

BIODEX ADVANTAGE SOFTWARE (V.4X)

OPERATION MANUAL

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BIODEX

Biodex Medical Systems, Inc.

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This manual covers operation procedures for the following Biodex Advantage Software, V.4X, products:

840-101	SOFTWARE, SYS 4 Q/S, RUS
840-102	SOFTWARE, SYS 4 Q/S, POL
840-103	SOFTWARE, SYS 4 Q/S, KOR
840-104	SOFTWARE, SYS 4 Q/S, JPN
840-105	SOFTWARE, SYS 4 Q/S, GER
840-106	SOFTWARE, SYS 4 Q/S, FR
840-107	SOFTWARE, SYS 4 Q/S, ITA
840-108	SOFTWARE, SYS 4 Q/S, SPN
840-109	SOFTWARE, SYS 4 Q/S, ENG
850-101	SOFTWARE, SYS 4 PRO, RUS
850-102	SOFTWARE, SYS 4 PRO, POL
850-103	SOFTWARE, SYS 4 PRO, KOR
850-104	SOFTWARE, SYS 4 PRO, JPN
850-105	SOFTWARE, SYS 4 PRO, GER
850-106	SOFTWARE, SYS 4 PRO, FR
850-107	SOFTWARE, SYS 4 PRO, ITA
850-108	SOFTWARE, SYS 4 PRO, SPN
850-109	SOFTWARE, SYS 4 PRO, ENG



IMPORTANT NOTE

While this manual is an important source of information on using Biodex Advantage Software, it is by no means the only resource necessary to begin testing and rehabilitation programs for your clients. Just as important as an understanding of your computer is a thorough knowledge of the mechanical, physical and clinical aspects involved. To that end, the user is referred to the Biodex System 4 Pro Operation Manual, which offers detailed instructions and general guidelines for patient setups and various joint-testing and rehabilitation patterns, plus an explanation of system controls, modes and operation. For a detailed explanation of report parameters, refer to the Biodex System Multi-Joint and Rehabilitation System Clinical Reference Guide.

Should you have any questions about Biodex Advantage Software, please contact the Biodex Customer Service Department at the following address:

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REMARQUES IMPORTANTES

Bien que cette notice d'utilisation contienne beaucoup d'informations sur le logiciel BIODEX SYSTEM, elle ne peut être la seule source de renseignements nécessaires pour évaluer et rééduquer des patients. En plus d'une bonne compréhension de votre système informatique, il faut bien connaître les aspects mécaniques, anatomiques et cliniques applicables. A cette fin, nous vous référons à la notice du système multi-articulaire, laquelle fournit des consignes détaillées et des principes généraux pour les montages patient et les différents mouvements utilisés pour l'évaluation et la rééducation en plus d'explications sur les contrôles, les modes et le fonctionnement du matériel.

Pour de plus amples renseignements sur le logiciel BIODEX ADVANTAGE, nous vous demandons de bien vouloir contacter notre responsable local.

Authorized European Community Representative: Prothia, Paris, France

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1. INTRODUCTION

THE BIODEX ADVANTAGE

Biodex Advantage Software is a user-friendly software package developed specifically for isolated muscle testing and rehabilitation. Windows-based, it is comprehensive, fast and flexible. Whether you're a computer novice, computer genius or somewhere in-between, you'll find its many features, functions and applications – including a Biofeedback Graphical User Interface (GUI) screen - can greatly enhance your ability to quickly and easily test, motivate and rehabilitate patients.

Biodex Advantage Software features seamless architecture, pull-down menus and pop-up windows in a touch-screen Windows environment to provide for quick, intuitive operation. Need help? Simply follow the Wizard as it guides you through the standard procedures. Not sure how to set up for a particular pattern? Select an action video for a real demonstration of the desired exercise or testing setup. Want a report? Choose from a variety of formats with easy-to-read, easy to interpret normative data. Just setting up for a quick and easy exercise ? One touch of the screen or click of the mouse is all that's needed to activate the Biofeedback screen and begin.

Biodex Advantage Software makes it easy for clinicians to gather, organize and report on patient testing and rehabilitation. During testing and rehab sessions, the software gathers pertinent patient data for isometric, isokinetic, isotonic, passive and reactive eccentric modes. Curve analysis functions allow for comparison of results from different tests. Torque curves and bar graphs enhance biofeedback capabilities while a patient pain scale entry allows the clinician to track patient pain levels throughout the rehabilitation process. Test data can be generated in standard report format or in easy-to-read, narrative letters that are addressed and ready for mailing to referring physicians or third-party payers. Data legends and on screen editing simplify the task of communicating test results to doctors, payors and employers.

Easy to use, intuitively organized, versatile and complete, Biodex Advantage Software will help speed your patients on the road to functional outcomes, help you to increase your referral base, and make the day more manageable for you and your staff. That's the Biodex Advantage.

2. GETTING STARTED

HARDWARE REQUIREMENTS

Biodex Advantage Software, Version 4.X, can be used on any Biodex Multi-Joint System 4, or Biodex Multi-Joint System 3, Rev 2 or higher, with the proper hardware. Firmware must be Rev. 2K or higher.

Minimum hardware requirements are as follows:

- Windows XP
- Processor: P4
- Ram 512 meg
- CDRW
- 2 COM ports
- 2 USB ports
- Printer: HP 5550, HP 5650 or HP 6940

START-UP PROCEDURE

(See Figures 2.1 and 2.2.)

1. Ensure that no attachments are connected to the dynamometer to insure proper dynamometer initialization.
2. Turn the main power switch (black) on the back of the CDS Cart to the ON (I) position.
3. Ensure the dynamometer and computer power switches (green) on the back of the CDS Cart are set to the ON (I) position.
4. Press the ON switch on the Central Processing Unit (CPU) located on the left side of the CDS Cart. Following the system boot-up process, the software will display a note that it is initializing the dynamometer. Once dynamometer initialization is completed, the Advantage Software program will open to the Dynamometer Operation screen.

NOTE: Should an error message display on the screen as you try to access the Advantage Software program, check that all attachments have been removed from the dynamometer and that all connecting cables are secure. Turn OFF the main power switch, dynamometer and computer switches and the CPU ON switch. Wait at least 30 seconds, and then repeat steps 1 – 4 above. If the error message still appears, contact Biodex Customer Service for instructions on how to proceed.



Figures 2.1 and 2.2: The main power(1), dynamometer power (2), computer power (3) and CPU (4) switches must all be turned ON to run the Advantage Software program.

EXITING THE PROGRAM

Because Biodex Advantage Software operates within the Windows environment, it is vital that you use the Windows shutdown procedure after exiting Biodex Advantage Software. Always shut down the Windows program before turning OFF your computer.

! CAUTION: Turning your computer OFF without properly shutting down both the Biodex Advantage and Windows software programs may result in lost or damaged files or database corruption.

! ATTENTION: Arrêter l'ordinateur sans suivre les procédures de sortie et de sauvegarde du logiciel BIODEX et de WINDOWS peut compromettre l'intégrité des fichiers.

To Quit Windows and Shut Down the Computer

1. To close the Biodex Advantage Software application, select the <X> in the top right corner of the screen.
2. Select <Start> at the lower left side of the screen to access the Start menu.
3. Select <Turn Off Computer>.
4. Select <Turn Off> to shut down the computer.

NOTE: Be sure to back-up all database files at least once per month. See Chapter 10 for more information.

THE DYNAMOMETER OPERATION SCREEN

(See Figure 2.3.)

The Dynamometer Operation screen serves as the main screen for most operations and is automatically selected whenever you access the Biodex Advantage Software program. It is, in effect, the Main Screen for the Advantage Software program, serving as the launching point for all operations and procedures. You can navigate this screen, or any Advantage Software screen, using either the touch-screen feature or the mouse.

The Dynamometer Operation screen allows clinicians to easily jump back and forth between testing, exercise and biofeedback applications via the Configuration and Operating Mode Tool Bars. When the system is first accessed, the last mode of operation in use is automatically selected. Thus, the Dynamometer Operation screen may have the test/exercise scoring window or biofeedback graph displayed.

Note that the presence of some tool bars, and appearance of others, will change based on the procedure or mode selected. Except where otherwise noted, Biodex Advantage Software follows the same logic as the Windows operating system.

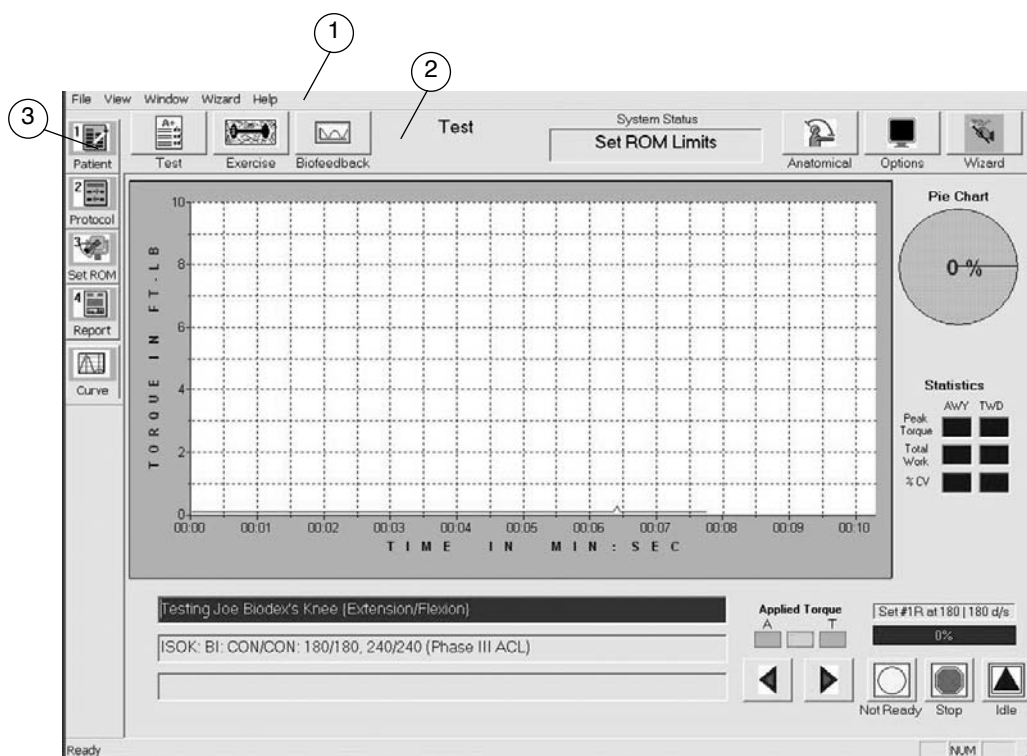


Figure 2.3. The Dynamometer Operation screen in Test Mode with scoring window displayed. The System Menu Tool Bar (1), Operating Mode Tool Bar (2) and Configuration Tool Bar (3), allow for quick and intuitive operation. Users can navigate all Advantage Software screens using touch-screen operation or the mouse.

The System Menu Tool Bar

Located at the top of the screen directly beneath the system header, the System Menu Tool Bar allows access to the File, View, Window and Help menus.

<File>: Allows access to Set Up, Database Manager, Compact Database, Verify Calibration, Diagnostics and Exit functions, each of which are described in detail later in this manual.

<View>: Allows the System Menu Tool Bar and Status Bar to be hidden or displayed.

<Window>: Allows selection of cascade or tile window formats and displays the currently active window.

<Wizard>: When accessed from the System Menu Tool Bar, allows system-wide topics to be selected from a list and then guides the user through selected functions and procedures.

<Help>: Displays basic Biodex Advantage Software information including release date and software version, and offers a video introduction to Biodex Medical Systems, Inc.

The Operating Mode Tool Bar

Located directly beneath the System Menu Tool Bar, the Operating Mode Tool Bar allows users to easily move between test, exercise and biofeedback applications and provides access to other important functions.

<Test>: Select this option for testing applications.

<Exercise>: Select this option for exercise applications.

<Biofeedback>: Select this option biofeedback applications.

Current Mode: The current mode of operation is always displayed in bold between the <Biofeedback> option and System Status. There are six operating modes of operation from which to choose: Setup, Isokinetic, Passive, Isometric, Isotonic and Reactive Eccentric. Setup mode is automatically selected when the system is first turned ON.

System Status: Displays the current dynamometer status and simple prompts or instructions (i.e., press <Start>). Also displays system status codes in the case of malfunction.

<Anatomical>: Select this option to display a short AVI movie or still image detailing subject setup and ROM for the currently selected pattern.

<Options>: Use this icon to change the way the dynamometer operation window displays data. This option is also used to enable/disable graph settings.

<Wizard>: Select this option to open the Biodex Wizard.

The Configuration Mode Tool Bar

Located along the left side of the screen during testing and exercise applications, the Configuration Tool Bar features icons for primary screens and functions used frequently throughout the program. Select on any icon to advance to the screen or function desired. From top to bottom the icons and their usage are defined as follows:

<Patient>: Access the Patient Selection screen to choose a patient or enter a new patient.

<Protocol>: Access the Protocol Definition screen to select a pre-defined or user-defined protocol, or to enter a new protocol.

<Set ROM>: Use this icon to set a new range of motion or adjust a previously stored range of motion at any point throughout the program.

<Report>: The Report Generation screen is used to select options and reports for preview and/or editing. Choose from Graphical Evaluation, General Evaluation, Comprehensive Evaluation, Narrative Cover Letter and Isomap Evaluation.

<Curve>: The Curve Analysis function allows the user to view test data on screen in various formats including individual curves, windowed curves, filtered curves, and a curve log.

The Status Bar

Located at the bottom of the screen, the Status Bar displays <Start> and application name.

SYSTEM SETUP

(See Figure 2.4.)

The Setup Options window allows the user to set default values for selected system prompts and preferences. It also provides access to the Orient Fixtures screen.

To Access the Setup Options screen:

1. Select <File> in the System Menu Tool Bar and select <Setup> from the pull-down menu. The Setup Options screen should now be displayed.
2. Select or enter the appropriate value or preference for each of the fields provided.
3. Once you are satisfied with all of the selections, select <Okay> to record the new settings and return to the Dynamometer Operation screen. When prompted, select <Yes> to restart the application and save the new settings.

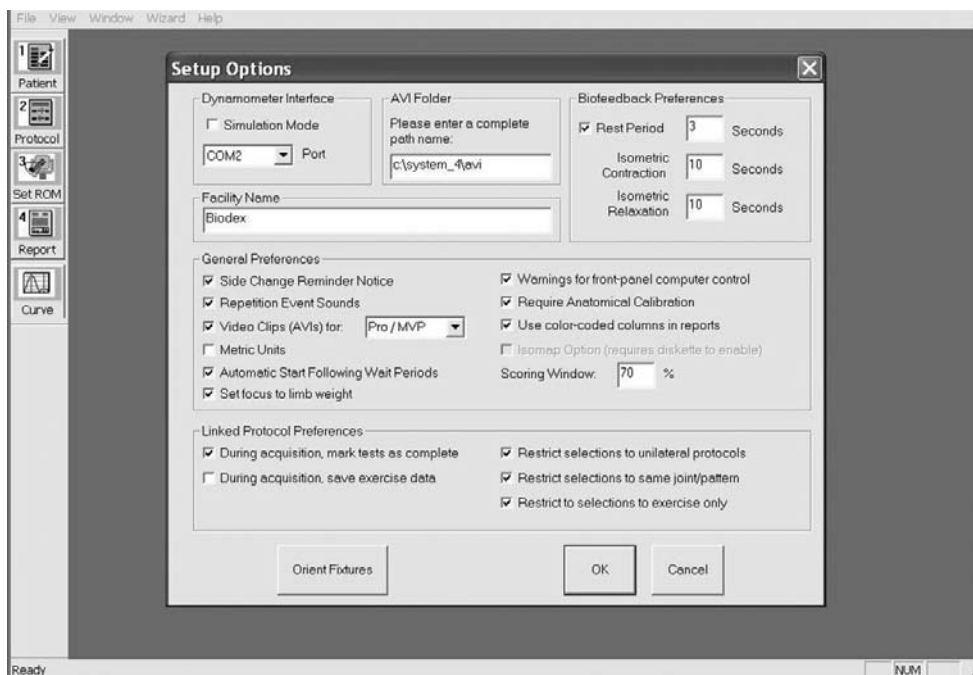


Figure 2.4. The Setup Options window. This screen is accessed through <File> in the System Menu Tool Bar.

Setup Options

The following options and fields are addressed from the Setup Options screen.

Dynamometer Interface

Values for this field are factory pre-set and should not be changed.

AVI Folder

Enter here the desired path for storage of the system AVIs (Action Video Inserts). The system default is to the CD-ROM drive. AVIs run faster off the hard disk, but they take up a lot of disk space. (Consult Biodex Customer Service before making changes to the AVIs.)

Facility Name

Select to the field to activate the cursor and enter your facility name here.

Biofeedback Preferences

Select the desired field to activate the cursor and use the keyboard to make changes to the following parameters:

NOTE: These will be the default values for the patient when using the Biofeedback Mode of the software for exercises.

- Rest Period: default value set for the length of rest period between sets.
- Isometric Contraction: default value set for the length of time a patient must maintain an isometric contraction.
- Isometric Relaxation: default value for length of time between repetitions.

General Preferences

- Side Change Reminder Notice: Toggles side change notice ON and OFF. If ON, a notice will appear after completion of all sets for first side.
- Repetition Event Sounds: Toggles audible start and stop signals for exercise and test sessions ON and OFF. If ON, signals are provided at the beginning and end of each set, and during each repetition during data collection.
- Video Clips (AVIs) for: Choose from Pro or Quick Set Formats at scroll bar. If ON, action AVIs can be selected from the Protocol Selection screen for any standard patient setup.

NOTE: Do not change this factory preset value without calling Biodex Customer Service first.

- Metric Units: When ON, all data is displayed in metric units. When OFF, all data is displayed in English measures.
- Automatic Start Following Rest Periods: Activate this toggle if you would like the system to initiate the countdown for the next set following completion of each previous set, as opposed to having the system await user input to begin the countdown.
- Set Focus To Limb Weight: When setting is checked, "Limb Weight" flashes in red on Set Dynamometer Range of Motion screen after anatomical position has been calibrated. When unchecked, "Limb Weight" does not flash in red but may still be set.

-
-
- **Require Anatomical Calibration:** When ON, requires anatomical calibration of the joint in the anatomical reference angle before testing can begin. It is recommended to perform anatomical calibration prior to the start of any test to correlate curve deficits to joint position.
 - **Use Color-Coded Columns in Reports:** Color is used in graphs and curves to indicate unin-
volved (blue) and involved (red) sides.
 - **Scoring Window:** This is drawn on the Dynamometer Operation screen as a horizontal pair of violet-colored lines. The scoring window allows the clinician to set a biofeedback goal for the patient. The top line is 100%. The lower line is a percentage of (default = 70% of max peak torque). To change the lower line default value, simply enter a new value in the scoring window parameter box. This setting also determines the isokinetic window when printing reports containing windowed data.

Linked Protocol Preferences

NOTE: All Linked Protocol Preferences described below are default settings.

- **During acquisition, mark tests as complete:** After completing a linked exercise protocol, an on screen prompt indicates completion of the protocol. On screen results are then automatically marked as completed to confirm for the clinician that the patient did complete the entire routine. Default =ON
- **During acquisition, save exercise data:** Selecting this option allows collected exercise data to be saved. Storage of this information required additional disk space. If you choose to save exercise data, the system will “time out” after 10 minutes of data collection due to limited database size. Therefore, exercise sessions must be limited to less than 10 minutes if data collection is desired. Default =OFF
- **Restrict selections to unilateral protocols:** When linking protocols, selecting this option allows only unilateral treatment protocols to be selected. Default =ON
- **Restrict selections to same joint/pattern:** When linking protocols, restricts selections to protocols for same joint/pattern. Default =ON
- **Restrict selections to exercise only:** When selected, this option restricts selection to exercise protocols only. Default =ON

Orient Fixtures

The <Orient Fixtures> icon at the bottom of the Setup Options screen is used during system installation to provide the system with information for correcting limb weight readings. You should not need to access this function unless you receive a new set of dynamometer attachments. If you do receive a new set of attachments, you may need to confirm that these settings are correct.

NOTE: If you receive new, updated or attachments other than those originally supplied for you system by Biodex, contact Biodex Customer Service for information on the Orient Fixtures procedure.

Database Manager

NOTE: This section is explained fully in Chapter 10.

Compact Database

This utility is used to remove any empty spaces that may occur in your database. This utility will occur on its own as the computer detects wasted database space.

CALIBRATION VERIFICATION

(See Figures 2.5 and 2.6.)

Your Biodex System Isokinetic Dynamometer comes factory calibrated. The only maintenance required to assure that your Biodex System remains calibrated is to once a month perform a Calibration Verification Procedure, as described below.

1. Select <File> from the System Menu Tool Bar and select <Verify Calibration> from the pull-down menu. The Calibration Verification screen should now be displayed.
2. Enter your name in the red field. This is required to perform the verification.
3. Attach the long shoulder attachment to the dynamometer (remove any handgrip).
5. Select <ROM Set> to advance to the Set Dynamometer Range of Motion screen.
6. Select <Clear Limits>.
7. Allow the long shoulder attachment to hang vertically so that Total ROM is zero degrees. Select the <SET> for the TOWARD Limit.
8. Move the long shoulder attachment away until Total ROM is 90 degrees and then select <SET> for the AWAY Limit.
9. Move the long shoulder attachment to vertical and calibrate the position, then select <Continue> to return to the Verify Calibration screen.
10. Select <Mode> and then select <Isometric Mode>.
11. Move the long shoulder attachment to full horizontal (90 degrees). Select <Start>.
12. Insert the calibration weight until the detent pin engages (torque = 50.0 ftlbs, 67.8 NM).
13. Select <Verify Calibration> when ready.
14. When finished, remove the calibration weight and select <Exit> to return to the Dynamometer Operation screen.

NOTE: If a message is displayed indicating an Invalid Calibration, repeat the calibration procedure. If you receive the message three times, please call Biodex Customer Service at 1-800-224-6339 or in the State of New York 631-924-9000 for assistance.

15. Select <Report> to generate a printed report, which can be filed for later reference.
16. If desired, select <History> to generate a listing of all Calibration Verifications performed on the machine.
17. Select <Exit> to advance to the Dynamometer Operation screen.

NOTE: For research applications, you may want to perform Calibration Verification after a specific number of patients in case questions regarding the validity of your data arise at a later time.

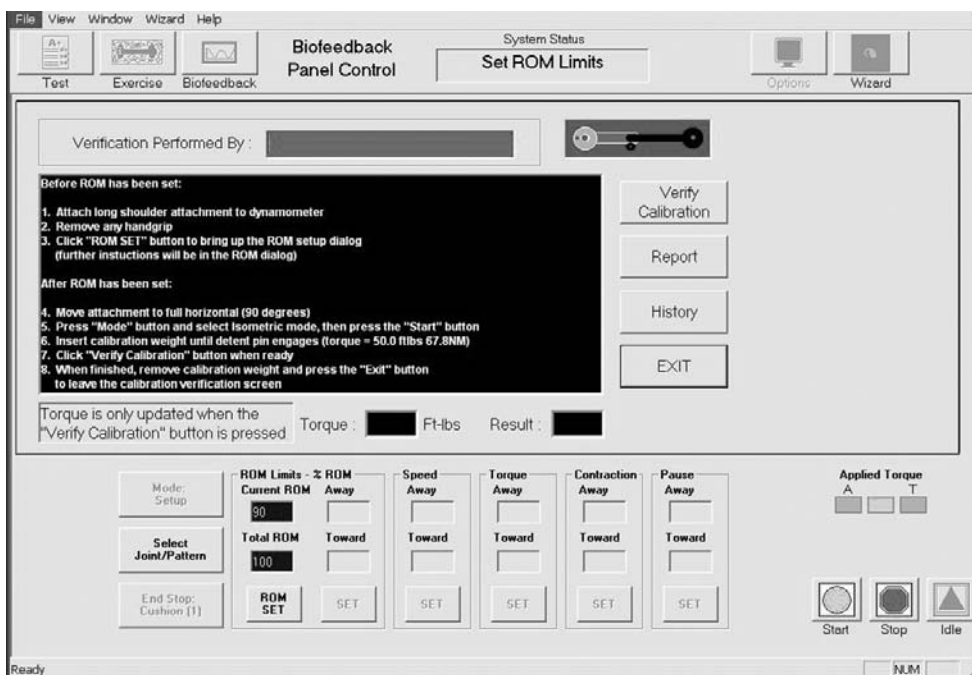


Figure 2.5. The Calibration Verification Screen.

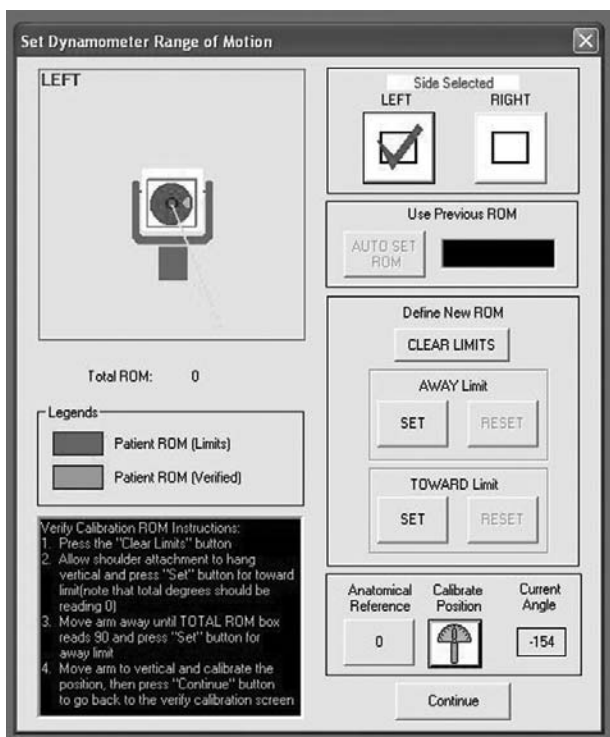


Figure 2.6. The Calibration Verification Set Dynamometer Range of Motion Screen.

3. PATIENT SELECTION

THE PATIENT SELECTION SCREEN

(See Figure 3.1.)

The Patient Selection screen is used to:

- Open and view existing Patient Records
- Add a New Patient to the Patient List
- Add a New Test or exercise to a Patient Record
- Update or Edit Patient Records
- Edit or Update the Pain Scale

NOTE: The Pain Scale must be edited or updated following each test or exercise session.

To access the Patient Selection screen select <Patient> from the Configuration Tool Bar in the top left corner of the Dynamometer Operation screen. The Patient Selection screen is now displayed. The last patient selected is the current patient.

The screenshot displays the Patient Selection screen with a menu bar (File, Record, View, Window, Help) and a toolbar with icons for Patient, Open, Add Patient, Edit, Save, Cancel, Del Test, Del Patient, and Close. The main form contains the following fields:

- Patient Information:** Last Name (Blodex), First Name (Joe), Height (5' 11"), Weight (186 lbs), Birthdate (10/17/64), Address (20 Ramsay Road, Shirley, NY 11967), Phone, ID# (6678), Admission Date (1/7/07), Release Date, and Diagnosis.
- Gender:** Radio buttons for Male (selected) and Female.
- Involved:** Radio buttons for Right (selected), Left, Both, and None.
- Dominant:** Radio buttons for Right (selected) and Left.
- Test/Exercise Information:** Date (1/3/2007 2:54:36 PM), Referral, Clinician, Notes, Protocol Description (Isokinetic Bilateral), Joint (Knee), and Pattern (Extension/Flexion).
- Pain Scale:** A horizontal scale from 0 to 10 with labels: No Pain, Mild, Discomforting, Distressing, Horrible, and Excruciating. The scale is currently set to 0.

