

ISOKINETIC TESTING AND DATA INTERPRETATION

principles of isokinetic

The principle behind Isokinetic exercise and testing is that the lever arm moves at a preset fixed speed allowing for accommodating resistance to the effort the subject applies. This means that the resistance encountered by the subject is equal to their effort. The set lever arm speed allows the dynamometer to measure the torque output by the patient throughout the range of motion (ROM). This is unlike manual muscle testing which is a static test, and Isotonic testing which measures strength at the strongest portion of the ROM and is also affected by speed of movement. Isokinetic resistance will accommodate to pain, fatigue, changes in length tension curve and biomechanical leverage of the muscle allowing for safe efficient exercise and testing.

Because of the accommodating resistance the muscle is loaded throughout the ROM, the patient's resistance is then equal to the effort they apply, regardless of the length tension curve which varies with Isotonic loading or pain. Therefore, making it a safer and more efficient form of exercise than Isotonics, which maximally loads the muscle at its weakest points. Also, when the patient begins to fatigue and they are unable to continue with the exercise they are still loaded maximally with the isotonic resistance, unlike Isokinetic resistance which will accommodate to this variable.

Much like the ROM carry-over effect seen with Isometric exercise, there is a 30° ROM carry over with Isokinetic exercise. The carry over is 15° on each side of the end ROM exercised. This will allow for strengthening of the muscle within the non-exercised ROM. (Davies A.T. Sports Health Care Perspective 1995 Vol 1:4)

There is also a 30°/sec physiological overflow between the speeds. This is important with exercise training, as each speed does not have to be exercised. For example, if you start an exercise at 60°/sec, you do not have to exercise at 90°/sec as the overflow will compensate for this. The variety of speeds and physiologic overflow has a distinct advantage over Isotonics, which are usually performed at 60deg/sec. (Davies as above)

PRINCIPLES OF SPEED

Velocity Spectrum

(degrees/second)

Slow	Medium	Fast
2-180	180-240	300-500

The one principle of Isokinetics which is important to remember for clinical applications and testing is that torque production varies with speed. The lower the preset speed the more torque can be produced concentrically. Increasing the preset speed concentric torque production will decrease. More motor units can be recruited at lower speeds than at higher speeds allowing more torque production. The converse is true eccentrically, the higher the preset speed the more torque will be produced, this is due to the nature of eccentric muscle physiology.

Compressive and translational forces across a joint will vary with speed also. Faster speeds have less compressive forces than slower speeds. This is important to remember clinically, as it will apply to treating specific pathologies. For example, patellofemoral pathologies should be started out at higher speeds to reduce the compressive forces across the joint which in turn will protect the joint surface and will be more comfortable to the patient. On the other hand, a shoulder with multidirectional instability should be started out with lower speeds to use the compressive forces to stabilize the shoulder in the glenoid fossa.

Translational forces across a joint also vary with speed. The knee joint experiences anterior translation of the tibia with slower speeds. This is due to the force vectors created by the quadriceps, and the biomechanics of the knee joint. Slower speeds should be avoided or used with care when rehabilitating an ACL deficient or post surgical patient. The opposite is true with the shoulder, the faster the speeds the more translational movements. This is also due to the biomechanics of the joint and the force vectors created by the musculature

The use of speeds are also important with curve analysis, as deficits will be more pronounced at the slower speeds. This is due to the fact that the muscle has enough time to recruit motor units and generate torque allowing compressive and translational forces which may elicit pain, or in the case of an ACL deficient patient translation of the tibia, which will alter the biomechanics of the joint. This is apparent as a dip in the torque curve.

At higher speeds there will be more artifact spiking. This is due to the lever arm decelerating into the end stop causing a spike in the torque curve at the end ROM. This may appear as a peak torque value, and can be eliminated, as you will see later, by windowing the data.

BENEFICIAL TRAINING EFFECTS OF ISOKINETIC EXERCISE

Since the subject essentially needs to "catch" the machine to develop resistance, isokinetic exercise helps to develop some of the following (further details of these values will be explained later):

- **Time Rate of Tension Development (TRTD):**
Up slope of a curve. Indicates how quickly torque can be developed during a muscular contraction. An example of this would be torque at .20 seconds.

- **Decreased RIT (Reciprocal Innervation Time):**
Time interval between the end of the agonist contraction and the beginning of the antagonist contraction. For example, the time between the ends of the quadriceps contraction to the start of the hamstring contraction.

- **Strengthens Musculotendonous Junctions:**
This occurs with any resistance exercise as the body adapts to the demands imposed on it. SAID Principle.