BASIC COURSE ON ISOKINETIC EQUIPMENT & ASSESSMENT

FACULTY OF GENERAL & ADAPTED PHYSICAL EDUCATION AND YOGA

BASIC COURSE ON ISOKINETIC EQUIPMENT & ASSESSMENT

Duration: 48 Hours

S. No	Topic	Total Hours	Theory	Practical
1	**ISOKINETIC EQUIPMENT:** Principles of isokinetic, isokinetic equipment – understanding the parts.	**10 HOURS**	06	04
2	**ISOKINETIC STUDIES:** Application attributes to general & injured population	**18 HOURS**	10	08
3	**ISOKINETIC APPLICATION:** Isokinetic testing protocol, Pre & Post-test analysis	**20 HOURS**	06	14
	TOTAL	**48**	22	26

References:

https://www.biodex.com/physical-medicine/products/dynamometers/system-4-pro

BASIC COURSE ON ISOKINETIC EQUIPMENT & ASSESSMENT


BIODEX


BIODEX

ISOKINETIC TESTING AND DATA INTERPRETATION

NUMERICAL ANALYSIS

The Biodex software (System2 and System3) collects and stores real time data. Every time test data is recalled, regardless of the actual test date, it will be exactly as it was collected during the original test. This is beneficial when comparing data points between tests.

The Need for data interpretation is, "What do I want to do with this data?", and "What am I trying to determine from testing?". Do you want to use the data for patient advancement, patient discharge, baseline information before a rehabilitation/training program, etc.

The following section will define the test data, and describe what may affect each variable. This basic knowledge should be helpful to interpreting data.

As mentioned before, you should determine what are you trying to gain from testing. Use Specific Criteria for Interpretation and consider the following:

- What do you want to do with the data: research, patient advancement
- What are you looking for from the data: %deficit, Acceleration/Deceleration time, etc.
- Population Criteria: Age, Sport, Position, Activity specifics
- Pathology: Curve Analysis

Use other clinical tests and correlate these findings to your Isokinetic test results. This is analogous to a Physician using X-rays and MRIs to confirm suspicions of a fracture or a torn ligament. You need to be a detective, and the test results are clues to help you solve the clinical mysteries for a successful rehabilitation.

READING TEST RESULTS:

NOTE: Please use the sample tests found in Section 6 to review the following values. Note, these tests were performed with System 3, however, the parameters are the same for System 2 users. The first concern of data interpretation is to determine if the test is reliable and valid. This can be done in two ways.

COEFFICIENT OF VARIANCE:

Determines the reproducibility of the test based on the amount of variation between repetitions.

- Large muscle groups ≤ 15%
- Small muscle groups ≤ 20%
- Work first 1/3 and Work last 1/3

This will determine when the most effort was produced and the amount of effort given during the test. More work should be produced in the first 1/3 of the repetitions if the patient is working at maximal effort and less work during the last 1/3. This is graphically represented as a down slope from left to right.

ACCEPTABLE COEFFICIENT OF VARIANCES ARE AS FOLLOWS:

• ***Large muscle groups: ≤ 15%***

Large muscle groups are primarily movements that cover a larger ROM and include: knee, shoulder, back, elbow. It is easier for a patient to produce torque for these joints due to increased time for major recruitment.

• ***Small muscle groups: ≤ 20%***

Small muscle groups are joints, which cover a smaller ROM and primarily include ankle and wrist patterns. After determining the acceptance of the test as valid or invalid analysis of the data is the next step. Data analysis can be made either as Bilateral Comparisons, in which case percent deficit is looked at; or Unilateral Comparisons, in which use of Normative Goals are used. Unilateral muscle ratios are also important to look at and will also be mentioned later.

PERCENT DEFICIT

Bilateral deficits are gained by comparing the uninvolved to the involved. The software calculates the percent difference. Percent differences between 1-10% are considered acceptable. A negative value implies the involved side is stronger than the uninvolved, provided the uninvolved was tested first. There are limitations to this range. For example, if you are treating a right handed pitcher or tennis player, you will need to rehabilitate the involved right extremity to a percent difference to greater than 10%. This is due to the fact the uninvolved side is not as dominant in the activity and therefore should not necessarily be used as a baseline measure. The acceptable range is –10% to +10%, except in special cases where side dominance is important.

NOTE: There are limitations to Bilateral Comparisons. Should the uninvolved limb be deconditioned secondary to lack of activity, insufficient rehabilitation, or bilateral injuries, then percent deficits are not helpful in this case. This is where it is helpful to look at other measures; Peak Torque to Body Weight for example.

PEAK TORQUE (PEAK TQ)

Highest muscular force output at any moment during a repetition. This can be determined within each rep for the entire set. Peak Torque can also be evaluated specific to time (Torque @ .20sec) or to ROM (Torque@ 30º).

Peak Torque indicates the muscle's maximum strength capability. This is also the equivalent to a 1-repetition maximum (RM) isotonic strength test. Peak Torque is an absolute value. Used alone, Peak Torque is difficult to assess the strength specific to a person. For example, two subjects can produce a Peak Torque of 100 ft/lbs. It would appear they are equally strong. However, if patient #1 weighed 100 lbs and patient #2 weighed 200 lbs, it is then more apparent which patient is stronger (Davies).

PEAK TORQUE / BODY WEIGHT (PEAK TQ/BW)

Peak Torque is represented as a percentage normalized to bodyweight and compared to an estimated goal. This value is more relative and pertinent to functional activity. By looking at the previous example, patient #1 is stronger than patient #2, as they both produced the same Peak TQ In looking at body weight, patient #1 is 100 lbs lighter than patient #2. This value can be taken to the Normative Goal chart in Section 8. Joint movement position, speed, and male and female ranges are also represented.