The status bar at the bottom shows "Ready" on the left and "NUM" on the right.

Figure 3.1. The Patient Selection Screen.

PATIENT SELECTION OPTIONS

Located at the top of the Patient Selection screen, the Patient Selection Operating Mode Tool Bar displays icons used to access the patient selection options. From left to right, the icons and their usage are defined as follows:

Open

(See Figure 3.2.)

The Open option is used to select and open an existing patient record, allowing the clinician to view, edit, update, delete the patient record or a selected test/exercise, print reports, repeat a test/exercise, or add a new test/exercise to the patient record.

To Open An Existing Patient Record:

1. Select <Open>. The Patient Name window should now be displayed with a listing of all previously entered patients.
2. Select any patient to expand the patient list to show all tests and exercise sessions for that patient. Use the scroll feature to advance through the alphabetical listing as needed or enter the patient Last Name or ID and select search to quickly locate a specific patient.
3. Select the desired test/exercise. The Patient Selection screen should now display the desired patient and the test/exercise selected.

NOTE: If you know a patient's last name or patient ID number, you can enter it in the search field below the patient list and select <Search> to advance quickly to that patient.

Selecting a patient activates the following options at the bottom of the Patient Name window:

- <New>: Select this option to proceed directly to the Protocol Definition screen.
- <Delete>: Select this option to delete from the patient record selected and all associated tests.

Selecting a specific patient test/exercise activates the following options at the bottom of the Patient Name window:

- <Repeat>: Select this option to advance directly to the Set Dynamometer Range Of Motion window and repeat the selected test/exercise.
- <Report>: Select this option to advance directly to the Report Generation screen.
- <Edit>: Select this option to edit Test/Exercise information on the Patient Selection screen.

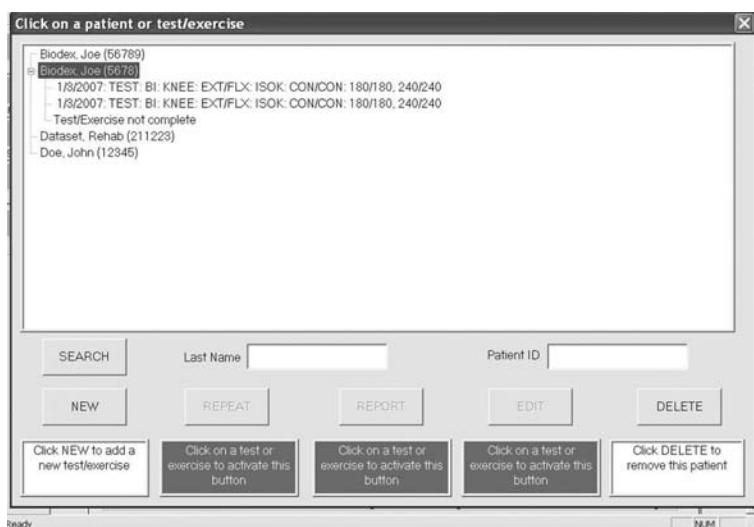


Figure 3.2. The Patient Record list.

Add Patient

(See Figure 3.3.)

Figure 3.3. All mandatory fields (red), must be completed to save a new patient record. Clinicians should also consider updating the patient pain scale when repeating a test so that patient pain can be plotted on Exercise Summary Reports.

The Add Patient option is used to enter a new patient on the patient list, creating a patient record. When you select this option, a blank Patient Selection screen is displayed. The new screen, must be filled out to create the new patient record.

The following fields on the screen appear in red. These are mandatory fields that must be completed to save this screen as a new patient record:

- Last Name
- Weight
- ID #
- Gender
- Involved Side

NOTE: If the first name of the patient is not filled out, you cannot edit this field later. It will remain blank.

NOTE: Although not a mandatory field, it is suggested that clinicians always adjust the patient pain scale when entering a new patient, editing a patient, or repeating a test. Using the pain scale, patient pain can be plotted on the Exercise Summary Report.

To adjust the pain scale, slide the pointer to the appropriate pain level reported by the patient. The zero setting (left end of scale) is equal to no pain and the 10 setting (right end of scale) is equal to excruciating pain.

When repeating a test, update the patient pain scale by selecting <Edit> before selecting <Repeat> and make the appropriate changes to the Patient Selection screen.

Data entry for the remaining fields is optional. Should you forget to fill in one of the mandatory fields and try to save the new patient, a prompt will appear to inform you that all mandatory fields must be completed before saving.

NOTE: The patient ID number is a permanent number used to identify the patient in your files. Once entered and saved as part of the Patient Record, it cannot be changed

To Add A New Patient to the Patient Record:

1. Select <Add Patient> A blank Patient Selection screen should now be displayed with mandatory fields in red.
2. Enter the appropriate information in each field, making sure that all mandatory fields are complete.
3. At the bottom of the screen, position the pain indicator along the pain scale to reflect the patient's current pain status. The pain scale indicates pain from zero (no pain) to 10 (excruciating pain) and must be updated following exercise sessions for pain to be plotted on the Exercise Summary Report.
4. Select <Save> in the Patient Selection Operating Mode Tool Bar to save the new patient record.
5. Select <Open> to display the Patient List and ensure the new patient record has been saved, or select <Close> to simply return to the Dynamometer Operation screen.

Edit

The Edit option allows the clinician to edit an existing patient record.

NOTE: Patient name and I. D. # cannot be edited.

To Edit an Existing Patient Record:

1. Select <Open> from the Patient Selection Operating Mode Tool Bar. The Patient Name window should now be displayed with a listing of all previously entered patients.
2. Select any patient to expand the patient list to show all tests and exercise sessions for that patient. Use the scroll feature to advance through the alphabetical listing as needed or enter the patient Last Name or ID and select <Search> to quickly locate a specific patient.
3. Select the desired test/exercise to edit. The Patient Selection screen should now display the desired patient and the test/exercise selected.
4. Select <Edit>. Fields that will allow editing will turn from gray to white.
5. Make the desired edits and then select <Save> in the Patient Selection Tool Bar to save the changes. The edited patient record is saved and now displayed as the currently selected patient record.

Save

The Save option allows the clinician to save any changes made to the currently selected or edited patient record.

To Save A New or Edited Patient Record:

1. Select <Save> from the Patient Selection Operating Mode Tool Bar. All changes will be saved to the patient record. After it has been saved, the patient record remains selected.

Cancel

The Cancel option allows the user to exit any operation on the Patient Selection screen without saving or making changes to the currently selected patient record. In some instances, you will need to cancel before closing a record if you do not wish to save.

To Cancel Any Operation:

1. Select <Cancel> in the Patient Selection Operating Mode Tool Bar. Any changes made since the last time the currently selected patient record was saved will be erased and the previous values will be restored. The currently selected patient file is still open.

Delete Test

The Delete Test\Exercise option allows any study to be permanently deleted from the currently selected patient record.

To Delete a Specific Test\Exercise from the Patient Record:

1. Select <Open> from the Patient Selection Operating Mode Tool Bar. The Patient Name window should now be displayed with a listing of all previously entered patients.
2. Select any patient to expand the patient list to show all tests and exercise sessions for that patient. Use the scroll feature to advance through the alphabetical listing as needed or enter the patient Last Name or ID and select <Search> to quickly locate a specific patient.
3. Select the desired test/exercise to delete. The Patient Selection screen should now display the desired patient and the test/exercise selected.
4. Select <Delete>.
5. Respond "YES" to the "Confirm Study Delete Operation?" prompt. The selected test\exercise will be permanently deleted from the patient record.

Delete Patient

The Delete Patient option allows for removal of a selected patient and associated records from the patient file.

To Delete A Patient From The Patient File:

1. Select <Open> from the Patient Selection Operating Mode Tool Bar. The Patient Name window should now be displayed with a listing of all previously entered patients.
2. Select any patient. Use the scroll feature to advance through the alphabetical listing as needed or enter the patient Last Name or ID and select <Search> to quickly locate a specific patient.
3. Select <Delete>.
4. Respond "YES" to the "Confirm Patient Delete Operation?" prompt. The currently selected Patient and associated tests, exercises and files will be permanently deleted from the patient record. The Patient Name window is now displayed.

NOTE: If you delete a patient, the entire patient record is permanently deleted from the patient file. This information cannot be restored unless it has been already been backed up.

Close

The Close option allows the clinician to close any screen or patient record currently displayed. The user is given an option to save or discard any changes made since the current patient record was last saved.

NOTE: If you have performed any operation on the screen or patient record, you must first <Save> or <Cancel> before closing.

To Close a Patient Record or Screen:

1. After saving the patient record, or canceling any function, select <Close> from the Patient Selection Operating Mode Tool Bar. The system will close the currently displayed screen display the logical next or previous screen.

4. PROTOCOL DEFINITION

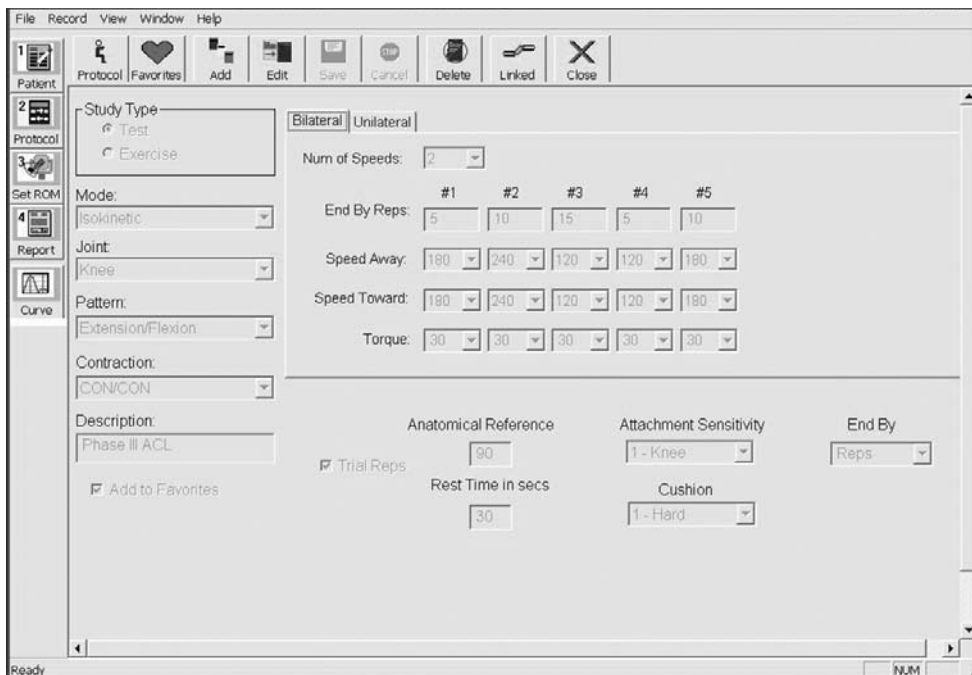


Figure 4.1. The Protocol Definition screen.

THE PROTOCOL DEFINITION SCREEN

(See Figure 4.1.)

The Protocol Definition screen allows the clinician to clearly define and recall individual test or exercise parameters. Protocols consist of both on-board pre-installed protocols and user-created, customized, selections. Custom protocols can be created, stored in a favorites list, and then recalled as needed for easy selection.

To edit, add or link protocols, select <Protocol> in the Configuration Tool Bar.

NOTE: Access the Protocol Definition screen directly to edit, add or link protocols. If you wish to select a protocol for use during testing, you must first select a patient test or exercise, then select <New> to advance to the Protocol Definition screen.

NOTE: The joint, pattern and study type selected on the Protocol Definition screen will be displayed on the Dynamometer Operation screen for testing and exercise sessions.

Located at the top of the Protocol Definition screen, the Protocol Definition Screen Operating Mode Tool Bar displays icons used to access the Protocol Definition options. From left to right, the icons and their usage are defined as follows:

Protocol

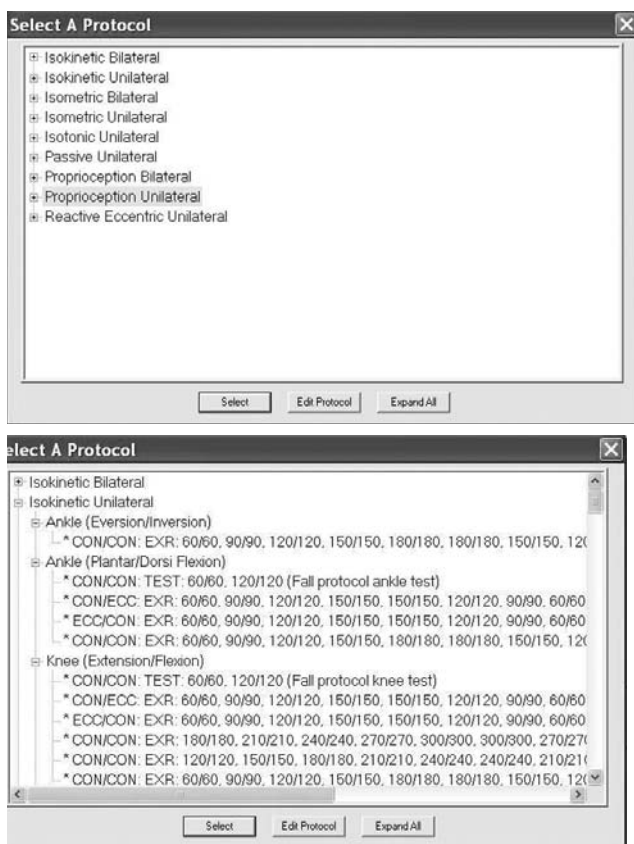
(See Figures 4.2 and 4.3.)

The <Protocol> icon is used to recall an existing protocol to select, add, edit or link.

To Select A Desired Protocol:

1. Select <Protocol> in the Protocol Definition Screen Operating Mode Tool Bar. A listing of existing protocols will be displayed in the Select A Protocol window. Protocols on this list are grouped by mode, joint and pattern.
2. Select <+> in front of any listed protocol to view the parameters for that selection, or select <Expand All> to view the parameters for all listed protocols.
3. Highlight the desired protocol and then click <Select>. The selected protocol should now be displayed on the Protocol Definition screen.

NOTE: If you select or add a protocol with a patient already selected, the program advances directly to the Set Range Of Motion screen.



Figures 4.2 and 4.3. Select <+> preceding any protocol to view specific parameters. Select <Expand All> at the bottom of the Protocol List for a full view of all protocol levels.

Favorites

The <Favorites> icon is used to list user-created, customized protocols, making them simple to access for testing or exercise while preventing accidental modification of the on-board, pre-installed, protocols.

NOTE: To place a specific protocol on the Favorites List, select <Favorites> when adding a new protocol.

To Select A User-Created Custom Protocol From The Favorites List:

1. Select <Favorites> in the Protocol Definition Screen Operating Mode Tool Bar. A listing of existing custom protocols will be displayed in the Select A Protocol window. Protocols on this list are grouped by mode, joint and pattern.
2. Select <+> in front of any listed protocol to view the parameters for that selection, or select <Expand All> to view the parameters for all listed protocols.
3. Highlight the desired protocol and then click <Select>. The selected protocol should now be displayed on the Protocol Definition screen.

Add

The <Add> icon is used to add a newly created protocol to the protocols list.

To Add A New Protocol:

1. Select <Add> in the Protocol Definition screen Operating Mode Tool Bar. The Protocol Definition screen will now highlight any fields that can be changed.
2. Enter the information required for each line on the Protocol Definition screen, making sure to provide a new name in the mandatory description field. To place this new protocol on the Favorites List, be sure to select <Favorites>.
3. Select <Save> in the Protocol Definition screen Operating Mode Tool Bar to add the new protocol to the protocols list. The newly added protocol is now the currently selected protocol.

Edit

Use the <Edit> icon in the Protocol Definition screen Operating Mode Tool Bar to edit or update any currently selected protocol.

NOTE: If you edit an existing protocol, it will be permanently changed for all patients that have used this protocol. If you try to repeat a test completed previous to the change, you will need to re-define the protocol for that test.

To Edit An Existing Protocol:

1. Select the desired protocol.
2. Select <Edit> in the Protocol Definition screen Operating Mode Tool Bar. All fields on the screen should turn from gray to white, indicating that you may now edit this protocol.
3. Edit the desired fields.
4. Select <Save> Protocol Definition screen Operating Mode Tool Bar to save your changes. The edited protocol is now the currently selected protocol.

Save

The Save option allows the clinician to save any changes made to the currently selected protocol.

To Save an Added, Edited or Linked Protocol:

1. Select <Save> in the Protocol Definition screen Operating Mode Tool Bar. All changes to the selected protocol will be saved. After it has been saved, the protocol remains selected.

Cancel

The Cancel option allows the user to exit any operation performed on the protocol without saving or making changes. In some instances, you will need to cancel before closing a protocol if you do not wish to save.

To Cancel An Operation:

1. Select <Cancel> in the Protocol Definition Screen Operating Mode Tool Bar. Any changes made since the last time the currently selected protocol was saved will be erased and the previous values will be restored. The currently selected protocol remains open.

Delete

The Delete option allows for removal of a selected protocol from the protocols list.

To Delete a Protocol from the Protocols List:

1. Select the protocol to delete.
2. Select <Delete> in the Protocol Definition Screen Operating Mode Tool Bar.
3. Respond “Yes” to the “Delete Protocol?” prompt.
4. The currently selected protocol will be deleted from the protocol list. The Protocols list is now displayed.

Link Protocol

See Linking Protocols, later in this chapter.

Close

The Close option allows the clinician to close any screen or protocol currently displayed. The user is given an option to save or discard any changes made since the selected protocol was last saved.

NOTE: If you have performed any operation on the screen or selected protocol, you must first <Save> or <Cancel> before closing.

To Close a Selected Protocol or Screen:

1. After saving a protocol or canceling any function, select <Close> in the Protocol Definition Screen Operating Mode Tool Bar. The system will close the currently displayed screen.

LINKING PROTOCOLS

(See Figure 4.4)

Once created, protocols can be “linked” or connected to an individual test or rehabilitation session. This saves the clinician several steps when rehab sessions are to be conducted using different protocols. It also provides more time for the patient to spend exercising since less time is spent on software set up. A patient could, for example, be set up for ten minutes of passive motion, followed in succession by bouts of isometric and isokinetic exercise. Once linked protocols are established and the patient is appropriately set up, the rehabilitation session can proceed from beginning to end with no need to reset the ROM stops or anatomical positioning for each new protocol.

NOTE: Ensure that exercise data is not being saved in Setup Options under “Linked Protocol Preferences” or the software will close due to application memory error.

NOTE: If <Restrict Selections> is selected on the Setup Options screen, pre-defined test protocols cannot be accessed.

To Link a Protocol to an Exercise Session:

1. Select <Protocol> from the Configuration Tool Bar. The Protocol Definition screen should now be displayed.
2. If they do not already exist, define (add or edit) any protocol(s) you would like to use to build the linked protocol.
3. Select <Linked> from the Protocol Definition Screen Operating Mode Tool Bar. The Linked Protocol Setup screen should now be displayed.
4. Select <Create> from the Protocol Definition Screen Operating Mode Tool Bar. You can now enter a name for the new linked protocol in the Linked Protocol Name field.
5. Select <+> next to each mode to expand the list of individual protocols.
6. Highlight the desired protocol to link, then select <Insert> in the Protocol Definition Screen Operating Mode Tool Bar. The selected protocol should now be displayed in the Linked Protocol Sequence window.
7. Continue to highlight and <Insert> protocols as desired. To view parameters for any specific linked protocol, highlight the protocol in the Linked Protocol Sequence window. The selected protocol parameters will be displayed in the Protocol Information section of the screen.
8. When all the desired protocols have been linked, select <Save> to save the linked protocol and return to the Dynamometer Operation screen or <Single> or <Close> to return to the Protocol Definition screen.

NOTE: To remove a single protocol from the linked protocol sequence, highlight it in the linked protocol sequence window and select <Remove>. The single protocol will be deleted from the linked protocol sequence.

NOTE: To link test protocols, make sure “Limit Linked protocols to exercise only” is unchecked in set up options screen.

To Delete a Linked Protocol From a Test or Exercise Session:

1. Select <Linked> in the Protocol Definition Screen Operating Mode Tool Bar.
2. Highlight the linked protocol to delete.
3. Select <Delete> and then respond “Yes” to the “Delete Protocol?” prompt.
4. The linked protocol should be deleted from the system.

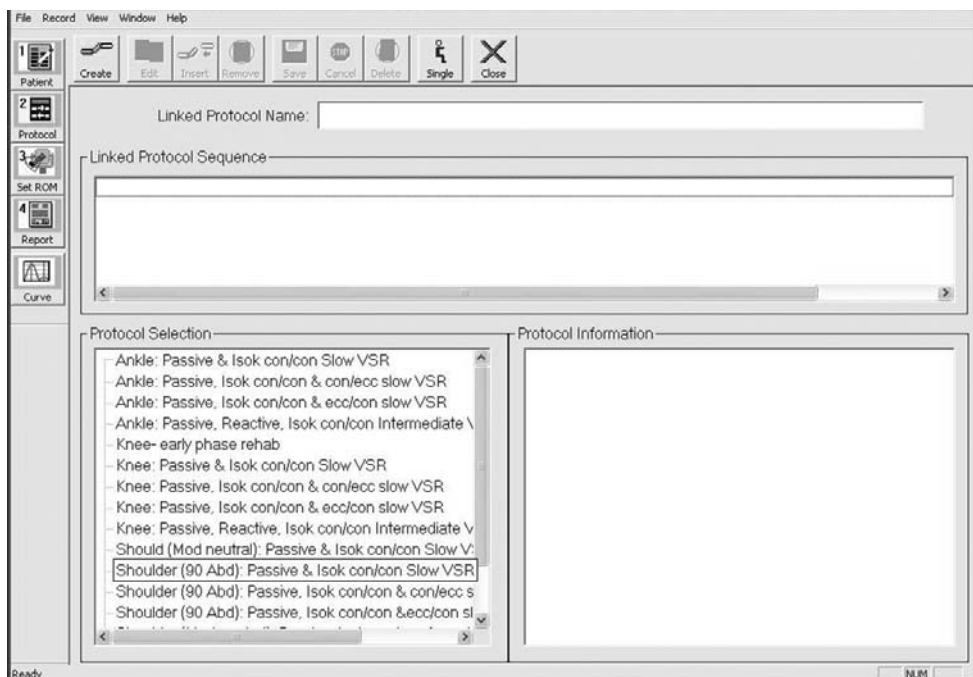


Figure 4.4. The Linked Protocol Setup screen. Highlight any protocol displayed in the Linked Protocol Sequence area to display protocol information.

PROTOCOL DEFINITION SCREEN PARAMETER FIELDS DEFINED

Study Type: Select Test or Exercise.

Mode: Choose from Isokinetic, Isometric, Isotonic, Passive, Passive Eccentric or Proprioception.

Joint: The joint to be tested or exercised. Choose from Knee, Ankle, Hip, etc. The description selected on this screen carries over to the Dynamometer Operation screen as well.

Pattern: The test or exercise pattern selected, i.e., Extension/Flexion, Pronation/Supination, etc. The description selected on this screen carries over to the Dynamometer Operation screen as well.

Contraction/Direction: The test or exercise contraction type, i.e., concentric/concentric, etc.

Description: This is the test or exercise type, i.e., Two-Speed Bilateral, Velocity Spectrum, etc. The description entered on this screen carries over to the Dynamometer Operation screen as well.

Bilateral: For Isokinetic testing and exercise, the user can set speeds away and toward, # of sets, number of reps for each limb to be tested. For Isometric testing, the user can set angles, away and toward.

NOTE: Number of sets refers to the number of speeds or angles for both bilateral and unilateral tests, (i.e., 2 for 2-speed tests, 3 for 3-speed tests).

Unilateral: For Unilateral testing and exercise the user can set speeds away and toward, # of sets, number of reps for the limb to be tested. The system defaults to the involved side when unilateral tests are selected.

Trial Reps: This field is used to toggle the Trial Reps function ON and OFF. Trial reps allows the patient to get used to the test speed before the test begins.

Anatomical Reference: The position of the limb immediately prior to testing or exercise. This figure carries over to the Dynamometer Operation screen. Each joint has a specific default value which can be changed as needed.

Attachment Sensitivity: This value controls acceleration based on attachment selection. It is a factory preset value based on the attachment selected.

Cushion: Select a value from one (hardest) to 10 (softest) for cushioning at the end ROM for each direction. As a general rule, "hard" cushions are used for testing while "soft" cushion are used to improve comfort during exercise and rehabilitation.

NOTE: If pain prohibits the use of hard cushion, or if a protocol calls for use of a soft cushion, there will be some decrease in time spent at isokinetic speed.

Rest Time in Seconds: This is the rest period between sets, in seconds.

End By: This is the parameter selected to end the exercise or test set. Available options are Rep, Time and Work.

5. SETTING RANGE OF MOTION (ROM)

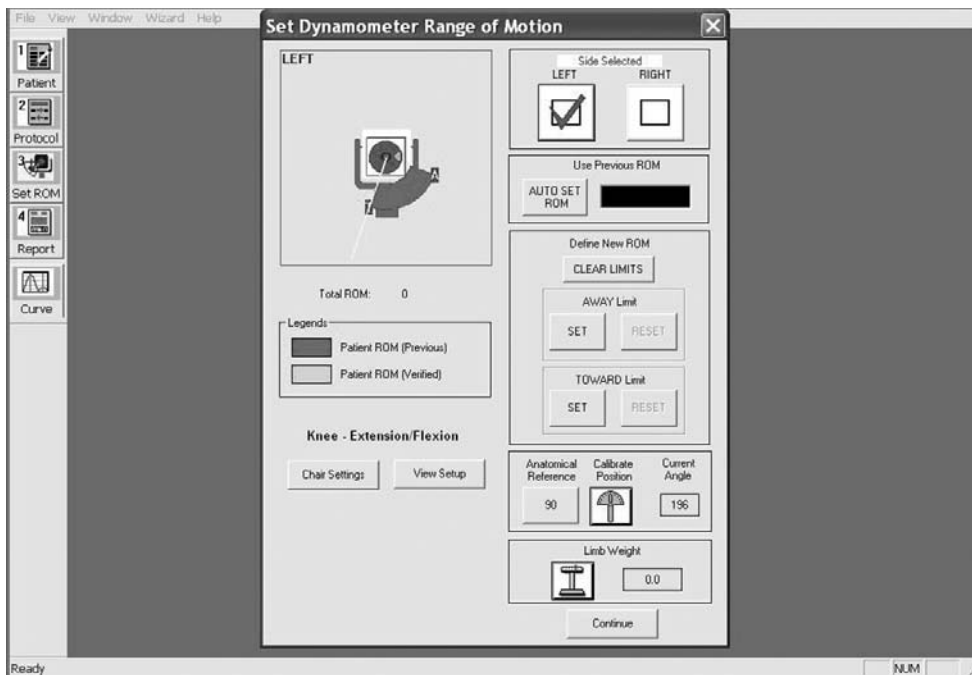


Figure 5.1. The Set Range Of Motion Screen allows users to set patient ROM and record both chair and dynamometer settings. Once ROM is set and calibrated, the Anatomical Reference value and Current Angle value should match exactly.

