJ, Callahan AD,   (eds): Rehabilitation of the Hand (3rd ed) 1990 585 -593 CV Mosby, St. Louis

3. Bell-Krotoski, JA: Sensibility testing: stat e of the art. In: Hunter JM, Schneider LH, Mackin EJ, Callahan AD, (eds): Rehabilitation of the Hand (3rd ed) 1990 575 -584 CV Mosby, St. Louis

4. Callahan, AD: Sensibility testing: clinical methods. In: Hunter JM, Schneider LH, Mackin EJ, Callahan AD, (eds): Rehabilitation of the Hand (3rd ed) 1990 594 -610 CV Mosby, St. Louis, MO

5. Doege TC, Houston TP (eds): Guides to the Evaluation of Permanent Impairment (4th edition) 1993 20 -31 American Medical As sociation, Chicago

6. Dellon AL: The moving two -point discrimination test: Clinical evaluation of the quickly adapting fiber / receptor system. J Hand Surg 3: 474 -481, 1978

7. Dellon AL, Mackinnon SE, Crosby PM: Reliability of two -point discrimination measurments. J Hand Surg 12A: 693 - 696 1987

8. American Society for Surgery of the Hand: The Hand: Examination and Diagnos is. American Society for Surgery of the Hand, 1978 Aurora, Colorado

Chapter 2
Sensory Testing Using TRACKER Software

Selecting a Test

After selecting a patient, sensory tests for the hand are accessed by selecting "Hand Tests" from the main TRAC KER screen, and then "Sensory" from the resulting menu. If you do not have "Sensory" as an available option, contact JTECH custo mer service at 800-985-8324.

To perform sensory hand tests, click here...

....then here.
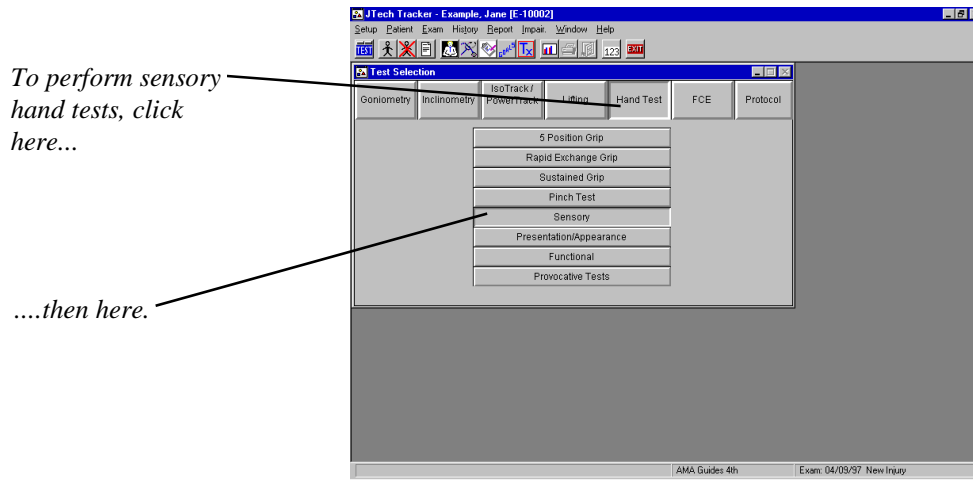
The following dialog will appear. Select a specific test from the list of available protocols by highlighting it and clicking on "Test", or perform all of the available sensory tests by clicking the "Test All" button. If a test has been previously performe d, the most recent test date is documented in the lower left hand corner of the dialog.

Select the desired test from the list.

Click here to perform all tests listed.

The highlighted test is listed with the most recent of previous test

Click here to perform the individual test which is highlighted.
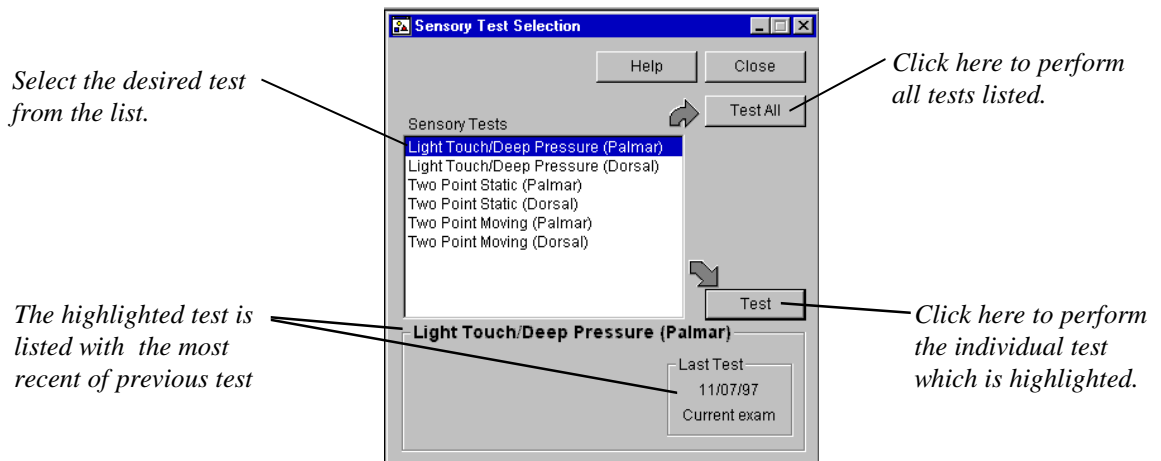
All sensory dialogs appear as zonal maps of either the palmar or dorsal surface of the hand as shown below. To document the resu lts of testing, click on the tested zone and select the correct sensory value from the drop -down list which is displayed (see ne xt page). Use the left mouse button to fill in the just the specific zone clicked, or use the right mouse button to fill the who le side of the finger distal to and including the zone clicked.
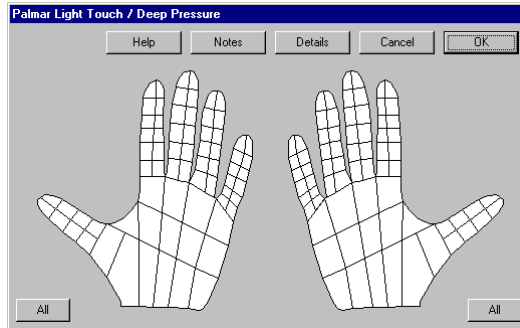
Mapping Conventions

A notation convention was established to help effectively map the regions of the hand. Each finger is broken into three segment s: distal phlange, middle phlange, and proximal phlange. Each phlange is subdivided again to create six zones (labeled 1 -6) and to provide greater resolution for documentation. The thumb consists of only four zones because of the lack of a middle phlange. The thumb zones are therefore labeled 1,2,5,6. The fingers and thumb are then bisected to create a side innervated by the ulnar digital nerve and a side innervated by the radial digital nerve.
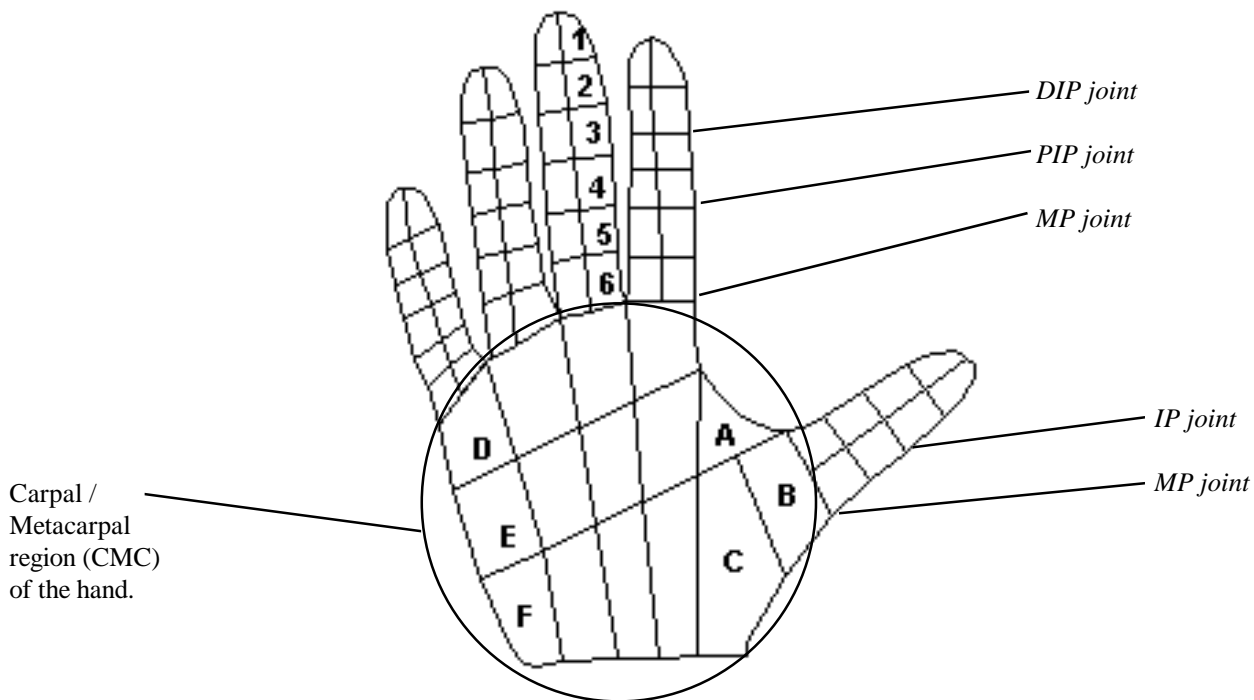
A. Distal -most aspect of CMC region associated with the thumb.
B. Middle aspect of CMC region associated with thumb.
C. Proximal-most aspect of CMC region associated with thumb.
D. Distal-most aspect of CMC region associated with little finger.
E. Middle aspect of CMC region associated with little finger.

Drop-Down Menus

A color-coded menu appears when the either mouse button is clicked. This menu varies depending upon the test bei ng performed. Use the mouse to select the appropriate result from this menu. The zone(s) selected are then painted or "filled" w ith the selected color, and the

Border indicates that this value will be selected and entered into the map of the

Click "All" to color entire hand.
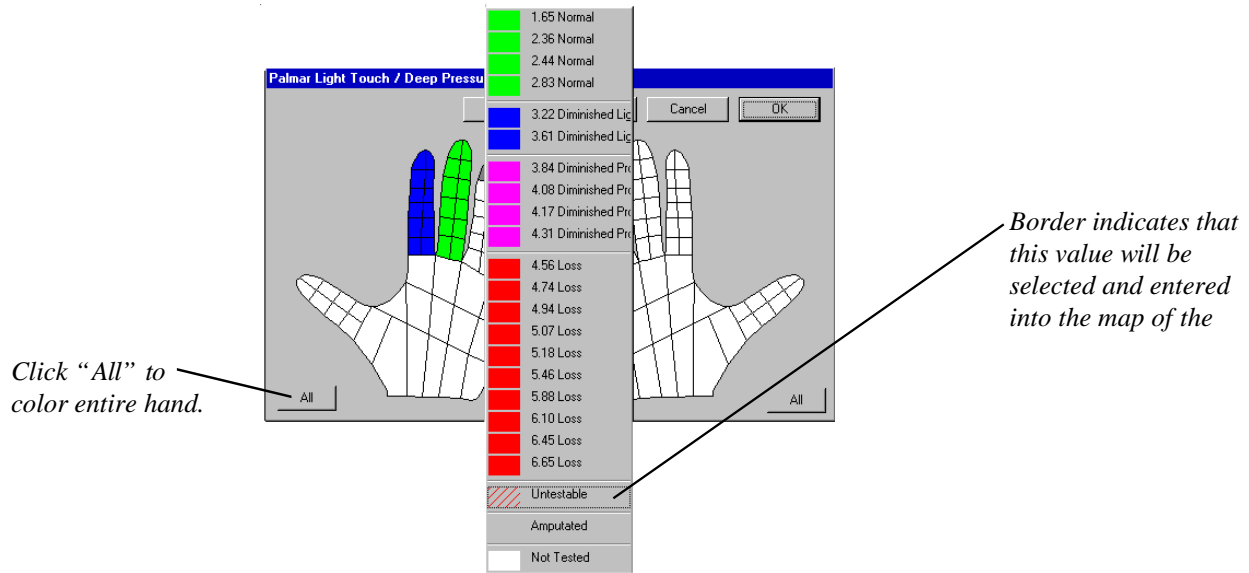
Note: Previously recorded data for a specific zone is erased if "Amputation" is selected for that same zone. A warning dialog will be displayed and must be acknowledged before this overwrite occurs.

Previously entered data can be erased by clicking on the do cumented zone(s) and selecting "Not Tested".

Selecting the button labeled "All" fills the entire hand with the chosen color and   corresponding value.

Other selectable tests such as static two-point and moving two -point discrimination have different grading scales than the light -touch and are pictured below. The function of the software and mapping is exactly the same however. If a digit(s) is marked as   amputated, it shows as amputated for all tests.

Static two-point discrimination

Moving two-point discrimination values

Use the buttons in the dialog for the following:

OK-   Save changes and return to the Sensory Test Selection screen.
Cancel - Ignore changes and return to the Sensory Test Selection screen
Details - Displays a summary of sensory test data in numeric chart f ormat.
Notes - Create notes (up to 255 characters) specific to the open test.
Help - View for general information and instructio ns for the specific test procedure.
All -   Assigns the selected value to all zones of the hand and paints the entire hand the
             corresponding color.

The grey zone indicates the current location of the cursor.

An amputation is represented as a wireframe showing the outline of the amputated finger.

Palmar Light Touch / Deep Pressure

Help   Notes   Details   Cancel   OK

All   All
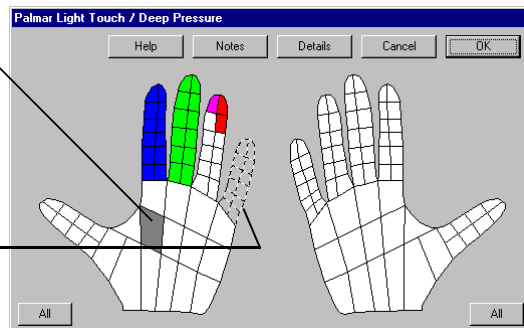
Selecting "Details" results in the following dialog. Data for each finger and the thumb appears in the top chart. Finger data is reported as defined by zone and radial (R) versus ulnar (U) side. The data for the palm or dorsum (CMC region) of the hand is l isted in the bottom chart.

Palmar Light Touch / Deep Pressure Details

		Left									Right									
Phalanges		Thumb		Index		Middle		Ring		Little		Thumb		Index		Middle		Ring		Little
Digit Segment		U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R
Distal	Zone 1			3.61	3.61	2.83	2.83	4.31	6.65	Amp	Amp										
Phalanx	Zone 2			3.61	3.61	2.83	2.83		6.65	Amp	Amp										
Middle	Zone 3			3.61	3.61	2.83	2.83			Amp	Amp										
Phalanx	Zone 4			3.61	3.61	2.83	2.83			Amp	Amp										
Proximal	Zone 5			3.61	3.61	2.83	2.83			Amp	Amp										
Phalanx	Zone 6			3.61	3.61	2.83	2.83			Amp	Amp										

Carpal/Meta.	Thumb	Index	Middle	Ring	Little	Thumb	Index	Middle	Ring	Little
Distal										
Middle										
Proximal										

Help   Close

Selecting "Notes" allows the user to document findings or observations (up to 255 characters) specific to the test. Notes are pr inted as part of the report.

Hand Sensory Notes

Results of testing indicate normal sensation for middle finger, and reduced sensation of index finger of left hand. Marked decrease of sensation on tip of ring finger. Little finger amputated 10 years ago as a result of a farming accident.

OK   Cancel   Help
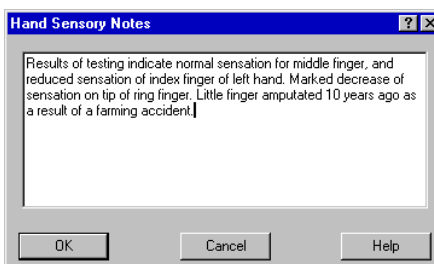
Impairments

Impairments are automatically determined for the results of the two -point discrimination sensory test if the impairm ent module was purchased. Call JTECH at 800 -985-8324 if you don't have impairment rating capability. The effect of the test resu lts on the impairment of the hand is shown in the "Details" section of the palmar static two -point test. An example is shown bel ow.

Impairment chart for static two-point results.

Resulting hand impairment is shown here.

Palmar Static Two Point Discrimination Details																					
		Left										Right									
Phalanges		Thumb		Index		Middle		Ring		Little		Thumb		Index		Middle		Ring		Little	
Digit Segment		U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R
Distal Zone 1				7	7	5	5	12	1p	Amp	Amp										
Phalanx Zone 2				7	7	5	5		1p	Amp	Amp										
Middle Zone 3				7	7	5	5			Amp	Amp										
Phalanx Zone 4				7	7	5	5			Amp	Amp										
Proximal Zone 5				7	7	5	5			Amp	Amp										
Phalanx Zone 6				7	7	5	5			Amp	Amp										
Long. Loss %		0	0	15	10	0	0	3	9	40	60	0	0	0	0	0	0	0	0	0	0
Trans. Loss %		0		25		0		12		100		0		0		0		0		0	
Carpal/Meta.		Thumb		Index		Middle		Ring		Little		Thumb		Index		Middle		Ring		Little	
Distal																					
Middle																					
Proximal																					

Left Impairment = 16% Right Impairment = 0%   Help   Close

Viewing History

The sensory test history of a patient can be viewed and printed by selecting "History" and then "Graph" from the resulting menu.

JTech Tracker - Example, Jane [E-10002]

Setup Patient Exam History Report Impair. Window Help

Graph...
Displayed Exams...
Print Graph

Test Selection

Goniometry	Inclinometry	IsoTrack / PowerTrack	Lifting	Hand Test

5 Position Grip

Rapid Exchange Grip
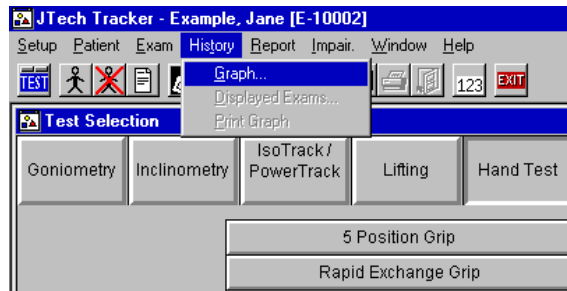
The following dialog appears. Select the specific test history to view by highlighting it from the list.

