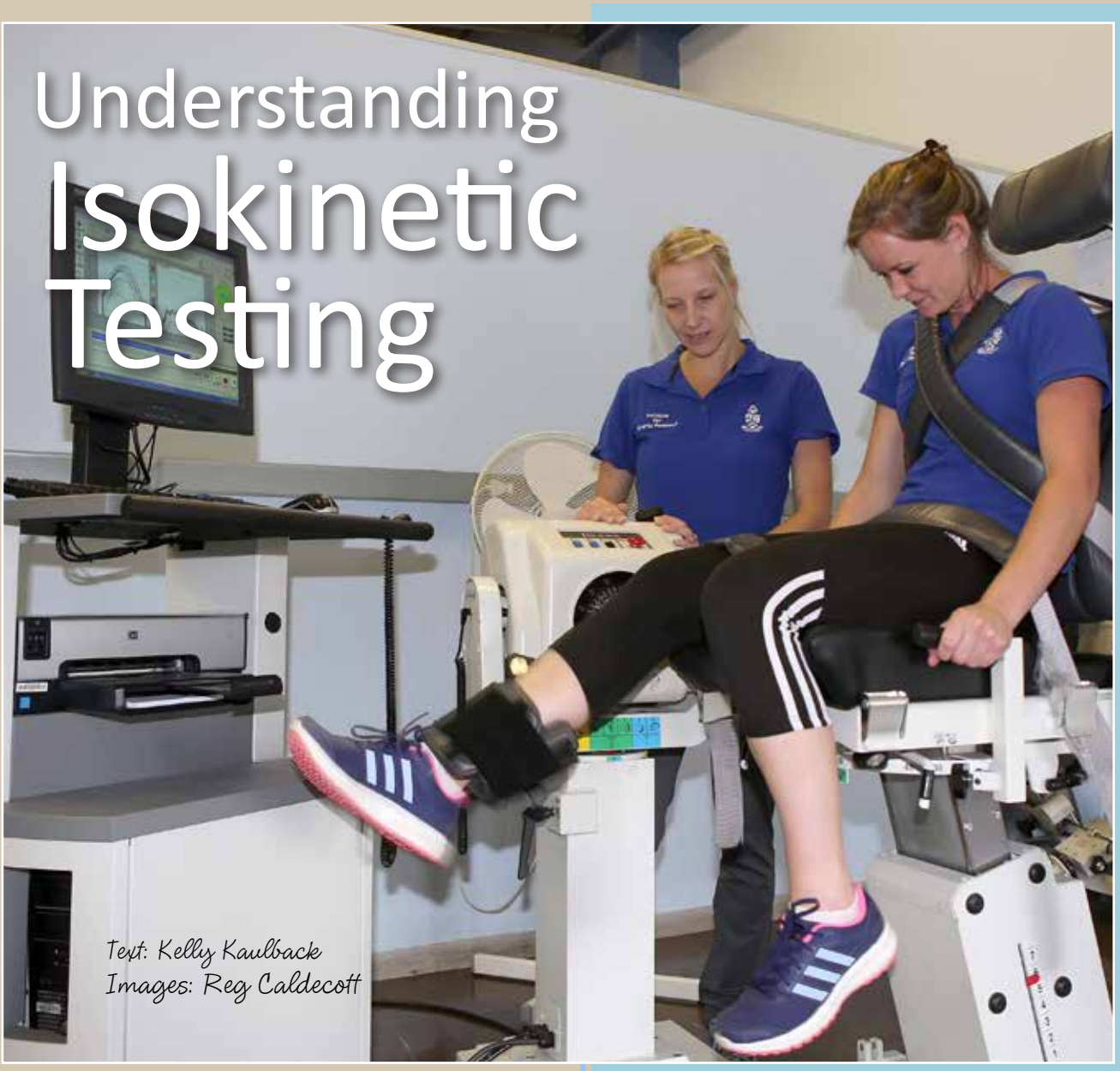
Understanding Isokinetic Testing



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Isokinetic (constant speed) testing is a well-established method of muscular function assessment with invaluable uses in both the rehabilitation and high performance setting. Isokinetic testing, through the use of a Biodex dynamometer, provides objective data concerning muscular comparisons between bilateral joints as well as between opposing muscle groups in a single joint.

