

ISOKINETIC STRENGTH

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1. Background and Rationale

Standing up from a chair or climbing stairs requires concentric contractions of the knee extensors, while sitting down slowly or descending stairs requires eccentric contraction of the same muscle group. Concentric (CONC) refers to contraction of the muscle as it shortens and eccentric (ECC) to contractions of the muscle as it lengthens. Both types of contractions are essential to function. In Health ABC only concentric contraction will be tested because the two are highly correlated.

A Kin-Com isokinetic dynamometer will be used to evaluate the concentric strength of the knee extensors. Isokinetic dynamometers test muscle performance as the participant applies force against a continuously moving mechanical arm. This is in contrast to

isometric dynamometers which require application of force against a fixed mechanical arm or lever. The Kin-Com is capable of testing a variety of muscle groups while the mechanical arm is moving at a variety of speeds. However, studies have found that muscle performance at one speed is highly correlated with performance at other speeds. We will test the performance of knee extensors at 60° per second.

To minimize time and participant burden, we will test knee extensors on the right side only, unless the right leg has been injured or affected by a condition, such as osteoarthritis, that will impair joint motion. In that case, we will test the left side, and this should be noted in the participant's file. We will test participants at 60° per second, three times, in the concentric mode.

2. Equipment and Supplies

- Kin-Com 125 AP Dynamometer
- Level with magnet
- Certified 5 kg (11 lb) weight with hook or handle and velcro strap for attaching weight to load cell
- Step stool, preferably with a handrail

2.1 Service and Maintenance

Health ABC has contracted with the Chattanooga group for an extended service contract to cover the length of the study. This contract provides for two Planned Maintenance inspections per year. The first inspection will be done by the Kin-Com representative during operator training. Thereafter, Planned Maintenance inspections must be scheduled every six months. Regular service schedules must be strictly observed.



2.2 Calibration

See Appendix 1 for step by step calibration instructions. These should be followed daily for 2 months. If after 2 months it is found that the calibration has remained stable (you have not had to adjust the machine), the frequency of calibration may be reduced to once a week. Each clinic will have a certified 5 kg (11 lb) weight for daily calibration. Cross calibration will be estimated from the daily calibration data.

3. Safety Issues and Exclusions

The quadriceps test using the Kin-Com is generally safe and well-tolerated by most older participants. However, injury may occur in patients with knee joint pathology or if the machine is operated incorrectly. To avoid injury during testing the mechanical hardware stops must always be in place when training or testing a participant. These pegs, attached to the Kin-Com dynamometer head, act as a backup to the manually determined software stop and start angles. The mechanical stops should be positioned 5° beyond the desired stop and start angles. Failure to place the stops properly may endanger the participant and damage the system. The patient interrupt switch should always be in the participant's grasp during any activity on the Kin-Com. This switch enables participants to stop the lever from moving if they feel that speeds or forces are excessive.

Participants should not be tested on the dynamometer if they have either of the following conditions:

- History of cerebral aneurysms or cerebral bleeding. Since participants are unlikely to know whether a previous stroke was hemorrhagic or ischemic, stroke will be considered a contraindication.
- Blood pressure $\geq 200/110$ mm Hg
- Severe bilateral knee pain that would make the examination uncomfortable. Participants with severe unilateral right knee pain can be tested on the left side.
- Previous total knee replacement; if unilateral, the other knee should be tested.

In addition, if the participant has severe pain or a restricted range of motion on the right side, and the left is less affected by these conditions than the right (i.e. pain does not preclude testing), the test should be performed on the left side. Similarly, if the participant has suffered an injury resulting in the right leg being weaker than the left, the left leg should be tested.

4. Participant and Exam Room Preparation

The minimum space requirements for Kin-Com dynamometry is 9'x12', and a 12'x14' space is very comfortable.

Ideally, this test should be performed after a short period of warm-up exercise. The Long-distance Corridor Walk is well-suited to this purpose and should be performed first.

5. Detailed Measurement Procedures

Health ABC will use the Kin-Com 125 AP dynamometer. This dynamometer has an automatic positioning feature that stores and recalls a participant's exact positioning and testing protocol from one examination to the next. It is important for this longitudinal study that the methods of strength testing and the participant positioning be consistent throughout the study. Step-by-step instructions for use of the Kin-Com during the test procedures can be found in Appendix 2 (new participant), and Appendix 3 (repeat participant).