History Selection

Test

Pinch - Tip
Pinch - Key
Pinch - Palmar
Pinch - Thumb to Middle
Pinch - Thumb to Index
Pinch - Thumb to Little
Sensory - Palmar Light Touch/Deep Pressure
Sensory - Palmar Light Touch/Deep Pressure
Sensory - Palmar Two Point Static - Right
Sensory - Palmar Two Point Static - Left
Whole Person Improvement

OK
Cancel
Help
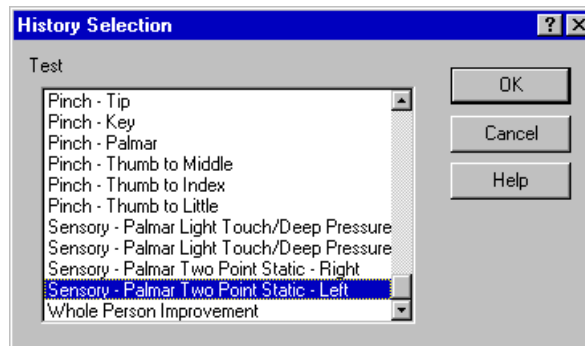
Up to eight hands will appear, each representing the sensory results map created for the specific test date listed below the han d. If more than eight tests have been performed, a scroll bar allowing view of the other tests appears.
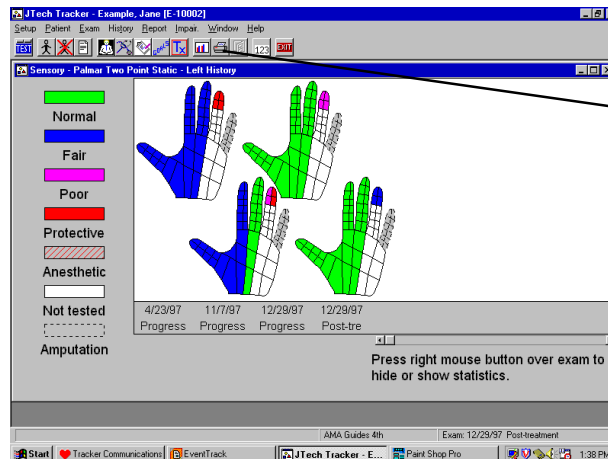
To print the single progress chart, click on

Scroll bar to view graph if more than 8 tests appear.

Once displayed, the graph can be printed by clicking on the printer icon on the button bar.

To print multiple graphs simultaneo usly, select "Report" then "Progress" from the resulting menu. Select all the tests you wish to print. See Module 1, Chapter 8   *Printing a History* for more information.

Chapter 1
Provocative Testing

Provocative testing is used to elicit a physiological response that indicates or supports a condition or symptom. These tests ca n take the form of a presentation, posture, maneuver, response, or action. The outcome of the testing typically reveals some fo rm of pain, presentation, instability, audible sound, or change in function. Any of these responses can be classified as a positive finding, but further evaluation is necessary to ensure the response is related and specific to the presenting problem.

Typically, provocative tests are simple procedures that can be performed quickly without sophisticated equipment or complicated acti ons. Testing provides information regarding origin , cause, extent, and anatomical structure involvement. Positive findings usua lly relate to injury and/or pathology of the neurological system, musculoskeletal system, or vascular system. Illness, disease, and/or temporary conditions, such as pregnancy, should be ruled out as sources for the positive findings.

Provocative testing is a very important part of any evaluation. Care should be taken to guard against false positives and "normal" but painful respon ses. Use the uninvolved side for comparison and consider the overall presentation of your patient. Always support your findings with other forms of evaluation and diagnostics.

Libraries and Custom Tests
There are two sources of provocative tests used by TRACKER. Provocative test libraries can be purchased from JTECH, or you can create your own "custom" tests. The Provocative Test mo d-ule includes a "starter" library of 38 tests. JTECH has test libraries available for Upper Quarter as well as Orthopedic provoca tive tests. Creating custom tests is described later in this chapter. For more information about Provocative Test libraries, con tact JTECH at 800-985-8324 or 435-657-2500.

Accessing the Dialog
To define a provocative test list for a patient who has already been selected, click on the button labeled with a lightning bolt or select "Exam" then "Provocative" from the resulting menu. If you have purchased the CHE (Comprehensive Hand Evaluation) software, you can also click on "Hand" and "Provocative Tests" within the TRACKER Main menu.

To initiate the provocative test dialog, click either here....

or here (if you have the CHE hand testing module)....

or here....

...then here.
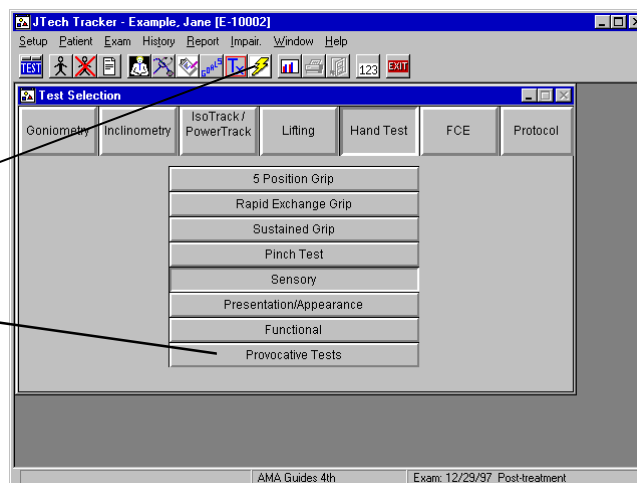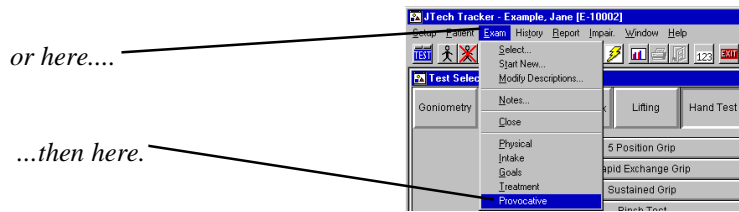
The following dialog appears. If provocative tests have not been previously defined or performed on the patient selected, the di alog appears empty, as illustrated below. If provocative tests have been used in a prior exam for the selected patient, the dial og is filled with the previously performed tests.
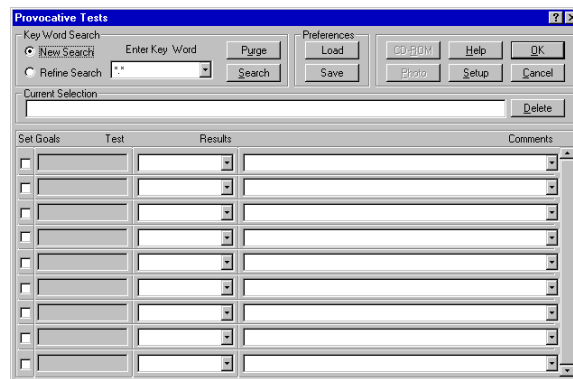
Selecting Tests

To view the database of available tests pertaining to a specific pathology or anatomical structure, select the appropriate keyword from the drop -down list and click "Search." Ensure the radio button in the upper left of the dialog indicates that a "New Search" is being performed.

Note: Use "*.*" as the keyword to view all available provocative tests contained within the   database.

When beginning a search, ensure that "New Search" is selected.

Search using *.* as the keyword to see all of the available tests.
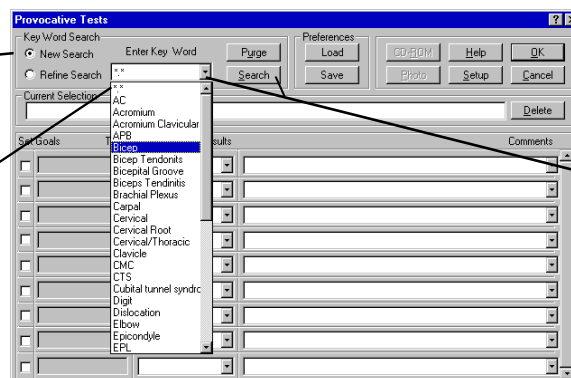
Click the downward arrow to see all of the keywords. Select one, then click "Search."

A list of all tests with the selected keyword in its definition will appear in the list. Use the scroll bar to view the addition al tests in the list. When a specific test from the resulting list is highlighted, its keyword definition appears under the "Cur rent Selection" heading.

Currently selected test listed here.

Results of the search listed here.

Use the scroll bar to see more tests if current list exceeds space provided.
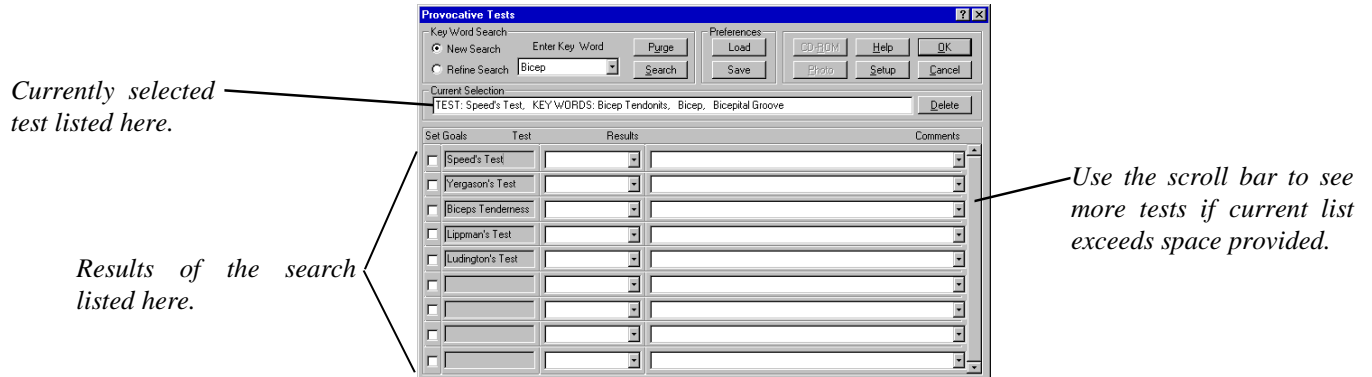
If the search has yielded more tests than desired, the search may be refined to yield a test list which is more specific to your needs. To do this, click once in the radio button next to "Refine Search," in the upper left corner of the dialog, select a new keyword, and click "Search." The displayed test list will reduce in size to show only those tests which have both selected keywords. In this example, the list created by searching on "Bicep" was narrowed by performing a "Refine Search" using the keywo rd "Biceps Tendonitis."

To refine search parameters, click here.

Test list resulting from revised search.

New keyword listed here.
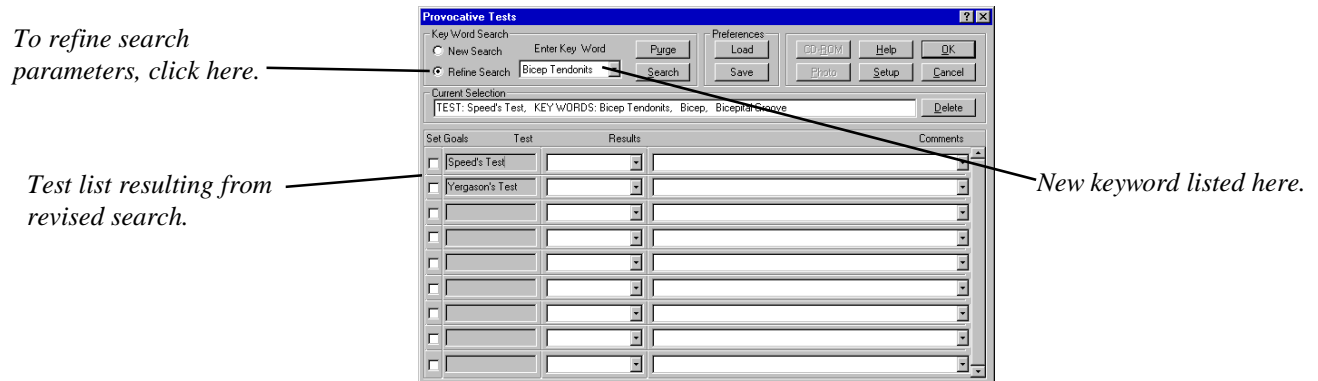
Click "Setup" to see any specific instructions or observations to note for the highlighted test.

Active test listed here.

Click here to see test setup dialog.
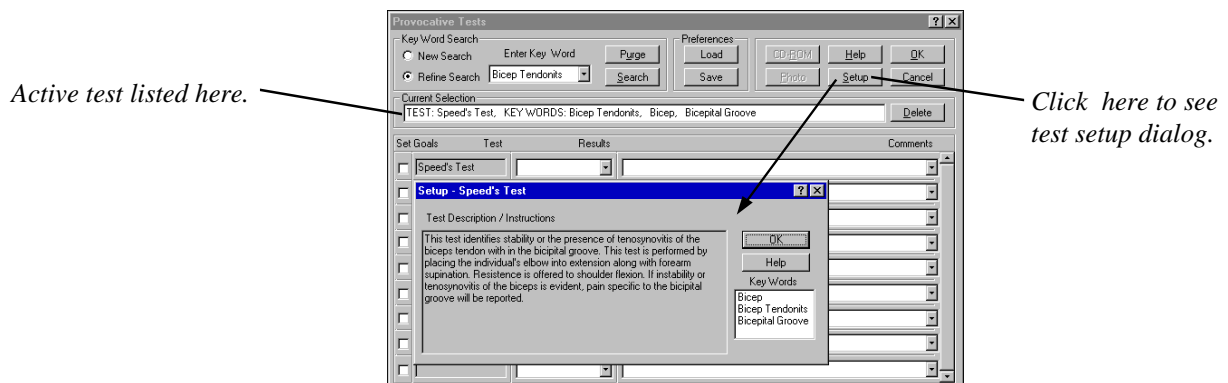
You can define a list of tests as a "Preference" which simplifies test selection for patients with a specific pathology. To do this, simply click on "Save as Preference" once a test list is defined. Enter a name for the "Preference" as prompted by the soft ware.

The tests listed here will be defined as a " Preference" list.

Type in the name of the new "Preference."

Click here to load a set of tests previously defined as a

Click here to save current list as a

An established "Preference" can be opened by clicking on the "Load Preference" button and selecting it from the list which appea rs (as pictured below). All provocative tests associated with that "Preference" then appear in the dialog.
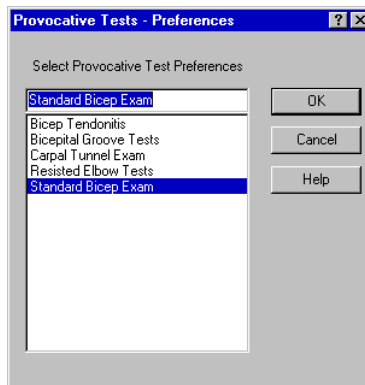
Documenting Test Results

Use the drop-down lists to document both the results of testing and any comments relative to the test. If the drop-down lists do not contain the results or comments you wish to use, simply type in the word or phrase you want, and i t will appear as part of the list box from that time forward.

Click on the downward arrows to select a result and a comment.

Click in the box and type in your own result for the current test and for in the future.

Drop down list automatically expands as more

Creating Custom Provocative Tests

Some of the provocative tests which you perform as part of your practice may not appear in the list supplied. The tests can easily be added to the database with the TRACKER system. Click "Setup," "Custom Tests," then "Prov ocative" respectively from the resulting menus.

To create your own custom tests, click here....

...then here....

...then here.
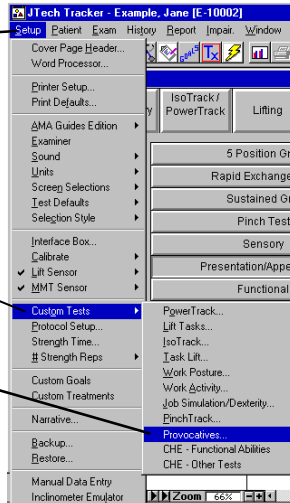
Note: JTECH can provide you with comprehensive libraries of various provocative tests to add to your database. Call 800-985-8324 or 435-657-2500 for more information.

When the following dialog appears, click "Add Test" to create a new provocative test.
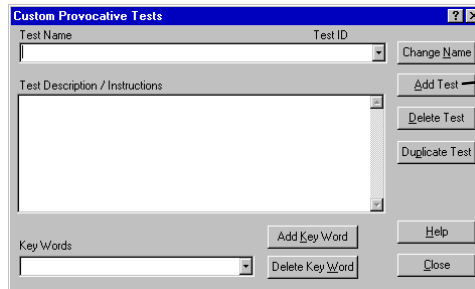
To create a new custom test, click "Add Test."

Type the name of the new provocative test. Click "OK" when finished.
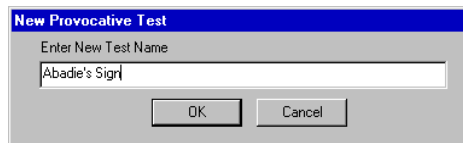
To include a test description, use the "Tab" key or click in the test description field. Enter any information about the test, i ncluding specific instructions, pertinent observations, and clinical significance of a positive finding. Click "Add Key Word" ea ch time you wish to add a related term to the search engine. Any keywords added automatically become part of the master drop - down list for future searches.

Click here to see list of keywords assigned to this new test.
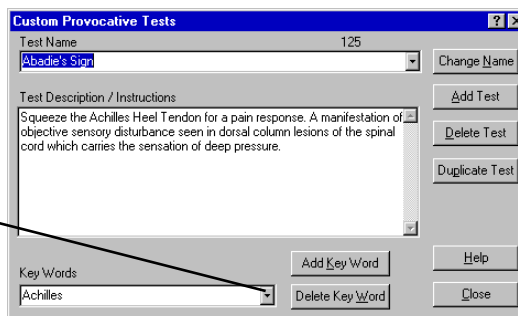
Existing tests can also be used as the basis for new tests. To do this, click on the downward arrow under "Test Name." From the resulting list, select a test which best resembles the new test you wish to create. Once selected, click "Duplicate Test." Once duplicated, highlight the new test and change its name by clicking "Change Name." Make the necessary modifications to the keywords and the test setup.

Changes name of highlighted test.

List of existing tests accessed by clicking here.

Deletes highlighted test from the database.

Duplicates highlighted test.