THE SET RANGE OF MOTION SCREEN

(See Figures 5.1 – 5.3.)

Patient ROM must be set prior to beginning any test, exercise or biofeedback session. You can set ROM at any time from the Dynamometer Operations screen by either choosing <SET ROM> from the Configuration Tool Bar when it is available on the left side of the screen, or by selecting <ROM SET> at the bottom of the Biofeedback screen. Either selection will call up the Set Dynamometer Range of Motion screen.

While at the Set Dynamometer Range of Motion screen, users can also record chair and dynamometer positioning and view setup for the selected pattern.

Recording Chair, Dynamometer and Attachment Length Settings

The Set Range Of Motion screen allows the opportunity to record settings for the dynamometer, chair and attachment length.

1. Select <Chair Settings>. The Chair Settings window should be displayed.
2. Enter the appropriate values in all appropriate fields for both the left and right sides. Use the scales on the chair, seat and attachment for accurate measurements.
3. Select <OK> to return to the Set Range Of Motion screen.

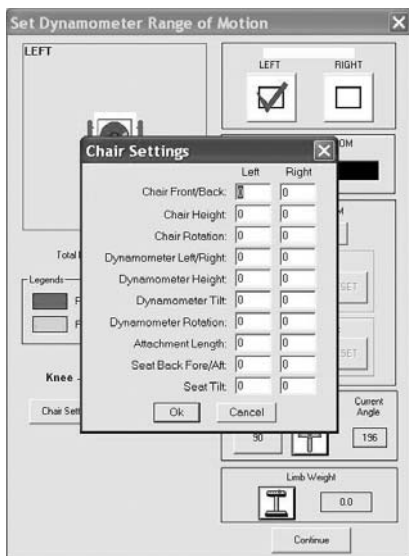


Figure 5.2

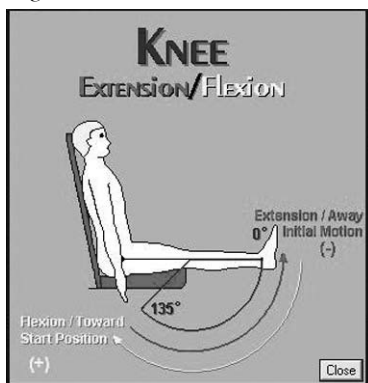


Figure 5.3

Figures 5.2 and 5.3. Both the Chair Settings and View Setup screens can be accessed from the Dynamometer Range of Motion window.

Setting ROM



NOTE: Ensure finger guard is in place when using this attachment.



NOTA: S'assurer que le doigtier est bien en place lorsqu'on utilise cet accessoire.

1. Place the patient in the anatomical reference angle specific to the joint to be tested or exercised and press the <Hold> button to lock the dynamometer arm in place.
2. Select <Set ROM> from the Configuration Tool Bar. The Set Dynamometer Range of Motion window will be displayed.
3. Select <Left> or <Right> side. The uninvolved side is the default value for the start of a test. If there is no involved side, the dominant side is tested first.
4. With new patients, clear the existing ROM by selecting <Clear Limits> in the Define New ROM section of the screen.

-
-
5. Set the <Away> and <Toward> Limits by moving the input adapter to the desired limit for each direction. Select <Set> at the limit for each direction. The subject ROM should now be displayed.

NOTE: The ROM settings are not “locked in” until ROM is set for both directions.

6. Select <Anatomical Reference>. A keypad will now be displayed. Use the keypad to enter the desired anatomical reference in degrees so the system will be goniometrically correct for the test or exercise selected. Reference values are joint specific.
7. Select <OK> to record the anatomical reference value in the anatomical reference box.
8. Move the dynamometer input arm to the anatomical reference position and select <Calibrate Position>. The anatomical reference value and the current angle displayed in the bottom right corner of the Set Range Of Motion screen should now match exactly. The previous patient ROM and the new (verified) patient ROM are now displayed in the ROM illustration at the top left of the screen.
9. Once you have set the ROM for each direction, select <Continue> to return to the Dynamometer Operations Screen.

NOTE: For testing or exercise, once all sets for the current side are completed, the Auto Set ROM prompt appears. This feature allows clinicians recall ROM settings from a previous test or for testing the opposite limb. Auto ROM saves the operator time in setting the range of motion, ensures that the ROM is set equally for both sides, and provides a way to repeat range of motion values from previous tests. This feature is explained further in the “Test/Exercise” procedure.

CLINICAL APPLICATIONS FOR SETTING ROM



NOTE: Range limits must always be set after the subject is positioned and prior to switching to a test or exercise mode. Limits should not be set at points that are beyond the safe maximum allowable range of motion for the individual subject. The system will not allow selection of mode until ROM end points are set.



NOTE: Always assume that previously set ROM limits are inappropriate for successive subjects and for successive joints on the same subject. Always set new limits when testing a new subject or moving from one joint to the next.



NOTA: Les amplitudes réglées antérieurement doivent être considérée inappropriées a priori. Régler les limites après chaque nouveau positionnement, changement d'accessoire, ou changement de côte. Au cours de la séance on peut augmenter l'amplitude, mais sans pour autant, passer au-delà des limites réglées lors du montage. Avant tout mouvement d'examen ou d'entraînement, s'assurer que l'amplitude est confortable.



NOTA: Les limites d'amplitude doivent être réglées après le positionnement du patient et avant de passer à un mode d'entraînement. Ces limites doivent être placées à des angles de sécurité pour le sujet concerné.

1. As the available range of motion decreases for a particular joint, as in short arc exercise, the speed of movement should decrease also. Limited range of motion will not always provide sufficient time for the joint to reach higher speeds.
2. Joints that have a greater range of motion, such as shoulders, can generally achieve higher speeds of exercise. Conversely, joints that have less range of motion, such as ankles, cannot attain the higher speeds.

Percent ROM (Away and Toward)

The Percent ROM buttons are used to selectively reduce the total range of motion established during patient setup. When the Set Limit Away LED is illuminated the Percent ROM -/+ Away button can be used to decrease the percent ROM allowed in the away direction (movement away from the body such as knee extension). Likewise, the Percent ROM -/+ Toward button can be used to decrease the percent ROM allowed in the toward direction.

NOTE: During exercise, limits can be moved within, but never beyond, the ROM established in the Setup mode. Before proceeding with a test or exercise bout, always ensure a comfortable range of motion for the subject.

Pause (0 to 30 seconds)

The Pause buttons, (Away and Toward toggles) allow the introduction of time delays between reciprocating patterns of motion during exercise in the Passive mode. The Pause function is inactive when set to zero seconds. Use the Pause Away button to increase or decrease the time length of the pause in the away direction (movement away from the body such as knee extension,) as indicated in the Seconds window. Use the Pause Toward to increase or decrease the time length of the pause in the toward direction.

6. GENERATING REPORTS

Biodex Advantage Software is extremely flexible when generating printed reports. In addition to four standard report formats displaying bar graphs, pie charts and statistical data, you can print a Rehab Session Summary and cover letters for referrals and payors. Progress reports are available in Graphical Evaluation and General Evaluation formats.

NOTE: For a detailed explanation of report parameters, refer to the Biodex Multi-Joint System Clinical Reference Guide.

REPORT FORMATS

(See Figures 6.1- 6.10.)

The Biodex Reports can be grouped into the following categories:

- Graphical Evaluation
- General Evaluation (not available for passive, isotonic and reactive eccentric)
- Comprehensive Evaluation
- Progress Reports (compare two similar protocols of different test sessions)
- Narrative Cover Letter
- Rehab Session Summary (See Generating A Rehab Session Summary Report later in this chapter.)

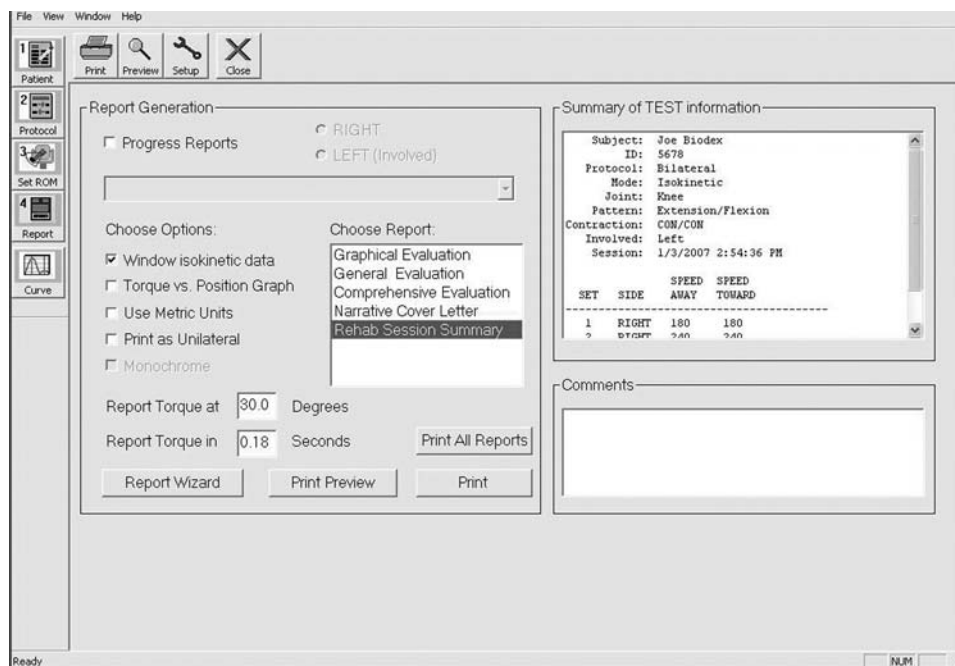


Figure 6.1. The Report Generation Screen.

GENERATING REPORTS

NOTE: The following procedure details generation of Graphical, General, Comprehensive and Evaluation reports, Progress Reports and Narrative Cover Letters for saved patients. Reports can also be generated immediately following any test by selecting the <Report > icon.

Rehab Summary Reports are detailed later in this chapter.

To Generate A Report

1. Choose <Patient> in the Configuration Tool Bar. The Patient Selection screen should now be displayed. The last patient saved is the current patient.
2. Select <Open> in the Operation Mode Tool Bar. The patient list should be now be displayed.
3. Select the desired patient from the Patient List.
4. Select the test for which you desire a report.
5. Select <Report> at the bottom of the screen to view reports available for the selected patient. The Report Generation screen should now be displayed. A summary of test information for the selected test appears on the right side of the screen. For progress reports, proceed to step 6. For other report formats, proceed to step 8.
6. Select "Progress" if a Progress Report is desired. The system will determine which sides are available for progress reporting (left or right). If both sides are available, select the desired side.

NOTE: Progress Reports can only be printed for tests that are similar in protocol (mode, speed, number of reps, etc.). You can, however, generate a report based on a bilateral test from one date and a unilateral test from a later date.

7. Under "Choose Report" select a test date for comparison. The system will automatically order the test dates so that the most recent test date is compared to the previous test date.
8. Under "Choose Option," select the desired report options. As options are selected, the list of available report formats displayed in the Choose Report window is narrowed to reflect only those report formats available based on the options selected.

NOTE: For a description of each report option, click on the Report Wizard at the bottom of the screen or see the section "Report Options" later in this chapter.

9. If you wish to enter any comments on the report, key them into the Comments box at the bottom right of the screen. You can now enter up to four lines of comments. These will appear at the bottom of the report.
10. Select the report format desired in the "Choose Report." For Narrative Cover Letters, proceed to step 11. For other report formats, click <Print Preview> to see the report on the screen and proceed to step 12.

11. If you have selected a Narrative Cover Letter, complete the Recipient Name, Address and Comments and Signature fields. Use the scroll feature to select the appropriate description or value for each of the parameters presented. Select <OK> to advance to the Print Preview screen.
12. At the Print Preview screen, ensure that the correct report is displayed with accurate information. If desired, select <Zoom> at the top of the screen to enlarge the report display for enlarged viewing.
13. Select <Print> to print out a hard copy of the report, or choose <Close> to exit without printing a report.
14. Once the report has been printed, select <Close> to return to the Report Generation screen.

PRINT ALL REPORTS

(See Figure 6.2.)

The <Print All Reports> feature allows clinicians to print all reports associated with a selected test in a single operation.

At the Report Generation screen, select <Print All Reports>. The Print All Reports screen should now be displayed.

Select the desired test, or select <Add All Reports>. The selected tests should now be displayed in the Selected Tests section of the screen.

Select <Print All> to print all available reports for the test selected.

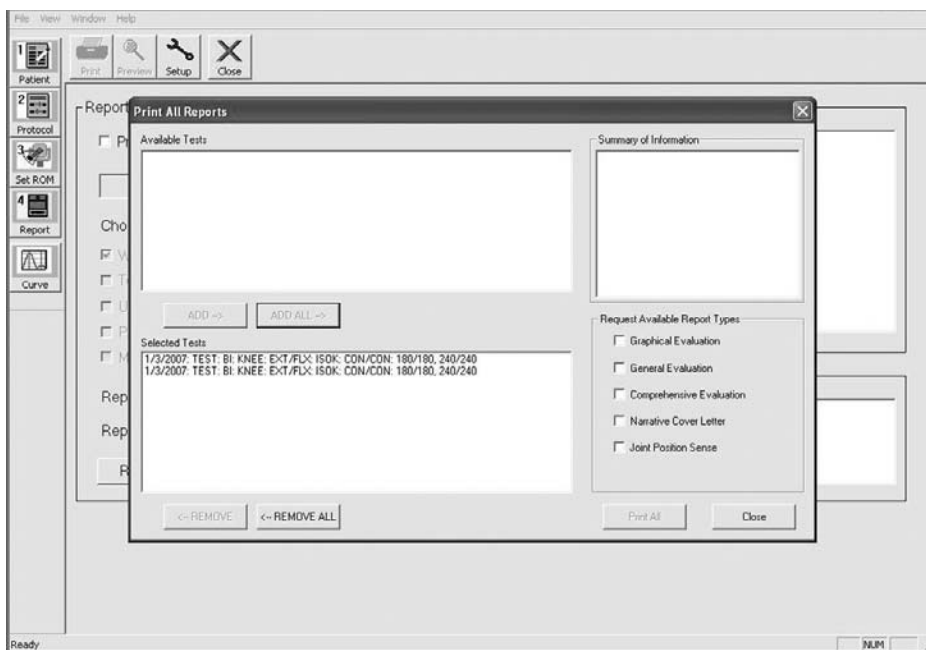


Figure 6.2. The Print All Reports option allows clinicians to select and print several reports consecutively.

REPORT OPTIONS

Window Isokinetic Data: Applies to isokinetic protocols only. This option filters out points inside the isokinetic data curve that fall below a predetermined percentage of the specified dynamometer speed.

Torque vs. Position Graph: All graphs in reports are normally plotted as Torque vs. Time. This option allows Position (in degrees) to appear on the x-axis of graphs in reports.

Use Metric Units: This option allows the data to be reported in metric units.

Print as Unilateral: Applies to bilateral tests only. This option allows the operator to print unilateral style reports for a bilateral test. This option is useful for printing results on partially completed tests.

Monochrome: This feature is not available in this software version.

NOTES ABOUT WINDOWING, CUSHION FILTERING AND CURVE FILTERING

When operating at high speeds and torques, it is possible to generate torque spikes as the subject decelerates into the end stop. Sometimes, this end stop spike is erroneously reported as the peak torque. To address this problem, Biodex software imposes cushion filtering and windowing. These are separate, selectable parameters that are set to default values in the software.

Windowing

During report selection, if windowed data is enabled, only data above 70% of isokinetic speed value is reported. The numeric data will also be windowed. The report will indicate whether data is windowed or non-windowed. The default value for isokinetic speed is to report all torque above 70% of isokinetic speed. This can be changed in the set-up options (under File in the main tool bar.)

Cushion Filtering

This is an additional method used in conjunction with isokinetic windowing to eliminate erroneous torque end spikes caused by deceleration into the end stop. This is not selectable in the report selection menu. The amount of filtering is calculated from the speed of the dynamometer and the level of the deceleration. If one assumes a cushion setting of 1 (default) for testing, this corresponds to a deceleration of 6 degrees per second per degree traveled. At 180 degrees per second, deceleration will begin 7.25 degrees from the stop. The “cushion” filter will remove torque values that occur within 7.25-degree deceleration zone. The cushion filter values can also be changed. These are INI file parameters. The default is ON. The default degree setting is 6 (degrees per second per degree).

NOTE: See appendix C for more information concerning Cushion Filtering.

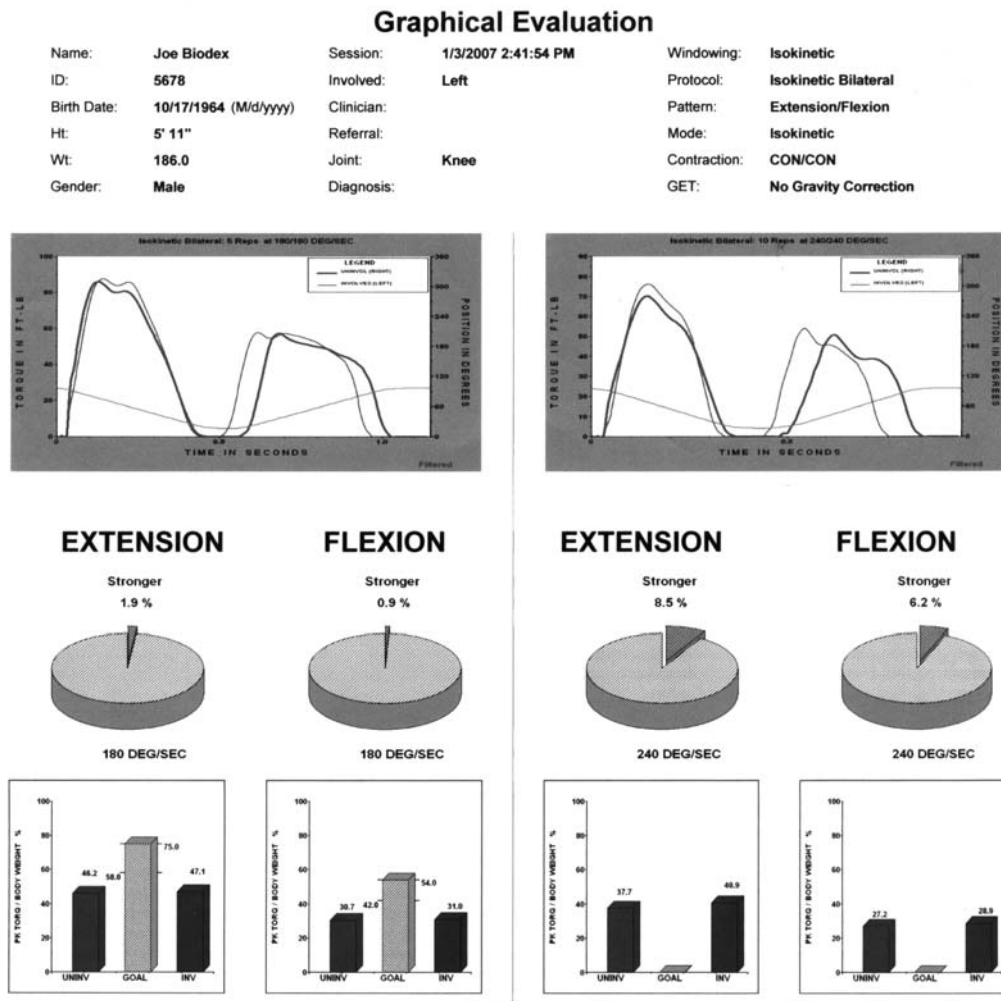
Curve Smooth Filter

A different type of filtering called Curve Smooth Filter is also used for reports. The curve smooth filter is used to provide a more graphically appealing curve. The exact method is explained in Appendix B, Biodex Multi-Joint System Dynamometer Structures, Formulas and Calculations.

GRAPHICAL EVALUATION REPORTS

(See Figure 6.3.)

Graphical Evaluation Reports provide graphical data of a bilateral comparison of peak torque values. The line graph documents the maximum repetition of peak torque of involved to unininvolved muscle groups. The pie chart shows the percent of peak torque deficit between the involved and the unininvolved muscle groups. The bar graph compares the peak torque to body weight ratio of involved and unininvolved muscle groups to a population goal.



Comments:

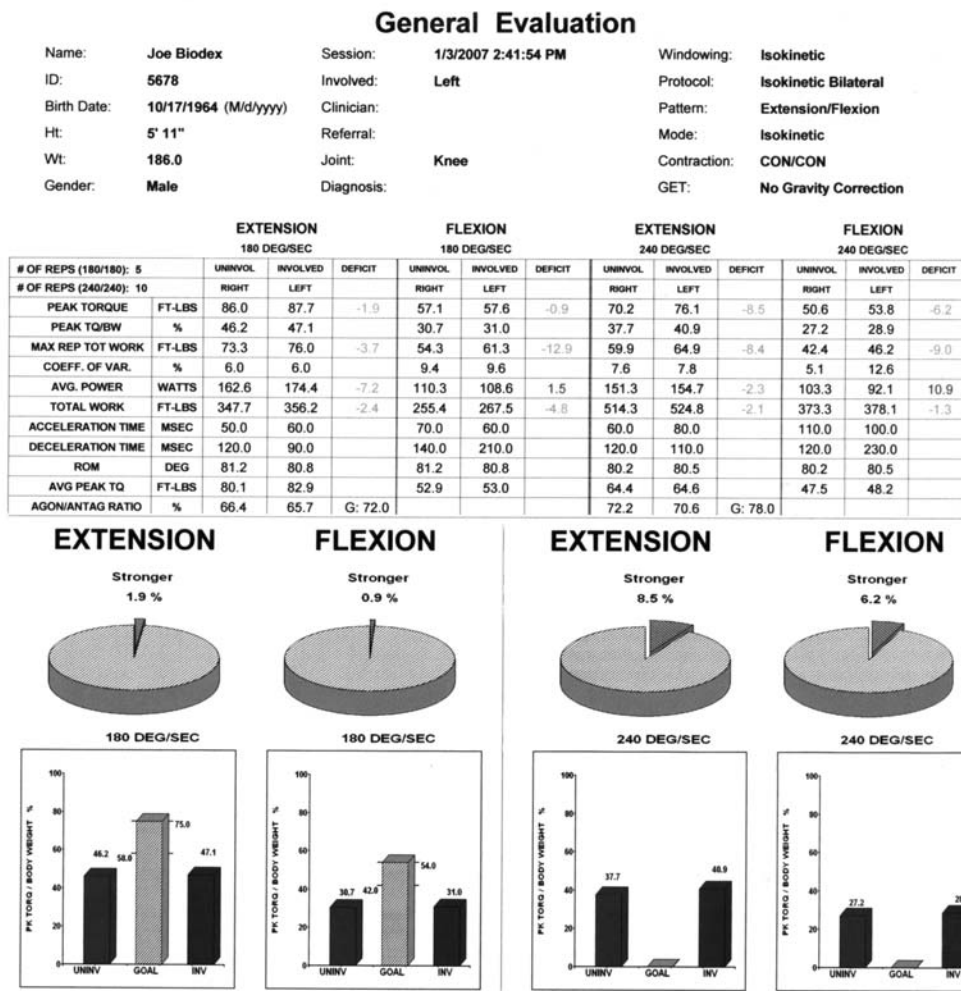
PEAK TORQUE: Highest muscular force output at any moment during a repetition. Indicative of a muscle's strength capabilities.
 PEAK TORQUE: Represented as a percentage normalized to bodyweight and compared to an established goal
 DEFICITS: 1 to 10% No significant difference between extremities.
 11 to 25% Rehabilitation recommended to improve muscle performance balance.
 > 25% Significant Functional Impairment
 (-) Negative deficit indicates involved extremity performed better than unininvolved

Figure 6.3. The Graphical Evaluation Report.

GENERAL EVALUATION REPORTS

(See Figure 6.4.)

This report generates numeric values including peak torque, peak torque to body weight ratio, maximum repetition of total work, coefficient of variance, average power, acceleration time, deceleration time, ROM, and agonist to antagonist ratio. Charts include a pie chart of peak torque deficits and a bar graph with peak torque to body weight ratios compared to a population goal. For this report, deficits are displayed in red.



Comments:

PEAK TORQUE: Highest muscular force output at any moment during a repetition. Indicative of a muscle's strength capabilities.
PEAK TQ/BW: Represented as a percentage normalized to bodyweight and compared to an established goal.
MAX REP TOT WORK: Total muscular force output for the repetition with greatest amount of work. Work is indicative of a muscle's capability to produce force throughout the range of motion.
AVG. POWER: Total work divided by time. Power represents how quickly a muscle can produce force.
ACCELERATION TIME: Total time to reach isokinetic speed. Indicative of a muscle's neuromuscular capabilities to move the limb at the beginning of the range of motion.
DECELERATION TIME: Total time to go from isokinetic speed to zero speed. Indicative of a muscle's neuromuscular capability to eccentrically control the limb at the end of the range of motion.
AGON/ANTAG RATIO: The Reciprocal muscle group ratio. Excessive imbalances may predispose a joint to injury.
DEFICITS: 1 to 10% No significant difference between extremities.
 11 to 25% Rehabilitation recommended to improve muscle performance balance.

Figures 6.4. A General Evaluation Report.

COMPREHENSIVE EVALUATION

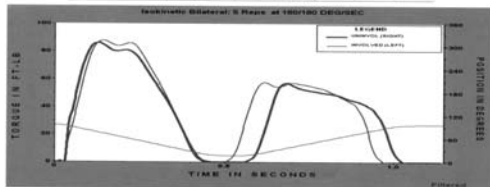
(See Figures 6.5 and 6.6.)

This report presents numeric data for 20 parameters, plus a line graph showing the maximum peak torque repetition. The numeric values include peak torque, peak torque to body weight ratio, time to peak torque, angle of peak torque, peak torque at X degrees of ROM, peak torque at X time, coefficient of variance, maximum reputation of total work, maximum work repetition number, work to body weight ratio, total work, work first third and work last third, work fatigue, average power, acceleration time, deceleration time, ROM, average peak torque, agonist to antagonist ratio.