5.1 Record Keeping

A form is provided as a backup to the computer storage of patient positioning and for a summary record of isokinetic dynamometry testing performed on each participant.

Record which leg is being tested (right, unless injured, weaker, or restricted in motion). Record participant positioning parameters, how many trials were attempted, how many trials were accepted, peak torque, average torque, whether or not the test was performed after the 2-hour blood draw, and the date of the test.

Important: A printout of the report form should also be made immediately after each testing session and kept in the participant's record in case of computer failure.

5.2 Administration

5.2.1 Determine Contraindications or Disabilities of Right Knee

1) Check the blood pressure form to ensure that the participant's blood pressure does not exceed 199/109 mm Hg. Record on Kin-Com Form.

2) If the participant indicates that they have suffered a cerebral aneurysm or stroke, record this on the Kin-Com form and do not continue. Testing is contraindicated in these participants.

Script: "Has a doctor ever told you that you have an aneurysm in the brain or have had a stroke?"

3) Determine which knee can be tested. Refer to Side to Measure Form.

Script: "Have you ever had an injury that has made one leg weaker than the other?"

"Is it difficult for you to either bend or straighten your knees fully due to pain, arthritis, injury or other condition?"

4) If the participant indicates that these conditions exist, determine whether the right leg is worse than the left leg in this respect. If both sides are affected, test the less affected side.

Script: "Which side is better?"

5) Determine if the participant has ever had a knee or hip replacement surgery where all or part of the joint was replaced. Note on Side to Measure form whether a scar is visible.

Script: "Have you ever had knee or hip replacement surgery where all or part of your joint was replaced?"

If the participant has had knee replacement surgery, do not test affected side.

6) Do not test either side if both knees would experience severe pain if tested. This can often be determined by a simple manual test. Have the participant extend their knee until the knee is flexed 60 degrees down from the fully extended position. The tester asks the participant to extend the knee and tests manually that the task is correctly understood.

Put hands above the participant's ankle and ask the participant to press against your hands. Keep your elbows extended and use the weight of your upper body to resist the push.

After having tried the movement, the participant should be asked:

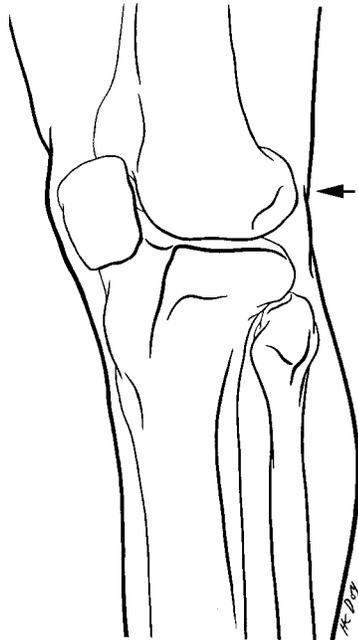
Script: "Did you have pain in your knee that stopped you from pushing hard?"

Record results of manual test on Kin-Com form.

5.2.2 Positioning the Participant on the Kin-Com

1) Participants are positioned sitting and with the back supported according to instructions. Stabilizing straps are placed across the pelvis and the distal thigh of the leg to be tested.

Script: "Now I would like you to sit in the chair with your hands comfortably in your lap. Please keep your hands in your lap during all testing."



2) The knee joint (lateral femoral epicondyle [see figures above]) is aligned with the rotational axis of the dynamometer. This can usually be accomplished by adjusting the dynamometer up/down and in/out. Occasionally seat angle up/down and seat in/out adjustments must be made. The resistance pad at the end of the lever arm is placed approximately two finger widths above the ankle bones (malleoli). (See figure below.) In very tall participants place the resistance pad as near to the ankle as possible.



3) The Kin-Com automatically records any changes to the dynamometer positioning and seat that might have been changed while fine tuning the participant's positioning. The software will also prompt the operator to make any necessary changes to the dynamometer tilt (parameter A) and rotation (B); lever arm stops (C&D); and seat rotation (E), back angle (F), bottom depth (G), or bottom angle (H). These changes in the manual parameters must be read from the dynamometer and entered manually into the program so that future measurements can be standardized.