Custom Provocative Tests

Test Name   Test ID

Tinel's
Passive Cervical Lateral Bending
Passive Cervical Flexion
Passive Cervical Extension
Passive Cervical Rotation
Passive Scapular Approximation
Cervical Distraction
Cervical Compression
Resisted Cervical Lateral Bending
Resisted Cervical Flexion
Resisted Cervical Extension
Resisted Cervical Rotation
Spurling's Test
Elevated Arm Test

Change Name
Add Test
Delete Test
Duplicate Test
Help
Close

Delete Key Word

Chapter 2

Manual Entry of Tracker Data

The ability to manually enter data into the Tracker program provides the clinician with several testing choices, all of which ar e extremely advantageous. They include:

1. Tests performed with non -computerized tools such as JAMAR, Pinch, bubble inclinometers etc. can be documented with Tracker reporting capability and tracked with Tracker's progress analysis system.
2. Several patients can be tested simultaneously with data input occurring later.
3. Testing is not necessarily halted if the comp uter goes down.

To initiate keyboard entry of data , click on the button just to the left of the exit button on the Tracker toolbar, and select the desired test. Keyboard entry is active when this button is in the down position. The instruments are activ e if the button is in the up position.

Since manually entered data and instrument data use the same database, data collected vi a instruments will appear in the keyboard dialogs, and vice versa.

To initiate keyboard entry, click on this button , and then select the specific test to be performed.
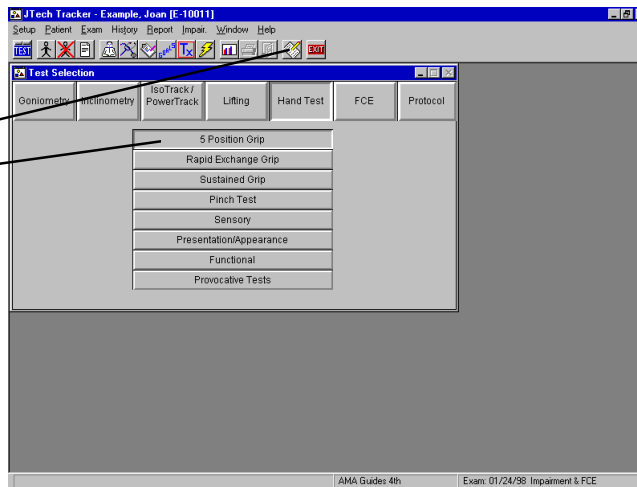
Keyboard entry button

Grip Data

Selecting "5 Position Grip", accesses the following dialog:

Click the mouse in the desired space and type in the corresponding data.

The CV is calculated automatically, and validity determined once a minimum of two reps have been added to a specific position. P opulation percentiles are also determined based on position 2 data if patient birthday information has been entered. Select the "Graph" button to see the force versus position graph and the possible presence of the characteristic bell -shaped curve. Refer to Module 8, Chapter 2 of the TRACKER User's Guide for more details on Grip Testing, validity determination, and the significanc e of the 5 position protocol.

The buttons in this dialog function as outlined below:

Graph	Display a graph of the patient's performance on the 5 position t est.
Defaults	This button controls the testing parameters such as number of repetitions, side(s) to be tested, and threshold.
Delete	To delete a specific data set, highlight the set and click "OK." To delete all tests, select "All" and click "OK." O nce data is deleted it cannot be recovered.
Notes	This button is used to add notes about a test.
Validity	This button denotes whether or not a test is valid, invalid, or undetermined in the "Validity Status" section of reports.
Close	Closes this dial og.

Rapid Exchange

Selecting the REG button results in the following dialog. Refer to Module 8, Chapter 2 of the TRACKER User's Guide for more deta ils on the REG protocol, validity determination and the test significance.

The buttons function as outlined below:

Position	Brings up a dialog that allows the REG test position selected by the software to be overridden.
Graph	Displays a graph showing results of the REG test.
Delete	Deletes all repetitions entered.
Notes	Add notes to the REG report summarizing test observations, etc.
Close	Closes current test.

Lift Data

Selecting "NIOSH Lift" from the Tracker test selection screen results in the following dialog.

Refer to Module 7, Chapter 2 of the TRACKER User's Guide for more background information on the Static Lifting protocols, statis tics, and validity determination.

Selecting the "Notes" button enables the examiner to indicate if repetitions showed signs for "ratcheting" (oscillations that ma y indicate submaximal effort), should be excluded from statistics calculations for any reason, and to enter comments. Clicking o n "Notes" displays the following dialog.

Check boxes are used to indicate if the repetition showed signs of ratcheting or if it should be excluded.

These boxes are used to enter comments. These comments are especially helpful when a repetition is excluded.

Pinch Data

Selecting "Pinch" from the Tracker test selection screen results in the following dialog.

Click the mouse in the desired space and type in the corresponding data. The CV is calculated automatically, and validity determ ined once a minimum of two reps have been added to a specific position. Custom Pinch tests are also included in the test selecti on list. Use the scroll bar to see additional tests if present. Refer to Module 9 for more information on the details of this di alog, the significance of pinch testing, and interpretation of the data.

The buttons in this dialog function as outlined below:

Norms   Accesses a dialog to view comparison of individual's data to that of published d a-
            tabase of norms.

Delete   To delete a specific data set, highlight the set and click "OK." To delete all tests,
            select "All" and click "OK." Once data is deleted it cannot be recovered.

Notes   This button is used to add notes about a test.

Close   Closes this dialog.

Muscle Testing Data

Selecting "PowerTrack" or "IsoTrack" from the Tracker test selection screen results in the following dialog. Select the tab cor responding to the anatomical structure to be tested. If custom tests have been defined, they appear under the tab labeled "Cust om."

Click the mouse in the desired space and type in the corresponding data. The CV and maximum percent difference are calculated aut omatically, and validity determined once a minimum of two reps have been entered into a specific test. Click on the radio button to designate left side versus right side data. If both sides have been entered, the deficit is calculated and displayed automat i-cally. Remove the check mark form the "Bilateral" box if the test is unilateral in design. Refer to Modules 4 and 5 for more information regarding manual muscle testing and isometric testing r e-spectively.

ROM Data

Selecting "Goniometry" or "Inclinometry" from the Tracker test selection screen results in the following dialog. Select the tab corresponding to the anatomical area to be tested. If custom tests have been defined, they appear under the tab labeled "Custo m."

Click the mouse in the desired space and type in the corresponding range of motion data. The validity is calculated automatically once a minimum of three reps have been entered. The sof t-ware will prompt the user for up to six reps until validity is achieved. If the impairment module is present as part of the system, the impairments are calculated and displayed automatically once validity is achieved. Refer to module 2 (Inclinometry) or module 10 (Goniometry) for more sp e-cific information on ROM protocols, validity determination, and/or impairment rating.

Chapter 3

EventTrack: Pain and Pulse Monitoring

Documentation of pain levels and heart rate during a test session is essential for functional capacity evaluations and procedure s used for medical-legal purposes. Each time it is activated, EventTrack creates a record in the database corresponding to the i nstant (day and time based on the computer clock) it is activated. The EventTrack is then used to enter heart rate, pain level, and other documentation. A report summarizing all documented times and events can be printed at the end of the test.

EventTrack (if enabled) begins when TRACKER is started. EventTrack can be located on the button bar of TRACKER, or it can be minimized t o sit on the Windows toolbar. Every time TRACKER is started, EventTrack remembers your preference for its location and status (v isible or minimized), and stays there until you move it.

EventTrack can be placed anywhere within the TRACKER screen, or minimized onto the toolbar.
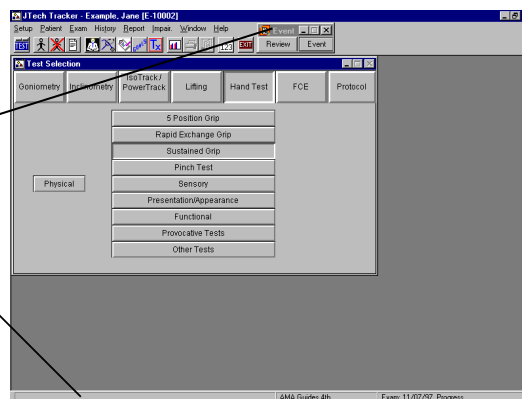
"Event" Button

To initiate the EventTrack dialog, a patient and exam must be selected. Click on the "Event Button" to access the data entry dia log with corresponding time and date information.

Click here to create the day and time stamp and access the dialog below.

Patient Name: Automatically entered based on patient selected within TRACKER.

Test Description: Automatically entered based on current exam.

Date/Time: Automatically entered based on current setting of system clock.

HR: If PulseTrack (JTECH's remote pulse monitoring system using Polar™ hardware) exists, a heart rate is entered into EventTrack automatically. Heart rate can also b e entered manually if PulseTrack does not exist or to overwrite the PulseTrack data if desired.

Pain: Pain levels (from 0-10) can be typed in or selected from the drop down menu.

When: Enter a significant descriptor used to identify event, e.g. "Star t of Grip Test..."

Comment: Enter up to 50 characters detailing the event or observation.

"Review" Button

Click here to see a log of previously entered data.

Clicking on the "Review" button displays a log of previous entries for this test session. A sample of the resulting dialog is pi ctured below. To delete an entry from the list, highlight it and click on the "Delete" button.

Chapter 1
Defining Goals and Treatment Plans

General Information

A significant component of reporting the results of your clinical evaluation focuses on providing documentation to the relevant parties (medical provider, referral source, insurer, case manager, etc.). Aside from actual results and findings of the evaluati on, the documentation should offer appropriate goals. The goals can be written to address the clinical findings associated with   the presenting problem, e.g. "Patient will be able to oppose thumb to within 5 cm of base of 5th digit by 2 weeks." The goals can also be written to focus on the implications of the clinical finding, e. g. "Patient will be able to perform ADL of buttoning shirt within 2 weeks." Long term goals can also be defined, such as "Increase thumb ROM to allow for full independence of dressi ng by week 8."

The course of action you intend to use in an effort to address any clinical findings and achieve the goals you've set for the patient is documented as part of the treatment plan. The treatment plan is typically documented on the initial ev aluation as a request for approval from the payer. Documenting and updating the treatment plan is also used as part of the SOAP or daily treatment note.

The TRACKER Goals & Treatment module automates the process of documenting and monitoring patient go als and treatment plans. Combined with the TRACKER Narrative Writer module, you can save valuable time in all phases of your cli nical documentation, especially your daily treatment notes.

Both goals and treatments can either be created specifically for th e patient, or generic ones can be selected from the included libraries. General goals and treatments can also be edited for specific patients and then saved to the respective libraries for future use. Goals can be updated or added in response to patien t progress as evidenced by re-evaluation. Goals that are not achieved need to be re-examined to provide a rationale for why. Pot ential modification of the goal can be explored at that time. If goals are consistently not achieved, then the effectiveness of   care should be considered and other means of intervention should be explored.

Documenting Goals

Creating a Goal List

To define a goal list for a patient who has already been selected, click on the button labeled "Goals" or select "Exam" and then "Goals" from the resulting menu. If a patient was not selected, the software will automatically prompt yo u to select one before entering the Goals dialog.

To initiate the goal creation dialog, click either here....

or here....

...then here.
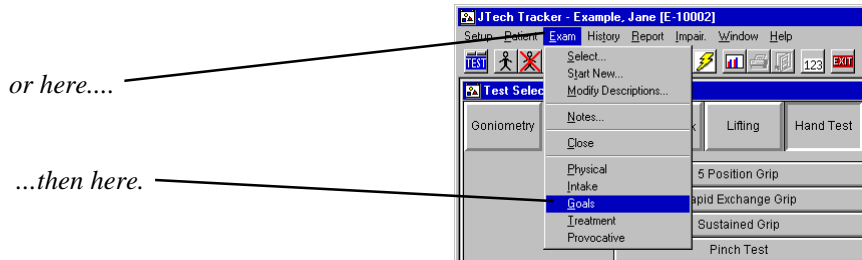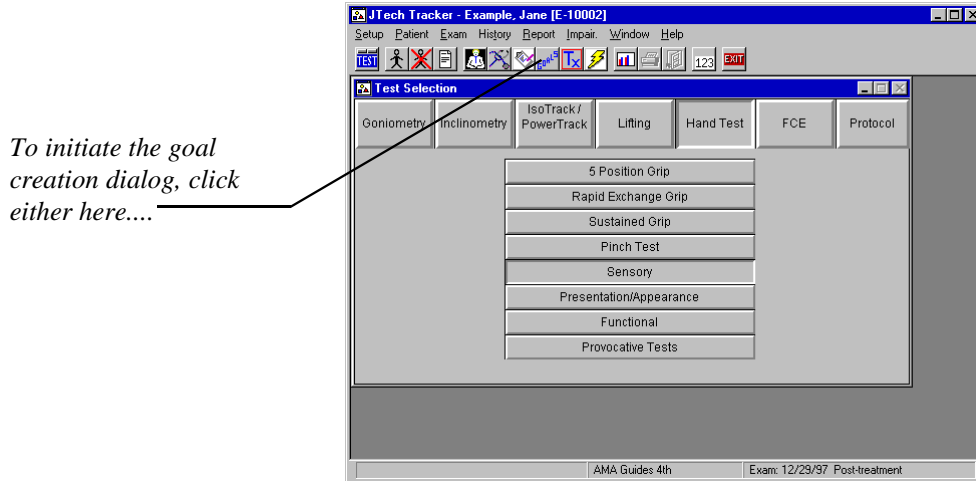
The following dialog appears. If goals have not been previously defined for the patient selected, the dialog appears empty as il lustrated below. If goals have been defined in a prior exam for the selected patient, the dialog is filled with the previously   entered data.
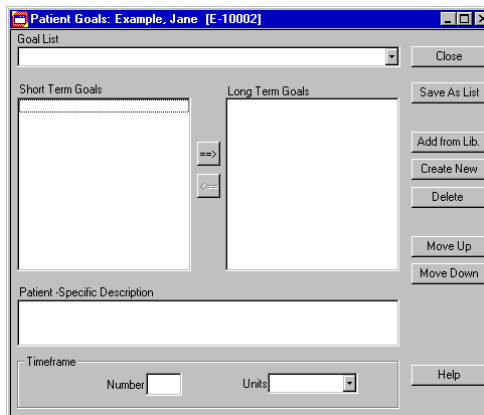
Select "Add From Library" to pick a goal(s) from the default list. This list can be added to by creating a custom goal (discusse d later in this chapter), or purchasing one of the Goals / Treatment Libraries from JTECH. Call 800 -985-8324 for more details.
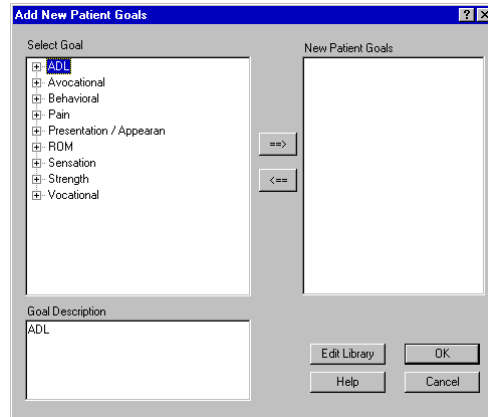
All items in the Goal Library are outlined in the "Select Goal" box. Those marked with a "+" are headings or subheadings which h ave a specific goal list attached. Double -click on these headings or subheadings to see the expanded list of goals. Add goals fr om the library to the "New Patient Goals" list by highlighting the desired selection and clicking on the button with the arrow pointing to the right. Both lists of goals only display up to 23 characters. If the goal is longer, it will appear cut off. When highlighted in the select goal box, the entire goal is displayed in the "Goal Description" box.

"**OK**" - saves the goals as part of the patient's data file and closes the dialog.
"**Cancel**" - ignores any changes and closes the dialog.
"**Edit Library**" - accesses the goals library. The resulting dialog can also be accessed by
            selecting "Setup" then "Custom Goals."

A "+" indicates there is a goal list under the heading/ subheading. Double click to see the list. A "-" indicates the list is already expanded to the fullest.

Full wording of the goal appears in this box.
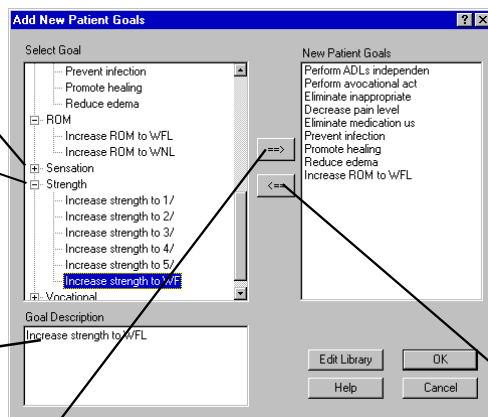
Click here to add the highlighted goal to the "New Patient Goals" listbox.

Click here to remove the highlighted goal from the "New Patient Goals" listbox.

All of the goals listed in "New Patient Goals" box are transferred to the "Short Term Goals" box as shown below. Highlight any g oals belonging in the "Long Term Goals" box and click on the button with the arrow pointing to the right.

Highlight any goals which belong in the long term goals list and click here.
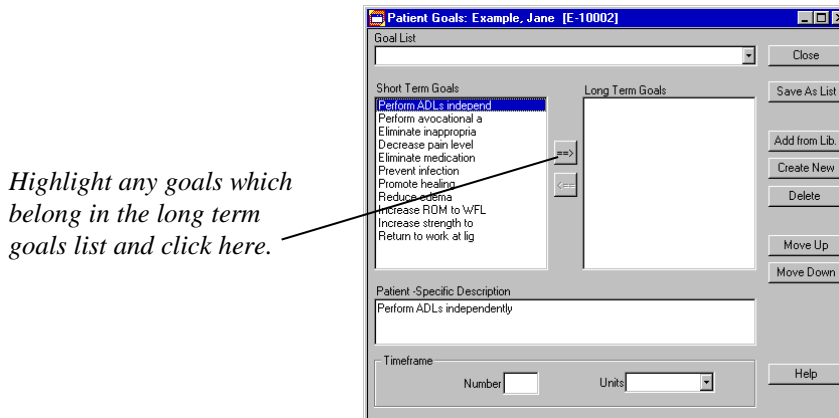
Attach a timeframe to a specific goal by highlighting the goal, selecting a unit from the "Units" dropdown list, and entering th e corresponding number in the "Number" box. This is illustrated below.