Comprehensive Evaluation

Name: Joe Blodex Session: 1/3/2007 2:41:54 PM Windowing: Isokinetic
ID: 5678 Involved: Left Protocol: Isokinetic Bilateral
Birth Date: 10/17/1964 (M/d/yyyy) Clinician: Left Pattern: Extension/Flexion
HT: 5' 11" Referral: Mode: Isokinetic
WT: 186.0 Joint: Knee Contraction: CON/CON
Gender: Male Diagnosis: GET: No Gravity Correction

EXTENSION 180 DEG/SEC				FLEXION 180 DEG/SEC			
# OF REPS: Right 5	UNINVOL	INVOLVED	DEFECT	UNINVOL	INVOLVED	DEFECT	
# OF REPS: Left 5	RIGHT	LEFT		RIGHT	LEFT		
PEAK TORQUE	FT.LBS	85.0	87.7	-1.3	57.1	57.6	-0.9
PEAK TQBW	%	45.2	47.1		30.7	31.0	
TIME TO PK TQ	MSEC	140.0	150.0		140.0	140.0	
ANGLE OF PK TQ	DEG	75.0	72.0		34.0	30.0	
TORG @ 30.0 DEG	FT.LBS	16.2	32.7	102.4	53.4	57.6	-7.8
TORG @ 9.18 SEC	FT.LBS	80.0	84.9	-6.2	52.8	55.1	-4.3
COEFF. OF VAR.	%	6.0	6.0		9.4	9.6	
MAX REP TOT WORK	FT.LBS	73.3	76.0	-3.7	54.3	61.3	-12.9
MAX WORK REP #	#	5	4		3	1	
WRK/BODYWEIGHT	%	39.4	40.9		29.2	33.0	
TOTAL WORK	FT.LBS	347.7	356.2	-8.4	255.4	267.5	-12.0
WORK FIRST THIRD	FT.LBS	127.7	131.9		93.9	112.7	
WORK LAST THIRD	FT.LBS	95.3	97.5		67.8	64.8	
WORK FATIGUE	%	24.6	26.1		27.8	42.5	
AVG POWER	WATTS	162.6	174.4	-7.2	110.3	108.6	1.5
ACCELERATION TIME	MSEC	50.0	60.0		70.0	60.0	
DECELERATION TIME	MSEC	120.0	90.0		140.0	210.0	
ROM	DEG	81.2	80.8		81.2	80.8	
AVG PEAK TQ	FT.LBS	80.1	82.9		52.9	53.0	
AGONANTAG RATIO	%	66.4	65.7	0.72.0			



Comprehensive Evaluation

Name: Joe Blodex Session: 1/3/2007 2:41:54 PM Windowing: Isokinetic
ID: 5678 Involved: Left Protocol: Isokinetic Bilateral
Birth Date: 10/17/1964 (M/d/yyyy) Clinician: Left Pattern: Extension/Flexion
HT: 5' 11" Referral: Mode: Isokinetic
WT: 186.0 Joint: Knee Contraction: CON/CON
Gender: Male Diagnosis: GET: No Gravity Correction

EXTENSION 240 DEG/SEC				FLEXION 240 DEG/SEC			
# OF REPS: Right 10	UNINVOL	INVOLVED	DEFECT	UNINVOL	INVOLVED	DEFECT	
# OF REPS: Left 10	RIGHT	LEFT		RIGHT	LEFT		
PEAK TORQUE	FT.LBS	70.2	76.1	-6.5	50.6	53.8	-6.2
PEAK TQBW	%	37.7	40.9		27.2	28.9	
TIME TO PK TQ	MSEC	150.0	170.0		150.0	170.0	
ANGLE OF PK TQ	DEG	69.0	65.0		43.0	39.0	
TORG @ 30.0 DEG	FT.LBS	17.6	33.3	-67.6	32.7	40.5	-23.7
TORG @ 9.18 SEC	FT.LBS	63.5	74.3	-17.2	49.6	49.4	0.5
COEFF. OF VAR.	%	7.6	7.8		5.1	12.0	
MAX REP TOT WORK	FT.LBS	59.9	64.9	-8.4	42.4	46.2	-8.0
MAX WORK REP #	#	2	2		1	1	
WRK/BODYWEIGHT	%	32.2	34.9		22.8	24.8	
TOTAL WORK	FT.LBS	514.3	524.8	-10.5	373.3	378.1	-4.8
WORK FIRST THIRD	FT.LBS	212.9	214.3		141.6	143.2	
WORK LAST THIRD	FT.LBS	132.4	137.1		105.6	93.1	
WORK FATIGUE	%	37.8	36.0		25.5	35.0	
AVG POWER	WATTS	151.3	154.7	-2.3	103.3	92.1	10.9
ACCELERATION TIME	MSEC	60.0	80.0		110.0	100.0	
DECELERATION TIME	MSEC	120.0	110.0		120.0	230.0	
ROM	DEG	80.2	80.5		80.2	80.5	
AVG PEAK TQ	FT.LBS	64.4	64.6		47.5	48.2	
AGONANTAG RATIO	%	72.2	70.6	0.78.0			

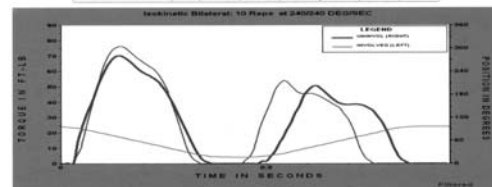


Figure 6.5. The Comprehensive Evaluation Report (pgs. 1 and 2).

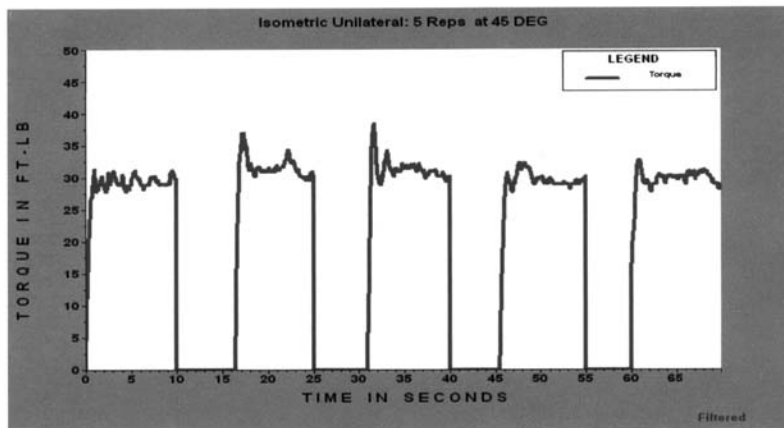
Comprehensive Evaluation

Name: John Doe Session: 4/3/2007 9:49:11 AM
 ID: 12345 Involved: Left Protocol: Isometric Unilateral
 Birth Date: 12:00:00 AI (M/d/yyyy) Clinician: Pattern: Extension/Flexion
 Ht: Referral: Mode: Isometric
 Wt: 185.0 Joint: Knee Contraction: AWAY
 Gender: Male Diagnosis:

AWAY
45 DEG

TOWARD
45 DEG

Side: LEFT			
# OF REPS: 5			
PEAK TORQUE	FT-LBS	38.1	0.0
AVG PEAK TQ	FT-LBS	34.2	0.0
AVE PKTQ/BW	%	18.5	0.0
RELAXATION TIME	SEC	5	5
CONTRACTION TIME	SEC	10	10
COEFF. OF VAR.	%	9.0	0.0
IMPULSE	FT-LBS	3.4	0.0
AGON/ANTAG RATIO	%	0.0	



Comments:

PEAK TORQUE: Highest muscular force output at any moment during a repetition. Indicative of a muscle's strength capabilities.
 PEAK TQ/BW: Represented as a percentage normalized to bodyweight and compared to an established goal
 COEFF. OF VAR.: Statistical representation of test validity based on reproducibility of performance. Lower values demonstrate higher reproducibility.
 AGON/ANTAG RATIO: The Reciprocal muscle group ratio. Excessive imbalances may predispose a joint to injury
 Use positive angles for Extension/Flexion

Figure 6.6. An Isometric Comprehensive Evaluation Report. For Isometric Reports, "Isometric Impulse" is the average torque in foot pounds. The unit of measure is ftlbs/sec.

NARRATIVE COVER LETTER

(See Figures 6.7 and 6.8.)

This is a form letter that allows the user to input certain parameters regarding an individual patient's test data. This letter provides the reader with a simple, clear and concise interpretation of the patient's performance.

NOTE: The software does not automatically update the letter to match patient's test data. The user must update the text.

3/28/2007

Dr. Warren
20 Ramsay Road
Shirley, NY 11967

re: Joe Biodex

Dear Dr. Warren:

As requested, please find a Biodex Isokinetic evaluation for Joe Biodex, The test was administered on 1/3/2007. The uninvolved knee was tested first, followed by the involved knee.

The results of the test reveal significant strength deficits in the involved knee as compared to the uninvolved knee.

The involved knee exhibited work capabilities similar to the work capabilities of the uninvolved knee.

Power capabilities for the involved knee were similar to the power capabilities of the uninvolved knee.

Range of motion for the involved knee was above normal limits.

Referencing the coefficient of variance, the reliability of the patient's test performance was acceptable.

It is my opinion that the patient is making good progress and should continue therapy for 5 visit(s).

Sincerely,

Jim Therapist

Figure 6.7. A Biodex Narrative Cover Letter.

Figure 6.8. The Recipient Name and Address screen allows the clinician to select appropriate descriptions for a variety of parameter fields.

Formatting Paper Size for Narrative Letters

The Narrative Cover Letter can be adjusted to fit different paper sizes. The following directions explain how to find the file to adjust the text layout and then save your adjustments. Adjust the file only if the Narrative Letter text is not fitting properly on the letter-size paper being used.

NOTE: The file used to print the text for a Narrative Cover letter is: ISOKCOVLET.TXT. The file is located on the System_4 directory. Make sure to make a back-up of this file and save it to the "My Documents" folder before making any changes in case you need to go back to the original file for any reason.

If you have any problems with the following procedure, contact Biodex Customer Service for support at (631) 924-9000 Ext. 2120.

1. Close the Biodex Advantage Software application before opening any new files.
2. Locate the file <ISOKCovLet.txt> in the System_4 directory. Open the file with Microsoft Notepad. Adjust file to fit the desired paper size.
3. Set up the page by positioning the curser ahead of the text you need to move to the next line. Select <Enter> to move to next line down.
4. When you are satisfied with the setup, select <File> from the upper left corner of the Notepad screen.
5. Select <Save>, then close the file by selecting <file> again from the upper left hand corner of the Notepad screen.
6. Select exit to close the Notepad program.
7. Open the Advantage Software Program and advance to the Reports screen. Print out a Narrative Cover Letter to verify the adjusted text positioning.

REHAB SESSION SUMMARY

(See Figure 6.9.)

The Rehab Session Summary Report presents strength, range of motion and pain data, plus up to four additional objective data points of your choice (i.e., joint laxity, balance, gait speed) on a single graph for a clear picture of the patient's rehab status and progress over time. Uninvolved data is graphed separately from involved data so that the uninvolved data can be used for patient goals.

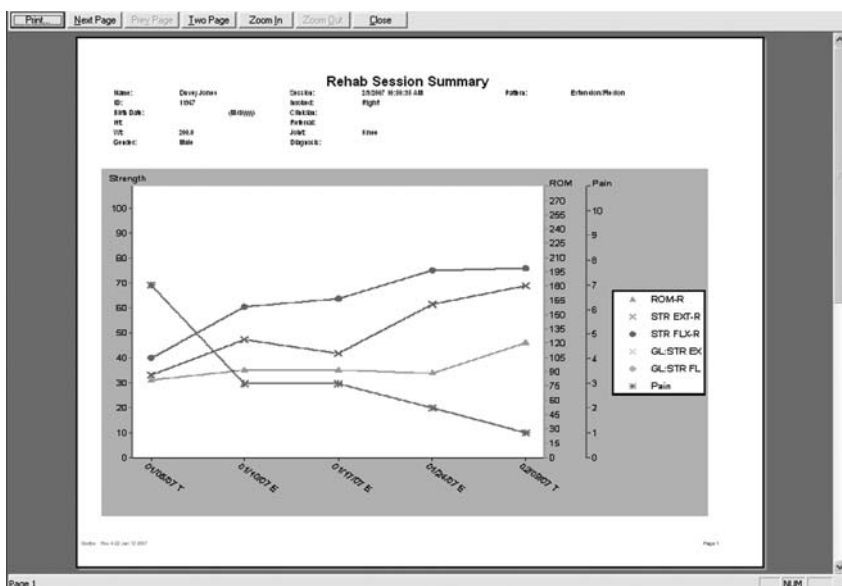


Figure 6.9. The Rehab Session Summary report shows strength, range of motion and pain data, plus up to four additional objective data points of your choice (i.e., joint laxity, balance, gait speed) on a single graph for a clear picture of the patient's rehab status.

Generating a Rehab Session Summary Report

1. Choose <Patient> in the Configuration Tool Bar. The Patient Selection screen should now be displayed. The last patient saved is the current patient.
2. Select <Open> in the Operation Mode Tool Bar. The patient list should now be displayed.
3. Select the desired patient from the patient list. The patient file should now be displayed.
4. Highlight the desired exercise and then select <Report> at the bottom of the screen to view a list of available reports. The Report Generation screen should now be displayed.
5. Select "Rehab Session Summary" from the Choose Report list. The Rehab Session Summary Report Selection screen should now be displayed.
6. Highlight the desired protocols in the Available Protocols window, and select <Add> to move the protocols to the Selected Protocols window. To select all available protocols, select <Add All>.
7. Check any selection desired in the Select Data To Graph list.
8. Under Options, check Graph Legend if you want a legend printed on the report.
9. Select <Continue> to advance to the Rehab Graph Data screen. At this screen, you can edit any of the displayed parameters.
10. Enter the minimal and maximal value for the "Other" fields.

NOTE: The minimum and maximum values entered must be lower and higher, respectively, than the corresponding values displayed in the parameters window.

11. Select <Continue> to advance to page one of the Rehab Summary Report, <Save Data> to save the rehab data for later recall, or <Export Data> to save the rehab session to another folder or destination.

PROGRESS REPORTS

(See Figure 610, 6.11 and 6.12.)

This report uses information from two different test\exercise sessions to compare patient performance for the same side (i.e., involved knee initial test vs. current test). Progress Reports can be generated in graphic, general and comprehensive formats.

NOTE: Progress Reports can only be printed for tests that are similar in protocol (mode, speed, number of reps, etc.). You can, however, generate a report based on a bilateral test from one date and a unilateral test from a later date.

General Progress Evaluation: RIGHT Side

Name:	Joe Biodes	Current:	2/27/2007 3:00:02 PM	Previous:	2/27/2007 2:53:41 PM
ID:	4667888	Involved:	Right	Protocol:	Isokinetic Bilateral
Birth Date:	(M/d/yyyy)	Clinician:		Pattern:	Extension/Flexion
Ht:		Referral:		Mode:	Isokinetic
Wt:	200.0	Joint:	Knee	Contraction:	CON/CON
Gender:	Male	Diagnosis:		GET:	No Gravity Correction

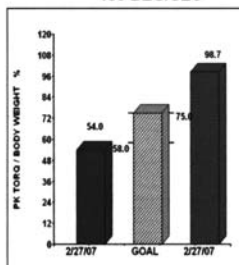
EXTENSION 180 DEG/SEC				FLEXION 180 DEG/SEC				EXTENSION 300 DEG/SEC				FLEXION 300 DEG/SEC			
# OF REPS (180/180): 5	TEST DATE	TEST DATE	PROGRESS	TEST DATE	TEST DATE	PROGRESS		TEST DATE	TEST DATE	PROGRESS		TEST DATE	TEST DATE	PROGRESS	
# OF REPS (300/300): 10	2/27/07	2/27/07		2/27/07	2/27/07			2/27/07	2/27/07			2/27/07	2/27/07		
PEAK TORQUE FT-LBS	108.0	197.4	82.8	58.7	77.6	32.1		133.5	80.7	-39.6		85.2	56.0	-34.2	
PEAK TQ/BW %	54.0	98.7		29.4	38.8			66.8	40.3			42.6	28.0		
MAX REP TOT WORK FT-LBS	114.0	241.5	111.8	67.6	100.4	48.8		177.0	85.6	-51.6		105.1	57.2	-45.6	
COEFF. OF VAR. %	20.9	16.4		5.9	14.8			42.0	9.1			36.5	6.0		
AVG. POWER WATTS	199.6	416.4	108.6	119.4	162.8	36.4		297.3	232.7	-21.7		208.6	161.9	-22.4	
TOTAL WORK FT-LBS	496.0	1068.5	115.4	298.5	428.7	43.6		1021.7	724.1	-29.1		758.3	520.7	-31.3	
ACCELERATION TIME MSEC	40.0	40.0		70.0	70.0			40.0	50.0			90.0	90.0		
DECELERATION TIME MSEC	100.0	160.0		110.0	130.0			130.0	100.0			120.0	90.0		
ROM DEG	97.5	98.5		97.5	98.5			97.1	96.4			97.1	96.4		
AVG PEAK TQ FT-LBS	80.4	167.4		52.5	66.7			79.8	71.4			59.0	51.4		
AGON/ANTAG RATIO %	54.4	39.3	G: 72.0					63.8	69.5	G: 78.0					

EXTENSION

Stronger
82.8 %



180 DEG/SEC

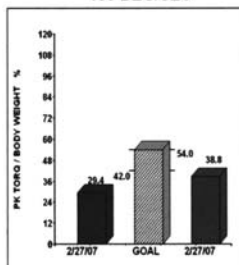


FLEXION

Stronger
32.1 %



180 DEG/SEC

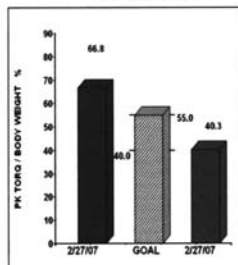


EXTENSION

Deficit
39.6 %



300 DEG/SEC

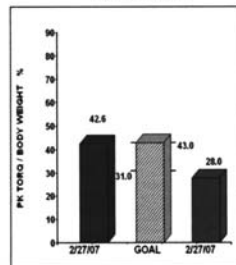


FLEXION

Deficit
34.2 %



300 DEG/SEC



Comments:

Figure 6.10. A General Progress Evaluation Report.

Comprehensive Progress Evaluation: RIGHT Side

Name:	Joe Blodex	Current:	2/27/2007 3:00:02 PM	Previous:	2/27/2007 2:53:41 PM
ID:	4667888	Involved:	Right	Protocol:	Isokinetic Bilateral
Birth Date:	(M/d/yyyy)	Clinician:		Pattern:	Extension/Flexion
Ht:		Referral:		Mode:	Isokinetic
Wt:	200.0	Joint:	Knee	Contraction:	CON/CON
Gender:	Male	Diagnosis:		GET:	No Gravity Correction

EXTENSION 180 DEG/SEC				FLEXION 180 DEG/SEC			
# OF REPS: Previous: 5		TEST DATE	TEST DATE	PROGRESS	TEST DATE	TEST DATE	PROGRESS
# OF REPS: Current: 5		2/27/07	2/27/07		2/27/07	2/27/07	
PEAK TORQUE	FT-LBS	108.0	197.4	82.8	58.7	77.6	32.1
PEAK TQ/BW	%	54.0	98.7		29.4	38.8	
TIME TO PK TQ	MSEC	160.0	230.0		190.0	180.0	
ANGLE OF PK TQ	DEG	77.0	80.0		29.0	43.0	
TORQ @ 30.0 DEG	FT-LBS	48.0	94.7	97.1	58.6	60.1	2.6
TORQ @ 0.18 SEC	FT-LBS	104.4	187.8	79.9	58.7	77.4	31.7
COEFF. OF VAR.	%	20.9	16.4		5.9	14.8	
MAX REP TOT WORK	FT-LBS	114.0	241.5	111.8	67.6	100.4	48.6
MAX WORK REP #	#	2	4		2	1	
WRK/BODYWEIGHT	%	57.0	120.7		33.8	50.2	
TOTAL WORK	FT-LBS	496.0	1068.5	115.4	298.5	428.7	43.6
WORK FIRST THIRD	FT-LBS	195.6	376.9		107.2	168.6	
WORK LAST THIRD	FT-LBS	127.5	328.6		86.2	116.9	
WORK FATIGUE	%	34.8	12.8		19.5	30.6	
AVG. POWER	WATTS	199.6	416.4	108.6	119.4	162.8	36.4
ACCELERATION TIME	MSEC	40.0	40.0		70.0	70.0	
DECELERATION TIME	MSEC	100.0	160.0		110.0	130.0	
ROM	DEG	97.5	98.5		97.5	98.5	
AVG PEAK TQ	FT-LBS	80.4	167.4		52.5	66.7	
AGON/ANTAG RATIO	%	54.4	39.3	G: 72.0			

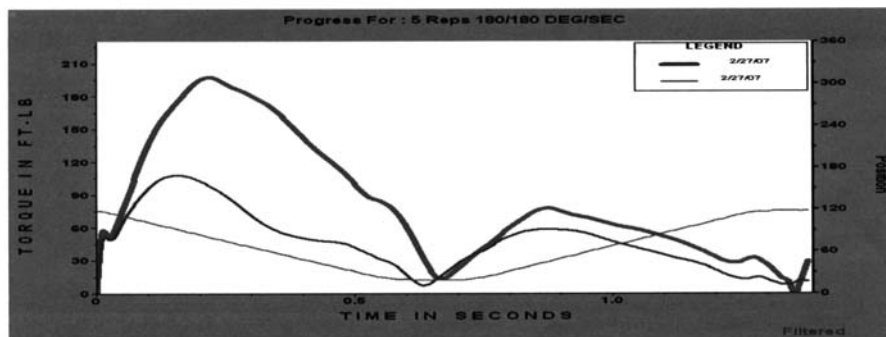


Figure 6.11. A Comprehensive Progress Evaluation (page 1).

Comprehensive Progress Evaluation: RIGHT Side

Name:	Joe Blodex	Current:	2/27/2007 3:00:02 PM	Previous:	2/27/2007 2:53:41 PM
ID:	4667888	Involved:	Right	Protocol:	Isokinetic Bilateral
Birth Date:	(M/d/yyyy)	Clinician:		Pattern:	Extension/Flexion
Ht:		Referral:		Mode:	Isokinetic
Wt:	200.0	Joint:	Knee	Contraction:	CON/CON
Gender:	Male	Diagnosis:		GET:	No Gravity Correction

EXTENSION 300 DEG/SEC				FLEXION 300 DEG/SEC			
# OF REPS: Previous: 10		TEST DATE	TEST DATE	PROGRESS	TEST DATE	TEST DATE	PROGRESS
# OF REPS: Current: 10		2/27/07	2/27/07		2/27/07	2/27/07	
PEAK TORQUE	FT-LBS	133.5	80.7	-39.6	85.2	56.0	-34.2
PEAK TQ/BW	%	66.8	40.3		42.6	28.0	
TIME TO PK TQ	MSEC	140.0	160.0		210.0	150.0	
ANGLE OF PK TQ	DEG	67.0	78.0		50.0	48.0	
TORQ @ 30.0 DEG	FT-LBS	106.8	5.0	-95.3	70.6	45.9	-34.9
TORQ @ 0.18 SEC	FT-LBS	124.9	77.1	-38.3	82.3	48.8	-40.7
COEFF. OF VAR.	%	42.0	9.1		36.5	6.0	
MAX REP TOT WORK	FT-LBS	177.0	85.6	-51.6	105.1	57.2	-45.6
MAX WORK REP #	#	5	8		5	2	
WRK/BODYWEIGHT	%	88.5	42.8		52.5	28.6	
TOTAL WORK	FT-LBS	1021.7	724.1	-29.1	758.3	520.7	-31.3
WORK FIRST THIRD	FT-LBS	383.4	238.8		362.0	197.6	
WORK LAST THIRD	FT-LBS	154.3	244.1		112.5	148.7	
WORK FATIGUE	%	59.8	-2.2		68.9	24.7	
AVG. POWER	WATTS	297.3	232.7	-21.7	208.6	161.9	-22.4
ACCELERATION TIME	MSEC	40.0	50.0		90.0	90.0	
DECELERATION TIME	MSEC	130.0	100.0		120.0	90.0	
ROM	DEG	97.1	96.4		97.1	96.4	
AVG PEAK TQ	FT-LBS	79.8	71.4		59.0	51.4	
AGON/ANTAG RATIO	%	63.8	69.5	G: 78.0			

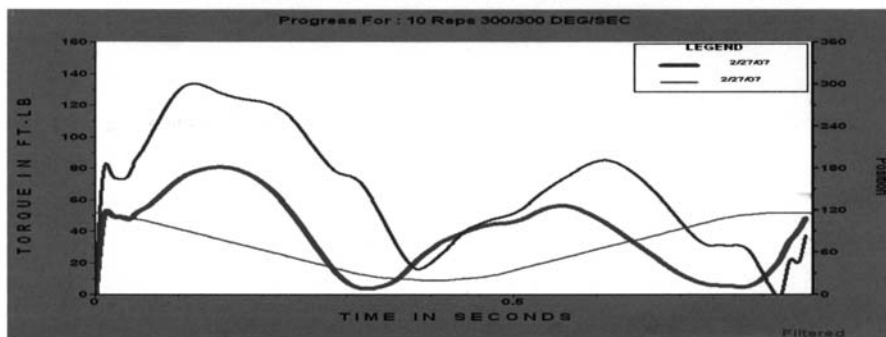


Figure 6.12. A Comprehensive Progress Evaluation (page 2).

PROPRIOCEPTIVE REPORT

Joint Position Sense: Active					
Name:	John Doe	Session:	3/28/2007 2:38:38 PM	Protocol:	Proprioception Unilateral
ID:	12345	Involved:	Left	Pattern:	Extension/Flexion
Birth Date:	12:00:00 . (M/d/yyyy)	Clinician:		Mode:	Proprioception
Ht:		Referral:			
Wt:	185.0	Joint:	Knee		
Gender:	Male	Diagnosis:			
POSITION 1					
STARTING POSITION		90			
TARGET POSITION		30			
MOVEMENT SPEED		150			
DEGREES		LEFT POS	LEFT DIFF		
REP	1	38.3	+8.3		
 AVERAGE		38.3	8.3		

Figure 6.13. A Unilateral Proprioception Report.

7. CURVE ANALYSIS

(See Figures 7.1 – 7.2.)

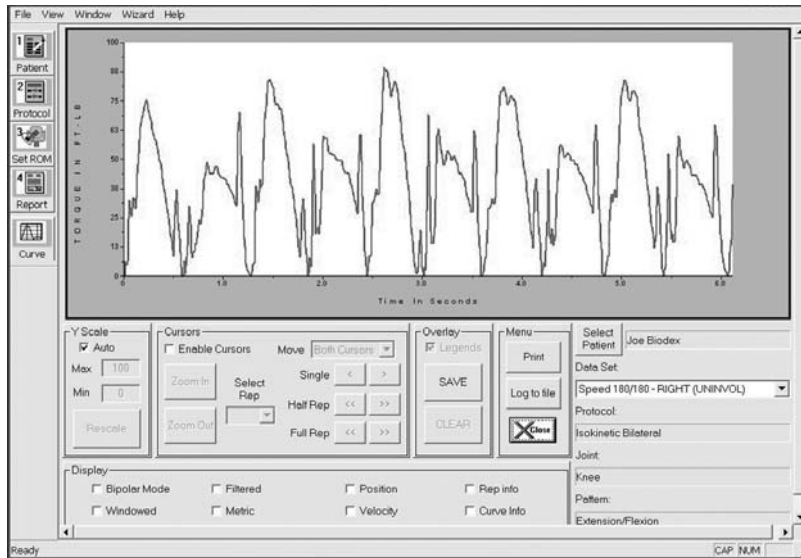


Figure 7.1. The Curve Analysis function allows clinicians to view test curves on a set by set basis.

CURVE ANALYSIS

The Curve Analysis function allows the user to view test data on screen in various formats including individual curves, windowed-curves, filtered curves, and a curve log. It also allows printing of curves for individual reps or complete sets.

To Access Curve Analysis

At the Dynamometer Operation screen, select <Curve Analysis> from the Configuration Tool Bar. The Curve Analysis screen should now be displayed with the most recent test displayed. Patient Name, Protocol, Joint and Pattern for the test are displayed at the bottom right of the screen.

To Select A Different Patient: If you desire a different patient from the one currently displayed, select <Patient>. You can then select a different patient and test from the patient list.

