

ISOKINETIC TESTING AND DATA INTERPRETATION

isokinetic testing

To determine the best type of test for a situation, avoid thinking of tests as a means of measuring strength. Instead, consider the type of test that will help identify problems of overall muscle performance during the functional activities.

Therefore, isokinetic testing offers significant clinical controls, such as: isolate particular muscle groups, determined contraction types and range of motion, and accommodated resistance. As mentioned, before the bottom line is a set lever arm speed measuring muscular output by the patient making it an efficient method for the assessment of muscle performance.

Isolation of a single muscle group for assessment is possible. This is easily done by choosing specific contraction types, which allows for assessment of the concentric or eccentric component of the muscle.

Range of motion is another controlled aspect of testing or exercising. By controlling the ROM, tests and exercises can be performed in an area of pain free ROM.

The accommodating resistance offered by isokinetics will address pain issues and variations in the length tension curve. This can be seen in the peaks and valleys of the strength curve. When a patient experiences pain or a “weak” point in the ROM, it will be represented as a dip in the torque curve.

Perhaps the most important reason for isokinetic testing is that it provides an effective way to attain objective measures. These objective measures are valid, reliable, and reproducible. Many studies have been performed to document this validity and reliability (See bibliography in Section 10).

Isokinetics assess the muscle performance values. A specific muscle group can be assessed for the following values, to name a few:

Peak Torque - highest muscular force output similar to a one repetition maximum effort in isotonics

Work - a more functional value of muscle performance, as work is torque sustained over distance in the active case, and torque sustained over time in an Isometric test.

Power - This is how effectively the muscle can perform work over time.

These values and others will be explained in greater detail later on in the manual.

Isokinetic testing can be used to provide valid, reliable, objective measure of a muscle's performance time after time. Following the guidelines established by Kevin Wilk can further assist these measures. The goal of these parameters is to improve the reproducibility of the test results. The parameters are as follows:

- **Patient Education**

As with other modalities in the clinic, a patient will be less apprehensive and respond more favorably to treatment if they understand the procedure. Educate your patient verbally about Isokinetics; and allow them a few practice sessions, if possible. This will make them more comfortable, and will produce better results as there is a learning curve associated with new movements. Wilk has shown that a patient educated through practice sessions is 80% more likely to give maximal effort of a test, while a patient who is not comfortable with the activity will only give 60% effort.

- **Test Order**

It is important to remember that a patient likes consistency. To make your results more reproducible between test sessions and patients (intra-test), your patient should perform the tests in the same order every time. The key to a good test session is consistency. By keeping the same order every time, it will reduce the clinician's time in administering the test. This will also make your patient more comfortable with your skills as a tester.

- **Axis Rotation**

This is important to allow for safe movement of the joint, and allows for isolation of muscle groups. Should there be any unnatural movement of the joint it will cause poor biomechanics, which in turn can cause joint surface irritation and substitution of the muscles being tested.

- **Warm-Ups**

Warm ups are broken down into 2 types:

1. **General Warm up**
2. **Pre-Speed Warm Up**

A muscle which is properly warmed up will function more safely and efficiently than a muscle which is not. It is recommended that the patient perform a general cardiovascular warm up for at least 10 minutes, this should be done by concentrating on the body part to be tested. For example, if the shoulders are going to be tested; warm up should be performed on an Upper Body Cycle. Pre-Speed warm ups should consist of three (3) sub-maximal efforts, and one (1) maximal effort. This will allow the patient to get a feel for the speed of the lever arm and what it will feel like to apply sub-maximal and maximal effort at the various speeds.

- **Stabilization**

Stabilization is important to prevent accessory movements of the segments. Accessory, or compensatory, movements may allow the patient to obtain higher torque values. It is recommended to use the straps provided on the chair to help stabilize the patient. Make sure that they are snug, but not too tight, as this may cause ischemia or change the length-tension relationship of the muscles being tested (much like a chopats strap does for the patellar tendon) and ultimately affect the test results.

- **Position**

George Davies recommends testing in non-biased position so the muscle is then unaffected by active or passive insufficiency. It may be necessary to recline the seat to reduce the pre-stretch effect of tight hamstrings. Positioning will vary with each body part tested. Remember to be consistent when administering multiple tests to the same patient.

