CHAPTER 4: ISOKINETIC TRAINING

4.1 INTRODUCTION

The ultimate goal of most training programmes is improvement in functional performance. If strength/endurance improvements are not transferred into functional improvements, like improved posture, more efficient gait, pain free activities of daily living (ADL), or jumping higher and running faster, the improvements are useless in themselves.

The question now arises: does isokinetic training lead to functional improvements? The following sections discuss the improvements that have been observed following isokinetic training.

4.2 ISOKINETIC TRAINING AND FUNCTIONAL PERFORMANCE

Although open-kinetic-chain (OKC) exercises are usually not very sport-specific, numerous studies have demonstrated **positive correlations** between OKC isokinetic testing and **CKC functional performance** (Tegner *et al.*, 1986; Wiklander & Lysholm, 1987; Sachs *et al.*, 1989; Barber *et al.*, 1990; Noyes *et al.*, 1991; Wilk *et al.*, 1994).

Unfortunately, isokinetics do not approach functional, sport-specific angular velocities (Rothstein *et al.*, 1987). Professional pitchers have reported angular velocities of between **6200°/s and 9200°/s** for shoulder internal rotation during the acceleration phase of pitching (Pappas *et al.*, 1985). The highest test velocity of an isokinetic dynamometer is **600°/s** for the Cybex Norm 7000 (User's Guide: Norm testing and rehabilitation system, 1996). This is obviously far slower than the velocities observed during functional movements.

In conflict with previous research, gains in functional performance like sprinting or throwing resulting from isokinetic training, have not been proven beyond doubt. The only resistance exercises that truly approach powerful athletic speeds, and that have been shown to enhance performance the most, are **"Olympic lifts"** (for example, "power cleans" and "clean and snatch"), and **plyometric exercises** like "bounding" and "depth jumps". This is probably because isokinetic training normally makes use of open-kinetic-chain and single-joint movements. By modifying subject positioning, isokinetics may approach more functional and sport-specific positions, thereby increasing its correlation with functional and sports performance (Davies *et al.*, 2000).

Isokinetics is also not the best choice, if **muscle hypertrophy** is the goal of training. Cote *et al.* (1988) reported no change in muscle fibre cross-sectional area even when the strength of the quadriceps increased 54% following an isokinetic training program. One possible explanation is that by **eliminating the eccentric part** of the contraction during concentric isokinetic training, the stimulus for muscle hypertrophy is diminished (Brown, 2000).

Researchers are thus **divided** regarding the effectiveness of isokinetic training and testing where sports performance is involved (Wilk *et al.*, 1994; Davies *et al.*, 2000). Does the same however hold true for rehabilitation situations?

4.3 THE USE OF ISOKINETICS IN MUSCULO-SKELETAL REHABILITATION

According to Snyder-Mackler *et al.* (1995), closed-kinetic-chain (CKC) exercise alone does not provide an adequate stimulus to the quadriceps muscle group to permit normal function of the knee in the stance phase: ***"... this is especially true for the early period after reconstruction of the anterior cruciate ligament."***

Most daily activities produce tension levels between 20% and 35% of maximum. This level is adequate for the maintenance of a person's strength level, however, if a muscle is **immobilized** there may be a loss of strength of between 8% per week to 5% per day. These strength losses should be seen against the rate of increases in muscle strength of between 5% and 12% per week (Muller, 1970; MacDougall *et al.*, 1980).

The clinical application of isokinetics mainly centres around two aspects: (1) the **clinical assessment** and (2) the **rehabilitation** of orthopaedic patients. Clinical evaluation or assessment may be performed on athletes at the pre-season evaluation to establish base-line data. Another method is to use an injured athlete's non-involved extremity to assess the strength and/or endurance deficit of the injured or involved side. During rehabilitation, isokinetics is used as a safe and effective mode for muscle strengthening and for improving local muscle endurance (Davies *et al.*, 2000).

A further aspect to take into account is the **muscle balance** between two antagonistic muscle groups like the quadriceps and hamstrings muscle groups (Burkett, 1970; Gleim et al, 1978; Yamamoto, 1993). Burkett (1970) reported that four athletes from a group of six, who had bilateral strength deficits of more than 10% in their hamstrings, sustained a **hamstrings injury** within three weeks of testing. Yamamoto (1993) found that hamstrings strength, knee flexion/extension ratio, and bilateral muscle imbalances were contributory factors to the development of hamstrings strains. Berg *et al.* (1985) reported an increased risk for **stress fractures** in the lower leg if there was a strength deficit of more than 20 ft-lb between the dorsi flexor and plantar flexor muscle groups.