To Select A Different Data Set: Use the Data Set scroll down button to view the other data sets from that test/exercise for the currently selected patient. Select the desired data set to view and the screen will refresh with the new data set displayed.

To Select A Different Test: If you desire to view a different test for the selected patient, select <Patient>. You can then select a different patient and test.

CURVE ANALYSIS OPTIONS

The lower portion of the Curve Analysis screen is divided into the following sections which allow the user to choose from various viewing options: Y-Scale, Cursors, Overlay, Menu and Display. Each section is explained in detail below.

Y-Scale: Enables the clinician to adjust a minimum and maximum scaling value for torque in ft-lb. When observing graph, the ft-lb setting runs vertically on the left side of the screen. The auto setting allows for automatic rescaling of the torque in ft-lb to compensate for the peak torque curve.

Cursors: Enable Cursors: Checking the enable cursors icon gives the clinician the ability to use and view data between the cursors labeled "A" and "B".

Move: This is a pull down menu for cursor movement that allows the following functions:

- Both cursors allows cursor "A" and "B" to be moved at the same time.
- Cursor "A" allows only the "A" cursor to be active.
- Cursor "B" allows only the "B" cursor to be active.

Cursors can also be moved by clicking and dragging, or with the single, half rep or full rep buttons described below.

- Single: allows the cursor(s) to be moved along one data point at a time
- Half Rep: Will place the cursor(s) at the start and end of a half rep
- Full Rep: Will place the cursors at the start and end of a full rep

Zoom In/Zoom Out: Use <Zoom In> or <Zoom Out> to magnify the area of the curve between the cursors. This allows closer evaluation of the curve quality.

Select Rep: An individual repetition can be viewed using the Select Rep feature. When viewing the graph with the cursors enabled, selecting rep will automatically place the cursors at the start and end of the corresponding repetition.

Overlay: Allows the clinician to select sets of the same parameters to overlay curves for comparison of torque. Up to four sets can be selected at one time.

To Overlay Curves:

1. Select <Curves> in the Configuration Tool Bar if not already on the Curve Analysis screen.
2. Display the first curve/set on the graph. The current patient is automatically displayed.
3. Select another patient if desired by choosing <Patient> in the Configuration Tool Bar.
4. Select <Save> to save the displayed curve/set.
5. Select <OK>. The first curve/set is now displayed.
6. Retrieve the next curve/set.
7. Select <Save>.
8. Select <OK>. Both sets/curves are now displayed, overlaid.

Legends: When checked, lists each set overlaid in order (in the upper left hand corner of the curve analysis screen) in the following corresponding color code:

- Violet = first set selected
- Blue = second set selected
- Black = third set selected
- Green = fourth set selected

If you wish to have legends displayed for overlaid tests, select <Legends> after saving curves/sets to overlay in steps 3 and 6, above.

Save: Drops the selected set onto the curve analysis screen in the order chosen.

Clear: Clears all overlaid data and graphs and returns graph to single set curve analysis.

Display:

- **Bipolar:** Displays the graph on a positive/negative axis and is useful for analyzing concentric/eccentric and eccentric/concentric data.
- **Windowed:** Select this if you want to see only data generated at or above the default percentage of selected isokinetic test speed. Any data acquired at less than 70% of the pre-set isokinetic speed will be eliminated from the display. This feature is used to eliminate torque spikes generated at end ROM stops. The default value of 70% can be changed in the set-up screen previously mentioned.
- **Filtered:** Select <Filter> to “smooth” the curves displayed. This feature does not alter data. It simply serves as a visual aid by rounding the curves to reduce spikes and noise.
- **Metric:** When selected, display units in metric values.
- **Position:** Indicates range of motion for the displayed reps. A purple horizontal line is used to indicate start (towards) direction.
- **Velocity:** The green line indicates the speed at which reps were produced.
- **Rep. Info:** Select <Rep Info> to display:
 - Beginning and end of each repetition
 - Peak torque repetition, both toward and away
 - Peak work repetition
- **Curve Info:** Click on <Curve Info> to display toward and away values for:
 - Peak torque rep
 - Peak torque ft-lb
 - Max work ft-lb
 - Max work rep
 - Average power (watts)
 - Seconds to peak torque (sec)

Menu:

Print: Choose <Print> to access print options. You can then edit the title and key in comments to be added to the printout. When ready, click on <Continue> to print.

Log To File: For a numeric log of the currently displayed curve, select <Log To File>. Choosing this feature opens a Notepad file displaying every data point for the set displayed for: time (microseconds,) torque (ft-lb,) dynamometer position (degrees,) anatomical position (degrees,) and velocity (deg/sec). If desired, you can save the data points in a “My Document” folder for later viewing

Close: Select <Close> to close the Curve Analysis screen and return to the Dynamometer Operation screen.

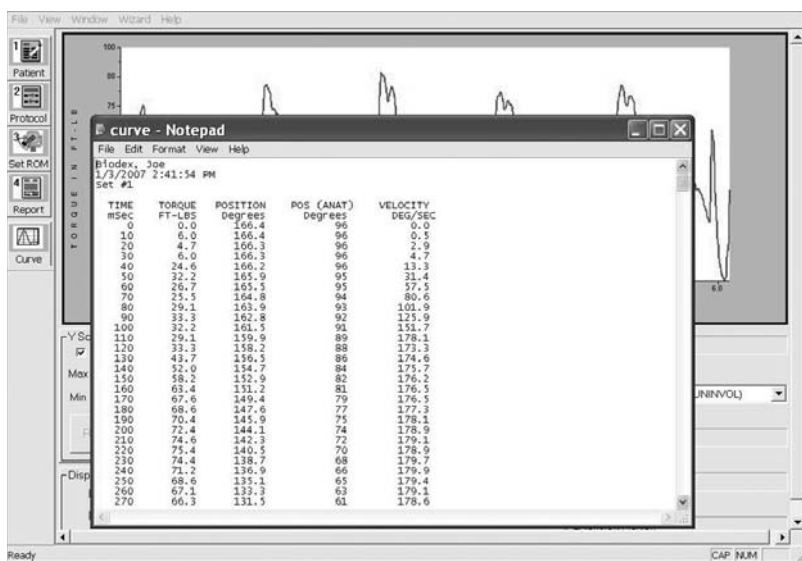


Figure 7.2. Select <Log to File> to view individual data points for the currently selected set.

8. TESTING /EXERCISE PROCEDURES

The standard procedures for both testing and exercise with the Biodex Multi-Joint System are nearly identical with only minor differences in report generation. Both procedures require the clinician to enter patient specific data before commencement of the test or exercise session. Following are basic guidelines for testing or exercise of a new patient, performing a new test or exercise with an existing patient, and repeating a test or exercise with an existing patient. For details on each of the screens presented during these procedures, refer to the screen explanations presented in chapters 2- 7.

NOTE: For proprioceptive testing and exercise, see “Proprioceptive Testing” and Exercise at the end of this chapter.

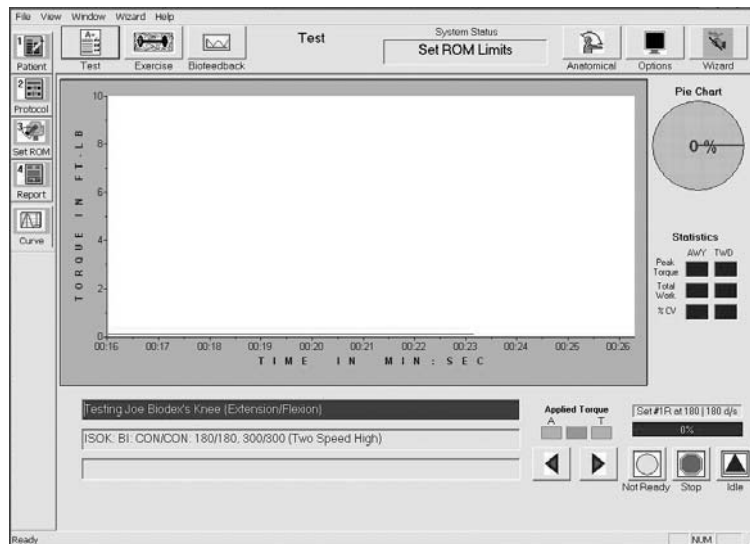


Figure 8.1.

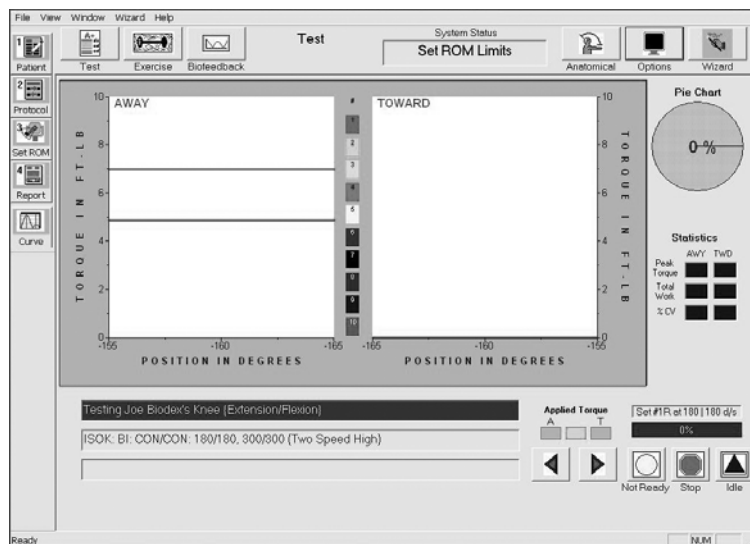


Figure 8.2.

Figure 8.1 and 8.2. The testing and exercise procedures assume that the patient is properly positioned and ready to begin. Clinicians can choose between Torque vs. Time and Torque vs. Position display screens. To add a scoring window, as in Figure 8.2, simply click the cursor or touch the screen where the window is desired. Touch or click on the gray-colored graph border to remove the scoring window.

NEW TEST OR EXERCISE WITH A NEW PATIENT

(See Figures 8.3 – 8.9.)

1. Position and set up the patient as required by patient protocol. (Refer to the Biodex Multi-Joint System Setup/Operation Manual, or select <Anatomical> from the Dynamometer Operation screen Operating Mode Tool Bar to view an AVI or illustration for the selected joint/pattern.)
2. At the Dynamometer Operation screen, select <Test> or <Exercise> from the Operating Mode Tool Bar. Based on your selection, either “Test” or “Exercise” will now be displayed in the Status area of the Operating Mode Tool Bar.
3. Select <Patient> from the Configuration Tool Bar. The Patient Selection screen should now be displayed.
4. Select <Add Patient> from the Operating Mode Tool Bar. Enter the patient information on the Patient Selection screen, making sure to select the appropriate level on the pain scale.

NOTE: Although not a mandatory field, it is suggested that clinicians always adjust the patient pain scale when entering a new patient, editing a patient, or repeating a test. Using the pain scale, patient pain can be plotted on the Exercise Summary Report.

To adjust the pain scale, slide the pointer to the appropriate pain level reported by the patient. The zero setting (left end of scale) is equal to no pain and the 10 setting (right end of scale) is equal to excruciating pain.

5. Select <Save> from the Operating Mode Tool Bar to save the new patient.
6. Select <Protocol> from the Configuration Tool Bar. The Protocol Definition screen should now be displayed.
7. Select <Protocol> from the Operating Mode Tool Bar to view a list of available protocols. Select “+” next to each protocol mode grouping to further expand the protocol. Select the desired protocol. The Set Dynamometer Range of Motion screen should now be displayed.

NOTE: If the desired protocol is not listed, close the protocol list screen and select the <Protocol> icon from the Configuration Tool Bar screen. Follow the procedure for adding a protocol as outlined previously in this manual. Do not edit protocols as this will change the preset protocol selected for ALL patients that have used that protocol.

NOTE: For isometric testing or exercise, be sure to disable the trial reps setting if creating a new protocol.

8. To record or verify the chair settings, select <Chair Settings>. The Chair Settings window will be displayed. Record the chair and dynamometer settings appropriately, then select <OK> to return to the Set Dynamometer ROM screen.
9. Verify the side to be tested, left or right.

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10. Clear the existing ROM by selecting <Clear Limits>.
 11. Set the Away and Toward values by moving the patient and the attachment to the desired limit for each direction (use the Hold button on the dynamometer to lock the input shaft in place). Select the appropriate <Set> button at the limit for each direction. The patient Total ROM should now be displayed in red on the screen diagram and listed in the Total ROM box. Verify that the ROM displayed is appropriate for the patient to be tested or exercised.

NOTE: For isometric mode, ensure the Total ROM is inclusive of the angle or angles to be tested or exercised.

12. Once you have set both ROM limits, calibrate the patient's anatomical position by placing the joint to be tested in the anatomical reference angle specific to the default value. Use the Hold button on the dynamometer to lock the dynamometer in input shaft in place.

NOTE: If you want to use a different anatomical position than the default, use the scroll keys or keyboard to enter the new value (i.e.; 45 degrees) in the Anatomical Reference box. Be sure to measure this value with a goniometer.

NOTE: You must calibrate the patient's anatomical position to get the green "Go" light to collect data.

13. Select <Calibrate Position> to set the anatomical reference angle. The position reading under the icon should now match the patient's anatomical reference position.
14. If desired, calibrate the subject's limb weight (optional).
 - With the limb positioned at an angle greater than 40 degrees from vertical, press Hold on the dynamometer.
 - Instruct the patient to relax the limb, then select <Limb Weight> to record limb weight. The limb weight value displayed in the Limb Weight box will be used to negate gravity effect torque on collected data. Press Hold on the dynamometer to release the limb once the gravity effect torque value is displayed.

NOTE: Passive mode does not support gravity correction for any testing or exercise pattern. It is also unavailable for use with the back, lift and closed chain attachments, and work simulation tools.

15. Select <Continue> to advance to the Dynamometer Operation screen.
16. Select <Display Options> in the Operation Mode Tool Bar to open the Display Options window. Select the desired parameters to modify the appearance of the scoring window. If desired, add a scoring window to the graph by touching the screen or clicking the mouse where the scoring window is desired.
17. Select <Graph Settings> from the Display Options window and select the desired graph options to be displayed. Select <Close> to return to the Display Options window. Select <Close> again to return to the Dynamometer Operation screen.

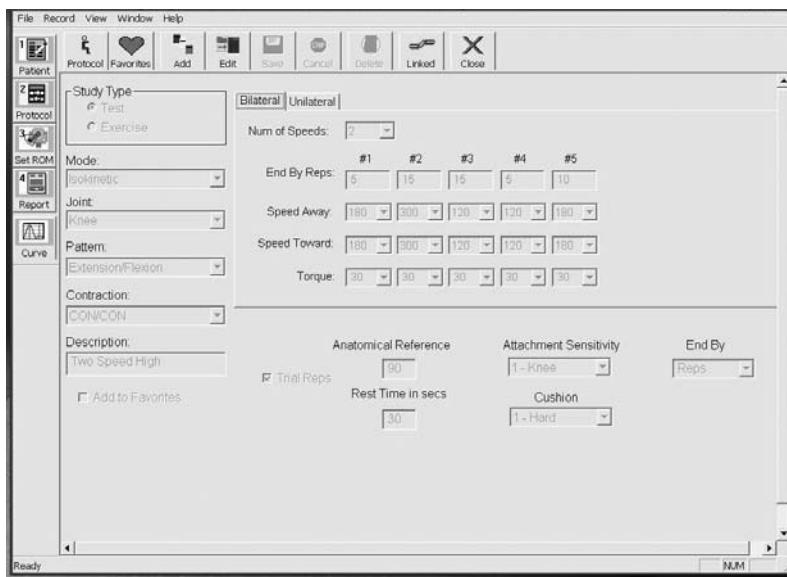


Figure 8.3. The Protocol Definition screen allows the clinician to view a selected protocol or define a new protocol.

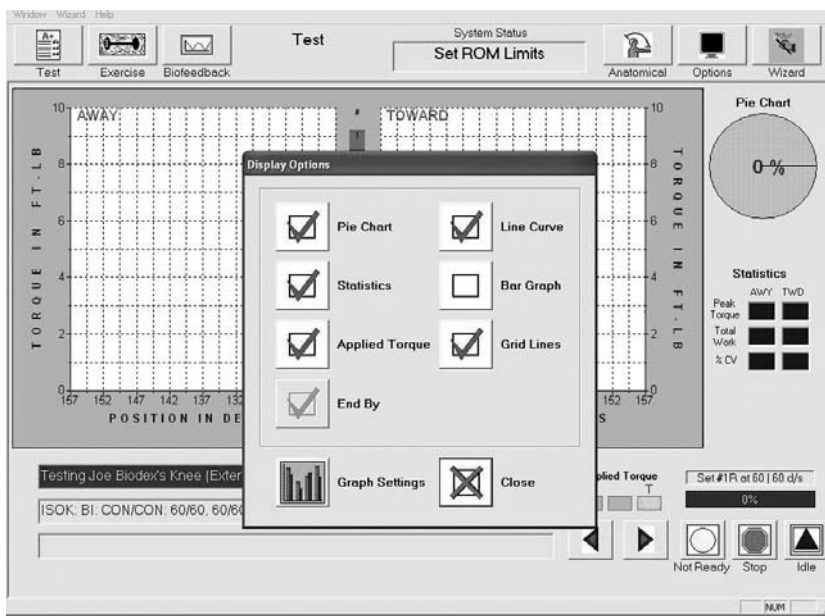


Figure 8.4. The Display Options window allows the clinician to modify the appearance of the test or exercise scoring window.

18. Position the patient to start the test. Select <Start> and follow the countdown prompts to begin the trial reps. Once the trial reps are completed, instruct the patient to hold the limb in the start position before beginning the test. For unilateral tests, proceed to step 26. For bilateral tests, proceed to step 19.

NOTE: Data is collected in the away direction first.

19. Once all sets for the current side are completed, the Auto Set ROM prompt appears. Select <Yes> to use the Auto Set ROM feature or select <No> to manually reset patient ROM.
20. If you have selected Auto Set ROM, a prompt will appear asking if you wish to auto-set the ROM for the opposite side. Select <Yes> to auto-set or <No> to abort the operation. The Auto Set ROM screen should now be displayed.

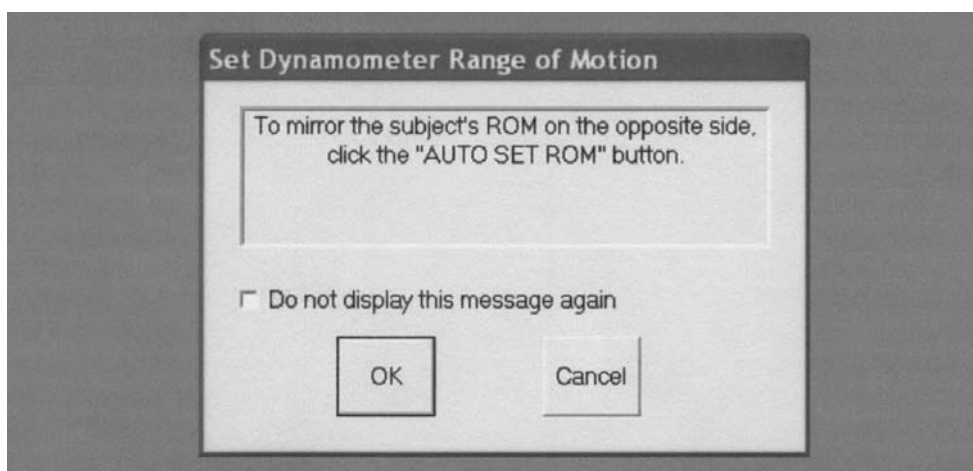
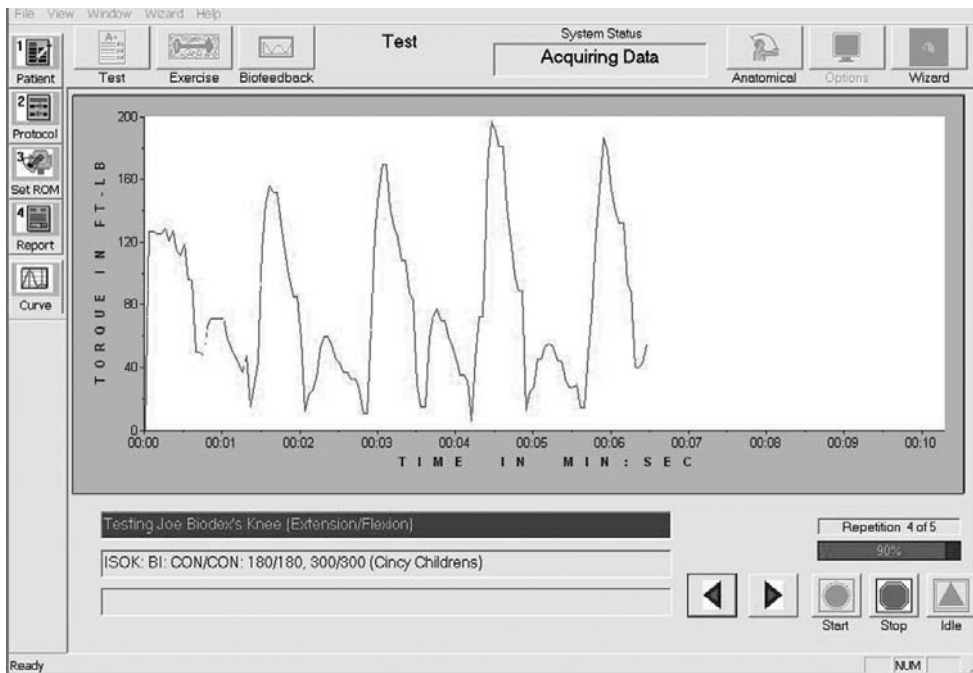


Figure 8.5. If you respond “Yes” to the Auto-Set ROM prompt, the system will request if you would like to mirror the subject’s ROM. If yes, the system will guide you through the verify ROM process.

21. Select <Auto Set ROM>. You will be prompted to remove the dynamometer attachment (not necessary if using the ankle attachment). Remove the fixture and select <OK> to continue. The system now “mirrors” the ROM for testing of the new side and prepares for verification of ROM on the new side. “Verify ROM” is displayed on the screen.
22. With the Auto Set ROM screen displayed, place the attachment for the opposite side on the dynamometer. Set up the patient and verify the ROM by moving the limb to be tested or exercised through the entire ROM. Once the limb has moved through the ROM, the system displays “ROM OK” and the Dynamometer Operation screen is again displayed.
23. Set the Anatomical Reference as previously explained.
24. If desired, weigh the patient limb for the new side as previously explained. Be sure to place the limb at the same point in the ROM as used for the first side.
25. Select <Go> and proceed with the test or exercise.
26. Once all sets have been completed the system prompts: “Finish Test” or “No to Repeat a Set”. Select <Yes> to complete the test or exercise and return to the Dynamometer Operation screen. Select <No> to go back and select a set to repeat.

NOTE: To repeat a set, scroll through the protocol to the desired set. You can only repeat sets on the current side.



Figures 8.6. Data acquisition in curve format.

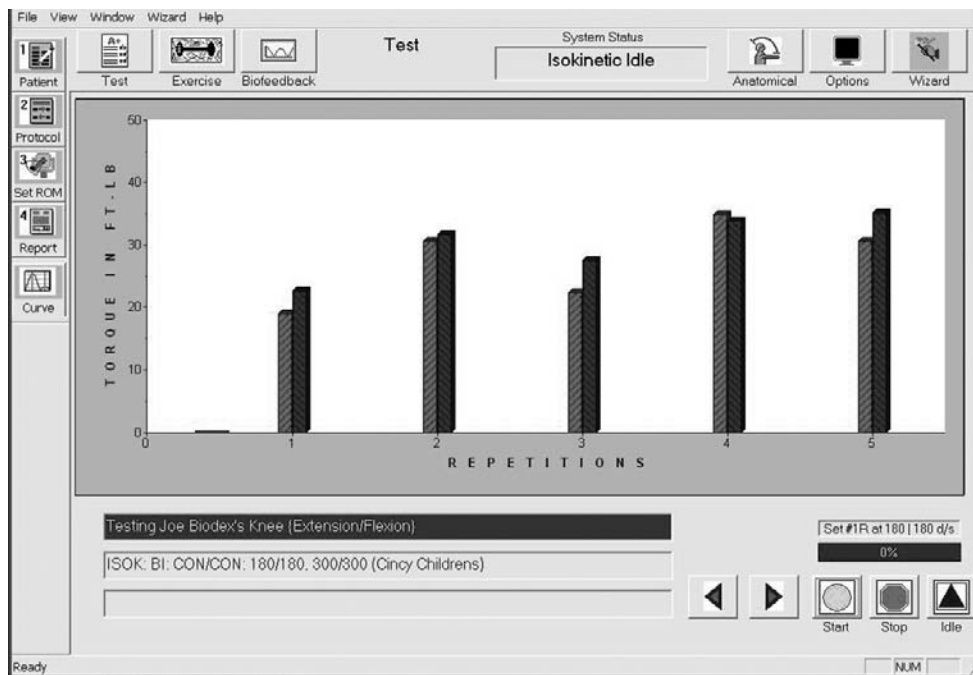


Figure 8.7. Data acquisition in bar graph format.

Figures 8.6, 8.7, 8.8 and 8.9. Based on patient protocol and clinician preferences, the Dynamometer Operation screen during data acquisition can present patient data in curve or bar graph format, with or without a grid, and with or without the patient goal bar.

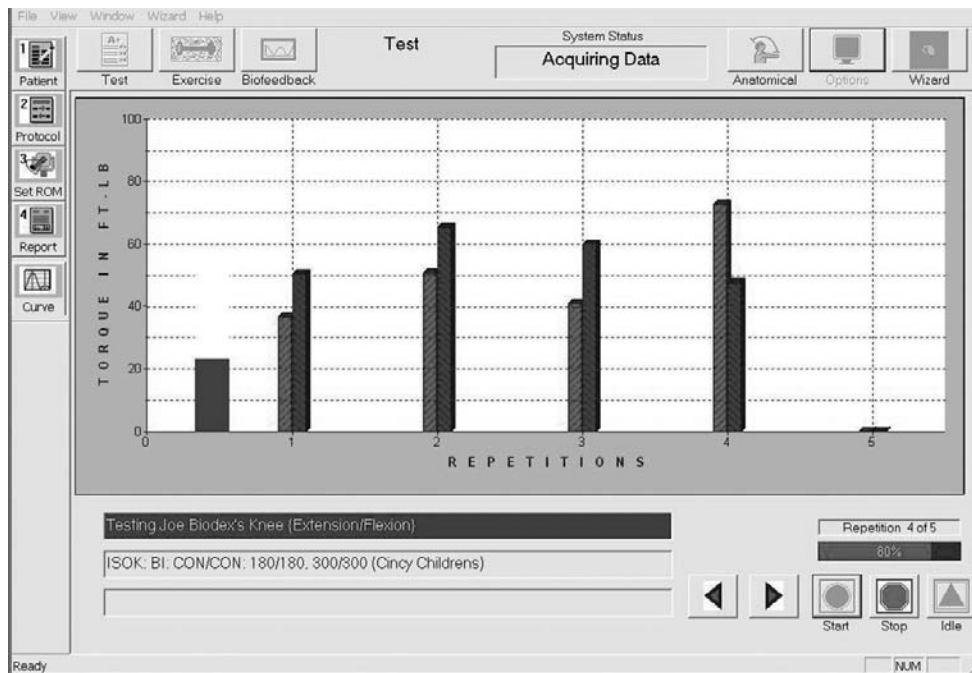


Figure 8.8. Data acquisition in bar format with grid selected.