5.2.3 Test Parameters

- 1) The computer joint angle is adjusted to anatomical joint angle by referencing the machine at 90° when the participant's knee is at 90°. ¹ The machine reference angle must then be entered as 90° (see Appendix 2).
- 2) To correct for gravity, the participant's limb is weighed at approximately 45°. Weighing and gravity correction are covered in detail in Appendix 2.
- 3) Start and stop angles are set at 90° and 30°.
- 4) Participant performs an isometric effort (lever arm not moving) to determine half-maximal force (used as start force for isokinetic testing)

¹Note to investigators analyzing Kin-Com data: By setting anatomical joint angle based on machine joint angle, there may be some error in the actual range of motion measured. This error may be the result of anatomical differences between participants so that the actual range of motion measured may not be 30° to 90°, although the range of motion will cover a 60° arc. In addition the seat angle (usually 15° above horizontal) will generally affect the true joint angle, and in turn affect the actual range of motion measured. The range tested within participant will be constant from visit to visit, but may vary across participants. This should be taken into account when describing the Kin-Com protocol.

5) Test concentric repeatedly with a 20-second rest between each until three similar curves have been obtained, but no more than 6 attempts.

5.2.4 Demonstration and Practice

1) Participants should be given the interrupt switch to hold and instructed to use it if during the test they become apprehensive that the machine is pushing them too hard or they experience pain that makes them want to stop the test. In this case, pushing the switch will shut down all power to the Kin-Com and it will come to a soft stop.

2) Before testing begins, participants should be asked to perform a maximum *isometric* effort (lever arm does not move) to determine the starting force for isokinetic dynamometry. The starting force will be set at half the maximum isometric effort.

3) Participants should perform two good submaximal practice efforts before testing begins. A good practice is based on the shape of the curve.

Script: "Now that you are all set up, I would like you to do a couple of practice tests. Push against the lever arm and keep pushing until it stops. I just want you to get the feel of it so you don't need to push as hard as you can. If you experience any pain, tell me and we will stop or adjust the machine."

4) If the participant complains of pain during the practice trials, determine how severe the pain is and whether testing should continue.

Script: "Does it hurt enough that you want to stop?"

If the participant complains of severe pain, discontinue testing unless the contralateral leg can be tested without severe pain.

5.2.5 Test

1) Once the participant has practiced the testing procedure, tell them that you will now begin the actual testing.

Script: "OK, this one is for real. I'd like you to push against the lever arm until it stops. Whenever you are ready, push as hard as you can."
(during the maneuver) "Harder, harder."
(after completion) "Now we'll let you rest" [allow a 20-second rest period].

2) You will have to push the lever arm back to the starting position. *Grasp the load cell, not the lever arm* and push the arm back to the starting position.

3) Starting with the second effort, the Kin-Com will display the new test overlaid on the old test. If the two efforts “overlay” very consistently, both are accepted. Appendix 4 gives examples of acceptable and unacceptable overlays. If the efforts do not overlay consistently, the one with lower amplitude is discarded.

After each test effort, tell the participant whether the previous two curves were similar or whether the latest effort was an improvement or the effort had dropped off. This feedback will tend to encourage maximal effort on each test.

Concentric efforts are repeated until three similar curves have been obtained. The participant should not be asked to attempt more than six cycles. Keep track of the total number of attempts and the number of attempts “accepted.” These numbers should be noted on the exam form.

With experience, it should be fairly easy to tell from the report curves when the participant isn’t trying. If it appears that less than maximal effort is being exerted, encourage the participant to try harder. Emphasize the importance of the data to the study.

If the participant is obviously fatiguing and efforts are decreasing in magnitude (each subsequent effort is lower than the previous) then after three or four attempts the test may be stopped.

The total number of trials accepted and stored (usually three) and the total number of trials attempted (accepted or rejected) should be recorded on the exam form.

5.2.6 Tape Backup of Data

Once a week, the data manager should back up all the data stored on the Kin-Com computer to a tape back up. This will make a copy of all data collected to date in the study. The tape back up will be sent to UCSF every other week for downloading into the data system and then returned for reuse. The sites should therefore have a number of tapes available for use (minimum three). Detailed instructions for making a tape back up are given in Appendix 5.