- **Verbal Coaching**

Research has been done in terms of how a patient is affected by verbal coaching. A patient will respond to any verbal encouragement that is given. If the clinician is not consistent or another clinician administers a test without verbal coaching, this may affect the test results.

- **Visual Feedback**

As with verbal encouragement, visual feedback is another variable that could affect the outcome of the test results. Research has also been performed regarding these effects and it has been determined that there are benefits to both. During a training session, it is helpful to have the biofeedback that may provide motivation for the patient. However, during a test the patient may fatigue sooner if they are using visual feedback, as they may try to improve torque output from the previous repetitions. Patients may also use the visual feedback to try and match the previous repetitions, giving possibly submaximal efforts and therefore alter the results.

- **Angular Velocities**

Choosing angular velocities are important. Traditionally, slow speeds have been considered "strength speeds" (60°/sec to 120°/sec) and fast speeds (180°/sec to 300°/sec) have been considered "endurance speeds." This is a fairly true assumption, however, ADLs are comprised of variable speeds and muscular strength needs to be assessed as such. Peak Torque, work, and power can be assessed at any speed chosen. It is important to remember to be consistent between tests, as this allows for comparison of like values. Normative values have been established for specific speeds. (See Section 8 for Normative Values).

- **Calibration**

Calibration of the system is necessary to ensure the validity of the test. The Biodex dynamometer does not necessarily need to be calibrated, rather a calibration verification is performed. Calibration verification should be done at least once a month. It is recommended that you check with state and local requirements, as some states may require this to be done more often. If the Biodex is being used for research purposes, calibration verification may be performed more frequently. In such cases, it should be performed after a predetermined number of patients. This will add credibility and reliability to the research. Should the dynamometer not pass this verification, please try it two (2) more times. If it does not pass after the third attempt, please call Biodex Service at 1-800-224-6339 extension 2120.

- **Planes of Motion Tested**

When isolating a particular joint, it is important to remember the biomechanics patterns and movement specific to that joint. For example, to isolate the quadriceps and hamstrings, flexion and extension occur in a sagittal plane. This ensures a safe movement pattern and isolation of these muscles.

- **G.E.T.**

Gravity Effect Torque. This is essentially the torque produced by of the limb and the attachment. For patterns effected by gravity, it is necessary to measure GET. This is done by the dynamometer, recorded by the software, and added to movements against gravity, and subtracted to movements assisted by gravity. For example, in the knee the quadriceps work against gravity and the hamstrings are assisted by gravity. Therefore, GET is added to extension and subtracted from flexion to compensate for the effect of gravity. In doing such, a unbiased torque value is given. There may be a difference between uninvolved and involved. This difference may be due to edema or muscular atrophy. GET should be measured at the same point in the ROM each time, particularly in a position which is unaffected by any possible muscular tightness. The optimal angle for knee testing is 30 degrees. This again allows for standardization between tests and subjects.

- **Test Repetitions**

Repetitions should be kept consistent between test sessions. By increasing the number of repetitions, the patient may experience fatigue or discomfort during the test. At least three (3) repetitions are needed for the Biodex Software to calculate the test data, provided the patient meets Isokinetic Speed.

Slow speed tests are generally conducted with 5 repetitions, and faster speeds are usually performed at 10 to 15 repetitions. Standard isokinetic knee testing is as follows:

60 deg/sec5 reps

180 deg/sec10 reps

300 deg/sec15 reps

- **Isokinetic System Level**

This last parameter is just as important as the first. If there is excessive movement of the dynamometer, it may be displayed in the test results. This is a variable, which can be controlled. The machine should be placed in a stable area, away from excessive clinical traffic, as the dynamometer is very sensitive. If the machine needs to be moved or becomes unstable, make sure to find a stable space within the facility or call Biodex directly for the rubber leveling pads, which can be used to stabilize the unsecured end.

TESTING PROTOCOL

- Patient performs general CV warm up
- As the patient is warming up, set up the computer information and dynamometer.
- Seat and Stabilize patient
- Pre-Speed warm up
- Run test set
- Rest period
- Repeat steps 4-6 to complete other test speeds