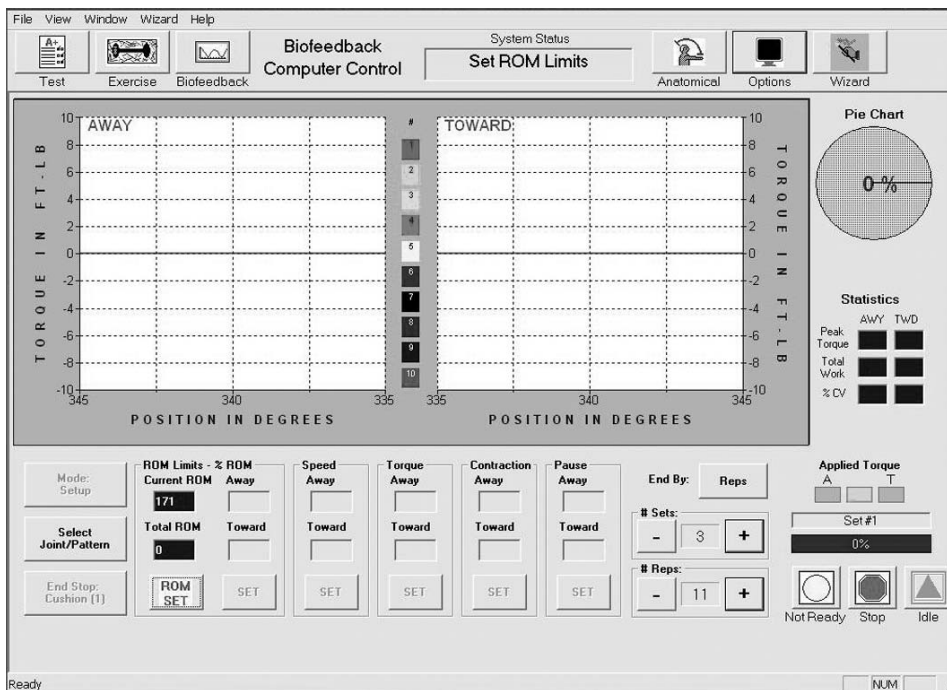


Figure 8.9. Data acquisition can also be presented in a bipolar format during testing, exercise and biofeedback sessions.

NEW TEST OR EXERCISE WITH EXISTING PATIENT

1. Position and set up the patient as required by patient protocol. (Refer to the Biodex System Setup/Operations Manual or select <Anatomical> from the Dynamometer Operation screen Operating Mode Tool Bar to view an AVI or illustration for the selected joint/pattern.)
2. At the Dynamometer Operation screen, select <Test> or <Exercise> from the Operating Mode Tool Bar. Based on your selection, either "Test" or "Exercise" will now be displayed in the Status area of the Operating Mode Tool Bar.
3. Select <Patient> from the Configuration Tool Bar. The Patient Selection screen should now be displayed.
4. Select <Open> from the Operating Mode Tool Bar and highlight the desired patient from the patient list displayed. All tests and exercise sessions for that patient should now be displayed.

NOTE: Although not a mandatory field, it is suggested that clinicians always adjust the patient pain scale when entering a new patient, editing a patient, or repeating a test. Using the pain scale, patient pain can be plotted on the Exercise Summary Report.

To adjust the pain scale, slide the pointer to the appropriate pain level reported by the patient. The zero setting (left end of scale) is equal to no pain and the 10 setting (right end of scale) is equal to excruciating pain.

When repeating a test, update the patient pain scale by selecting <Edit> before selecting <Repeat> and make the appropriate changes to the Patient Selection screen.

5. Select <New> at the bottom of the screen to advance to the Protocol Definition screen.
6. Select <Protocol> from the Operating Mode Tool Bar. A list of protocols should now be displayed.
7. Select "+" next to any protocol mode grouping to further expand the protocol. Select the desired protocol. The Set Dynamometer Range of Motion screen should now be displayed.

NOTE: If the desired protocol is not listed, close the protocol list screen and select the <Protocol> icon from the Configuration Tool Bar screen. Follow the procedure for adding a protocol as outlined previously in this manual. Do not edit protocols as this will change the preset protocol selected for ALL patients that have used that protocol.

8. To record or verify the chair settings, select <Chair Settings>. The Chair Settings window will be displayed. Record the chair and dynamometer settings appropriately, then select <OK> to return to the Set Dynamometer ROM screen.
9. Verify the side to be tested, left or right.
10. Clear the existing ROM by selecting <Clear Limits>.
11. Set the Away and Toward values by moving the patient and the attachment to the desired limit for each direction (use the Hold button on the dynamometer to lock the input shaft in place). Select the appropriate <Set> button at the limit for each direction. The patient Total ROM should now be displayed in red on the screen diagram and listed in the Total ROM box. Verify that the ROM displayed is appropriate for the patient to be tested or exercised.
12. Once you have set both ROM limits, calibrate the patient's anatomical position by placing the joint to be tested in the anatomical reference angle specific to the default value. Use the Hold button on the dynamometer to lock the dynamometer in input shaft in place.

NOTE: If you want to use a different anatomical position than the default, use the scroll keys or keyboard to enter the new value (i.e.; 45 degrees) in the Anatomical Reference box. Be sure to measure this value with a goniometer.

NOTE: You must calibrate the patient's anatomical position to get the green "Go" light to collect data.

13. Select <Calibrate Position> to set the anatomical reference angle. The position reading under the icon should now match the patient's anatomical reference position.
14. If desired, calibrate the subject's limb weight (optional).
 - With the limb positioned at an angle greater than 40 degrees from vertical, press Hold on the dynamometer.
 - Instruct the patient to relax the limb, then select <Limb Weight> to record limb weight. The limb weight value displayed in the Limb Weight box will be used to negate gravity effect torque on collected data. Press Hold on the dynamometer to release the limb once the gravity effect torque value is displayed.

NOTE: Passive mode does not support gravity correction for any testing or exercise pattern. It is also unavailable for use with the Back, Lift and Closed Chain Attachments, and Work Simulation Tools.

15. Select <Continue> to advance to the Dynamometer Operation screen.
16. Select <Display Options> in the Operation Mode Tool Bar to open the Display Options window. Select the desired parameters to modify the appearance of the scoring window.
17. Select <Graph Settings> from the Display Options window and select the desired graph options to be displayed. Select <Close> to return to the Display Options window. Select <Close> again to return to the Dynamometer Operation screen.
18. Position the patient to start the test. Select <Start> and follow the countdown prompts to begin the trial reps. Once the trial reps are completed, instruct the patient to hold the limb in the start position before beginning the test. For unilateral tests, proceed to step 26. For bilateral tests, proceed to step 19.

NOTE: Data is collected in the away direction first.

19. Once all sets for the current side are completed, the Auto Set ROM prompt appears. Select <Yes> to use the Auto Set ROM feature or select <No> to manually reset patient ROM.
20. If you have selected Auto Set ROM, a prompt will appear asking if you wish to auto-set the ROM for the opposite side. Select <Yes> to auto-set or <No> to abort the operation. The Auto Set ROM screen should now be displayed.
21. Select <Auto Set ROM>. You will be prompted to remove the dynamometer attachment (not necessary if using the ankle attachment). Remove the fixture and select <OK> to continue. The system now "mirrors" the ROM for testing of the new side and prepares for verification of ROM on the new side. "Verify ROM" is displayed on the screen.
22. With the Auto Set ROM screen displayed, place the attachment for the opposite side on the dynamometer. Set up the patient and verify the ROM by moving the limb to be tested or exercised through the entire ROM. Once the limb has moved through the ROM, the system displays "ROM OK" and the Dynamometer Operation screen is again displayed.
23. Set the Anatomical Reference as previously explained.
24. If desired, weigh the patient limb for the new side as previously explained. Be sure to place the limb at the same point in the ROM as used for the first side.

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25. Select <Go> and proceed with the test or exercise.
 26. Once all sets have been completed the system prompts: "Finish Test" or "No to Repeat a Set". Select <Yes> to complete the test or exercise and return to the Dynamometer Operation screen. Select <No> to go back and select a set to repeat.

NOTE: To repeat a set, scroll through the protocol to the desired set. You can only repeat sets on the current side.

REPEAT TEST OR EXERCISE WITH EXISTING PATIENT

1. Position and set up the patient as required by patient protocol. (Refer to the Biodex System Setup/Operations Manual or select AVI from the Select a Joint/Pattern window in the Set Dynamometer ROM Screen.
2. At the Dynamometer Operation screen, select <Test> or <Exercise> from the Operating Mode Tool Bar. Based on your selection, either "Test" or "Exercise" will now be displayed in the Status area of the Operating Mode Tool Bar.
3. Select <Patient> from the Configuration Tool Bar. The Patient Selection screen should now be displayed.
4. Select <Open> from the Operating Mode Tool Bar and select the desired patient from the patient list displayed. All tests and exercise sessions for that patient should now be displayed.
5. Highlight the exact test or exercise desired and then select <Repeat> at the bottom of the screen to advance to the Dynamometer Range of Motion screen. The test or exercise selected is now the current protocol.

NOTE: Although not a mandatory field, it is suggested that clinicians always adjust the patient pain scale when entering a new patient, editing a patient, or repeating a test. Using the pain scale, patient pain can be plotted on the Exercise Summary Report.

To adjust the pain scale, slide the pointer to the appropriate pain level reported by the patient. The zero setting (left end of scale) is equal to no pain and the 10 setting (right end of scale) is equal to excruciating pain.

When repeating a test, update the patient pain scale by selecting <Ed it> before selecting <Repeat> and make the appropriate changes to the Patient Selection screen.

6. To record or verify the chair settings, select <Chair Settings>. The Chair Settings window will be displayed. Record the chair and dynamometer settings appropriately, then select <OK> to return to the Set Dynamometer ROM screen.
7. Verify the side to be tested.
8. Set ROM. If you would like to use the exact same patient ROM used in the previous test, select <Auto ROM>. The system will prompt you to remove all attachments (except for the ankle attachment) from the input adapter. After removing attachments, click <Ok> to continue. The dynamometer shaft will move through the ROM. Verify that the ROM displayed is appropriate for the patient to be tested or exercised.

NOTE: If you want to set a new patient ROM, select <Clear Limits> and set ROM as when testing a new patient.

9. Once patient ROM limits are set, calibrate the patient's anatomical position by placing the joint to be tested in the anatomical reference angle specific to the default value. Press the <HOLD> button on the dynamometer to lock the dynamometer in input shaft in place.

NOTE: If you want to use a different anatomical position than the default, use the scroll keys or keyboard to enter the new value (i.e.; 45 degrees) in the Anatomical Reference box. Be sure to measure this value with a goniometer.

NOTE: You must calibrate the patient's anatomical position to get the green "Go" light to collect data.

10. Select <Calibrate> to set the anatomical reference angle. The position reading under the icon should now match the patient's anatomical reference position.

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11. If desired, calibrate the subject's limb weight (optional).
 - With the limb positioned at an angle greater than 40 degrees from vertical, press <Hold> on the dynamometer.
 - Instruct the patient to relax the limb, then select <Limb Weight> to record limb weight. The limb weight value displayed in the Limb Weight box will be used to negate gravity effect torque on collected data. Press <Hold> on the dynamometer to release the limb once the gravity effect torque value is displayed.

NOTE: Passive mode does not support gravity correction for any testing or exercise pattern. It is also unavailable for use with the Back, Lift and Closed Chain Attachments and Work Simulation Tools.

12. Select <Continue> to advance to the Dynamometer Operation screen.
13. Select <Display Options> to open the Display Options window. Select the desired parameters to modify the appearance of the Biofeedback Graph as explained in chapter 9, The Biofeedback Mode.
14. Position the patient to start the test. Select <GO> and follow the countdown prompts to begin the trial reps. Once the trial reps are completed, instruct the patient to hold the limb in the start position before beginning the test. For unilateral tests, proceed to step 21. For bilateral tests, proceed to step 15.

NOTE: Data is collected in the away direction first.

15. Once all sets for the current side are completed, the Auto Set ROM prompt appears. Select <Yes> to use the Auto Set ROM feature or select <No> to manually reset patient ROM.
16. If you have selected Auto Set ROM, a prompt will appear asking if you wish to auto-set the ROM for the opposite side. Select <Yes> to auto-set or <No> to abort the operation. The Auto Set ROM screen should now be displayed.
17. Select <Auto Set ROM>. You will be prompted to remove the dynamometer attachment (not necessary if using the ankle attachment). Remove the fixture and select <OK> to continue. The system now "mirrors" the ROM for testing of the new side and prepares for verification of ROM on the new side. "Verify ROM" is displayed on the screen.
18. With the Auto Set ROM screen displayed, place the attachment for the opposite side on the dynamometer. Set up the patient and verify the ROM by moving the limb to be tested or exercised through the entire ROM. Once the limb has moved through the ROM, the system displays "ROM OK" and the Dynamometer Operation screen is again displayed.
19. Set the Anatomical Reference as previously explained.
20. If desired, weigh the patient limb for the new side as previously explained. Be sure to place the limb at the same point in the ROM as used for the first side.
21. Select <Go> and proceed with the test or exercise.
22. Once all sets have been completed the system prompts: "Finish Test" or "No to Repeat a Set". Select "Yes" to complete the test or exercise and return to the Dynamometer Operation screen. Select "No" to go back and select a set to repeat.

NOTE: To repeat a set, scroll through the protocol to the desired set. You can only repeat sets on the current side.

PROPRIOCEPTIVE TESTING AND EXERCISE PROCEDURE

(See Figures 8 – 10.)

After selecting/entering a patient and the desired proprioceptive protocol, set ROM and press <Continue> to advance to the Proprioception screen.

NOTE: Total ROM must include all target angles.

NOTE: Before beginning the following procedure, position patient and explain how the <Hold/Resume> button is used to hold and free the limb.

Trial Repetition Steps:

1. Select <Start> to initiate the test angle sequence.
2. Move the limb to the start angle for the target position and press <Hold/Resume>. The system will hold the limb in place.
3. Give the <Hold/Resume> button to the patient. Select <OK> to continue.
4. Allow the limb to move to the target angle, hold for ten seconds, and then release as per the system countdown.

Test Steps:

5. Return to the start angle and press <Hold/Resume>. The system will hold the limb in place. Select <OK> to continue.
6. Have the patient move the limb to the perceived target angle and press <Hold/Resume>. The system will hold the limb in place while recording the position.
7. Repeat steps two through six for each repetition.
8. Repeat steps one through seven for each angle.
9. Once all sets have been completed, select <Yes> to finish the test or <No> to repeat a test.

NOTE: If “include trial reps” has been selected on a patient’s customized proprioceptive protocol, the system will prompt you to perform an additional (trial) repetition for each test rep. (i.e., one trial rep, show target angle, perform one test repetition to target angle.)

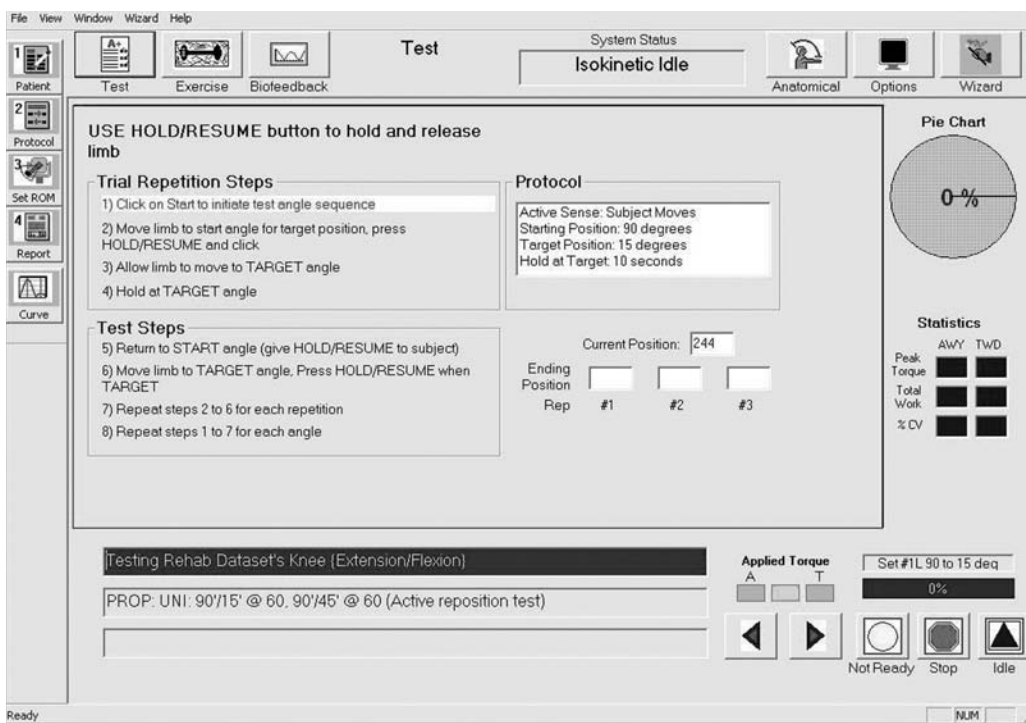


Figure 8.10. The Proprioceptive Testing Screen.

9. BIOFEEDBACK OPERATION

Biofeedback operation incorporates all the functions that, in earlier versions of Biodex Multi-Joint Systems, were controlled by the front panel. Using Biofeedback, clinicians can set up and begin patient exercise without entering patient-specific data such as name, address, weight, etc. During Biofeedback operation all settings default to match the last biofeedback session. Patient exercise data is displayed on the graph in real-time but cannot be printed or saved.

NOTE: When Biofeedback operation is selected patient exercise data is displayed on the graph in real-time but it cannot be printed or saved.

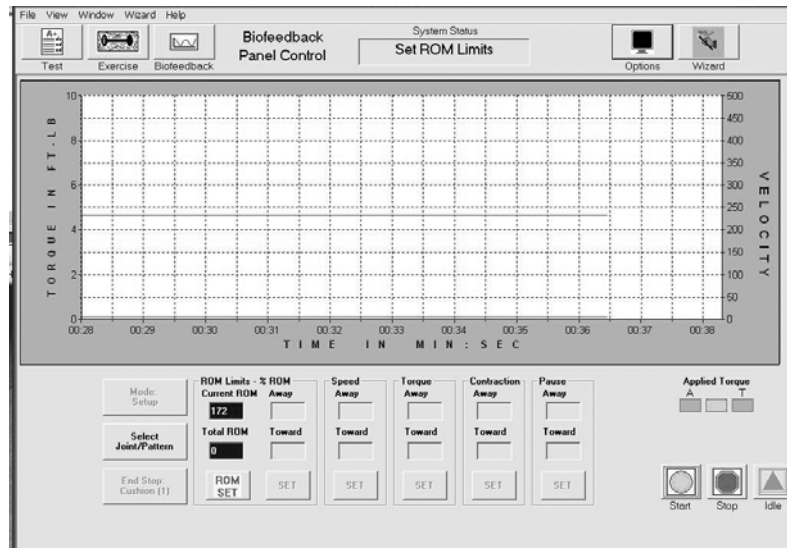


Figure 9.1. The Biofeedback Graph (with grid selected).

SETTING UP FOR BIOFEEDBACK EXERCISE

1. At the Dynamometer Operation screen select <Biofeedback> from the Operating Mode Tool Bar (if not already selected). The Biofeedback graph should now be displayed. "Set ROM Limits" is displayed in the System Status window.
2. At the bottom left of the Dynamometer Operation screen, select <ROM Set>. The Range of Motion screen will now be displayed.
3. Verify the side to exercise, left or right.
4. Clear the existing ROM by selecting <Clear Limits>.
5. Set the Away and Toward ROM values by moving the patient and the attachment to the desired limit for each direction (use the Hold button on the dynamometer to lock the input shaft in place). Select the appropriate <Set> button at the limit for each direction. The patient Total ROM should now be displayed in red on the screen diagram and listed in the Total ROM box. Verify that the ROM displayed is appropriate for the patient to be exercised.

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6. Once you have set both ROM limits, calibrate the patient's anatomical position by placing the joint to be tested in the anatomical reference angle specific to the default value. Use the Hold button on the dynamometer to lock the dynamometer in input shaft in place.
 7. Select <Calibrate Position> to set the anatomical reference angle. The position reading under the icon should now match the patient's anatomical reference position.
 8. Select <Continue> to advance to the Dynamometer Operation screen.
 9. Choose <Select Joint/Pattern> from the bottom left section of the screen. The Select Joint/Pattern window should now be displayed. At this screen you can select the joint and pattern or, if necessary, select a setup illustration or view an AVI.
 10. Select <Select a Joint> and choose the joint to be selected. This will determine your options for selecting a pattern.
 11. Select <Pattern> and choose the desired pattern. Select <OK> to return to the Dynamometer Operation screen.
 12. If desired, select <Mode> and then choose the desired mode of operation: Isokinetic, Isometric, Isotonic, Passive or Reactive Eccentric.
 13. If desired, select <Options> in the Operation Mode Tool Bar to open the Display Options window. Select the desired parameters to modify the appearance of the biofeedback scoring window. (See Modifying The Biofeedback Graph.)
 14. If desired, select <Graph Settings> from the Display Options window and select the desired graph options to be displayed. Select <Close> to return to the Display Options window. Select <Close> again to return to the Dynamometer Operation screen. (See Modifying The Biofeedback Graph.)
 15. If desired, change the biofeedback End By value at the bottom right of the screen. Choose from repetitions, elapsed time, work or % of fatigue. Use the <UP> and <Down> arrow keys to adjust the number of sets, number of repetitions or work values.

NOTE: If you change the default values, the new values entered become the default for future biofeedback sessions.

16. Position the patient to start the biofeedback session. Select <Go> to begin. All patient data will be displayed in real-time on the Biofeedback graph.

NOTE: As with testing and exercise, you must set patient ROM in order to start a biofeedback session and for the curves to accurately reflect the patient limb position on the biofeedback graph.

MODIFYING THE BIOFEEDBACK GRAPH

During, biofeedback, exercise or test sessions, therapists (and patients) can observe patient progress by looking at the Biofeedback Graph on the Dynamometer Operation screen. This graph allows real-time patient data to be displayed in a variety of formats.

NOTE: Data collected during biofeedback sessions is not saved to the database.

When Biofeedback operation is selected, the Biofeedback Graph Y-Axis (vertical) shows torque in ft-lb (Nm). Velocity and position curves may be displayed as well. The X-Axis (horizontal) displays time in minutes and seconds or position. The presentation of graphs can be altered in several ways as explained in the following section.

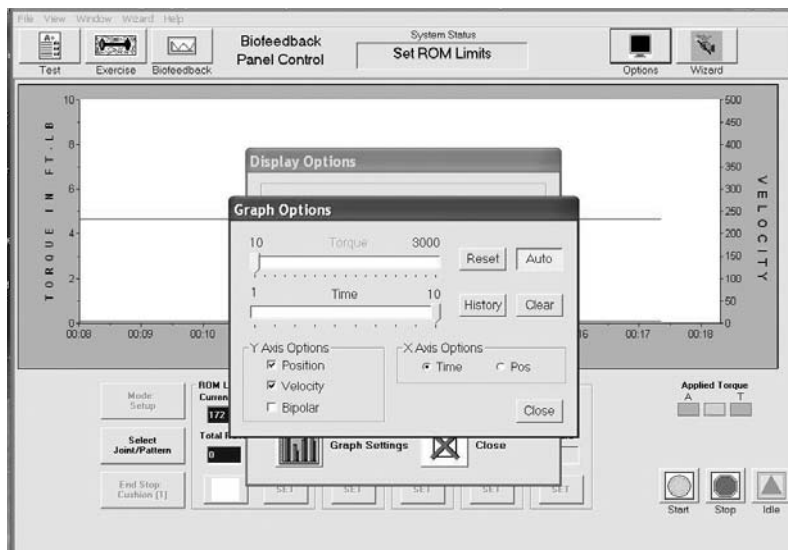


Figure 9.2. The Graph Options window allows clinicians to select both y-axis and x-axis options.

Modifying The Biofeedback Graph

With Biofeedback operation selected, choose <Options> in the Operating Mode Tool Bar of the Dynamometer Operation screen. The Display Options window should now be open. Options in this area allow the user to modify the appearance of the biofeedback graph. Highlight any option to see where it will be displayed on the graph in the background. The following display options are available:

Pie Chart: Toggle this option to display or hide a pie chart to the right of the Biofeedback graph during testing or exercise.

Statistics: Toggle this option to display or hide a full set of test or exercise statistics, shown in the away and toward directions, to the right of the Biofeedback graph.

Statistics include:

- Peak Torque: Highest muscular force output at any moment during a repetition.
- Total Work: Total muscular force output for the repetition with the greatest amount of work.
- % CV: Statistical representation of test validity based on reproducibility of performance.

Applied Torque: Toggle this option to display in real-time or hide the Applied Torque away and toward direction indicators.

End By: Toggle this option to display or hide the End By parameters.

Line Curve: Toggle this option to display information in Line Curve format.

Bar Graph: Toggle this option to display information in Bar Graph format.

Grid Lines: Toggle this option to display or hide grid lines on the biofeedback graph.

Graph Settings: Select this option to access the Graph Options windows. (See Graph Settings for details.)

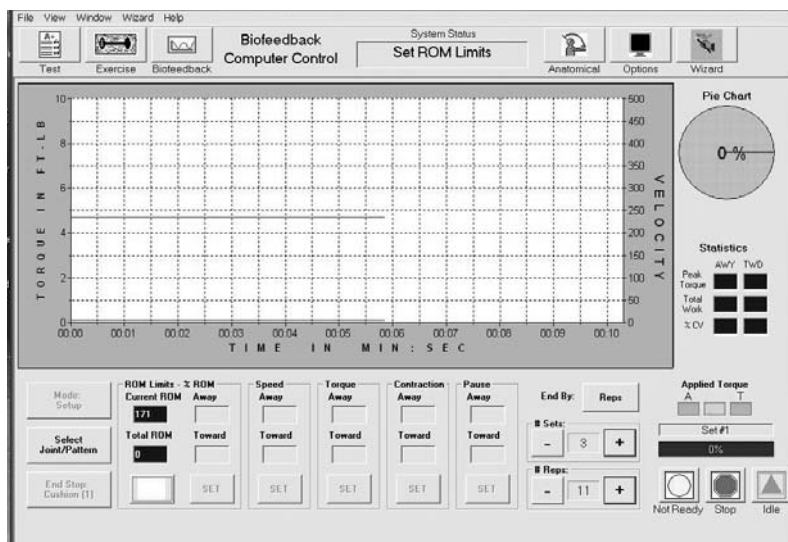


Figure 9.3. The Biofeedback graph in line graph format with pie chart, statistics, applied torque, end by and grid line options all selected.

GRAPH OPTIONS

(See Figure 9.3.)

The Graph Options window allows the user to set scaling torque values, time values, Y and X axis values, and to reset History.

To access the Graph Options window, select <Options> from the Operating Mode Tool Bar, and then select <Graph Settings>. The Graph Options window should now be displayed.

Scaling Torque Values

Auto and Manual Scaling options allow the clinician to scale the data curve y-axis prior to acquisition so that the curves will appear in proportion to the viewing screen. "Auto" appears as the default value. Using this feature the system will scale data curves based on max peak torque.