Click in here to add to the basic goal and customize it specific to the patient. Any custom changes will be saved for use as part of the next exam

Click on the downward arrow to see the dropdown list of available units.
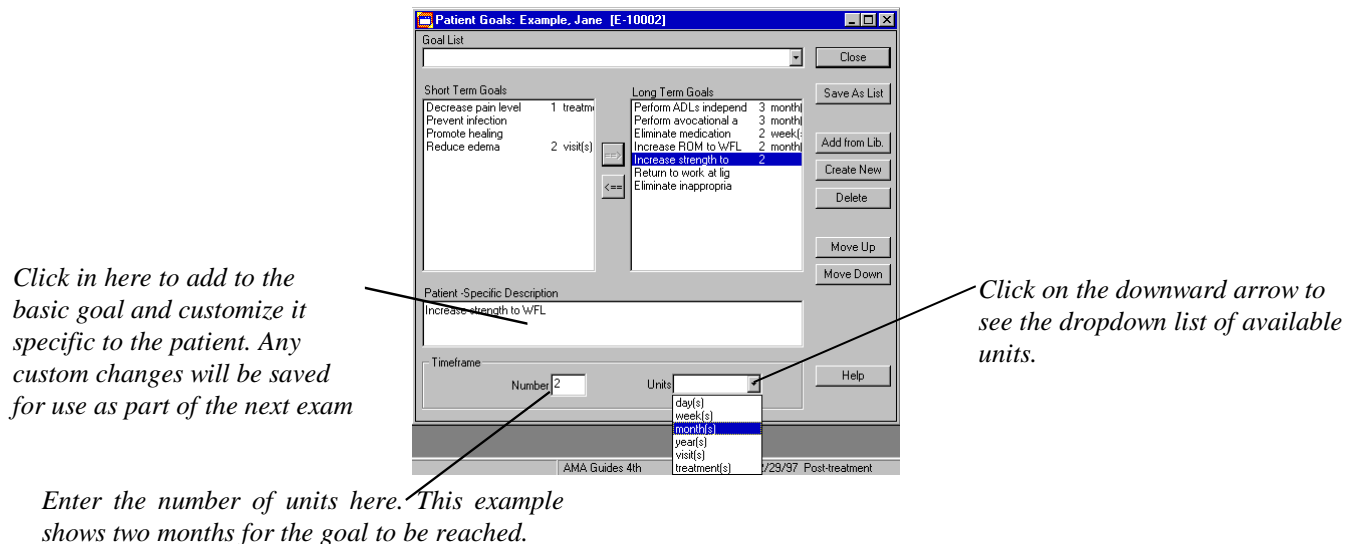
Enter the number of units here. This example shows two months for the goal to be reached.

Each goal is capable of being edited on a patient specific basis. To do so, simply place the cursor in the "Patient Specific Des cription" box and begin typing onto the end of the existing goal.

The button with the arrow pointing to the left, when pressed,   will move the highlighted "Long Term Goal" over to the "Short Term Goal" box. The other buttons function as follows:

Move Up: Moves the highlighted goal up one place in the list.
Move Down: Moves the highlighted goal down one place in the list.
Delete: Deletes the highlighted goal from the list.
Help: Accesses the TRACKER Help system and finds the Help text specific to this dialo g.
Close: Saves the Long and Short Term Goal Lists to the patient's database for reporting
          purposes and future use.

The "**Create New**" button allows the user to create a goal without having to access the library. This goal is specific to the sele cted patient and cannot be added to the library from this dialog.
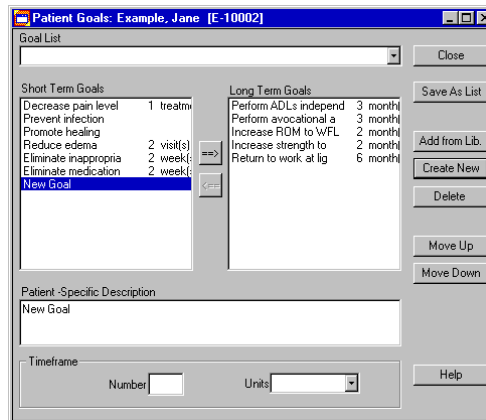
*Click here to create goals specific to the current patient.*

Highlight "New Goal" and place the cursor in the "Patient Specific Description" box to define the newly created goal.

The newly created list of goals is automatically saved for use with the next exam of this specific patient, but it can also be saved as a "Goal List" or template for all future patients. Click on the "**Save as List**" button to do this. A dialog will appear prompting   for a name for this template. Type the name of the new list and click "OK"

Type the name of the "Goal List" template to be used with other patients in
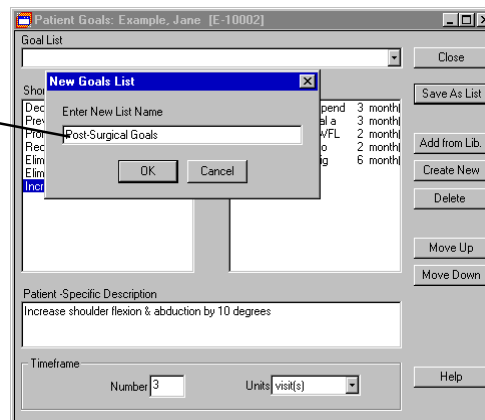
To access previously defined "Goal Lists," click on the downward arrow to see the dropdown menu. Select a template from the list   by highlighting it.
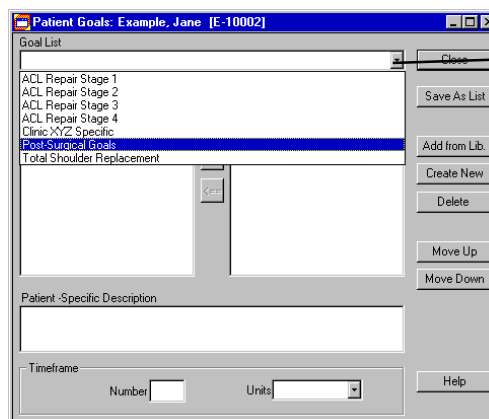
Click here to see a list of previously defined goal templates.

Creating Custom Goals

The TRACKER System is designed to provide the ultimate in flexibility for the user. By creating custom goals, the user can customize the available choices for documenting specific goals for special patient populations. To access this utility in the software, click on "Setup" at the main menu, then "Custom Goals" from the resulting menu.

To access the goal library or create new goals for future use, select here...

...then here.

The following dialog will appear. The standard library of goals will be visible in a tree structure format.
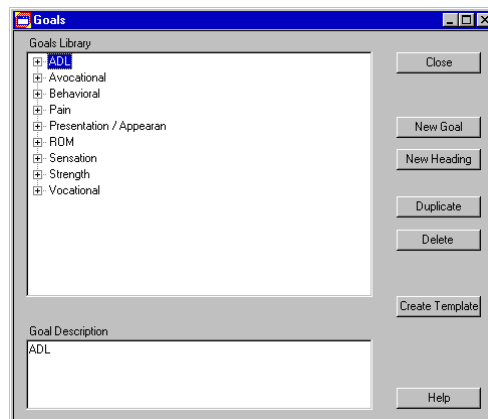
To add a new heading, or category of goals, highlight one of the existing headings and click on the "New Heading" button. Place the cursor in the "Goal Description" box and replace the "New Heading" text with the name of the new category of goals.
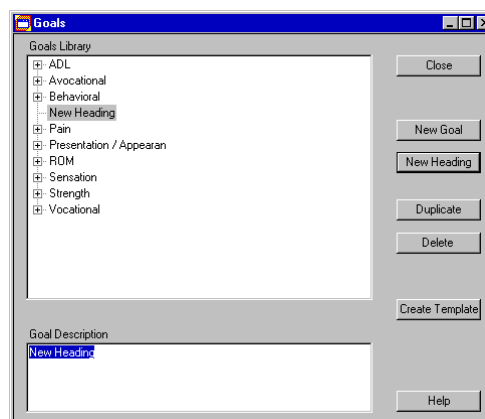
Once a heading has been defined, create goals under that heading by highlighting it, and clicking on the "New Goal" button. Defi ne the new goal by placing the cursor in the "Goal Description" box and replacing the "New Goal" text with a description of the   new goal. The goals library is only capable of displaying the first 23 characters of the goal description. The full description   will appear in the description box.

Only the first 23 characters of the goal are displayed, so these two goals appear to be the same. Refer to the "Goal Description" box to see the goal in its entirety.
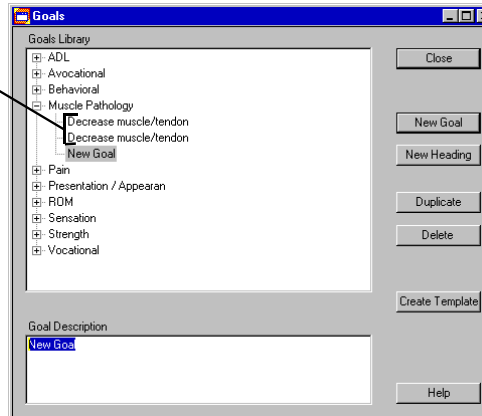
Note: As a general rule of thumb, "New Heading" creates a heading/goal at the same tier level as the highlighted item, while "New Goal " creates a heading/goal one tier below the highlighted item.

Documenting Treatment Plans

Creating a Treatment List

To define a treatment list for a patient who has already been selected, click on the button labeled "Treatments" or select "Exam" and then "Treatments" from the resulting menu. A patient must be selected before you can enter the treatment dialog.

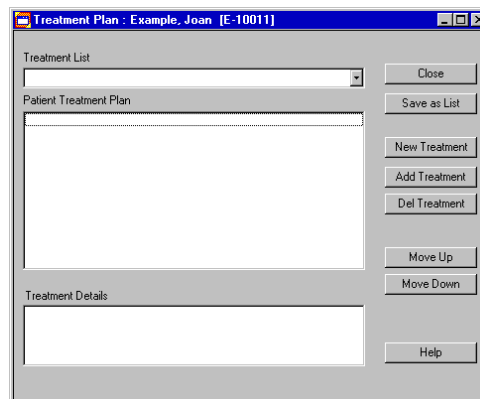*To initiate the treatment creation dialog, click either here....*
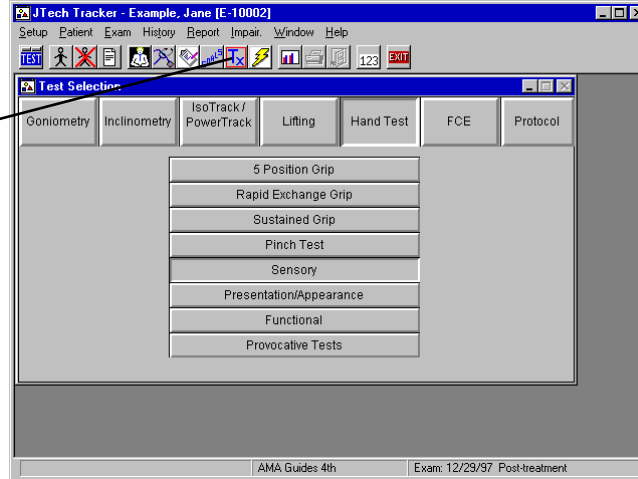

or here....

...then here.
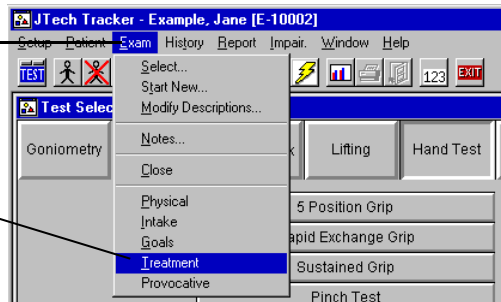
The following dialog appears. If treatments have not been previously defined for the patient selected, the dialog appears empty as illustrated below. If treatments have been defined in a prior exam for the selected patient, the dialog is filled with the p   reviously entered data.

Select "Add Treatment" to pick a treatment(s) from the default list. This list can be added to by creating a custom treatment (d iscussed later in this chapter) or by purchasing one of the Goals / Treatment Libraries from JTECH. Call 800 -985-8324 for more details.
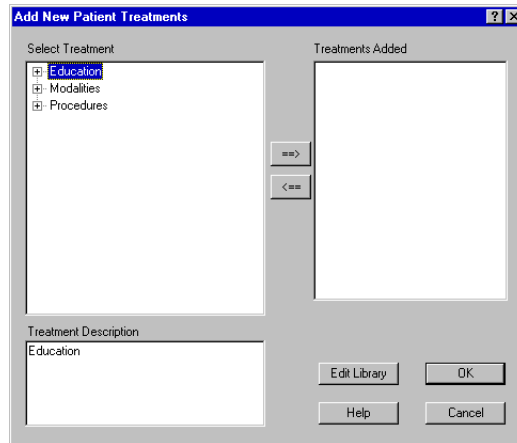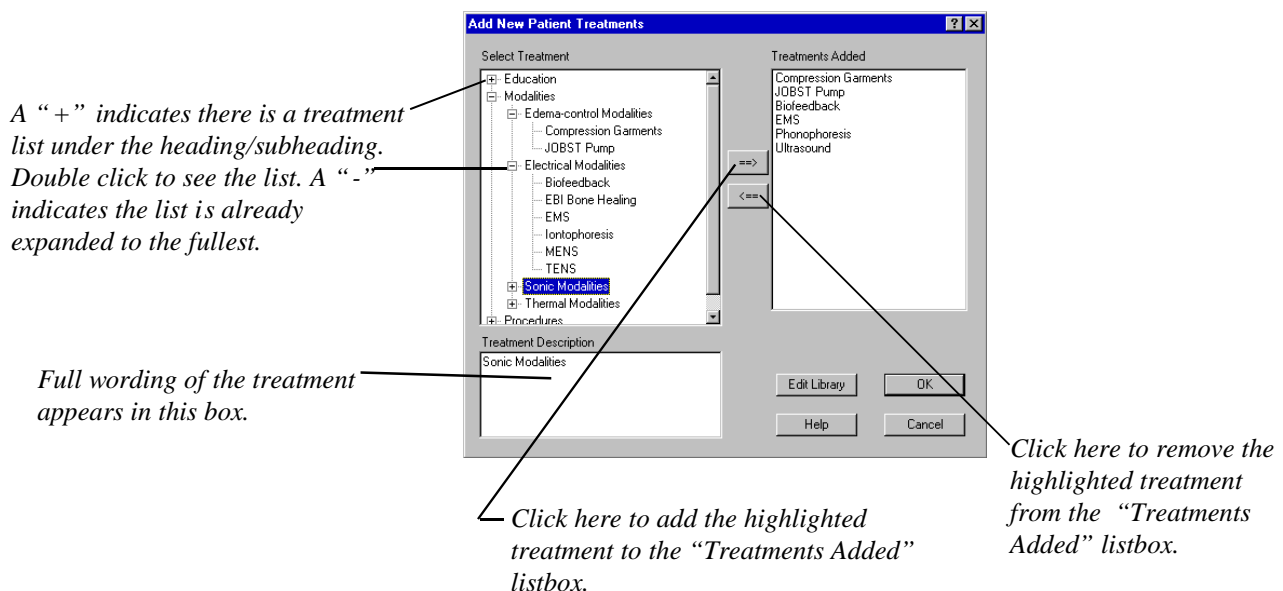

All items in the Treatment Library are outlined in the "Select Treatment" box. Those marked with a "+" are headings or subheadin gs which have a specific treatment list attached. Double - click on these headings or subheadings to see the expanded list of sele ctable treatments. Add treatments from the library to the "Treatments Added" list by highlighting the desired selection and clic king on the button with the arrow pointing to the right. Both lists of treatments only display up to 23 characters. If the treat ment is longer, it will appear cut off. When highlighted, the entire treatment is displayed in the "Treatment Description" box.

"**OK**" - saves the treatments as part of the patient's data file and closes the dialog.
"**Cancel**" - ignores any changes and closes the dialog.
"**Edit Library**" - accesses the treatment library. The resulting dialog can also be accessed by selecting "Se tup" then "Custom Treatments."

A " +" indicates there is a treatment list under the heading/subheading. Double click to see the list. A " -" indicates the list i s already expanded to the fullest.

Full wording of the treatment appears in this box.

Click here to add the highlighted treatment to the "Treatments Added" listbox.

Click here to remove the highlighted treatment from the "Treatments Added" listbox.

Click in here to add to the basic treatment and customize it specific to the patient. Any custom changes will be saved for use as part of the next
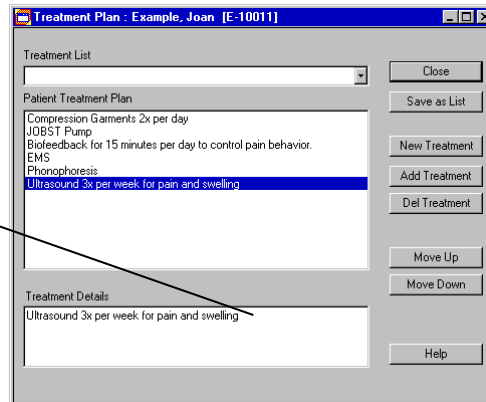
Each treatment is capable of being edited on a patient specific basis. To do so, simply place the cursor in the "Patient Specifi c Description" box and begin typing onto the end of the exisitng treatment.

The other buttons function as follows:

Move Up: Moves the highlighted treatment up one place in the list.
Move Down: Moves the highlighted treatment down one place in the list.
Delete: Deletes the highlighted treatment from the list.
Help: Accesses the TRACKER Help system and finds the Help text specific to this dialog.
Close: Saves the Treatment Lists to the patient's database for reporting purposes and future use.

The "**New Treatment**" button allows the user to create a treatment without having to access the library. This treatment is specifi c to the selected patient and cannot be added to the library from this dialog.

Once the new treatment has been created, define it by clicking in this box, and replacing "New Treatment" with the appropriate verbage.
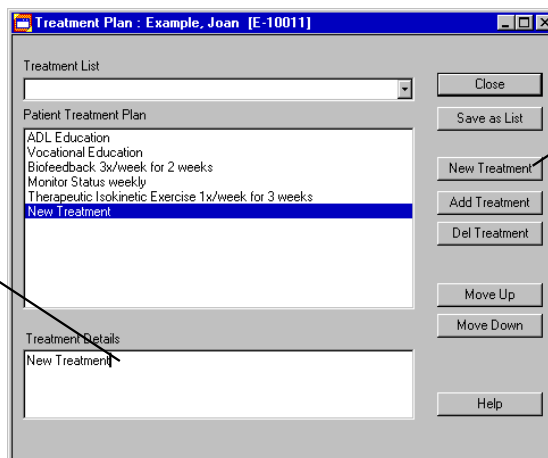
Click here to create a patient-specific treatment "on the fly."