Isokinetic rehabilitation was very popular during the 1970's and 1980's (Burkett, 1970; Gleim et al, 1978; Tegner *et al.*, 1986; Wiklander & Lysholm, 1987; Sachs *et* *al.*, 1989). However, in the 1990's, closed kinetic chain (CKC) exercises became the trend (Houglum, 2001). When comparing the limbs of an athlete who participates in a mono-lateral sport like javelin throwing, the biokineticist cannot use the one limb as a reference for the other (Dvir, 1995). Thus using an applicable **normative database** should be considered: compare the values of the dominant limb to the values of other javelin throwers and that of the non-dominant limb to values from the general population.

Rehabilitation of the surgically repaired anterior cruciate ligament (ACL) has been extensively researched (LoPresti *et al.*, 1988; Wilk *et al.*, 1994; Brukner & Khan, 2001; Houglum, 2001). The role of isokinetics in ACL rehabilitation has been controversial. However, most clinicians and researchers now do acknowledge that isokinetics can play a role during some part of the ACL rehabilitation programme (Perrin, 1993; Snyder-Mackler, 1995; Botha, 1997; Brown, 2000; Davies *et al.*, 2000).

It is clear that isokinetics have proven to be useful and safe in orthopaedic rehabilitation programmes, but **"prevention is better than cure"**. Could isokinetics help prevent musculo-skeletal injuries?

4.4 PREVENTION OF INJURIES BY MEANS OF ISOKINETICS

Previously, isokinetic testing was a popular way of trying to prevent sports injuries. The now notorious **"60:40-ratio"** of quadriceps to hamstrings peak torque is a classic example (Burkett, 1970). Today, researchers are not convinced that possible **hamstrings injuries** may be predicted by simply looking at a ratio of agonists to antagonists. In fact, it has been postulated that hamstrings injuries may stem from a **variety of factors**. For example, lack of flexibility, muscle imbalance and power deficits between the quadriceps and hamstrings, or inequality of strength of the left versus the right hamstrings group, may all cause injuries (Knapik *et al.*, 1991; Worrel *et al.*, 1991; Yamamoto, 1993; Aagaard, 1998). Deficits in local muscle endurance of the hamstrings, pelvic instability, weakness in the calf and/or gluteus muscles, and increased neural tension, have also received some attention (Brukner & Khan, 2001). Furthermore, **weakness** and lack of endurance in the **rotator cuff** or scapulo-thoracic musculature may lead to shoulder problems like **supraspinatus impingement** (Davies & Dickoff-Hoffman, 1993).

The true value of isokinetic testing may lie in the bilateral comparison of limbs and muscle groups, and in comparing subjects to **population-specific normative data** (Dvir, 1995). A large difference in quadriceps muscle torque between the left and right leg of a marathon runner, may predispose this athlete to an overuse injury.

Additionally, a rugby player whose knee musculature is not able to withstand high forces may injure the knee's ligaments or menisci during the course of training or competition. Furthermore, when rehabilitating someone with bilateral muscle atrophy for instance, the availability of applicable normative values, may become very useful in order to set realistic short- and long-term goals for muscle improvements.

4.5 THE RESEARCH PROBLEM

This brings one to the purpose of the present study. Why develop norms for SA men between 17 and 24 years of age?

This group falls into a "high risk" category. In South Africa, a learner's licence to drive a car is obtainable at the age of 17 and a driver's licence at 18. With the high incidence of motor vehicle accidents, one can expect that a large number of orthopaedic injuries may occur in the above population. This viewpoint is supported by the insurance industry that actually charges higher premiums on car insurance for male individuals under the age of 25. Males between 17 and 24 are also usually physically active and involved in competitive or recreational sporting activities. A large number of patients seen by sports physicians, general practitioners, and orthopaedic surgeons actually stem from this population.

Another question that might arise is why did the author then not establish sport-specific norms? This would have been a very time consuming process, because of the wide variety of sports being played in South Africa. The author decided to rather focus on a heterogeneous group of young South African men to make the results of the study more widely applicable and useful.

Thus the aim of the present study is: **to establish normative isokinetic torque values for rehabilitation in South Africa.**