- To activate the Auto Scale feature, select <Auto> to the right of then Torque Scale on the Graph Options window. To return to manual scaling, select <Auto> again.

Manual scaling allows the clinician to manually scale the Y-axis during exercise.

- For Manual Scaling, select <Auto> to turn off Auto Scaling and then drag the pointer to an estimate of max peak torque. Maximum Peak Torque value is 3000 ft-lb.

NOTE: Contraction torque display will appear as directed by the patient protocol. For example, if the protocol calls for concentric/eccentric contraction the display will only plot torque when it sees it in this manner. If the patient does not produce torque in the proper direction, the system will not record the torque produced.

Time Values

The Time Value scale is used to increase or decrease the frequency of the data reported. In other words, a lesser time value stretches out the graph for a better look at individual curves. A greater time value compresses the graph to allow viewing of more curves.

To change the Time Value:

- Select the pointer on the Time Value Scale bar and drag it to the appropriate point in the scale. The X-axis on the graph will immediately reflect the new time value setting.

History

Select <History> to view the last test set from beginning to end. This function is similar to set review except the user can choose scales. It is active during testing and exercise only.

Clear

Select <Clear> to clear the History data from the selected test or exercise session.

Y-Axis Options

The Y-axis of the Biofeedback Graph can be set to display position or velocity based on the test or exercise being performed. Both position and velocity can be displayed in standard or bipolar formats.

- To set position for the Y-axis, select <Position> in the Y-Axis area.
- To set velocity for the Y-axis, select <Velocity> in the Y-Axis area.
- For a bipolar format for either position or velocity in the y-axis, select <Bipolar> at the bottom of the Y-Axis area.

X-Axis Options

The X-axis of the Biofeedback Graph can be set to display time or position based on the exercise being performed. Time is displayed as the default. If you select position, the screen redraws with two graphs to show away and toward position in degrees.

- To set time as the X-axis, select <Time> in the X-Axis area.
- To set position as the X-axis, select <Position> in the X-Axis area.

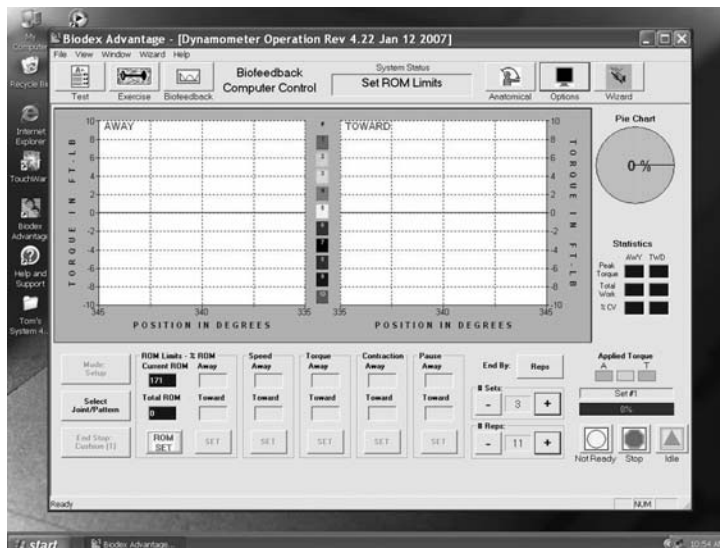


Figure 9.4. Y-Axis Options: The Y-axis of the Biofeedback Graph can be set to display position or velocity based on the test or exercise being performed. Both position and velocity can be displayed in standard or bipolar formats. This illustration shows a Biofeedback bar graph with a scoring window. Scoring windows are added by simply touching the screen or clicking the mouse at the location where the window is desired. To remove a scoring window, click on, or touch, the gray-colored graph border.

10. THE DATABASE MANAGER

The Biodex Database Manager is used for the following operations:

1. Copying, deleting, moving, or archiving patient files
2. Copying, deleting or moving protocols
3. Copying, deleting, moving or editing normative goals
4. Patient loads can be managed based on clinician or classification of patients. Separate databases can be created for each group of patients, clinician, or researcher at your facility, then the selected database can be made active for the current session.
5. Database Back-Up

Database files can be maintained on the primary hard drive, but for backup purposes, it is strongly recommended removable media be used. This Database Manager supports media such as USB flash drives or CD/DVD-RW disks. Removable media are preferred as they can be stored away from the computer and used to back up the existing database should you ever experience computer problems.

It is recommended that you back up your patient files on a regular basis and have a copy of the database stored in a safe place. See “Database Back-Up” at the end of this chapter.

Information can be easily transferred between databases. This is done by selecting the data you wish to transfer, or by checking the box found in front of each patient or protocol file.

ACCESSING THE DATABASE MANAGER

(See Figure 10.1.)

To access the Database Manager screen, select <File> from the System Menu Tool Bar (found at the top left portion of the screen). Select <Database Manager>. Once the DB Manager screen is open follow the directions below to develop databases to manage your patient load.

NOTE: *The Database Manager will also be automatically invoked when the application first starts, if the application detects an error in the database file it is attempting to read. If this occurs, you can set an alternate database active, or create a new database and make it active.*

NOTE: *Database Manager files are in Microsoft Access ‘2000 format and can be analyzed using this program.*

NAVIGATING THE DATABASE MANAGER MAIN SCREEN

Data Management

This is a blue box found on the top center portion of the screen and is used to select the database content you wish to view.

Patient/Studies

Will open up the currently selected patient database. Once you have selected this option you will be taken to the Patient Data Screen. From this screen you are able to move, copy, delete, or archive patient records. You will also be able to create and open other databases. These operations will be described further in the section titled: Patient Data Screen.

Protocols

Will open current list of protocols available in the database. Once you reach the list of protocols you will be able to sort them by using a filter to look at specific exercise protocols and, even further, by joint pattern. The operations specific to this icon are described in the section titled: Protocol Screen.

Normative Goals

Opens the current list of normative goals available in the database selected. The Normative Goals screen displays joint-position, speed (deg/sec), gender, age (min-max), peak torque per body weight and ratio. Selecting a normative data record will show the allowable actions that can take place on that record (i.e.: add, delete, edit, select all, clear all, select standard or select by check box.) You can also reset all the normative goals back to the factory default settings, copy/replace the complete set to another database or copy/replace the complete set from another database.

Active Database

This is the blue box located at the bottom of the Database Manager screen. It provides information regarding which database is actively in use by the application. This box will allow you to select the active "in use" database by browsing your computer and external drives for additional databases that have been created. It also maintains a list of the most recent active databases for quickly switching from one to another.



Figure 10.1. The Database Manager Main Screen.

Pull Down Menus

The Pull Down Menus found at the top of the Database Manager Screen are useful for a variety of operations, although many of their functions are available on the Main Database Manager Screen.

From the <File> pull down menu you can access the following:

Patient/Studies: This will list the patients in the database selected. Further navigation of this screen can be found in the section titled: Patient Data Screen.

Protocols: This will take you directly to protocols that are available in the database. Further navigation of this screen can be found in the section titled: Protocol Screen.

Normative Goals: This will take you directly to normative goals that are stored in the database. Further navigation of this screen can be found in the section titled "Normative Goals."

Browse for a Database: Will allow you to search for databases saved on your computer or on any of the external drives.

Exit: This will close the application.

From the <Options> pull down you can access the following:

Change Path to Application: Used to change the location of the installed System 3 application. This should only be used when the Database Manager is installed in a different folder than the application. This is not a typical installation, and it is not recommended to use this command.

From the <Help> pull down menu you can access the following:

Contents: Displays a listing of help topics.

Search For Help On: Displays all help topics.

About: Displays the program version, company information, and access to System Info, which provides detailed information on the configuration of your computer.

THE PATIENT DATA SCREEN

(See Figure 10.2.)

This screen displays the patient listed in the current database and allows you to Move, Copy, Delete and Archive patients to a back-up database on an external drive; or Create new databases which can be category specific. Information regarding the total number of patients, total number of studies and total number of protocols can be found at the bottom of each database list.

This screen can be repositioned by clicking on the title bar of the screen, holding the mouse button down and dragging the screen to the desired location. The screen can be resized by clicking on a corner, holding the mouse button down, and dragging the screen corner to the desired size.

Columns can be sorted by clicking on the column header by which you wish to sort the record data. Clicking again will change the sort order from ascending to descending, or descending to ascending.

Columns can be resized by dragging the column header dividing lines left or right.

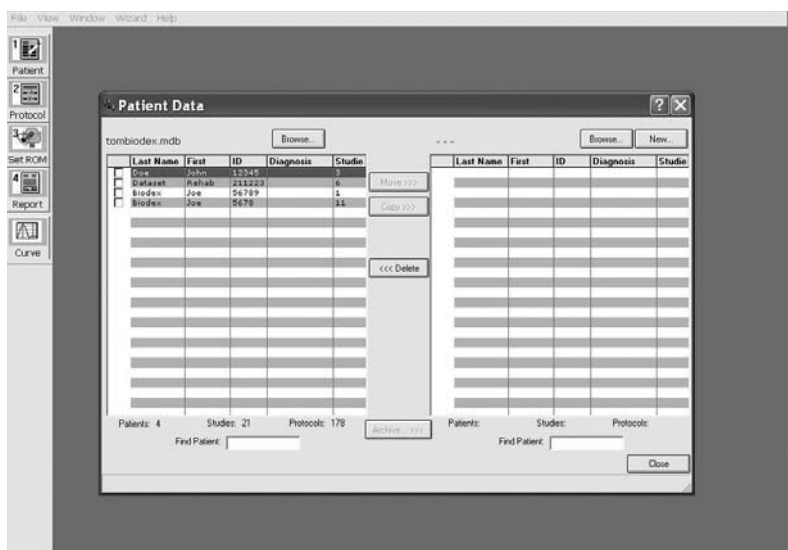


Figure 10.2. The Patient/Studies Data Screen.

Controls On the Screen

Below is a list of the action controls present on the screen and how they are used:

Browse: This icon will allow you to browse and open databases you may have stored on your hard drive or an external drive. To open databases from here, click on the database and it will then open on the side you clicked.

New: This icon is used to create a new destination database in which to save data. The destination location can be either in an area of the hard drive or an external, removable media drive.

Move: This icon will completely move selected patients (single click on the patient or click the check box in front of it) to the destination database. There will be no record remaining of this data in the source database. Do this only when you wish to completely remove a patient and all their data records from the original database.

Copy: This icon will copy the selected patients and their data to the destination database while leaving a copy in the original source database.

Delete: This will delete the selected patients and their data completely from the source database – USE WITH CAUTION.

Archive: This icon, when clicked, will take you to a dialogue box that will prompt you for a Move "Patient Data Prior To" date. This will then move all patient data prior to that date to the archive database.

Find Patient: You can find any patient by simply typing their last name into the text box.

Close: This will allow you to exit from the current screen.

Column Specific Navigation

This applies to both the Patient Data Screen and the Protocols Screen. A right mouse click on the heading or content of each column will provide a quick method for navigating through patient records. By right mouse clicking on the column headings or on the list you will get the following options on the pull down menu:

Find: When clicked a dialogue box will pop up. Type in the name, or number you are looking for and the item will be highlighted. This can be done for each column.

Select All: When clicked this will select all records of the list displayed in which you are working in.

Clear All: This will clear or turn off all the selections which have been previously made.

Select By Check Box: This will allow you to select file by using a check mark placed in a box next to the file you wish to select.

Select By: Standard: This selection highlights the row blue that you select. You can select multiple rows by holding the Ctrl key down while clicking on a row. To do a contiguous group of rows, click the top row of the group, move the cursor downward to the bottom row, then hold the Shift key down while clicking on the bottom row of the group.

Compact Database: Compacts the displayed database. Compacting reduces the file size if there is wasted space in the database file. If you have deleted many patients with studies from a database, compacting the database will save a significant amount of disk space. This is especially important when moving the database to removable media for backup, archive, or transport purposes.

THE PROTOCOLS SCREEN

(See Figure 10.3).

This screen is set up and controlled much like the Patient Data Screen with a few differences as shown below.

Filter By: This area, found at the top of the screen, shows you what restrictions are placed on the displayed protocol lists. The displayed lists of protocols are filtered in regards to type of Protocol(s) and specific Joint Patterns for each protocol type you select. To make changes to these filters use the pull down menu provided and make your selections from there. The database file name displayed in parenthesis to the right of "Filter By" is the database used to determine what Protocols and Joints are available, and listed in the pull down menus. To change this database, mouse click on the displayed file name above the left list or right list.

Browse: This icon will allow you to browse and open databases you may have stored on your hard drive or an external drive. To open databases from here, just click on the database and it will then open on the respective side you clicked the Browse icon on.

New: This icon is used to create a new destination database to save data into. The destination location can be either in an area of the hard drive or an external, removable media drive.

Move: This icon will completely move selected protocols (single click on the protocol or click the check box in front of it) to the destination database. There will be no record remaining of this data in the source database. Do this only when you wish to completely remove protocol records from the original source database.

Copy: This icon will copy selected protocols to the destination database while leaving a copy in the original source database.

Delete: This will delete selected protocols completely from the source database - USE WITH CAUTION.

Close: This will allow you to exit from the current screen.

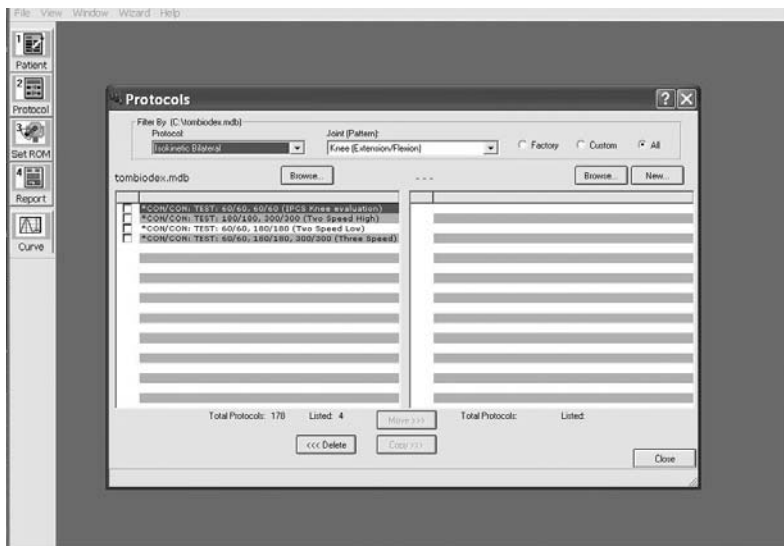


Figure 10.3. The Protocols Screen.

THE NORMATIVE GOALS SCREEN

(See Figure 10.4.)

The Normative Goals screen displays the current normative data goals of peak torques, based on the joint-position and speed, then according to the patient's gender and age. There is full edit capability on these goals, where goals can be added or deleted as well as modified. If desired, the factory defined set of normative goals can be restored.

All data edit modifications must be accomplished via the mouse, and right-clicking or double-clicking on a normative data record. A double-click will edit the data record. When the right click occurs, a pop-up menu will show the allowable actions that can take place on that record. You can add, delete, or edit that record. See the section Normative Data Editing for details on adding or editing a record. In addition on the menu, you have the ability to select all records, clear all selections, or choose what selection to use: Check Box (single record at a time), or Standard (Windows method using Ctrl and Shift mouse clicks).

- This screen can be re-positioned by mouse clicking on the title bar of the screen, holding the mouse button down and dragging it. The screen can be re-sized by mouse clicking on a corner, holding the mouse button down and dragging it.
- Columns can be sorted by clicking on the appropriate column header. Clicking again will change the sort order from ascending to descending, or descending to ascending. Columns can be re-sized by dragging the column header dividing lines left or right.
- The file name of the appropriate database is displayed on the top of the list. To view the full path-name of the database, place the cursor over the file name.

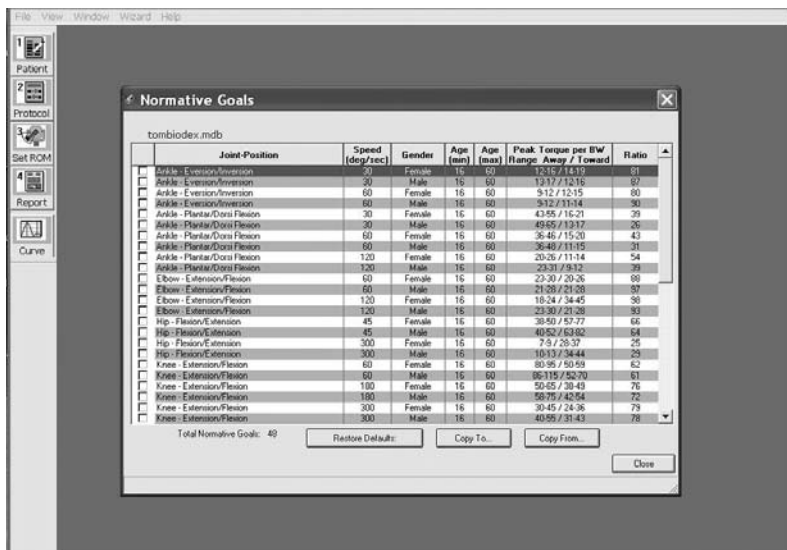


Figure 10.4 The Normative Goals screen.

Screen Controls

- **Restore Defaults:** This action will restore the complete set of all normative goals back to the factory defined list of normative goals. Any user defined changes, including added or deleted goals will be lost from the current active database.
- **Copy To:** This action will copy the complete set of all normative goals from the current active database to the selected destination database. You will be prompted to select a database to copy the normative goals to. All pre-existing normative goals in the selected database will be lost, replaced by the ones in the current active database.
- **Copy From:** This action will copy the complete set of all normative goals from a selected database to the current active database. You will be prompted to select a database to copy the normative goals from. All pre-existing normative goals in the current active database will be lost, replaced by the ones in the selected database.

Normative Data Editing

When you select to <Edit> or <Add A Normative Goal Data Record>, the Normative Goal Definition screen is displayed. This screen allows you to fully define all appropriate fields of information to define a Normative Goal.

If editing a Normative Goal record, the current values are displayed in all fields, allowing you to modify them. You then have the choice to Save the modified record or Save these values as a new Normative Goal record. If you choose "Save as new", the criteria chosen must not conflict with existing records. For example, if there is an existing record of the same criteria for an age of 16-60, and you chose an age range of 45-50, the age overlaps, therefore the software cannot determine which goals you really want to effect, and will display an error message and not allow it to be saved. To solve this example, the best approach is to split the age setting into 3 records: 16-44, 45-50, 51-60.

DATABASE BACK-UP

The Database Manager can be used to back-up and store your entire database. Back-up the database on a regular basis and keep a copy of the database stored in a safe place.

Database Back-Up Procedure

1. Select <File> from the System Menu Tool Bar.
2. Select <Database Manager> to access the DB Manager screen.
3. Select <Patients and Studies> to advance to the Patient Data screen. The currently selected database is listed at the top left of the screen.
4. Select <New> from the right side of the screen to create a new back-up database.
5. At the Look In field, enter the folder to which you want to save the new database (we suggest "My Documents").
6. At the File Name field, enter the name you would like to assign to the back-up database file (we suggest "Backup").

NOTE: Be sure to record the path used to store the new back-up database in case you need to return to it in the future.

7. Select <Open> to create the new backup with a single patient, John Doe. The new database name should now be listed on the right side of the patient data screen.
8. At the left of the screen, use the check boxes to select the entire list of patients to copy to the new database you have just created. Select <Copy> to copy the patients. The copied patients should now appear under the new database.
9. After the patients have been copied, select <Close> to exit the patient data screen and return to the DB Manager screen.
10. Under the heading Data Management, select <Protocols> and then copy your protocols to the new database.
11. Select <Exit> to exit the Database Manager.

NOTE: Once the backup database is complete, we suggest removing it to a CD or flash drive for off-site storage.

NOTE: If you have any difficulties with the back-up database procedure, contact Biodex Customer Support at 1-800- 224-6339, ext. 2120.

APPENDICES

A. BIODEX MULTI-JOINT SYSTEM STRUCTURES, FORMULAS AND CALCULATIONS

INTRODUCTION

The purpose of this document is to present technical information regarding the database structure, formulas and calculation methods used in the Advantage Software application.

The application software is written in the Microsoft Visual C++ language with MFC (Microsoft Foundation Classes). The program is structured as a “multiple document interface” (MDI) application. The user is presented with a group of windows or views, each of which encapsulates a group of related functions. The user can navigate between views by clicking on the main toolbar icons or by clicking on the window titles of any view.

DATABASE ENGINE

The application utilizes DAO (data access objects) to interface with Microsoft’s Access database engine. This strategy yields a reliable database platform with the fastest possible access times. There is no password protection and any user can view the contents of the database by opening the “database\biodex.mdb” file using MS-Access ‘2000.

Figure A1 illustrates the tables that comprise the System database. Patient information is recorded in the Patient Set table. A unique identifier is assigned to the patient. This identifier (key) is subsequently used to link study information (StudySet) and raw data (DataSet) with the patient’s record. The application also maintains tables to store protocol information and values for normative data.



Figure A1. System 3 Database Tables.

A key point concerning the database is that “results” are not saved. In other words, the numerical results computed from study parameters and datasets are dynamically evaluated and sent to reports (in either PRINT or PRINT PREVIEW mode). There is no risk of generating reports using stale parameters. Relevant changes in patient and study information are instantly reflected in any report mode.

A data “export” function is provided so that numerical results from tests can be saved in an ASCII delimited text file. This mechanism provides a standard interface with external applications such as word processors, spreadsheets or customized applications.

ISOKINETIC REPETITIONS

Before measurements can be made on isokinetic data, it is imperative to accurately determine the start and end points of all repetitions in a data set. Repetitions must further be resolved into “half” reps. A “half” rep in the away direction and a “half” rep in the towards direction constitutes a whole rep. The dynamometer velocity signal contains both magnitude and direction information and is the most reliable and reproducible source for determination of half reps.

Figure A2 illustrates a five repetition test showing the torque and velocity signals superimposed upon each other. The graph is in Bipolar mode which allows both positive and negative numbers to be viewed on the axis. Note that the velocity signal has positive and negative components. Once the dynamometer range of motion limits have been properly set, the sign of velocity will always indicate direction of travel. Positive velocity values occur during the “away” segment of the repetition. Negative velocity values occur during the “toward” segment of the repetition. This holds true for both anatomical sides (right and left).

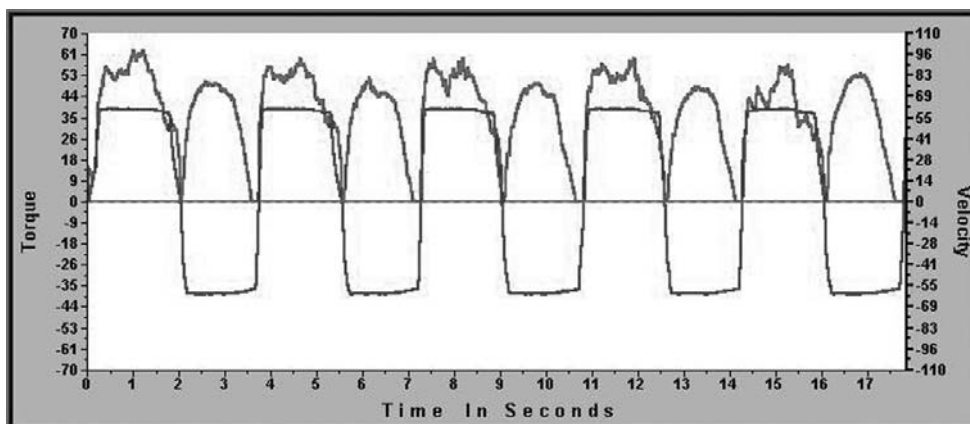


Figure A2. A five-repetition test showing the torque and velocity signals superimposed upon each other.

The Advantage Software scans the velocity signal and establishes the points of “zero” crossing. In other words, by marking points where the velocity signal changes sign, one can accurately determine the start and end points of every repetition in the test. This method of rep detection relies heavily on the accuracy of the velocity signal. If there are spikes or other forms of noise, the software may count more repetitions than really exist. To help eliminate false counting, a velocity threshold (defined in the application’s INI file as “IsokRepVelThresh”) is used to introduce a small amount of hysteresis. At the points where the velocity magnitude rises above or drops below this threshold, a half repetition is established. This method increases noise immunity and insulates the rep detector against noise spikes occurring at the range of motion limits.

Figure A3 illustrates a normal (unipolar) view of a torque curve with velocity superimposed. The small bars identify the starting and ending points of repetitions as calculated by the software. Notice the tight alignment of the endpoints with the velocity signal. Altering the threshold in the INI file will have an impact on the placement of the endpoints and can subtly change calculations of times to peak torque and work integrations. However, these differences are small relative to the accuracy of the dynamometer. The threshold percentage delineates the tradeoff between accuracy and sensitivity to noise.

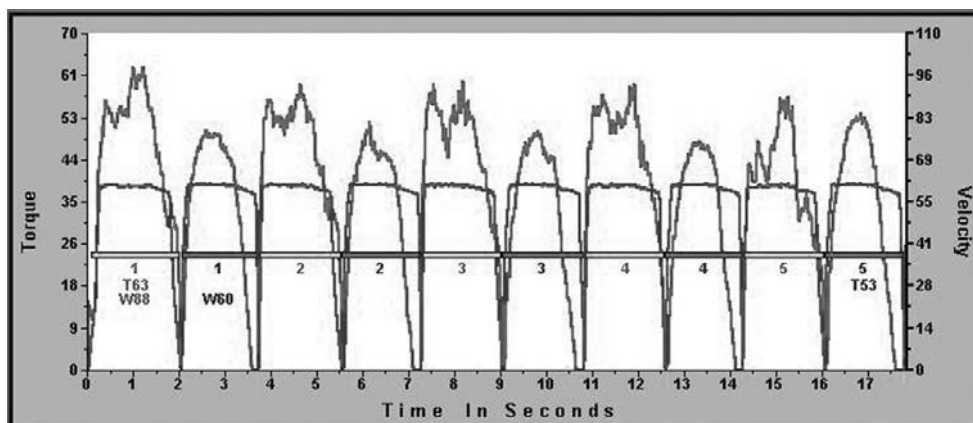


Figure A3. A unipolar (normal) view of a torque curve with velocity superimposed.

ISOKINETIC WINDOWING

In a perfect Newtonian world, there would be no need for isokinetic windowing. All data points collected by the dynamometer would occur at zero speed or at the selected isokinetic speed. However, this is an imperfect world. In terms of a dynamometer, there are discrete phases of acceleration and deceleration when can produce torques that are not “isokinetic” and torques that do not occur at the selected speed. Using torque data from these “non-isokinetic” phases can introduce substantial errors in all measurements associated with torques.