Highlight "New Treatment" and place the cursor in the "Patient Specific Description" box to define the newly created treatment.

The newly created list of treatments is automatically saved for use with the next exam of this specific patient, but it can als o be saved as a "Treatment List" or template for all future patients. Click on the "**Save as List**" button to do this. A dialog wi ll appear prompting for a name for this template. Type the name of the new list and click "OK"

Type the name of the "Treatment List" template to be used with other patients in the future and click "OK."
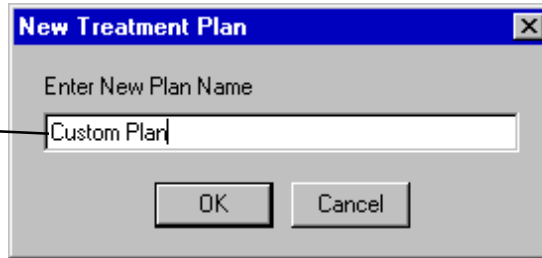
To access previously defined "Treatment Lists," click on the downward arrow to see the dropdown menu. Select a template from the   list by highlighting it.
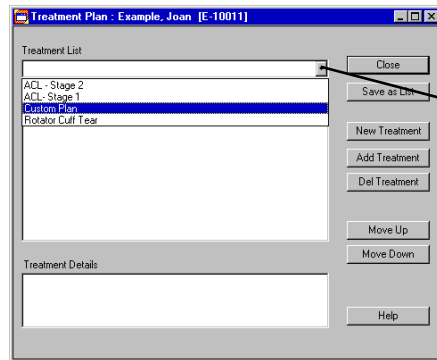

Click here to see a list of previously defined treatment templates.

Creating Custom Treatments

The TRACKER System is designed to provide the ultimate in flexibility for the user. By creating custom treatments, the user can customize the available choices for documenting specific treatments for special patient populations. To access this utility in the software, click on "Setup" then "Custom Treatments" from the resulting menu.

To acess the treatment library or create new treatments for future use, select here...

...then here.
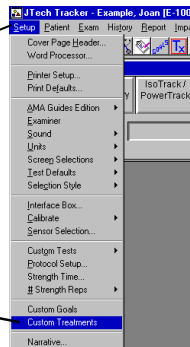
The following dialog will appear. The standard library of treatments will be visible in a tree structure format.
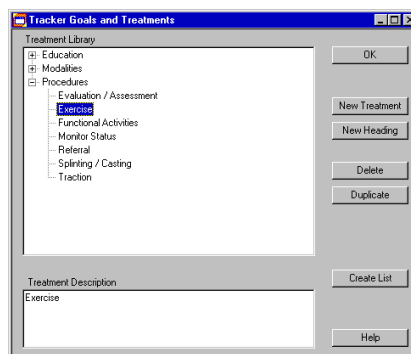
To add a new heading, or category of treatments, highlight one of the existing headings and click on the "New Heading" button. P lace the cursor in the "Treatment Description" box and replace the "New Heading" text with the name of the new category of treat ments.
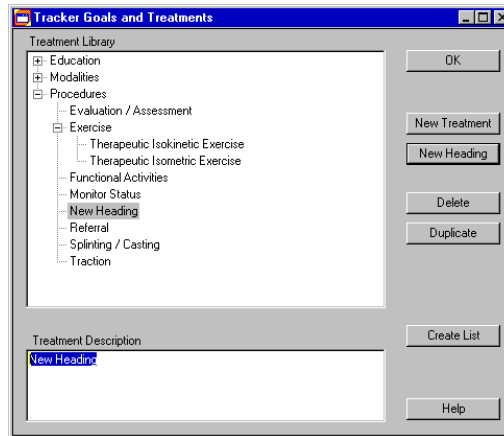
To create treatments under a specific heading, highlight the heading, and click on the "New Treatment" button. Define the new tr eatment by placing the cursor in the "Treatment Description" box and replacing the "New Treatment" text with a description of th e new treatment. The treatments library is only capable of displaying the first 30 characters of the treatment description. The full description appears in the description box.
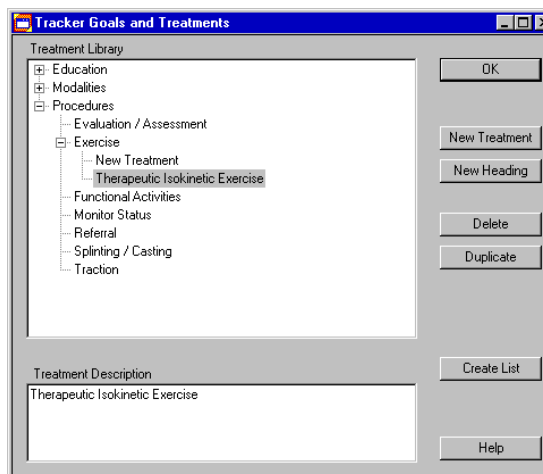
Note: As a general rule of thumb, "New Heading" creates a heading/treatment at the same tier level as the highlighted item, and "New T reatment" creates a heading/treatment one tier below the highlighted item.

Chapter 2
Narrative Writing

General Information

Aside from the adage "If it is not written, it did not happen," documenting the results of your clinical evaluation, (re)assessm ent, or daily treatment is necessary for many reasons. Documentation is needed to insure effective communication to all parties   associated with a given patient. Effective documentation of your exam findings and results sets the foundation for all of your clinical and administrative needs. Specifically, it sets the platform for reimbursement for your services. Any insurer, case mana ger, or third party payer involved in the case will need proof of care and a treatment plan before any action associated with re imbursement will occur. Your findings also need to be well documented and defined to inform the referral source as well as the other treating parties what your findings are along with your plan of care. It is also prudent to document that any risks or pote ntial contraindications have been explored and that any services intended or provided are not only safe but usual and customary.   The ability to create excellent documentation is based on the ability to convey concise, well defined and well thought out information that comprehensively address the individual's complaints, the referral's directives and the insurer's understanding of c are.

There is not a predetermined protocol which defines appropriate documentation in terms of inclusions, nature or length. Th is can only be defined by your clinic practice and its client driven needs. As a guideline, your documentation should note that   some form of health risk survey was performed, that a prescription for care was provided if appropriate, add that the individual understood the nature of the exam or care that was provided (some form of informed consent maybe appropriate in some cases). Al so note that some form of review of the medical or care history was performed. Clinically, you should document the nature of the   individual's complaints or symptoms, any relative medical history, the nature of your exam and the corresponding findings, your professional opinion as to what is the nature of the injury, insult or condition and lastly, your plan of care and the correspo nding goals associated with your intended care.

It is important to be as thorough and comprehensive as possible in terms of yo ur evaluation and documentation. However, time management is also a significant concern as a provider. It is important to strike a balance between these forces. The ability of the TRACKER to design user defined templates offers a compromise to combine thes e two directives. By being able to utilize user defined templates, you avoid documentation that appears "canned" and enjoy the comprehensiveness of documentation that follows your own typical style.
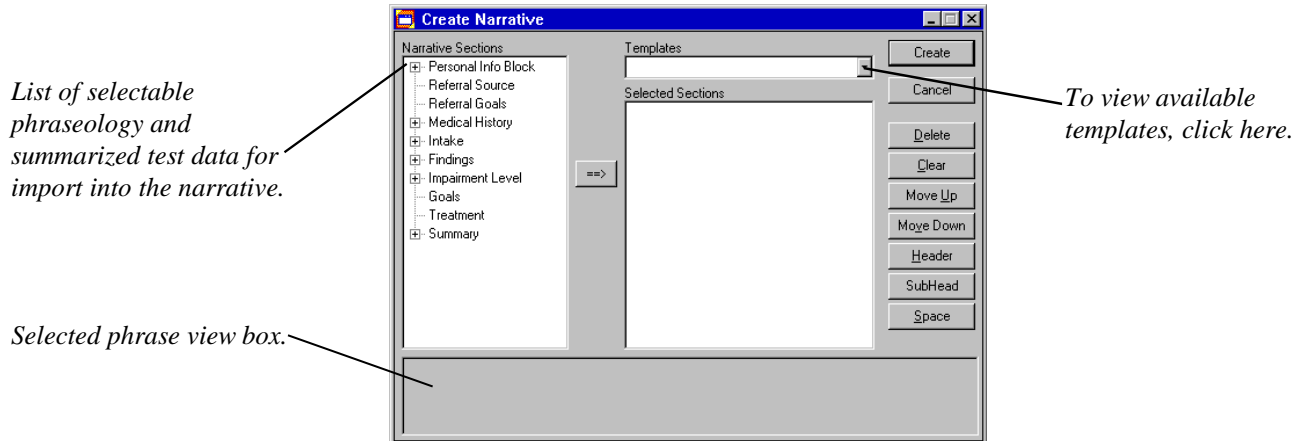
Using the Software to Create Narratives

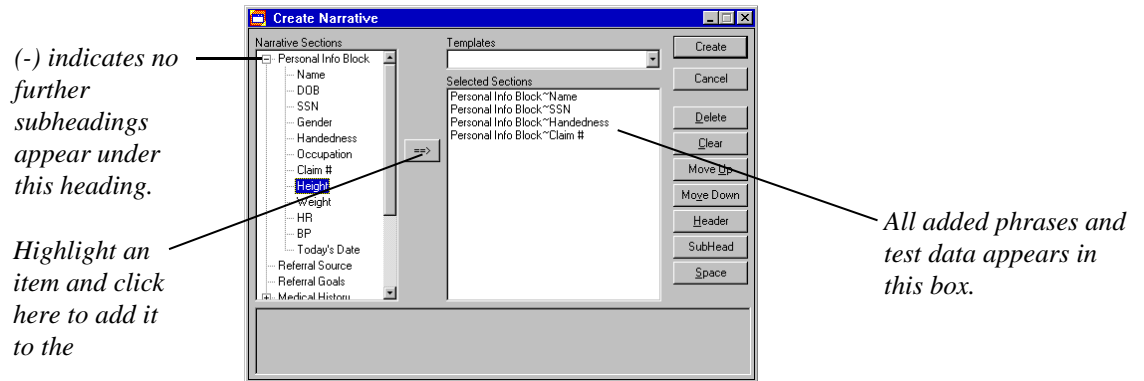To access the narrative writer, select here...

...then here.
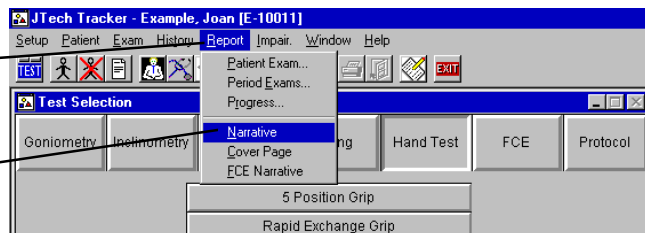
The following dialog appears. A narrative can be created by selecting choices from the list of standard phraseology on the left (labeled as "Narrative Selections"), or selecting a previously defined template. Click on the downward arrow in the "Templates" field to view all previously defined templates. The TRACKER system comes with standard templates. To purchase a comprehensive li brary of additional Narrative Templates and associated phraseology, contact JTECH at 800-985-8324 or 435-657-2500.

List of selectable phraseology and summarized test data for import into the narrative.

To view available templates, click here.

Selected phrase view box.

The "Narrative Selections" menu functions similar to other tree structures in Windows 95 applications (or like creating a protoc ol, if you have used TRACKER before). A plus (+) next to a heading indicates there are more listings under that specific heading . To view those listings, click on the "+". A minus sign (-) next to the heading, indicates that the heading has been fully revealed. Click on the " -" to display only the heading. Select a desired component of the narrative and highlight it with a sin gle click. Click the arrow button in the center of the dialog to add the chosen phrase to the narrative. All added phrases / dat a fields will be displayed in the "Selected Sections" field of the dialog. Repeat the process until all desired elements have be en added.

Use the buttons on the right -hand side of the dialog to control the appearance of the narrative. Button function is o utlined as follows:

Create: Create the narrative using the word processor identified in the "Setup" menu.
Cancel: Close the dia log without saving any changes.
Delete: Deletes highlighted phrase from the list.
Clear: Clears every selection from the list.
Move Up: Moves the highlighted sentence up in the list.
Move Down: Moves the highlighted sentence down in the list.
Header: Creates a user-defined header as part of the narrative.
Subheader: Creates a user-defined subheader as part of the narrative.
Space: Creates a blank between two consecutive sentences. Used to start a new
                paragraph.

(-) indicates no further subheadings appear under this heading.

Highlight an item and click here to add it to the

All added phrases and test data appears in this box.

A time-saving alternative to creating a narrative "on -the-fly", is to use one of the pre-defined templates which come with TRACK ER, or create your own. An example is shown below.


All available templates are listed as part of the drop-down list.
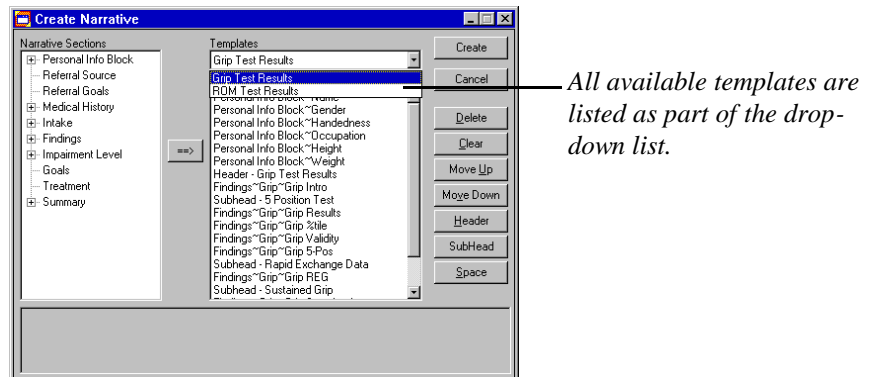
Select a template from the list and all components of that template will appear in the "Selected Sections" field. Highlight a sp ecific component of the selected template to view its verbage and/ or data contents in the text box at the bottom of the dialog.

*Data for selected narrative component visible in box below.*
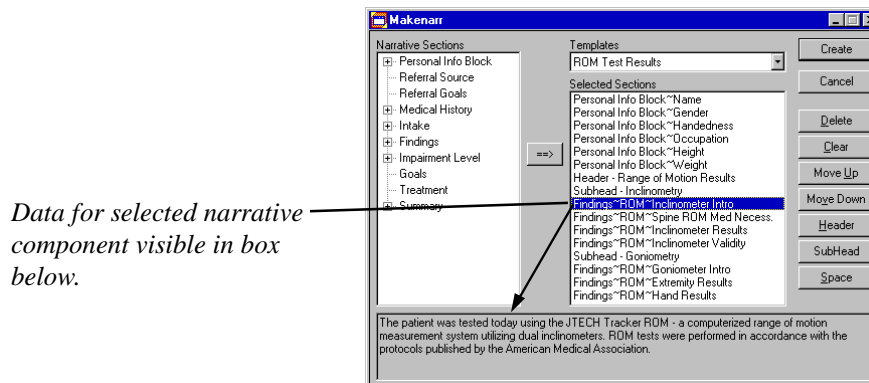
Click "Create" once the components of the narrative are arranged as desired. The narrative will be created in an RTF (Rich Text Format) file and imported into WordPad by default. TRACKER can be configured to automatically import the RTF file into the word processor you have loaded on your computer. See Module 1, Chapter 3 for more information.

Word processors such as Word and WordPerfect will convert the narrative to a proprietary file format. This conversion typically requires an acknowledgement from the user, as illustrated in the following dialog.
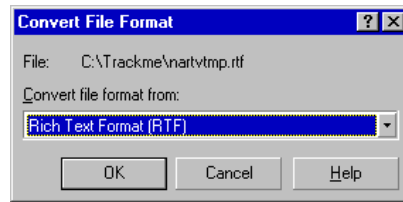
Once the narrative has been imported, the text can be edited and manipulated in the same manner as a normal word-processed document. The user can then save the file, print it out, or both. TRACKER stores the narrative in a temporary file (narrtmp.rtf), th erefore the file is overwritten each time a narrative is created.   JTECH recommends that you save your patient -specific narrative with a different name to prevent potential loss of data.
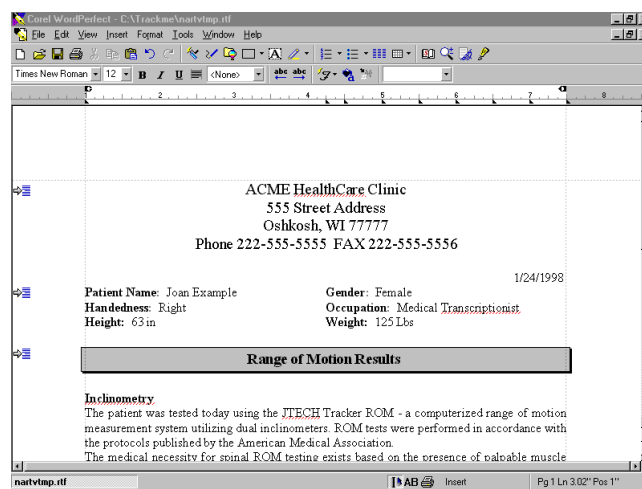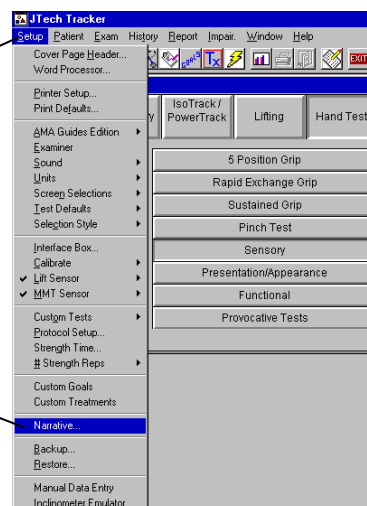

Creating Custom Templates and Phrasing

Custom Templates

Creating custom templates to meet your specific needs will make your documentation process much more efficient. To do this, sele ct "Setup" from the TRACKER pulldown menu items, and then "Narrative" from the resulting menu.

To create custom narrative templates, select here...

...then here.