6. Procedures for Performing the Measurement at Home

This examination is not feasible for home visits.

7. Alert Values/Reporting to Participants

When the testing is completed, tell the participant that it looks like they have “done well.”

8. Quality Assurance

8.1 Training and Certification

The Kin-Com manufacturer will provide on-site training at one or both field centers, covering basic machine operation and the fundamentals of testing, as well as study-specific procedures. After the initial training session operators should practice on other staff members and themselves until reliable measurements are achieved. It is especially useful to practice on volunteers who are not knowledgeable about what to expect. Training should include:

- attend manufacturer’s training (or observe measurement by experienced examiner)
- read manufacturer’s user’s guide and Health ABC OM with goal of understanding
 - the proper use of equipment
 - the proper calibration and adjustment of equipment
 - exclusions and safety considerations
 - detailed testing procedures
- practice on colleagues and “naive” volunteers

8.2 Certification Requirements

- Complete training requirements
- Recite exclusion criteria
- Demonstrate calibration and adjustment of Kin-Com
- Perform test on two volunteers under the observation of clinic QC officer or designated Kin-Com expert.

8.3 Quality Assurance Checklist

- Log indicates calibration according to schedule
- Blood pressure form checked to determine if testing contraindicated
- Consults side-determination form to choose side to test
- Performs manual test to determine pain exclusion

- Participant positioning correctly determined (from stored values if repeat test, by fine tuning in the manual mode if first test occasion)
- Manual hardware stops in place
- Patient interrupt switch in participant's hand during demonstration and testing and its operation properly explained
- Gravity correction correctly applied
- Correct instructions given while demonstrating procedure
- Two good (based on curve) submaximal practice efforts
- Standard level of encouragement (motivation and feedback) offered to participant
- Correct determination of trials to be stored (based on overlay with previous trials)
- Three successful trials stored or a maximum of six trials attempted after good practice efforts
- Key points from script stated and clearly delivered
- Data saved to Kin Com file
- Total number of trials and number of accepted trials noted on exam form
- Report printed and placed in participant's file
- Reviews form for completeness
- Form correctly filled out

9. References

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APPENDIX 1
KIN-COM CALIBRATION PROCEDURE
Part I
Diagnostics

From the Kin-Com Main screen: Touch screen anywhere

1. Select Kin-Com
2. Select System Utilities
3. Type: test
4. Type: yes
5. Select option 1
6. Select option 1
7. Position mechanical stop C at 2; mechanical stop D at 34
8. Make sure the load cell is firmly attached to the lever arm.
9. Position lever arm in approximately the horizontal position and pick up the patient abort switch.
10. **MAKE SURE THE LEVER ARM IS UNOBSTRUCTED AND WILL NOT CONTACT ANY OBJECT!** The lever arm will be moved passively throughout the full range of motion of the machine. This will be done at various speeds including full speed (250+ degrees per second). **DO NOT STAND CLOSE ENOUGH TO BE STRUCK BY THE LEVER ARM DURING THIS PROCEDURE.** During the Diagnostic check the software will actuate the lever arm several times and at several speeds. Do not get in the path of the lever arm until you have completed the Diagnostic check and have safely returned to the Kin-Com software.
11. Press Enter and the Diagnostics program will run.
12. Press the Patient abort switch when requested.
13. When the message Diagnostics program complete appears, press escape.
14. Press escape.
15. Press escape.
16. This concludes the Diagnostic portion of the calibration procedure. If any problems were encountered during diagnostics, they would be reported on the screen. If problems are encountered, call service at 800-494-3398.

Part II
Load Cell

From the Kin-Com Main screen: Touch screen anywhere.