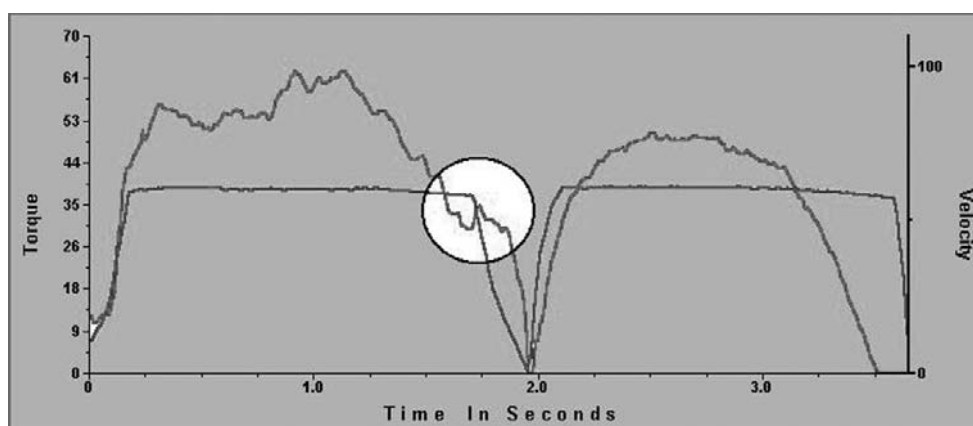


Figure A4. Temporal relationships between torque and velocity in a single repetition at 60° per second.

Figure A4 illustrates the temporal relationships between torque and velocity in a single repetition acquired at 60 degrees per second. The region highlighted in the circle illustrates a torque artifact resulting from deceleration. Note that the torque level increases as the velocity is dropping. At high speeds, this torque artifact can be large and often exceeding the true peak torque of the repetition.

An isokinetic window is a filter that removes torque points that lie outside of a specific temporal envelope. Two components contribute to the formation of the filter envelope. The first is an INI file parameter called “IsokWindowThresh”. This threshold is expressed as a percentage and determines the velocity below which data are no longer isokinetic. Torque points measured at speeds below this threshold are removed. The second component is controlled by INI file parameters called “CushionFilter” and “CushionDeceleration”. Based on the testing speed, the program calculates the exact beginning of the dynamometer’s deceleration phase. Torque points measured in this phase are also removed.

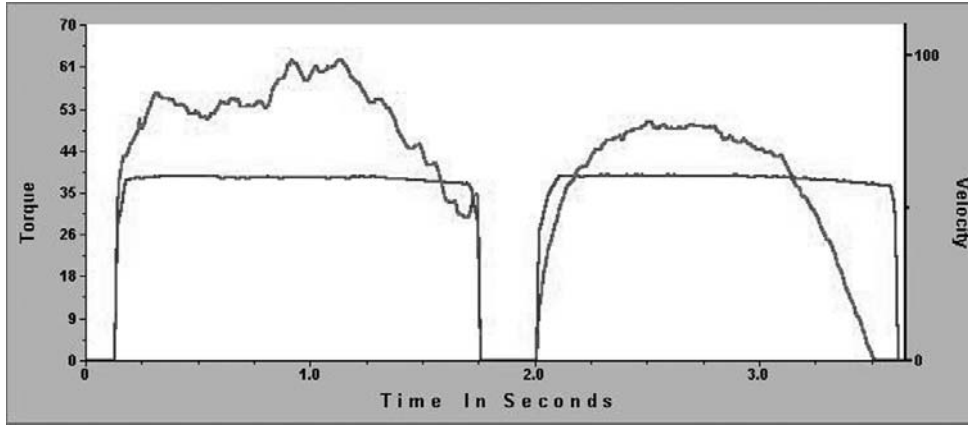


Figure A5. Application of a 70% isokinetic window threshold (with cushion filter).

Figure A5 illustrates the application of a 70% isokinetic window threshold (with cushion filter) to the curves of Figure B4. Notice that all of the torque points falling outside of the velocity envelopes are set to zero and do not contribute to data measurements.

NINE-POINT WEIGHTED SMOOTH “FILTER”

For presentation of graphical data, it is often visually desirable to “smooth” the rough edges of torque curves. The Biodex Multi-Joint offers the option to “smooth” curves using a convolution function. In curve analysis, the filter option is applied to the raw data. Using the cursors, the effect of the filter can be observed on a point-by-point basis. In report mode, the filter is applied to the only to the visual graphs. The raw data (and measurements made from this data) are not affected by the filter in Report mode. Advantage Software uses this strategy for a simple reason. The application of a smoothing filter can dramatically alter peak torque measurements as it tends to average data points.

Figure A6 illustrates the basic concept of convolving a one-dimensional function using digital numeric methods. For each curve data point in the output domain, eight neighboring data points are included in the calculation. The contributions of the neighboring points are “weighted” and close neighbors have a large effect while distant neighbors have a small effect. To calculate the filtered value of P0 in Figure A6 (inside circle) the following equation is used:

Filtered =

$$[(P-4 * k_4) + (P-3 * k_3) + (P-2 * k_2) + (P-1 * k_1) + (P_0 * k_0) + (P_1 * k_1) + (P_2 * k_2) + (P_3 * k_3) + (P_4 * k_4)]$$

Where:

$$k_4 = 1 / 18$$

$$k_3 = 1 / 18$$

$$k_2 = 2 / 18$$

$$k_1 = 3 / 18$$

$$k_0 = 4 / 18$$

Where:

$$k_4 = 1 / 18$$

$$k_3 = 1 / 18$$

$$k_2 = 2 / 18$$

$$k_1 = 3 / 18$$

$$k_0 = 4 / 18$$

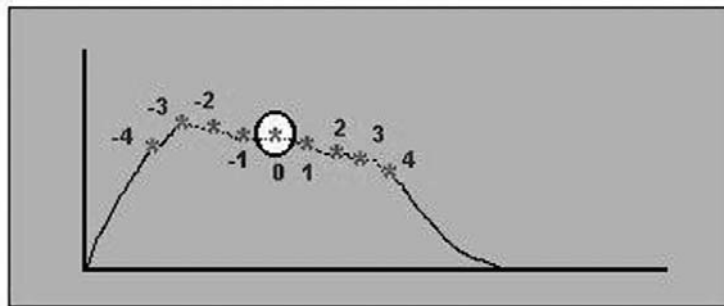


Figure A6. Convolving a one-dimensional function using digital numeric methods.

The result of these “binary-weighted” coefficients is to produce a high-frequency filter. Rapid changes in curve data are suppressed. Slow changes in data (attributed to the subject’s strength) are not affected. Figure A7 illustrates the curve of Figure A5 with the “filter” option turned on.

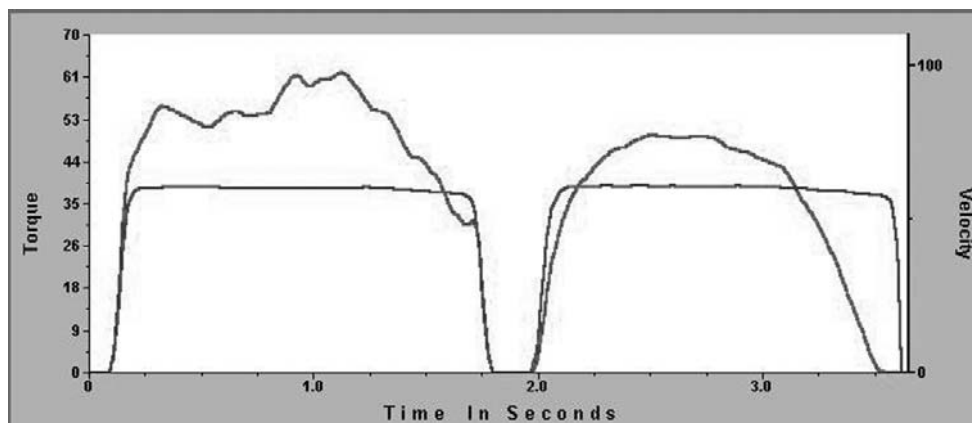


Figure A7. Curves with filter option turned on.

GRAVITY CORRECTION

For various joints in the body (such as the knee), the weight of the limb can be a significant factor in measuring the performance of the joint. To deal with this factor, the Advantage Software can optionally perform gravity correction on the torque data. There are two steps in the gravity correction process:

- Measure the weight of the limb
 - Apply the correction based on direction of shaft rotation
-
- Measure the weight of the limb
 - Apply the correction based on direction of shaft rotation

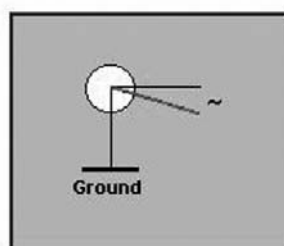


Figure 8

The measurement of limb weight is made with the dynamometer. The subject's limb is anatomically positioned at the point of maximum gravity effect (horizontal with respect to the ground). The subject is asked to relax and a torque measurement is made. It is not always possible to move the limb to the position of maximum gravity effect so the software corrects for any angular error from the horizontal. Figure 8 depicts the angle of error from the horizontal. This correction is only permitted within 45 degrees of the horizontal. Beyond 45 degrees, the error associated with the measurement is too large. The torque is corrected by the equation:

Figure A8. Angle of error from horizontal.

The measurement of limb weight is made with the dynamometer. The subject's limb is anatomically positioned at the point of maximum gravity effect (horizontal with respect to the ground). The subject is asked to relax and a torque measurement is made. It is not always possible to move the limb to the position of maximum gravity effect so the software corrects for any angular error from the horizontal. Figure A8 depicts the angle of error from the horizontal. This correction is only permitted within 45 degrees of the horizontal. Beyond 45 degrees, the error associated with the measurement is too large. The torque is corrected by the equation:

$$T(\text{Limb}) = T(\text{Measured}) / \sin(\text{angle})$$

During a test, the limb weight contribution is calculated as:

$$T(\text{Correction}) = T(\text{Limb}) * \sin(\text{angle})$$

Depending upon the direction of travel, the limb weight correction is added or subtracted. For the knee, the away direction is upward (working against gravity) so the gravity correction is added to the subject's torque. The towards direction is downward (working with gravity) so the gravity correction is subtracted from the subject's torque. Figure A9 illustrates a knee dataset with no gravity correction (left) and a dataset for the same patient with a limb weight contribution of 20 ft-lb (right). Notice that limb weight corrections are added to the quadriceps muscle data (away direction) and subtracted from the hamstring muscle data. Although the curves appear similar in height they are not similar in magnitude. The torque scale for the left graph is 30 ft-lb while the scale for the right graph is 60 ft-lb.

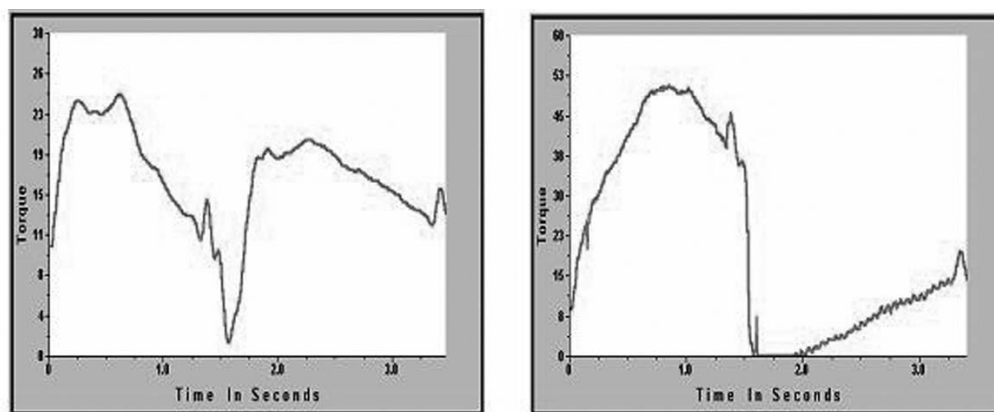


Figure A9. Knee datasheets with gravity correction (left) and without gravity correction (right).

WORK INTEGRATION

The value of “work” is calculated from the basic physics equation:

$$\text{Work} = \text{Force} \times \text{Distance}$$

In the Biodex Multi-Joint System environment, rotational force is measured in foot-pounds and distance is measured in degrees. To integrate work over the entire half repetition, numerical methods are used to sum the work contributions from each data point. Thus, the work contribution at time “t” is:

$$\text{Work}(\Delta t) = [\text{Torque}(@t) \cdot \Delta \Omega \{ \text{Torque}(@t) - \text{Torque}(@t-1) \}] * [\text{Position}(@t) \cdot \Delta \theta \{ \text{Position}(@t) - \text{Position}(@t-1) \}]$$

The total amount of work is the sum of the contributions (deltas). Figure A10 graphically illustrates the work area under the torque curve for a single point. Note that the height of the area “rectangle” is halfway between the current and previous torque points. This is a numerical estimation technique and yields very accurate results when the distance between sample points is small.

The total amount of work is the sum of the contributions (deltas). Figure 10 graphically illustrates the work area under the torque curve for a single point. Note that the height of the area “rectangle” is halfway between the current and previous torque points. This is a numerical estimation technique and yields very accurate results when the distance between sample points is small.

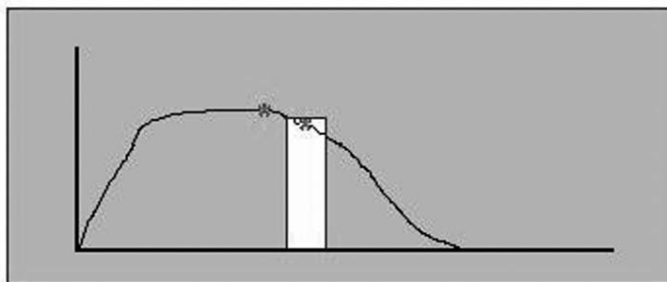


Figure A10. Graphic illustration of the work area under the torque curve for a single point.

WORK “FIRST” AND “LAST” THIRD

The amount of work produced in the “first third” of a test is obtained by calculating the total number of sample points in each direction (away and toward) and then integrating the first third of these sample points. Similarly, work produced in the “last third” is obtained by integrating the sample points from the last third of the test:

$$\text{NumSamplesAway[Third]} = \text{TotalSamplesAway} / 3$$

$$\text{NumSamplesTwd[Third]} = \text{TotalSamplesTwd} / 3$$

$$\text{WorkAway[First Third]} = ((t=0 \text{ to } t=\text{NumSamplesAway[Third]}) \text{ WorkDelta}[t]$$

$$\text{WorkTwd[First Third]} = ((t=0 \text{ to } t=\text{NumSamplesTwd[Third]}) \text{ WorkDelta}[t]$$

$$\text{WorkAway[Last Third]} =$$

$$((t=(\text{TotalSamplesAway} - \text{NumSamplesAway[Third]}) \text{ to } t=\text{TotalSamplesAway}) \text{ WorkDelta}[t]$$

$$\text{WorkTwd[Last Third]} =$$

$$((t=(\text{TotalSamplesTwd} - \text{NumSamplesTwd[Third]}) \text{ to } t=\text{TotalSamplesTwd}) \text{ WorkDelta}[t]$$

AVERAGE POWER

$$\text{AveragePowerAway (in watts)} = (\text{TotalWorkAway} / \text{Total Time}) * 1.3560$$

$$\text{AveragePowerToward (in watts)} = (\text{TotalWorkToward} / \text{Total Time}) * 1.3560$$

COEFFICIENT OF VARIATION

The coefficient of variation is defined as the standard deviation of a set of points divided by the set's mean value. In the Biodex Multi-Joint System, peak torques (away and toward) for each repetition are used to compute the CV. At least three repetitions are required and the CV will not be calculated until the end of the third repetition and after which the CV is recalculated for subsequent complete repetitions.

$$(\text{CV}) = \sqrt{ \left[\frac{\sum (x - \bar{x})^2}{n} \right] / (n-1) }$$

$$\text{CV} = \left(\frac{s}{\bar{x}} \right)$$

TIME TO PEAK TORQUE

This is the time interval measured from the beginning of the peak torque repetition to the point where peak torque occurs for that repetition. It is calculated independently for the away and toward components of the repetition.

ACCELERATION / DECELERATION TIMES

The acceleration time is defined as the time interval measured from the beginning of the peak torque repetition to the point where the velocity threshold is reached. The velocity threshold is calculated as:

$$\text{VelocityThreshold} = [\text{DynamometerSpeed} * \text{ISOKWINDOWTHRESH}] / 100.0$$

Where ISOKWINDOWTHRESH is the “isokinetic window threshold” defined in the application’s INI file (see SYSTEM 3 INI FILE PARAMETERS section). For example, if the dynamometer speed was 60 degrees per second and the isokinetic window threshold is 70%, the velocity threshold is $(.7 * 60)$ or 42 degrees per second.

Deceleration time is defined as the time interval measured from the velocity threshold to zero velocity at the end of a repetition.

Advantage Software INI FILE PARAMETERS

The Advantage Software application maintains a private INI file in the application’s working folder. In general, the contents of this INI file should not be changed. Most of the settings are maintained automatically by the software and changing them can disable the application.

There are several settings which can be altered by the user to customize the application’s behavior for a site’s specific requirements. These settings are as follows:

[Dynamometer]

IsokWindowThresh=70	; velocity threshold for isokinetic windowing (in %)
IsokVelAcqMin=1	; velocity threshold for motion (deg/sec)
IsokRepVelThresh=15	; velocity threshold for start of a repetition (in %)
TorqueLimitAwy=100	; default torque limit away for eccentric motion
TorqueLimitTwd=100	; default torque limit toward for eccentric motion
TorqueLimitThresh=10	; default torque limit threshold for eccentric motion
MinPositionThresh=15	; minimum position (in degrees) to initiate acquisition
DebouncePercentage=10	; % of total ROM limit used to debounce direction change
IsomTorqThresh=3	; torque threshold (ft-lb) for start of isometric acquisition
CushionFilter=0	; flag to enable isokinetic cushion filter component (1=on)
CushionDeceleration=6	; deceleration value used for cushion filter (deg/sec)

If adding a record is chosen, the values are defaulted, allowing you to modify each value. Again as in the case of “Save as new” described above, you must carefully select a criteria that will not conflict with existing stored goals.

If you saved the edited or newly added record, then <Close> this screen and the new or modified record will be displayed in the list of Normative Goals.

B. RANGE OF MOTION CUSHION IMPLEMENTATION

The Biodex Multi-Joint System firmware implements the Range Of Motion cushions. Both the main 68331 processor and the DSP are involved in this implementation. The 68331 processor computes the width of the cushions and then the associated starting position, while the DSP actively implements the deceleration within the cushion range.

CUSHION WIDTHS

The cushion widths are computed based on the front panel settings. The max velocity and cushion setting directly effect the width of the cushions. The 68331 processor computes the cushion widths whenever one of the following commands are received, either from the Front Panel or the computer:

- Set Commanded Velocity
- Set Cushion Value (1 – 9)
- Set Range Of Motion
- Set Range Of Motion Percentage

Once the cushion width is determined, the 68331 computes the resulting start position of the cushions and downloads these positions to the DSP.

The algorithm to calculate the width uses a table to define the velocity delta to apply to the current commanded velocity, in order to slow the attachment down to stop at the end ROM position. The equation is as follows:

$$\text{cushion width \{in degrees\}} = \text{commanded velocity} / \text{delta velocity}$$

There are two special rules applied on the resulting cushion width:

- The cushion width is restricted to 43 degrees maximum (if greater, it's forced to 43)
- If the two cushion regions overlap, both cushions will be reduced by setting the start of cushion positions to the mid-point of their overlapping regions.

There are 5 separate tables defining delta velocities, 1 table per velocity range, where each table has 9 elements, one per cushion setting. The table definitions are as follows:

< 60 deg/sec		>= 60 and < 90 deg/sec		>= 90 and < 150 deg/sec		>= 150 and < 240 deg/sec		>= 240 deg/sec	
deg/sec Value	Cushion Delta	deg/sec Value	Cushion Delta	deg/sec Value	Cushion Delta	deg/sec Value	Cushion Delta	deg/sec Value	Cushion Delta
20	1	20	1	24	1	24	1	24	1
16	2	17	2	20	2	20	2	21	2
12	3	14	3	16	3	16	3	18	3
8	4	11	4	12	4	12	4	15	4
4	5	8	5	8	5	8	5	12	5
3	6	7	6	7	6	7	6	11	6
2	7	6	7	6	7	6	7	10	7
1	8	5	8	5	8	5	8	9	8
1	9	4	9	4	9	4	9	8	9

Using the equation and the values above, this results in the following example cushion widths being calculated:

Max Velocity	Cushion Setting	Cushion Width
180 deg/sec	1	7.5 degrees
75 deg/sec	5	9.4 degrees
300 deg/sec	7	30 degrees
45 deg/sec	1	2.3 degrees
45 deg/sec	6	15 degrees

CUSHION DECELERATION

Once the cushion width is computed on the 68331 processor, it downloads the resulting start of cushion positions to the DSP. The DSP will then perform cushion deceleration dynamically, based on the actual measured velocity when the cushion region is first entered. Once the system enters the cushion region and maintains movement in the direction towards the ROM stop position, the velocity is decreased in real-time (every 1/2 milli-second) until 0 velocity is reached at the ROM stop position, or the direction of movement is reversed. This real-time method will result in a smooth, controlled stop, minimizing impact and any noticeable stepped down speed.

CUSHION FILTERING

This is an additional method used in conjunction with Isokinetic windowing to eliminate erroneous torque end spikes caused by deceleration into the end stop. This is not selectable in the report selection menu. The amount of filtering is calculated from the speed of the dynamometer and the level of the deceleration. The cushion width (in degrees) is defined by the firmware and is based on the lever arm speed and the cushion value selected on the front panel. For example, at 180 deg/sec and a cushion setting of 1, deceleration will begin at 7.25 degrees from the end stop. With the same 180 deg/sec and a cushion setting of 9, deceleration will begin 45 degrees from the end stop. The "cushion" filter will remove torque values that occur within the deceleration range. The cushion filter values can also be changed. These are INI file parameters. The default is ON. The default degree setting is 6 (degrees per second per degree).

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Clinician:

[illegible]

Biodex Phone: 1-800-224-6339	Clinical Education ext. 114	Software Support ext. 120	Service ext. 241
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D. CURRENT RECORDED NORMATIVE GOALS (ENGLISH UNITS)

JOINT MOVEMENT AND POSITION	SPEED DEGREES/SECONDS	PEAK TORQUE/BW RANGE				FLEX/EXT RATIO		EXT ROT/INT ROT RATIO		ABD/ADD RATIO		DORSI/PLANTAR RATIO		EVER/INVER RATIO	
		MALE		FEMALE		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Lumbar Flexion Semi Standing	60 90 120	114 * *	121 * *	* * *	* * *										
Lumbar Extension Semi Standing	60 90 120	150 133 145	162 139 150	* * *	* * *	49 59 51	49 59 51								
Shoulder External Rot. Mod. Neutral	60 180	13 11	17 15	10 8	13 12										
Shoulder Internal Rot. Mod. Neutral	60 180	19 17	26 23	14 13	18 17			64 66	71 71						
Shoulder Flexion Seated	60 180 300	25 22 9	34 29 12	23 20 21	30 26 27										
Shoulder Extension Seated	60 180 300	28 22 28	37 30 37	24 18 17	31 23 23	90 83 69	79 83 81								
Shoulder Abduction Seated	60 180	20 18	27 24	16 14	20 18										
Shoulder Adduction Seated	60 180	32 27	43 36	27 25	35 33					66 53	64 78				
Ankle Plantarflexion Seated	30 60 120	49 36 23	65 48 31	43 36 20	55 46 26										
Ankle Dorsiflexion Seated	30 60 120	13 11 9	17 15 12	16 15 11	21 20 14							26 31 39	39 43 54		
Ankle Eversion Seated	30 60	13 9	17 12	12 9	16 12										
Ankle Inversion Seated	30 60	12 11	16 14	14 12	19 15									87 90	81 80
Knee Flexion Seated	* *	* *	* *	* *	* *										
Knee Extension Seated	60 180 300	86 58 40	115 75 55	80 50 30	95 65 45	61 72 78	62 76 79								
Hip Flexion Supine	45 300	40 10	52 13	38 7	50 9										
Hip Extension Supine	45 300	63 34	82 44	57 28	77 37	64 29	66 25								
Elbow Flexion Seated	60 120	21 21	28 28	20 34	26 45										
Elbow Extension Seated	60 120	21 23	28 30	23 18	30 24	97 93	88 98								
Wrist Flexion Seated	60 120	4 2	7 4	4 2	7 4										
Wrist Extension Seated	60 120	2 2	4 4	2 2	4 4	57 97	57 97								

* The Biodex normative database is a compilation of published information to be used as unilateral goals. Peak Torque to body weight is expressed in a range which enables these goals to be recommended for various groups (Prepubescent patients do not apply).

D. CURRENT RECORDED NORMATIVE GOALS- (METRIC UNITS)

JOINT MOVEMENT AND POSITION	SPEED DEGREES/SECONDS	PEAK TORQUE/BW RANGE				FLEX/EXT RATIO		EXT ROT/INT ROT RATIO		ABD/ADD RATIO		DORSI/PLANTAR RATIO		EVER/INVER RATIO	
		MALE		FEMALE		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Lumbar Flexion Semi Standing	60 90 120	38.1 * *	40.4 * *	* * *	* * *										
Lumbar Extension Semi Standing	60 90 120	50.1 44.4 48.4	54.1 46.4 50.1	* * *	* * *	49 59 51	49 59 51								
Shoulder External Rot. Mod. Neutral	60 180	4.3 3.7	5.7 5.0	3.3 2.7	4.3 4.0										
Shoulder Internal Rot. Mod. Neutral	60 180	6.3 5.7	8.7 7.7	4.7 4.3	6.0 5.7			64 66	71 71						
Shoulder Flexion Seated	60 180 300	8.4 7.4 3.0	11.4 9.7 4.0	7.7 6.7 7.0	10.0 8.7 9.0										
Shoulder Extension Seated	60 180 300	9.4 7.3 9.4	12.4 10.0 12.4	8.0 6.0 5.7	10.4 7.7 7.7	90 83 69	79 83 81								
Shoulder Abduction Seated	60 180	6.7 6.0	9.0 8.0	5.3 4.7	6.7 6.0										
Shoulder Adduction Seated	60 180	10.7 9.0	14.3 12.0	9.0 8.4	11.7 11.0					66 53	64 78				
Ankle Plantarflexion Seated	30 60 120	16.4 12.0 7.7	21.7 16.0 10.4	14.4 12.0 6.7	18.4 15.4 8.7										
Ankle Dorsiflexion Seated	30 60 120	4.3 3.7 3.0	5.7 5.0 4.0	5.3 5.0 3.7	7.0 6.7 4.7							26 31 39	39 43 54		
Ankle Eversion Seated	30 60	4.3 3.0	5.7 4.0	4.0 3.0	5.3 4.0										
Ankle Inversion Seated	30 60	4.0 3.7	5.3 4.7	4.7 4.0	6.3 5.0									87 90	81 80
Knee Flexion Seated	* *	* *	* *	* *	* *										
Knee Extension Seated	60 180 300	28.7 19.4 13.4	38.4 25.1 18.4	2.7 16.7 10.0	31.7 21.7 15.0	61 72 78	62 76 79								
Hip Flexion Supine	45 300	13.4 3.3	17.4 4.3	12.7 2.3	16.7 3.0										
Hip Extension Supine	45 300	21.0 11.4	27.4 14.7	19.0 9.4	25.7 12.4	64 29	66 25								
Elbow Flexion Seated	60 120	7.0 7.0	9.4 9.4	6.7 11.4	8.7 15.0										
Elbow Extension Seated	60 120	7.0 7.7	9.4 10.0	7.7 6.0	10.0 8.0	97 93	88 98								
Wrist Flexion Seated	60 120	1.3 .7	2.3 1.3	1.3 .7	2.3 1.3										
Wrist Extension Seated	60 120	.7 .7	1.3 1.3	.7 .7	1.3 1.3	57 97	57 97								

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