Isokinetic testing uses accommodating resistance with a set and constant joint angular velocity. What exactly does this mean? Essentially, the force generated is not equal to the resistance BUT, the greater the force applied by the individual being tested, the greater the resistance felt from the dynamometer; and the lesser the force, the lesser the resistance. We are not equally strong throughout an entire range of motion (ROM) of a joint, therefore angular velocity is kept constant by adjusting resistance appropriately.

Various joints and joint movements can be assessed using isokinetic testing, however, the three main joints that are frequently assessed include knee flexion/extension, shoulder external/internal rotation in a modified neutral position and ankle plantar/dorsi flexion. These three joints will be discussed in further detail but isokinetic testing is not limited to these joints or to these joint movements.

An isokinetic test holds value in the individualized set up and specificity of the test protocol that can be used. For each individual, their particular range of motion for the joint under assessment is set and each limb is weighed to adjust for gravity. Two tests are usually performed for each joint – one for power, and one for endurance. In terms of the protocol, the velocity can be selected from a range of 0°/sec - 300°/sec, depending on the purpose of the test. The rest intervals between each test can also be set. For example, a knee flexion/extension test usually measures power at 60°/sec over 5 repetitions, and endurance at 180°/sec over 10 repetitions.

When integrated with a complete history, subjective examination, and physical and functional evaluation, isokinetic testing can be a valuable tool for the clinician in the assessment, rehabilitation, and performance enhancement of the athlete. An isokinetic report objectively defines deficits between an injured side compared to an uninjured side across various parameters and any imbalances between the agonist and antagonist muscle group of that joint. The following parameters are considered most important and are most commonly discussed from an isokinetic test report:

Peak Torque (N-M):

The highest muscular force output at any moment during a repetition. Indicative of a muscle's strength capabilities (the 'best repetition' out of the total repetitions). A percentage deficit is stated between the uninjured side and injured side. Deficits between left and right need to be between 0-10% for an athlete to return to play.

Peak Torque to Body Weight (%):

Represented as a percentage normalized to bodyweight and compared to an established goal. I.e. this compares the individual to the general population and sport population norms for someone of the same age and bodyweight. For an athlete, this gives a good indication of where their strength and endurance outputs lie in relation to a sports population and can identify areas of focus or improvement e.g. hamstring endurance, or quadriceps power.

Total Work (J):

The total amount of work completed over all the repetitions. Similar to peak torque, a percentage deficit is indicated between the uninjured and injured side, which should be below 10%.

Agonist/Antagonist Ratio (%):

Compares the anatomically weaker muscle group to the stronger muscle group. In isokinetic testing, the agonist is always the weaker muscle group. E.g:

JOINT	MOVEMENT	AGONIST	ANTAGONIST
Knee	flexion/extension	Hamstrings	Quadriceps
Shoulder	external/internal rotation	Dorsi flexors	Plantar flexors
Ankle	plantar/dorsi flexion	External rotators	Internal rotators

Excessive imbalances may predispose a joint to injury. There are specified norms for the agonist/antagonist ratio for each joint and for each test. For example, the agonist/antagonist ratio for a knee flexion/extension test performed at 60°/sec is 55-65% and at 180°/sec the norm is 65-75%. These ratios indicate how much work the hamstrings should be doing in relation to the quadriceps. If the ratio is below the norm, it indicates that the hamstrings need to be improved, where as if the ratio is above the norm, then the quadriceps would need to be improved to achieve the balanced agonist/antagonist ratio.

The value of isokinetic testing in the information it provides about a particular joint is hopefully now explicit. The deficits and comparisons provide valuable data from which to base specific rehabilitation and points of focus. Isokinetic testing also provides a good progress tool as an individual can be re-tested after 4-6 weeks, and any improvements (or regression) can be illustrated objectively. A progress report can also be drawn up comparing the injured joint on the initial day of testing to the injured joint on the second test date.

Limitations of isokinetic testing have not been discussed here, however, it is suggested that the open-chain nature of isokinetic testing could be a limitation, its unfamiliarity to most, and the Biodex does not assess functional movements. Timing of an isokinetic test is dependent on the injury as well as the pain/pain rating experienced by the individual.

Isokinetics can also be used as a training modality, allowing for either unilateral or bilateral training of a joint under specific protocols that can be individualized according to the goals and injury status of the athlete in terms of speed, sets, repetitions and rest intervals. Whether testing or training, the familiarization process, motivation and warm up is crucial.

In conclusion, isokinetic testing enhances the injury evaluation and rehabilitation process through the provision of scientific information that indicates clear areas of deficit, weakness, strength, and imbalance that can be used to guide and track the progress of an individual going forwards.