The following dialog appears. Click "New Template" to intiate the process.
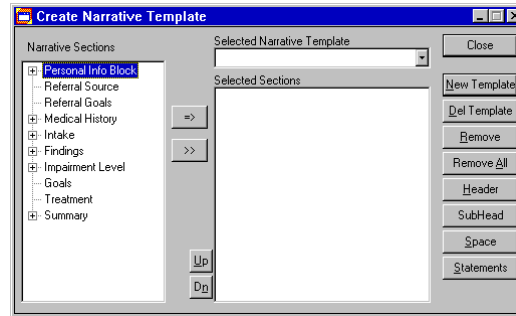
Type a name for the new template and hit "OK".

A narrative template is assembled by combining the desired components from the "Narrative Selections" field into the "Selected S ections" field. Select individual components by highlighting them and clicking the top arrow button (labeled "=>"). Clicking the   bottom arrow button (labeled ">>") will add all phrases / data fields to the "Selected Sections" field. Highlighting a heading (marked with a "+") will add all phrases/data fields under that heading to the "Selected Sections" field.

Note: If no data exists for a specific component, and it appears as part of the template, neither the verbage associated with that phrase nor the heading w ill appear.

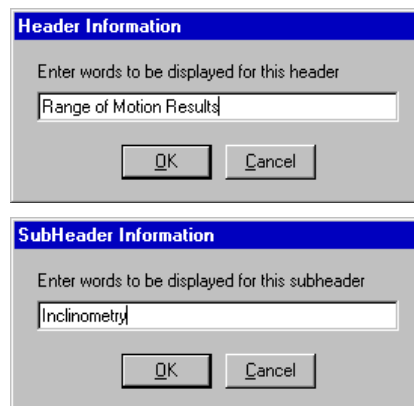*Highlight a specific component and click here to add it to the "Selected Sections" box.*

Click here to add all narrative components to the "Selected Sections" box.
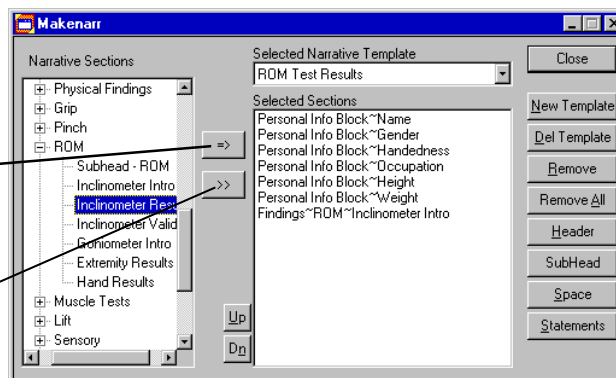
Use the dialog buttons to customize the template. Their action is as follows:

Close   Close the dialog without saving any chang es.
New Template Close existing template and create a new template.
Del Template Delete the highlighted template.
Remove   Remove the highlighted phrase / data field / header from the "Selected Sections"
                field.
Remove All   Remove all phrases / data fields / headers from the "Selected Sections" field
Header   Creates a user-defined header as part of the narrative. Header appears as a
                bolded, centered 16 point font which may have a shaded border (depends on
                word processor capability.)
Subheader   Creates a user-defined subheader as part of the narrative. Subheader appears as
                bolded 12 pt font, justified to the left.
Space   Creates a blank line between two consecutive sentences. Used to start a new
                paragraph.
Statements   Create new or edit existing phraseology .
Help   Access the Help system for more information.

Up   Moves the highlighted narrative component up in the list.
Dn   Moves the highlighted narrative component down in the list.

When the buttons are selected, the following dialogs appear to help define   headers and
subheaders, respectively.

Header Information

Enter words to be displayed for this header

Range of Motion Results

[OK]   [Cancel]

SubHeader Information

Enter words to be displayed for this subheader

Inclinometry

[OK]   [Cancel]

Existing templates can be edited in the manner outlined above. Click on the downward arrow to
see the dropdown menu of templates . Select the template to be edited from the list.

Custom Phrasing

TRACKER allows the user to create their own canned phraseology to summarize the results of testing or provide background informa tion to the reader about the tests performed. These phrases are then added to the narrative tree structure for future use. The d ialog to do this is accessed by clicking on the "Statement" button within the dialog below.
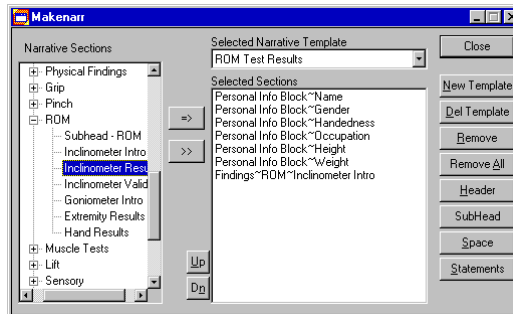
The following dialog is then used to either access existing statements within the library to be edited, or to create new stateme nts. To edit an existing statement, click on the downward arrow to see the pulldown menu of statements currently in the library.   Only those statements without any TRACKER variable input can be edited.
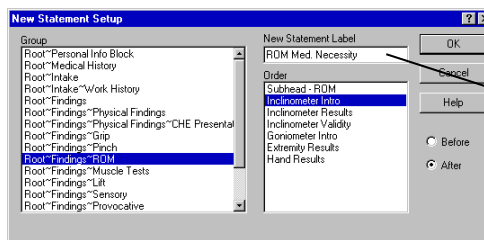
To edit an existing phrase, click your mouse within the white box and make the desired changes.
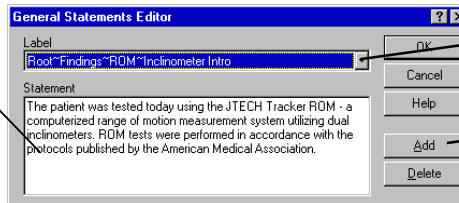
Click here to see existing phrases which can be edited.

Click here to add new statements to the narrative writer library.

To create a new statement, select the "Add" button in the dialog above. The following dialog appears.


*A name must be entered to proceed with this dialog.*

The preceding dialog is used to define the location of the phrase you wish to create within the tree structure. Select a heading you wish your statement to appear under in the tree by highlighting one in the "Group" field. Select the position of the phrase   relative to other statements within the group by highlighting a selection in the "Order" field and selecting the radio buttons corresponding to either "Before" or "After". Give the phrase an identifier by placing a name in the box marked "Label."

OK   Accesses the statement editor dialog with the newly created label.
Cancel   Ignores created labels and closes the dialog.

Once the name and location of the statement is defined, the following dialog appears. Click your mouse in the white edit box and begin typing the new statement.
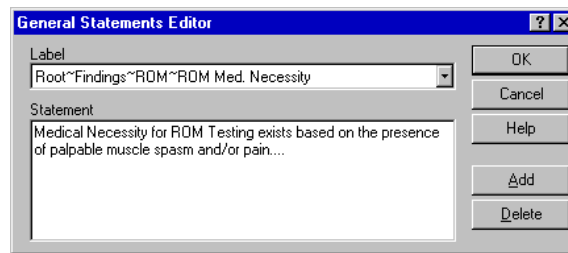
Once defined, the new statement is available for use in creating templates as illustrated below.
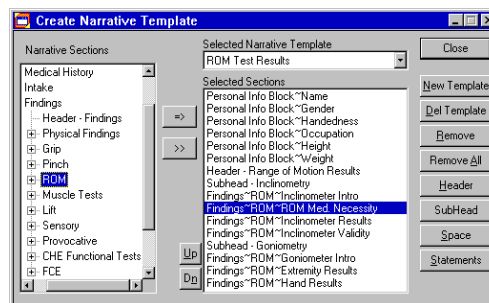
Upon closing the dialog, TRACKER asks if you wish to save the changes to the template.
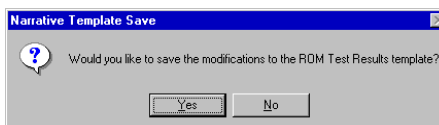
Chapter 3
TWCC-69 Form

Background Information

Per Rule 130.1 of the Texas Worker's Compensation Commission form TWCC -69 must be submitted within seven days after an examinati on if MMI (maximum medical improvement) has been reached. A copy of the form is submitted by the examining doctor to each of the   following:

> TWCC Field Office handling claim
> Insurance Carrier
> Injured employee and/or representative.

If the doctor filling out the form is not the treating doctor, a form must be sent to the treating doctor within seven days after the examinat ion. The treating doctor must then fill out section 22, state whether he/she agrees or disagrees with the examining doctor's cer tification of MMI and / or impairment rating, and send the form to the TWCC field office handling the claim.

TWCC also requires that a narrative history summarizing the employee's medical condition(s) and the worksheets used to determine whole body impairm ent be submitted with the TWCC -69 form.
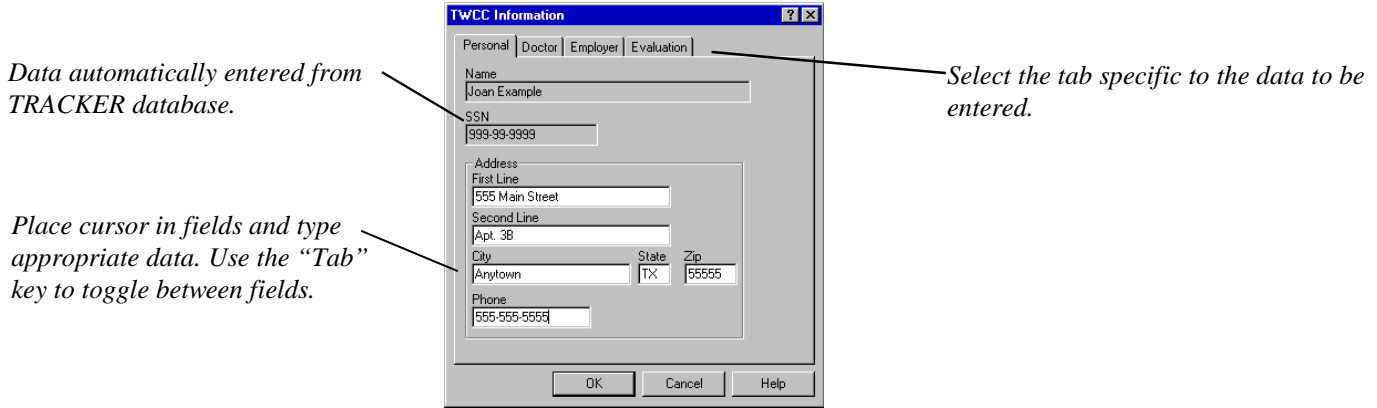
For Texas doctor's convenience, the TWCC -69 form has been added to the TRACKER syste m. Parameters matching the required input for the TWCC -69 form are automatically pulled from the TRACKER database and input on t he form. Those parameters not already part of the TRACKER database are added in a TWCC specific dialog.

The TWCC dialog is acce ssed in TRACKER by selecting "Exam" and then "TWCC -69" from

Select here....

*...then here.*
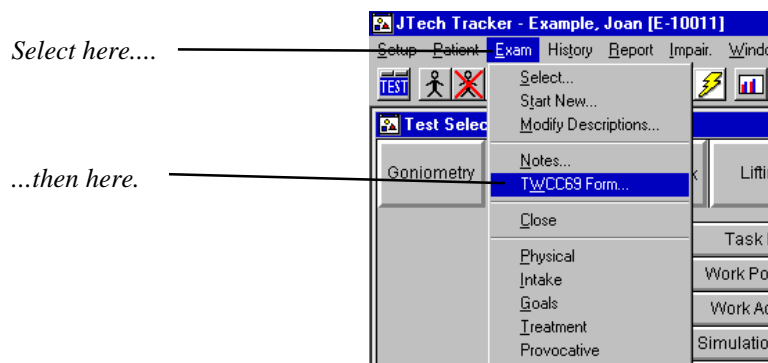
Entering Patient Information

At the TWCC-69 dialog, click on a "tab" to access the data fields corresponding to that tab. To enter data into a specific field , place the cursor into that field and begin typing. Use the "Tab" key to toggle between fields. Hitting the "Enter" key saves t he data and exit the dialog. The "Close" button also saves all changes to the data and exits the dialog. "Cancel" ignores all changes and exits the dialog. "Help" accesses the TRACKER Help System specific to this dialog.

Data automatically entered from TRACKER database.

Select the tab specific to the data to be entered.

Place cursor in fields and type appropriate data. Use the "Tab" key to toggle between fields.

The "Personal" tab, as shown above, requires information for the patient, including: name (from TRACKER), Social Security number (from TRACKER), address with zip code, and current phone number.
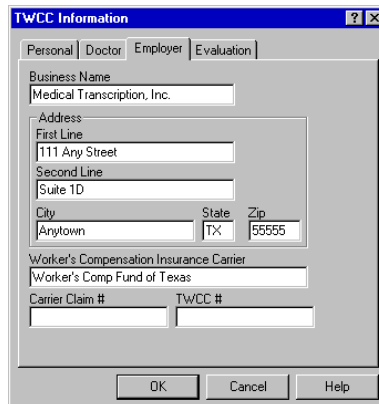
Entering Examining Doctor Information

The "Doctor" tab shown below, requires information about th e examining doctor. Data required includes: Name (from TRACKER), title, specialty (if applicable), address with zip code, phone number, professional license number, and federal tax identification number.
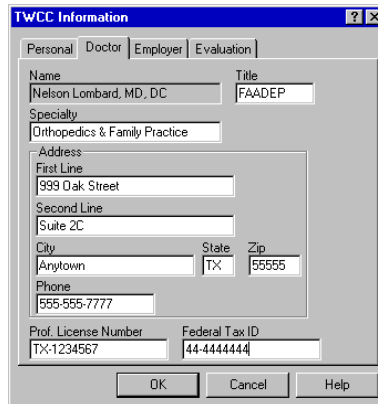
Entering Employer Information

The "Employer" tab shown below, requires information about the employer. Data required includes: employer name, employer address including zip code, name of the workers' compensation carrier at the time of the patient's injury, including occupational disea se. If the carrier's claim number and/or TWCC number are known, enter the numbers in the space provided. If numbers have not bee n assigned, leave the fields blank.

Entering Examination Information

The "Evaluation" tab, shown below, requires information about the patient's condition. Data required includes: date the injury o ccurred or occupational disease was diagnosed, date of visit, and impairment rating (all from TRACKER). According to TWCC rules,   the impairment rating is "based solely on the compensable injury, stated in terms of whole body impairment" and must be calculated using the AMA's *Guides to the Evaluation of Permanent Impairment*, third edition, 2nd printing, February 1989.

Diagnoses

Up to four diagnoses related to the compensable injury can be documented. The TRACKER medical database has three fields and are imported   into the data fields below. The TWCC -69 form requires the diagnoses be entered via ICD -9 codes, with field (1) being the primary diagnosis.

Click on the arrows to see the list of choices.

ICD-9 code should be entered in a xxx.x format.
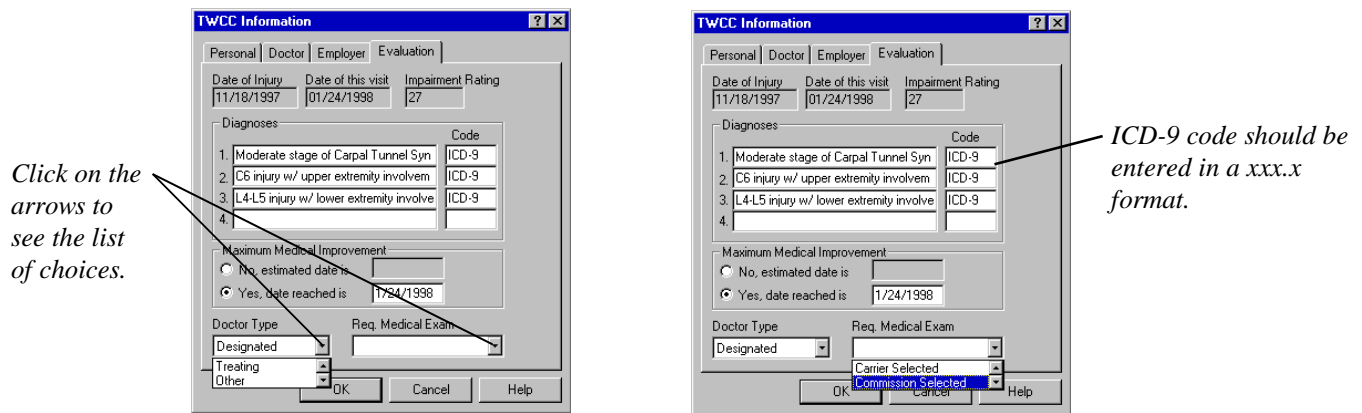
Maximum Medical Improvement

A statement regarding maximum medical improvement (MMI) is also required. MMI is defined as the "earliest date after which, base d on reasonable medical probability, further material recovery from or lasting improvement to an injury can no longer reasonably   be anticipated; OR the expiration of 104 weeks from date on which income benefits began to accrue." Clicking on the "Yes" radio button is "formal assertion of medical facts or expert opinion by a doctor supporting or relating to MMI." Once a radio button is selected, the coresponding date field becomes active. If "No" is selected, enter the date you anticipate the patient will be   at MMI. If "Yes" is selected, enter the date the patient reached MMI (cannot be prospective).

Doctor Type

"Doctor Type" is also required for TWCC-69. Click on the dropdown menu to see available selections. These include:

Treating: "Doctor primarily responsible for employee's injury -related health care."

Designated: "Doctor appointed by mutual agreement of parties or by commission to resolv e a dispute about employee's medical condition."

Other: "Consulting doctor; referral doctor; or other doctor licensed and author ized to practice and who examines employee for a compensable injury."

Document if the doctor was selected by the carrier or the Commission using the dropdown menu labeled "Required Medical Examination."

