ANALYSIS OF RESULTANT TORQUE DURING KNEE REHABILITATION

C. S. Lima*, A. C. S. Guimarães*
* Exercise Research Laboratory, Federal University of Rio Grande do Sul, Porto Alegre/Brazil

INTRODUCTION

The anterior cruciate ligament (ACL) is highly susceptible to injuries that often require surgical procedures (Bynum et al., 1995; Plapler, 1995; Yack et al. 1993; Howell, 1993; White, 1993 e Graham et al., 1993) and consequently a rehabilitation period. Besides the concern of the literature regarding the anterior tibial displacement (ATD) imposed by open kinetic chain (OKC) and closed kinetic chain (CKC) exercises (Yack et al., 1993; Howell, 1993; White, 1993; Lima et al., 1999), one should also be concerned with the gain of muscle force during rehabilitation.

In a previous publication Lima et al (1999) found that both, OKC and CKC procedures produced similar effects on the isokinetic muscle torque produced by knee extensor and flexor muscles after a 3 month treatment period.

The purpose of this study was to monitor the isokinetic torque-time response knee flexor and extensor muscles of patients submitted to ACL reconstruction, produced by OKC and CKC exercises during a period of three months.

METHODS

Sample

All subjects were volunteers and were submitted to ACL reconstruction surgery. Five subjects were assigned to a group that was treated using OKC exercises and five to a group that was treated using CKC exercises.

Procedures

Tests

A total of four tests were performed: prior to treatment 6 to 8 days after surgery, 4 and 8 weeks later and at the end of the treatment period, 12 weeks later.

The knee extensor and flexor muscles were evaluated. Concentric maximal voluntary resultant peak torque were measured using an isokinetic Cybex-Norm dynamometer. All subjects warmed-up for 5 minutes using a stationary bicycle. For safety reasons the angular displacement of the arm of the dynamometer was from 30 to 80 degrees, assuming full knee extension as zero degrees (Draganich et al., 1989; Silfverskiol et al., 1988 e Renström et al., 1986). The angular speed adopted was 30 degrees/second. The resultant torques obtained were corrected for the torque due to weight of the segments.

Treatment

Both, OKC and CKC groups attended 3 sessions per week (30 – 45 minutes each) for 12 weeks. The sessions started using stretching exercises for the hamstrings, quadriceps and triceps surae. The subjects of the OKC group practiced knee and hip extension exercises on weight machines, whereas the subjects of the CKC group practiced squat exercises.

The equivalence of load, so that both OKC and CKC exercises demanded the “same” muscle effort for each subject was calculated based on procedures described previously by Yack et al (1993).

Statistical Analysis

The data obtained from the four evaluations were submitted to an analysis of variance for repeated measures, and whenever necessary, to a Bonferroni post-hoc test. The level of significance adopted was 0.05.
RESULTS AND DISCUSSION

**Extensor Torques**

For the OKC group, significant differences were found between the first evaluation and each of the three subsequent evaluations. For the CKC group, however, a significant difference was found only between the first and fourth evaluations (Figure 1a).

**Figure 1.** (a) Mean knee peak extensor torques (n=5) of the four evaluations for OKC and CKC groups, (b) Mean knee peak flexor torques (n=5) of the four evaluations for OKC and CKC groups.

* = significant difference between the first and subsequent evaluations.

**Flexor Torques**

For the OKC group, significant differences were found between the first evaluation and third; and first and fourth evaluations. For the CKC group, no significant differences were found between the first and the following three evaluations (Figure 1b).

The literature tends to favor the use of CKC exercises in the rehabilitation of ACL reconstruction, assuming that it produces less ATD, and also that these exercises reproduce daily movements better than OKC exercises (Bynum et al., 1995; Papler, 1995 e Yack et al., 1993). The literature, however, lacks information about the effects of OKC and CKC exercises on muscle force/torque.

The results of this study suggest that in spite of the fact that both OKC and CKC exercises produced similar results after 12 weeks, OKC exercises appear to produce effects on muscle torque sooner than CKC exercises. Assuming that muscle torque can be representative of muscle force, this may be an important finding, considering that muscle plays a major role in knee stability.

It is speculated that this finding might be associated with some neural adaptations, as OKC exercises are less natural than CKC exercises and may, therefore, demand more involvement of motor units.

One limitation that might have affected the results obtained for the OKC exercises was that the torques due to the weight of the segments were not taken into account, and that had some influence on the load that was imposed to the subjects.

Although some differences were found between OKC and CKC exercises in terms of how fast the effects on muscle force were seen, it has to be pointed-out that no differences were observed between the two procedures after 12 weeks.
REFERENCES