1. Select Kin-Com
2. Select Exercise
3. Select Protocol
4. Select Calibration
5. Select Continuous

6. Select Turn On Anatomical Reference
7. Move lever arm to horizontal and check with a level.
8. Select Enter
9. Actual joint angle is: 0; Select Enter
10. Grasp the load cell, **not the lever arm**, and move lever arm up a few degrees towards vertical.
11. Select Enter
12. Select Enter
13. Grasp the load cell, **not the lever arm**, and move the lever arm down towards horizontal until Stop Angle = 0; Select Enter.
14. Select Set Start Angle
15. Grasp the load cell, **not the lever arm**, and move the lever arm down towards vertical until Start Angle = 90; Select Enter
16. Select Enter
17. Force should read zero.*
18. Select Start Exercise.
19. Pull up on load cell for about one second.
20. Place a known weight (11 lb or 5 kg) on the load cell. This is most easily done by attaching the weight to the load cell with a velcro strap.
21. Force should read 50 Newtons**
22. Remove weight
23. Select Escape.

*If the reading flickers back and forth between +1 or -1 and 0, this may be as close as you can get. If force does not flicker between 0 and +/- 1 or read zero with lever arm vertical, remove cover from Kin-Com, find the decal on the computer that shows the location of pot #7 force gain and #8 force zero adjustment (offset). With the lever arm vertical, adjust the zero adjustment screws until force reads zero.

** If force reading does not read 50 Newtons in the horizontal position with the 11 lb (5 kg) weight attached, adjust #7 (gain) until it reads 50 Newtons. Calibration is complete.

APPENDIX 2

HEALTH ABC KIN-COM OVERLAY TEST PROTOCOL
New Participant

- Power-up the Kin-Com.
- Touch the screen anywhere to Enter the Kin-Com Main menu.
- Touch Kin-Com to access the main menu.
- Touch Patient Positions.
- Touch Preset Position.
- Touch joint: Knee.
- Touch Ext.
- Touch side: Right or Left as appropriate.
- Touch the screen anywhere.
- Follow on-screen instructions to position the unit in the standard preset position for knee extension.
- Place participant on machine
- Touch the screen anywhere to proceed to Manual Mode for fine tuning adjustment for this participant.
 - Make the necessary adjustments so the participant can be taken passively through the range of motion without the shin pad moving up or down the shin.
 - If adjustments to the manual positions A-H are necessary, make the adjustments, then touch Index Locations. Use the arrow buttons on the keyboard to move the highlight bar to the appropriate position(s). Type in the new number(s) and touch Accept.
- Touch Enter to save this as a Participant position.
 - A patient scroll box will be displayed. Select New Patient and enter all appropriate data.
- Touch Enter to accept, or Re-do to make changes.
- A blue message box will display: "Adding positional data to the Patient Position Database."
- Touch screen anywhere to continue.
- Touch Evaluation to access the evaluation program.
- The patient scroll box will be displayed with the appropriate participant's name highlighted.
- Touch Enter to accept this participant.
- After reviewing patient information, touch Enter.
- A blue message box will display: "You will need the following attachments: Double shin pad" (you already have it)
- Touch Turn ON Gravity Compensation

- Move Lever Arm to horizontal position (check with a level)
- Touch Enter (you will get joint specification screen)
- Touch Enter.
- Touch Protocol
- Select ABC, then touch Enter
- Touch Overlay.

- Set Lever arm length:
 - The lever arm length is the distance from the axis of rotation to the end of the load cell.
 - Enter the correct number on the numeric pad on the screen.
- Touch Enter.
- Set anatomical reference.
 - Select Joint Position
 - Move lever arm to vertical position (pointing down, check with level)
 - Touch Enter to record mechanical position of the lever arm at 90°.
 - Enter Actual joint angle: 90 using screen keypad.
 - Touch Enter
- Move joint angle positive.
 - Move the knee towards flexion.
- Press Enter to record the direction as positive.
- You will see a blue message box saying “Anatomical reference is now set for knee extension”
- Press Enter to advance to the next screen.
- Blue text will tell you to “Move the lever arm as close to the horizontal position....” Ignore this message. Current angle will be displayed
- Move Lever Arm to Current angle: = 42° for Right knee; 44° for Left knee
- Move mechanical stop C to 13 for Right knee; D to 25 for Left knee
- Screen will show current angle close to 42 degrees, touch Enter

- *
- With the participant’s limb attached to the pad, ask them to relax.
- When the weight reading stabilizes, touch Enter
- Limb weight will be displayed
- Ask the participant to contract and then relax their leg and repeat from *

- If your weight readings agree, press enter, otherwise repeat again until you have a reading that you think is accurate
- Touch Enter
- Set Stop angle:
 - **Grasp the load cell (not the lever arm)** and move the lever arm to 30 degrees.
 - Press Enter to record stop angle.