REQUIRED INFORMATION

1. Injured Employee's Name	Injured person's complete name.
2. Social Security Number	Injured person's Social Security Number.
3. Date of Injury	Date the injury occurred or date an occupational disease was diagnosed.
4. Injured Employee's Mailing Address	Injured person's address including ZIP code.
5. Phone Number	Injured person's current phone number.
6. Employer's Business Name	Business name of employer for whom the person worked at the time of injury.
7. Workers' Compensation Insurance Carrier	Name of workers' compensation carrier at time of the person's injury, including occupational disease.
8. Employer's Mailing Address	Employer's address including ZIP code.
9. Doctor's Name, Title and Specialty	Name of doctor who conducted the exam and doctor's title and specialty, if applicable.
10. Date of this Visit	Date person examined for purposes of this report.
11. Doctor's Mailing Address	Doctor's address, including ZIP code.
12. Doctor's Phone Number	Doctor's office phone number.
13. Professional License Number	Doctor's professional license number.
14. Diagnosis (ICD-9 Codes)	ICD-9 code for each diagnosis related to the compensable injury with (1) as the primary diagnosis.
15. Federal Tax Identification Number	Doctor's federal tax identification number.
16. Narrative History	Narrative history of person's medical condition including information requested in a, b and c.
17. Maximum Medical Improvement	Earliest date after which, based on reasonable medical probability, further material recovery from or lasting improvement to an injury can no longer reasonably be anticipated; **OR** the expiration of 104 weeks from date on which income benefits began to accrue. To certify means formal assertion of medical facts or expert opinion by a doctor supporting or relating to maximum medical improvement.
18. Impairment Rating	Impairment rating based solely on the compensable injury, stated in terms of whole body impairment; determined by using correct edition of AMA "Guides to the Evaluation of Permanent Improvement."
19. Doctor Type	***Treating:*** Doctor primarily responsible for employee's injury-related health care. ***Designated:*** Doctor appointed by mutual agreement of parties or by commission to resolve a dispute about employee's medical condition. ***Other:*** Consulting doctor; referral doctor; or other doctor licensed and authorized to practice and who examines employee for a compensable injury. ***Required Medical Examination:*** Doctor selected by carrier or commission to resolve questions on the appropriateness of health care, impairment, maximum medical improvement or similar issues.
20. Signature of Doctor	Signature of the doctor who conducted the examination.
21. Date of this Report	Date report completed. The report must be sent no later than 7 days after the examination to the employee, employee's representative if any, carrier, commission field office handling claim, and treating doctor if any doctor other than a designated doctor certifies maximum medical improvement.
22. Treating Doctor's Certification of Maximum Medical Improvement and/or Assigned Impairment Rating	Statement indicating treating doctor's agreement with certifying doctor's certification and impairment rating; or statement indicating treating doctor's disagreement with either the finding that employee has reached maximum medical improvement or impairment rating assigned by certifying doctor in accordance with Rule 130.3(b).
23. Signature and Printed Name of Treating Doctor	Signature and printed name of treating doctor.
24. Date Signed	Date report is signed by treating doctor.

TWCC-69 (Rev. 5/94)   **Rule 130.1**   **TEXAS WORKERS' COMPENSATION COMMISSION**

Printing TWCC-69

To print the completed form, select "Report," then "Patient Exam" from the resulting menu as pictured below.
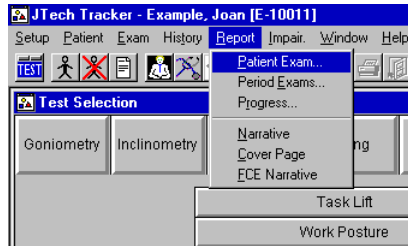
Select "TWCC-69" from the list of available printouts as shown below. Once printed, the examining doctor must sign and date the   form and send a copies of it within seven days to the field office handling the claim, the carrier, the employee, the employee's   representative (if any), and the treating doctor (if applicable) as outlined earlier. Remember to attach a copy of the narrative outlining the employee's medical history as it relates to the claim and the worksheets showing the impairment calculat ion.
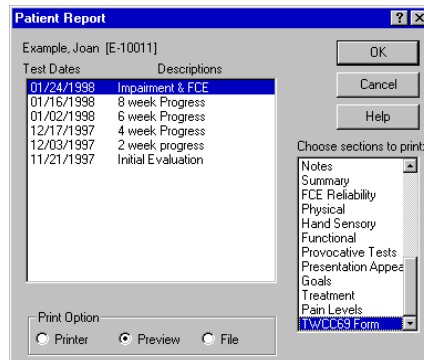
Chapter 1
The Tracker CHE System

Components of a Hand Evaluation

In 1981, the American Society of Hand Therapists (ASHT) assembled their first committee of experts to create a document to stan dardize protocols used to evaluate a patient with a hand - injury. The *Clinical Assessment Recommendations, 2nd edition* (1992) summarize those findings. Standard protocols have been established for evaluating the following:

> Edema
> Wounds and Scar s
> Vascular Assessment
> Grip Strength
> Range of Motion
> Sensibility
> Dexterity
> Function

Componen ts of the Tracker System can be assembled to create various levels of hand evaluation. The Tracker CHE system provides the clini cian with a comprehensive system which satisfies the recommendations of the ASHT.

The Tracker CHE consists of instruments and modules designed to save the clinician valuable time in the evaluation and documentation of the hand -injured patient. The syste m includes:

> GripTrack Grip Strength Dynamometer
> PinchTrack Pinch Strength Dynamometer
> RangeTrack Electrogoniomet er
> Tracker interface and software
> Sensibility evaluation tools and software
> Dexterity and functional status softw are
> Provocative Testing with CHT -specific library of tests
> Presentation / Appearance documentation
> Goals and Trea tment Documentation
> Narrative Writer

Refer to each respective module in this manual for more information on these individu al components.

Chapter 1
Custom ROM

Background Information

Most all of the protocols for specific ranges of motion which are measured via the inclinometer or goniometer in Tracker softwar e follow the requirements set forth in the AMA's *Guides to the Evaluation of Permanent Impairment.*. The motions measured and the validity determination are dictated by the *Guides*. Frequently, as a clinician, you may want to measure motions which are not part of standard protocols, or you may want to only perform a single rep instead of three. Conversely, you may want to perform thr ee reps for an extremity ROM and perform a validity check on the data. In response to the input we have received over the years, we have created a module which allows the clinician to dictate the motions and protocols used. Custom ROM module can be used with either the RangeTrack goniometer, or the Tracker ROM inclinometers.

Using the Dialog

Once a patient and exam have been selected, initiate the custom ROM dialog by selecting "Custom ROM" from either the Inclinometr y or Goniometry Test Selection menus.

Select "Custom ROM" from either Inclinometry or Goniometry.
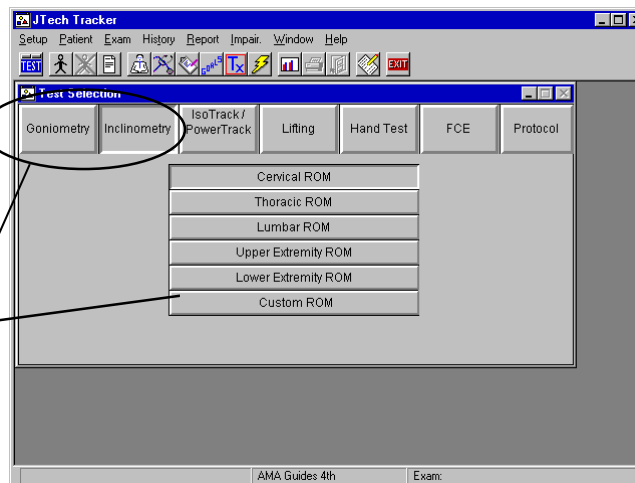
The following dialog will appear. Highlight the test to be performed and click "Test." If you wish to perform all of the tests o n the list, click "Test All." If no tests have been created, the white box will be blank.
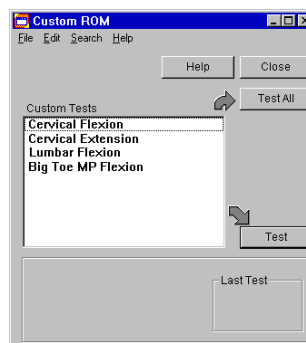
The dialog for the custom ROM data acquisition is similar to that of the Goniometer or Incl i-nometer screens. The software walks the examiner through the test as the user defined it when the test was created via prompts i n the white box. There are no voice prompts with the custom ROM however.
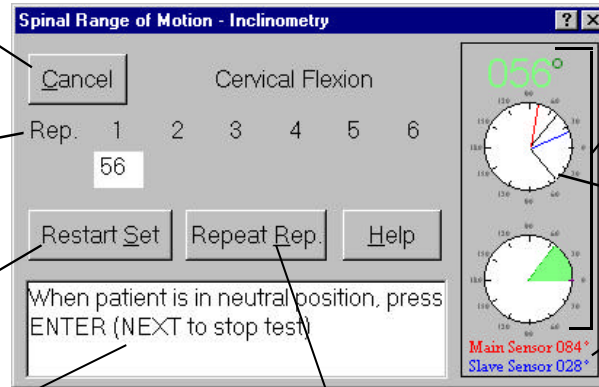
"Cancel" deletes all repetitions completed and returns you to the previous screen.

Number of repetitions dependent upon amount requested in setup of custom test.

Deletes all completed repetitions and returns to rep 1.

Follow prompts in this box to complete the test.

Deletes current repetition and starts it again.

Numeric and graphic display of the differential angle between the main and slave sensors for inclinometer and/or angle b e t w e e n   a r m s   o f

Display of norm based on user input in Setup.

Numeric and graphical displays of the angle of both the main and slave sensors from neutral position for inclinometry (no display for goniometry test).

Creating Custom ROM Tests

To create a custom ROM test, click "Setup" from the Tracker menu item line, then "Custom Tests", and "Range of Motion" from the resulting menus, respectively.
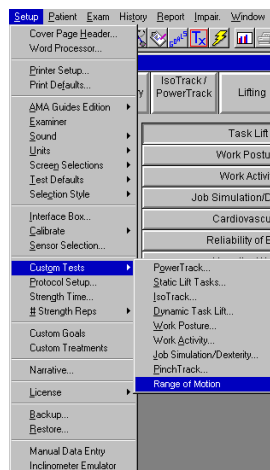
The following dialog appears. To create a new custom test, click "Add Test" and enter the name of the new test in the dialog box which appears. To edit an existing test, click on the downward arrow to see the list of previously created custom ROM tests.
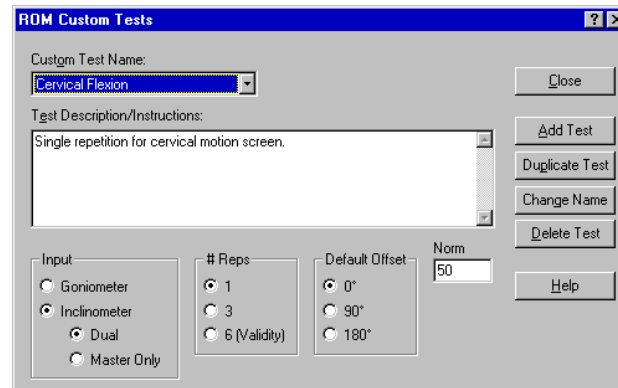
Click the mouse into the white edit box to define the test protocol or provide background info r-
mation to the examiner for standardization.

Click the mouse in the appropriate radio buttons to define the following:

Input   Choose either the Goniometer or Inclinometer. If Inclinometer, dictate if both
                 sensors are to be used or just the main sensor.

# of reps   Select either 1, 3, or up to 6. By selecting "Up to 6", you are telling   the software
                 to calculate validity after a minimum of 3 reps. If validity is achieved, the test
                 ends. Otherwise, the software wi ll prompt for up to 6 reps to achieve validity.
                 The validity used is the same as the AMA Guides 4 th Edition for spine ROM, i.e.
                 3 consecutive reps within 5 degrees or 10% (whichever is greater) of the average.

Default offset   The starting orientation of the goniometer arms or zero point from which the
                 ROM is measured.

Normal   Enter the normal value (if one exists) for the custo m test and it will be printed on
                 the report.

Use the additional buttons in the dialog to perform the following:

Duplicate Test   Copies the parameters of the highlighted test into a new test that you name.
Change Name   Change the name of the highlighted t est.
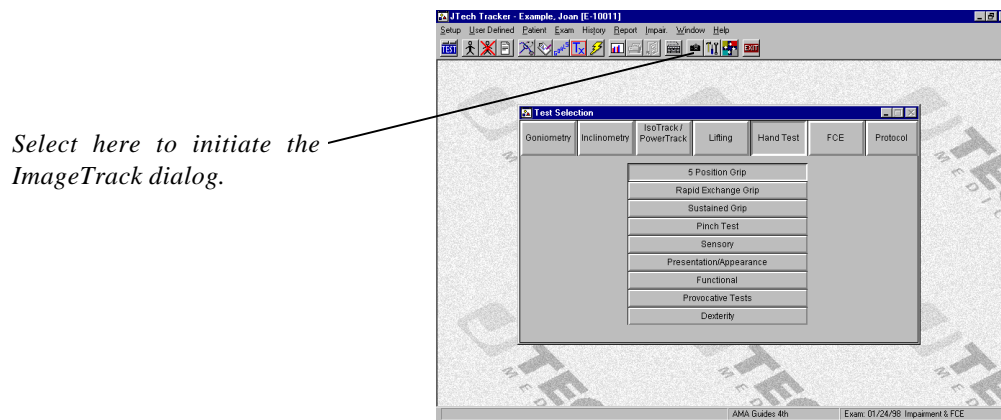Delete Test   Delete the highlighted test from the list.

Chapter 1
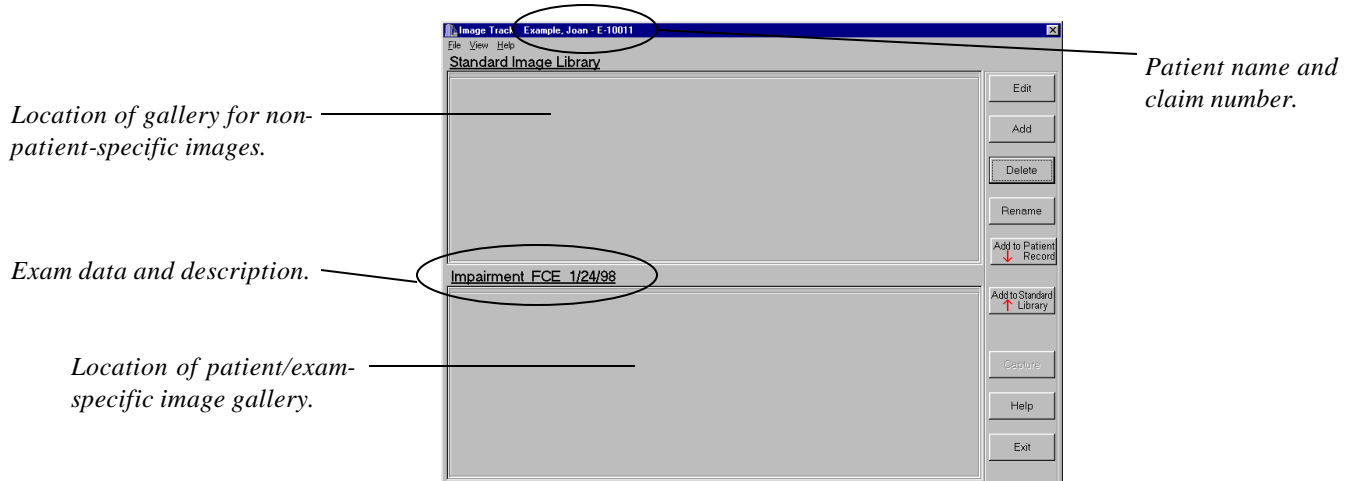# Documentation with Digital Images

Background Information

ImageTrack allows the user to import either bitmap, JPEG, TIF, or GIF images into its software. With ImageTrack, these images can be annotated, incorporated into Tracker history data, printed as part of the Tracker report, re-output as bitmaps for other applications, and included in Tracker narrative r e-ports. The source of the images can be a digital camera (we recommend the Sony Mavica), a scanner, or any electronic media (clipart, etc.). This flexibility makes I mageTrack a very versatile tool in the p a-tient documentation process. With ImageTrack, your r eports can now include several photos of the patient's current status, a whole history of photos documenting the patient's progress over time, and visual comparisons of patients to a "normal" condition.
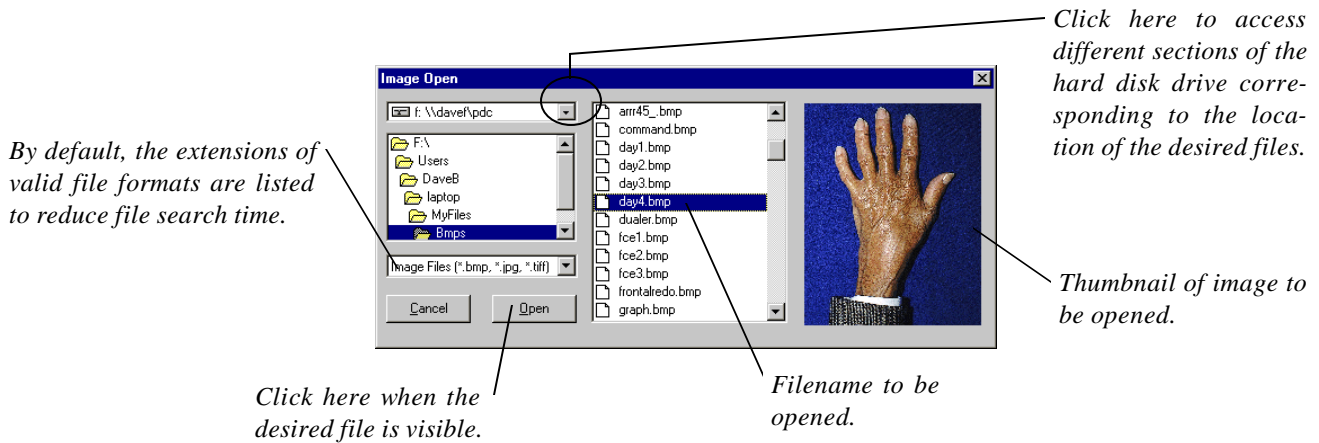
Using ImageTrack Software

Once a patient and exam have been selected, initiate the ImageTrack dialog by selecting the bu tton re-

Select here to initiate the ImageTrack dialog.

The following dialog appears.…

Patient name and claim number.

Location of gallery for non-patient-specific images.

Exam data and description.

*Location of patient/exam-specific image gallery.*

Images can be added to the database as part of a standard library which is accessible for all patients, or into a patient/exam-specific section. To add to either section, click the mouse in the desired section (insure the header is highlighted in blue) and click the "Add" button. The following dialog appears....

Click here to access different sections of the hard disk drive corresponding to the location of the desired files.

By default, the extensions of valid file formats are listed to reduce file search time.

Thumbnail of image to be opened.

Click here when the desired file is visible.

Filename to be opened.