The test value should fit into this range. Patients that demand high performance should be at the high end of the range or beyond. This is perhaps one of the better indicators of successful rehab, as this is a more relative value to base safe activity on.

TIME TO PEAK TORQUE

A measure of time from the start of a muscular contraction to the point of the highest torque development (Peak TQ). This value is an indicator of the muscles functional ability to produce torque quickly. The value is taken from the Peak Torque repetition.

ANGLE OF PEAK TORQUE

Defined as the point in the ROM where peak torque is produced. It usually occurs at the same range in the ROM for similar movements and speeds. Angle of peak torque typically occurs in the mid range of a motion. This should be at the point in the ROM where the length tension relationship of the muscle is maximal. This value is also taken from the Peak Torque repetition

TORQUE AT 30°

This value is calculated from the Peak Torque repetition and displays torque produced at pre-set angle in ROM. This point in the ROM can be reset in Software to evaluate other angles as needed. Thirty degrees (30°) is typically used, as it is a critical point in knee stabilization. This is the angle that is achieved many times in succession during normal ambulation. This should be compared bilaterally with torque values relatively close to one another.

TORQUE AT .2 SECONDS

Displays Time Rate of Tension Development (TRTD). This value represents the amount of tension developed in this time. It has been documented that upon heel strike it takes the leg extensors approximately .2sec to develop enough force to support the body in normal ambulation. Wilk determined that by this time 80-90% of Peak Torque should be achieved in the knee extensors, and should be evaluated as such. This value can be reset in the software as needed.

MAX REP TOTAL WORK

Defined as the total muscular force output for the repetition with the greatest amount of work. The equation for work is: W = F x D. This is a better indicator of the function of a muscle group than Peak Torque, as torque must be maintained throughout the ROM shows more neuromuscular rehabilitation than Peak Torque values, as the muscle need to keep maintain torque over distance. The repetition with the most total work is called the Max Rep Work. It should occur within the first few repetitions of a test bout. The units of measurement are foot pounds.

MAX WORK REP #

Previously stated, this is the repetition where the maximum amount of work was accomplished during the test bout. This can be used to determine if most of the work was accomplished at the beginning or end of the test/exercise bout. The maximum amount of work in one repetition should occur within the first few reps of a test bout.

WORK TO BODYWEIGHT RATIO

Ratio displayed as a percentage of the maximum work rep to the subject's body weight. Much like Peak TQ./Body Wt., this value needs to be high as it represents an increased work value.

TOTAL WORK

The amount of work accomplished for the entire set. This represents the muscle's capability to maintain torque throughout the test bout. Total work is most useful to determine rehabilitation of an injury. In order to accomplish ADL's, movements must be maintained over distance. This value may be affected by low peak torque values or variations in the ROM and should be evaluated as such. If a patient's overall torque production is low, the amount of work capability can be affected. If the ROM is smaller on one side, the total work will be affected even if the peak torque is the same.

WORK FIRST 1/3… WORK LAST 1/3

The sum of work produced in the first 1/3 and last 1/3 of the test bout. With maximal effort from the patient, there should be more work in the First 1/3 of the reps and less work during the Last 1/3 of the reps. If the patient does not give a consistent effort, the work completed in the first 1/3 may be less than the work completed in the last 1/3. This, along with a poor CV, may be an indicator of poor effort by the subject due to pain, lack of effort, and poor instruction. This is a useful measure to determine work fatigue. As the patient improves his or her endurance, the work in the last 1/3 should start to become more and more equal. This, in turn, will produce a smaller Work Fatigue factor.

WORK FATIGUE

This is a ratio of difference between the first 1/3 and the last 1/3 of work in the test bout. It is a valuable parameter in documenting progress during endurance training to detect the amount of fatigue

throughout the test bout. As the subject progresses through an endurance training program, this value should decrease as the Work last 1/3 produced will get closer to the Work first 1/3.

AVERAGE POWER

Power = Amount of total work divided by the time to complete that total work. This value is used to provide a true measure of work rate intensity defined as total work divided by time. Power represents how quickly a muscle can produce force. An important value to evaluate as power development is important for injury prevention.

ACCELERATION TIME

Total time used to reach Isokinetic Speed. Indicates a muscle's neuromuscular capabilities to move a limb from a resting position to Isokinetic speed.

DECELERATION TIME

Total time to go from Isokinetic Speed to zero. Indicates a muscle's neuromuscular capability to eccentrically control movement towards the end ROM.

RANGE OF MOTION

This is the greatest Range of Motion (ROM) the joint achieves during the set. (This may vary from the set ROM as the patient does not reach full ROM.) Allows analysis of the test curve in relation to ROM.

AGONIST TO ANTAGONIST RATIO

Reciprocal muscle group ratio.

***Peak torque HS / Peak torque QS* -** Imbalance may predispose a joint to injury as opposing muscle groups provide dynamic joint stability. These values may be found on the Normative Value Sheet. (Section 8)

GRAVITY EFFECT TORQUE (GET)

This is the torque effect produced by the weight of the limb and the attachment. Used to eliminate the additional torque applied to the muscle tested and gives a measure of true muscle torque production. The GET is added to torque when limb is working against gravity (in the case of the Quadriceps) and GET is subtracted when working with gravity (in the case of the Hamstrings). This should be taken for each limb, as oedema and atrophy may cause variations. Allows standardization between tests and subjects.