- Move mechanical stop C back to 8 and D to 19 for Right Knee; C to 20 and D to 30 for Left Knee
- Set start angle:
 - **Grasp the load cell (not the lever arm)** and move the lever arm to 90 degrees.
 - Press Enter to record the start angle and advance to the next screen.
- Secure all stabilization straps
- Set Concentric Activation Force:
 - Ask participant to push as hard as possible against the lever arm. Be sure to tell them that the lever arm will not move.
 - Watch the maximal torque numbers scroll by on the right of screen, and record the maximum number.
 - Divide that number by two, and set concentric activation force to that number (50% of maximum isometric torque):
 - Select Change, then Force Limits, then Start Forward Force.
 - Enter the desired number on the screen keypad, hit Enter, then select Enter Return to Test
- Touch Start Measure
 - Ask participant to push up on the pad with less than maximal effort for practice. When lever arm stops, touch No.
 - Touch Start Measure
 - **Grasp the load cell (not the lever arm)** and move the lever arm back to 90 degrees. When lever arm stops, touch No.
 - Touch Start Measure
- Repeat CONC practice effort at less than maximal effort.
 - Touch Start Measure
 - Ask participant to push up on the pad with less than maximal effort. When lever arm stops, touch No.
 - Allow the participant 20 seconds before starting the real test or repeating the practice test. Participants should perform two good practices (based upon shape of curve) before testing begins.
- Touch Start Measure to begin recording data for the first concentric effort.
 - Tell the participant to push as hard as possible until the lever arm stops.
 - Always Touch Yes to accept the initial concentric effort.
 - Touch Start Measure
 - **Grasp the load cell (not the lever arm)** and move the lever arm back to 90 degrees. When lever arm stops, touch No.
 - Wait 20 seconds
- Touch Start Measure to begin recording data for the second concentric effort.
 - As data for the second effort is recorded it will be displayed in blue “over” the previously collected initial effort (in green). If the two efforts “overlay”

very consistently, then Touch Yes to accept latest effort and Touch Yes to accept previous effort. This will average the two efforts together.

- If the latest effort is greater in amplitude, Touch Yes to latest and No to previous. This will save the latest effort and delete the previous.
- If the latest effort is of lower amplitude than the previous, Touch No to latest and it will be deleted.
- Continue in this fashion until three concentric curves have been accepted.
- Touch Save to save data (Button will change from 0 to 1)
- Touch Escape three times to return to the main menu.
- Touch Reports
- Touch Overlay
- Touch Comparison
- Select Patient, enter
- Select date, enter
- Select test 1, enter
- Select test 2 (same test), enter
- Enter
- Touch Print, enter
- Enter
- Enter
- Report should be printing

APPENDIX 3

HEALTH ABC KIN-COM OVERLAY TEST PROTOCOL
Repeat Participant

- Power-up the Kin-Com.
- Touch the screen anywhere to enter the Kin-Com Main menu.
- Touch Kin-Com to access the main menu.
- Touch Patient Positions.
- Touch Patient Position.
- Select Patient from scroll box.
- Touch Enter
- Select side.
- Touch Enter.
- Follow on-screen instructions to position the unit in the Patient's position for knee extension.
- Touch the screen anywhere to proceed to Manual Mode, no adjustment should be necessary.
- Touch escape, twice.
- Touch Evaluation to access the evaluation program.
- The patient scroll box will be displayed, select the appropriate participant's name.
- Touch Enter to accept this participant.
- After reviewing Patient Information, touch Enter.
- A blue message box will display: You will need the following attachments:
Double Shin pad" (you already have it)
- Touch Turn ON Gravity Compensation.
- Move Lever Arm to horizontal position (Check with a level).
- Touch Enter (you will get the joint specification screen again)
- Touch Enter
- Select the highlighted test protocol.
- Touch Enter.
- Touch Overlay.
- Set Lever arm length:
The correct lever arm length should be displayed.
Move the load cell to the displayed length.
- Touch Enter.
- Place participant on machine.
- Set anatomical reference.
 - Select joint position; move lever arm to vertical position (pointing down, check with a level)
 - Touch Enter to record mechanical position of the lever arm at 900.