Find the filename corresponding to the desired image from the list. A thumbnail of the highlighted file should be visible. To access a different path on the computer's hard drive, click on the downward arrow in the box. To view the files with a valid file format, ensure the label matches the extensions you are looking for, i.e Bitmaps (*.bmp), Tagged Image File Format (.tif), JFIF – compliant (.jpg), or Graphics Interchange Format (.gif). As an alternate, select **All Files (*.*)** to view any and all files saved within the subdirectory.

Single click on "Open" to access the file for ImageTrack. The following dialog appears....

Click here to see previous entries used to define other images.
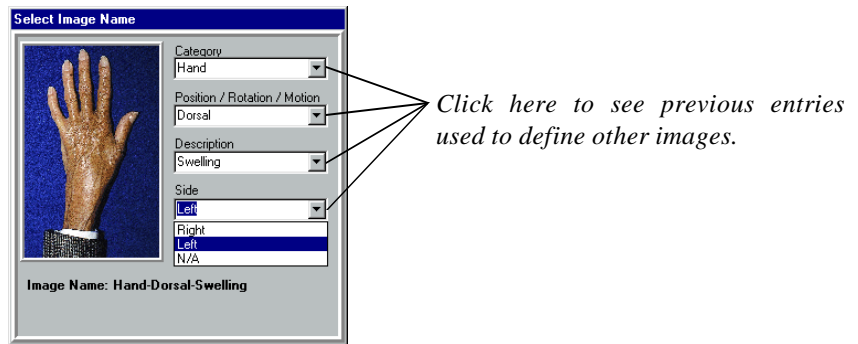
A file naming convention is invoked to help ensure repeatability when naming images which need to be compared. **To successfully generate a history report, all images to be compared in that history must have the same name.** Using the example above, photos of a RSD patient's hand taken over a four week interval (one photo each re-evaluation) were each named **Hand-Dorsal-Swelling-Left.**

Conversely, each image within a specific exam description must be uniquely defined to prevent the duplication and overwriting of files.
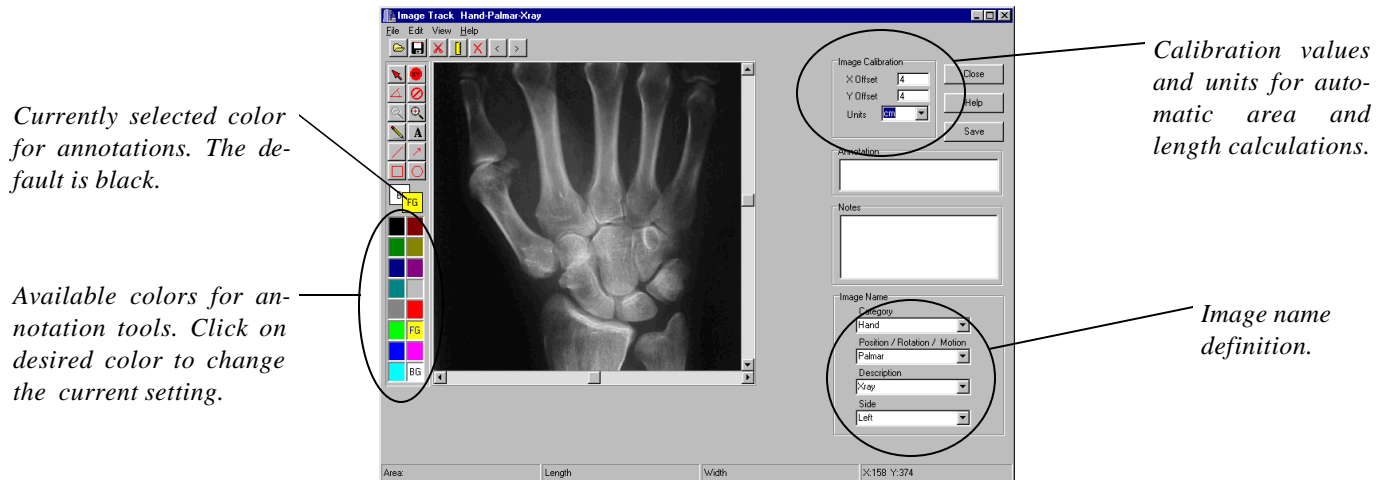
The dropdown menus (accessed by clicking on the downward arrows) will show previously entered descriptions used in the image naming process. The field headings (Category, Position, Description, Side) are intended to be used as a recommendation or reference. It is not required that the naming conventions follow the field heading theme.

Image name located under each thumbnail. The text under the currently selected thumbnail is bolded.

Click here to access Image Annotation dialog.

Click here to add new images to either gallery.

Click either of these two buttons to move images from one gallery to the other.

As images are imported into ImageTrack, the respective galleries will fill with thumbnails of each. When the number of images ex ceeds the dialog' s capacity, scroll bars will appear.

Using the Image Editor Dialog

To annotate or modify a specific image, click the mouse on that image   and then click the "Edit" button. The following dialog appears...

Currently selected color for annotations. The default is black.

Available colors for annotation tools. Click on desired color to change the current setting.

Calibration values and units for automatic area and length calculations.

Image name definition.

The color spectrum on the lower left of the dialog is used to control the color of the annotations to the image (labeled FG). Cl ick on the desired color to switch from the default of black. The drawing tools at the upper left of the dialog are used to crea te the annotations and are discussed in detail below.

The name of the image is displayed in the lower right of the dialog. Cal ibration data is displayed in the upper right of the dialog. Notes can be tied to each image and are part of the ImageTrack repo rt. The notes are entered in the box located in the mid -right of the dialog.

Scroll bars automatically appear on those images w hich are larger than the viewable area of 450 x 450 pixels. Use the scroll bars to see the entire image.

If the image has been calibrated, bounded areas and lengths of lines are automatically calculated and displayed. The calibration process will be discu ssed below. By default, the calculations are placed into the annotated text box for inclusion with the image.

Notes that are printed as part of the ImageTrack report.
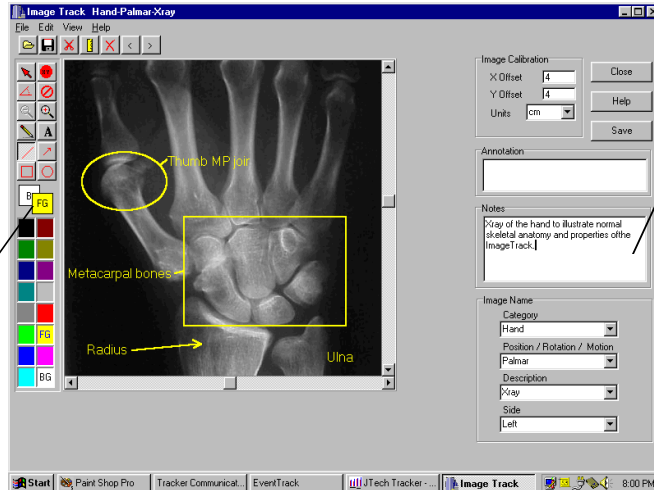
Color of the drawings controlled by the box labeled "FG."

ImageTrack Editor Dialog Buttons

Returns dialog control to the cursor

Clears the area that was validated. Area validation will be discussed later.

Measures the included angle between two lines that are created with this tool.

Erases the most recent annotation or drawing from the ima ge.

"Zoom In" and "Zoom Out" tools for creating a better view of the image.

Click and hold the mouse while drawing a free -form image that traces the path of the mouse. Once the mouse button is released, the drawing will stop.

Creates a transparent field that displays the contents of the Annotation text box. Click and hold the mouse to create the upper left corner of the field. Release the mouse once the field has reached the desired size.

Creates a line. Click and hold the mouse to create the line ori gin. Release the mouse to end the line.

Creates a line with an arrow. Click and hold the mouse to create the tip of the arrow.   Release the mouse to create the tail of the arrow.

Creates a square. Click and hold the mouse to create the upper left corner o f the square. Release the mouse once the square has reached the desired size.

Creates a circle. Click and hold the mouse to cre ate the upper left boundary of the circle. Release the mouse once the circle has reached the desired size.

The buttons located across the top of the dialog perform the following functions:

Prompts user with dialog for importing new file.

Saves the image and any newly created annotations under the currently defined   name.

Prompts for calibration coordinates of the image. If the digital photograph is not taken on the I m-ageTrack stand (purchased separately), then a ruler or reference length must appear in the picture in both the horizontal and ve rtical directions. This only applies if you anticipate using or needing the auto area/length calculations of ImageTrack.

Delete s the current image from its respective gallery.

Advances to the previous or subsequent (depending on which button is clicked) image in the corr   e-

Controlling Pen Width and Font Size

The width of the pen used to draw the images and annotations can be controlled. A single click of the right mouse button accesse s a menu with various pen widths. The default is Pen Width 2.

The font size and type for text annotating are also adjustable, and the feature to do so is also selectable with the right mouse button. Choose "Select Font" from the resulting list.
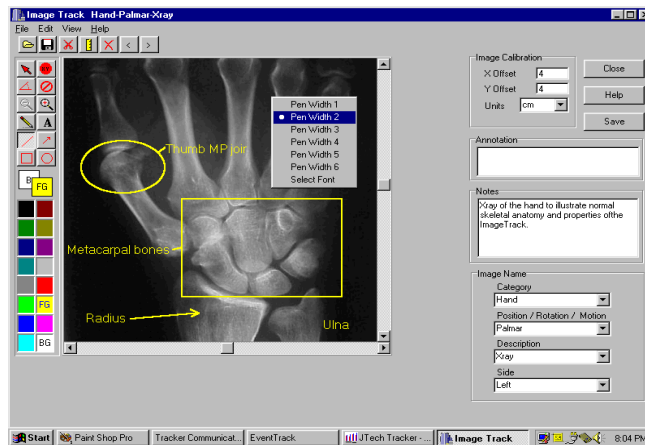
Area Calibration and Validation

If the digital photograph is not taken on the ImageTrack stand (purchased separately), then a ruler or reference length must appear in the picture in both the horizontal and vertical directions. This only a   p-plies if you anticipate using or needing the auto area/length calculations of ImageTrack. To calibrate the image, click on the r uler button (see above). The software will prompt for an origin. Click the mouse on a point corresponding to zero. The software will then prompt for a change in x distance. Click the mouse on the point corresponding to the "x" value as denoted in the box l abeled "X Offset." Repeat

As previously mentioned, when calibration values exist for an image, area is automatically calculated for any bounded area. This includes circles, squares, or closed area created with the drawing pen. The area can then be validated to ensure the user the a ppropriate area was considered in the calculation process. The validated area will appear as a white shaded area. Click on the " Area Validation" button to get rid of the shaded area. This process is pictured below.
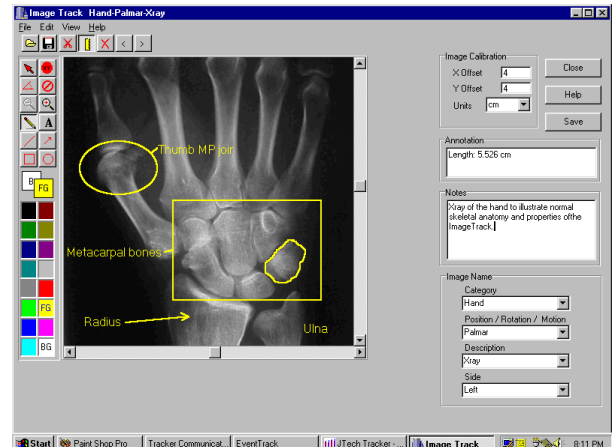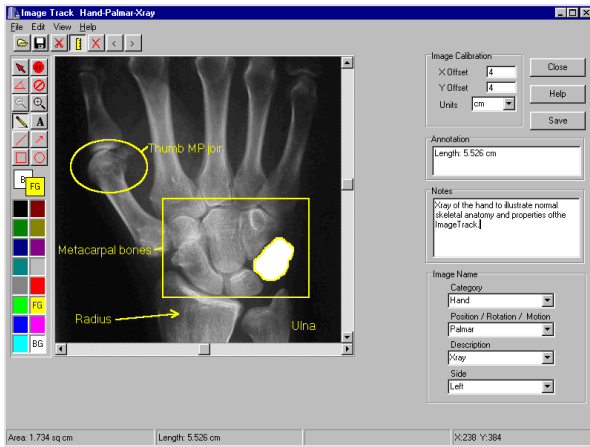

Exporting the Annotated Image

To save the image as a bitmap for importation into other applications (Tracker Narrative Writer, word processor, etc.), click "File" and "Save as bmp" from the resulting menu as pictured below. A dialog prompting for a filename will appear.
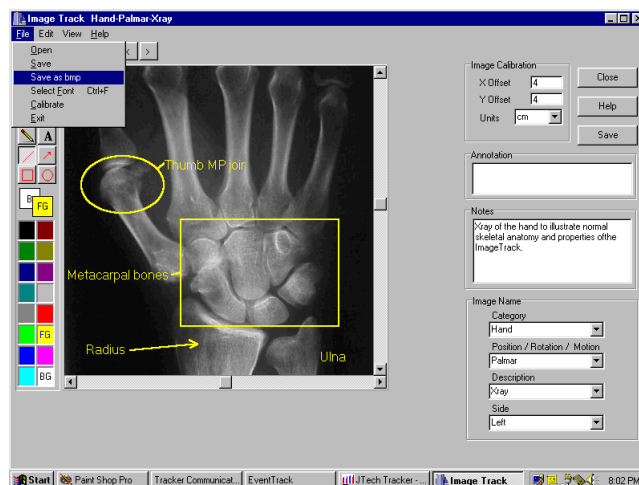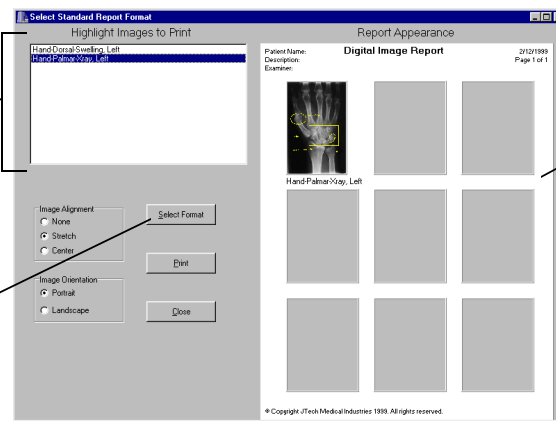
Printing an Image or Multiple Images

To print an image, select "File" and then "Print" from the resulting menu.
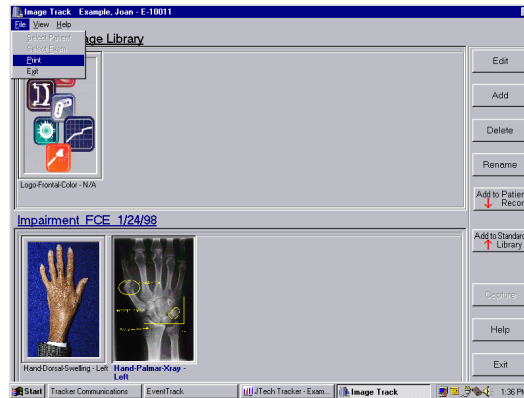

The following dialog appears....

Highlight all the im-
ages to be printed
here. The images will
be printed in the order
they appear on the list
and in the format cho-
sen.

Up to 9 images can be
printed on a single sheet.

Use this button to se-
lect the desired output
format.

Select the desired images to print by highlighting them in the box located in the upper left of the dialog. Use the "Select Format" button to control the appearance of the ImageTrack printout. Available fo r-mats for printing images include one, two, four, six, eight, and/or nine per single page. The sequence of printed images follow s the order in the listbox in the upper left -hand corner of the dialog.
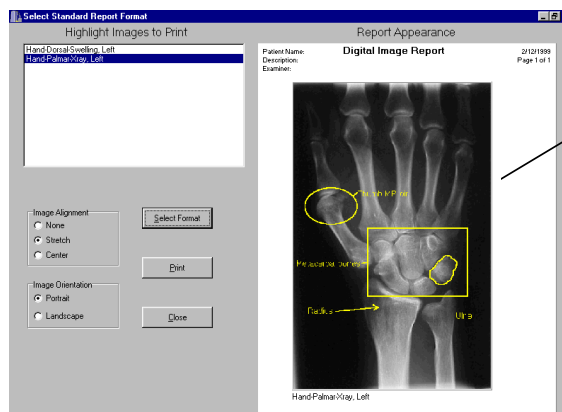

A single image in maximized
format.

Viewing and Printing Image History

Highlight a specific image to be viewed as part of the Tracker History Report. The system will aut o-matically find all instances of the specific file name for each exam performed on this patient. Once an image is highlighted, s elect "View" and then "History" from the resulting menu.

Highlighted image.
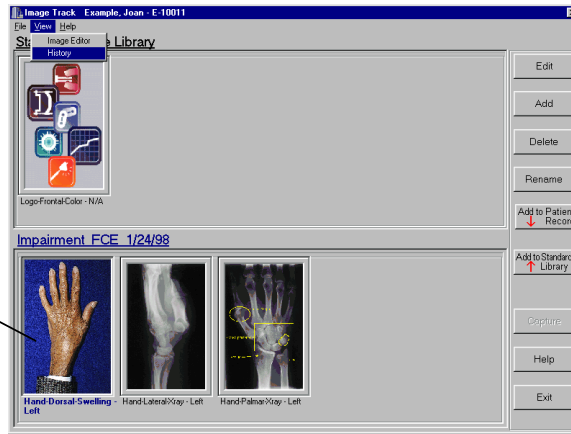
The initial screen will show all instances of the like -named images on one graph, along with the corr e-sponding exam dates. Use the "Select Graph" button to tailor the graph based on number of images, orientation of the images, de sired size and detail, etc.
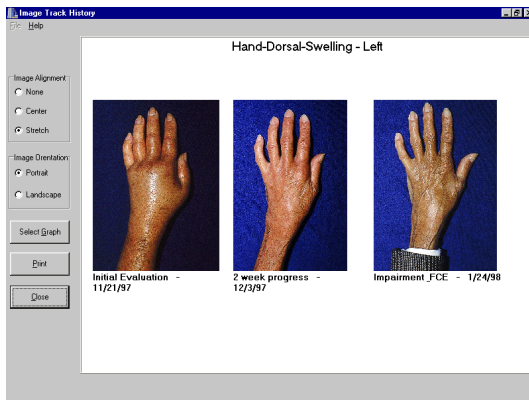
Select the "Print" button to print the image history.