- Enter Actual joint angle; 90.
 - Touch Enter.
 - Move joint angle positive.
 - Move the knee towards flexion.
 - Press Enter to record the direction as positive.
 - Press Enter to advance to the next screen.
 - Move Lever Arm to Current angle: =42° for Right knee; 44° for Left knee.
 - Move mechanical stop C to 13 for Right knee; D to 25 for Left knee, touch Enter.
 - Screen will show current angle close to 42 degrees, touch Enter
- *
- With the participant's limb attached to the pad, ask them to relax.
 - When the weight reading stabilizes, touch Enter.
 - Limb weight will be displayed.
 - Ask the participant to contract and then relax their leg and repeat from *
-
- If your weight reading agree, press enter, otherwise repeat again until you have a reading you think is accurate
 - Touch Enter
 - Set Stop angle:
 - A blue box will display last angle of 30 degrees.
 - Grasp the **load cell** and move the lever arm to 30 degrees. The blue box will turn red when you get to 30 degrees. (It also turns red at 29 and 31; make sure it is on 30 before you press Enter)
 - Press Enter to record stop angle.
 - Move mechanical stop C back to 8, and D to 19 for Right Knee; C to 20 and D to 30 for Left Knee.
 - Set start angle:
 - A blue box will display last angle of 90 degrees.
 - Grasp the load cell and move the lever arm to 90 degrees. The blue box will turn red when you get to 90 degrees. (It also turns red at 89 and 91; make sure it is on 90 before you press Enter)
 - Press Enter to record the start angle and advance to the next screen.
 - Secure all stabilization straps
 - Touch Start Measure
 - Ask participant to push up on the pad with less than maximal effort for practice. When lever arm stops, touch No.
 - Touch Start Measure
 - **Grasp the load cell (not the lever arm)** and move the lever arm back to 90 degrees. When lever arm stops, touch No.
 - Touch Start Measure
 - Repeat CONC practice effort at less than maximal effort.

- Touch Start Measure
- Ask participant to push up on the pad with less than maximal effort. When lever arm stops, touch No.
- Allow the participant 20 seconds before starting the real test or repeating the practice test. Participants should perform two good practices (based upon shape of curve) before testing begins.
- Touch Start Measure to begin recording data for the first concentric effort.
 - Tell the participant to push as hard as possible until the lever arm stops.
 - Always Touch Yes to accept the initial concentric effort.
 - Touch Start Measure
 - **Grasp the load cell (not the lever arm)** and push the lever arm back to 90 degrees. When lever arm stops, touch No
 - Wait 20 seconds.
- Touch Start Measure to begin recording data for the second concentric effort.
 - As data for the second effort is recorded it will be displayed in blue over the previously collected initial effort (in green). If the two efforts overlay very consistently, then Touch Yes to accept latest effort and Touch Yes to accept previous effort. This will average the two efforts together.
 - If the latest effort is greater in amplitude, Touch Yes to latest and No to previous. This will save the latest effort and delete the previous.
 - If the latest effort is of lower amplitude than the previous, Touch No to latest and it will be deleted.
- Continue in this fashion until three concentric curves have been accepted.
- Touch Save to save data. (Button will change from 0 to 1)
- Touch Escape three times to return to the main menu.
- Touch Reports
- Touch Overlay
- Touch Comparison
- Select Patient, Enter.
- Select date, Enter
- Select test 1, enter
- Select test 2, Enter
- Enter
- Touch Print, Enter
- Touch Enter twice, report prints.

APPENDIX 4
(page 1 of 2)

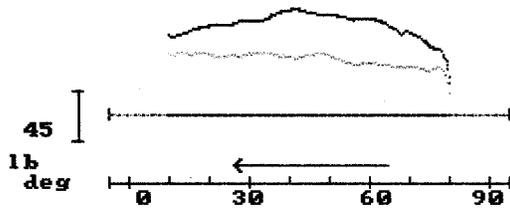
1
CONCENTRIC

Accepted

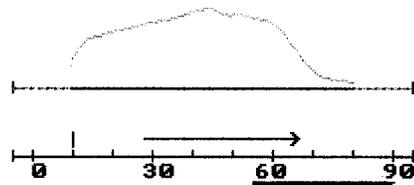
1
ECCENTRIC

Speed °/s
F: **30**
B: **30**

Unacceptable



Force
Angle



70

Accept latest?

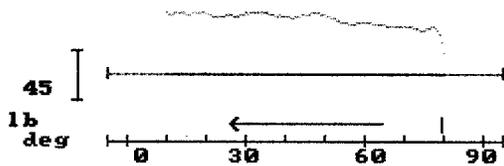
1
CONCENTRIC

Accepted

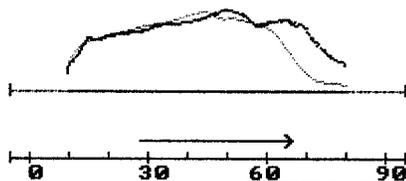
1
ECCENTRIC

Speed °/s
F: **30**
B: **30**

Probably acceptable



Force
Angle



22

Accept latest?

APPENDIX 4
(page 2 of 2)

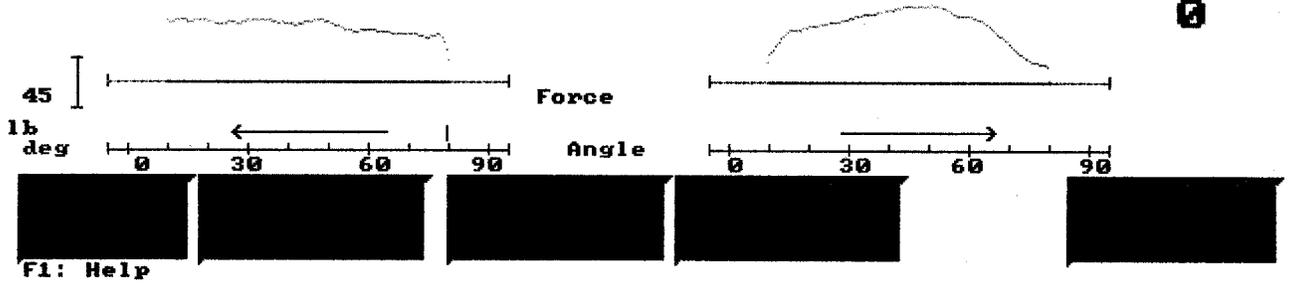
1
CONCENTRIC

Accepted
01:56:82

2
ECCENTRIC



*Probably accept.
AVERAGED together*



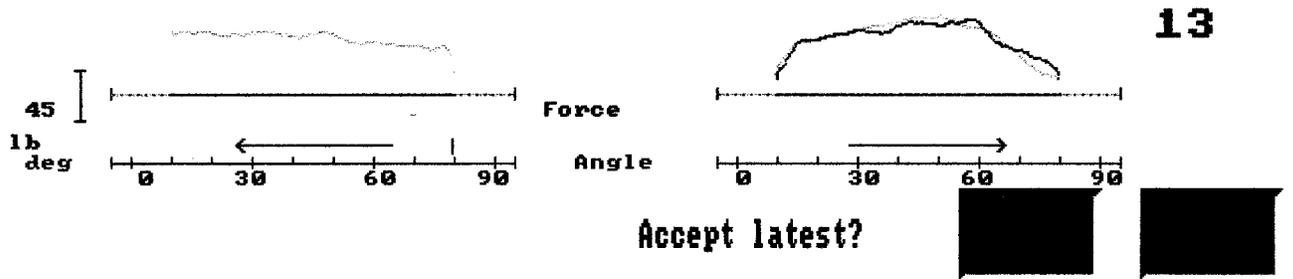
1
CONCENTRIC

Accepted

2
ECCENTRIC

Speed %/s
F: **30**
B: **30**

Acceptable



APPENDIX 5

**PROTOCOL
Tape Backup**

- Make sure your backup tape is in the drive.
- From the Main screen Touch Utilities in the lower right hand corner of screen.
- Touch System Utilities
- Touch Files Manager
- Touch Backup Data Files
- Touch Backup to tape
- Type Yes
- Program will automatically back up all data files.