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Closed kinetic chain alone compared to combined open and closed kinetic chain exercises for quadriceps strengthening after anterior cruciate ligament reconstruction with respect to return to sports: a prospective matched follow-up study

Received: 15 January 2000
Accepted: 3 August 2000
Published online: 12 October 2000
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Abstract Rehabilitation after anterior cruciate ligament (ACL) reconstruction has focused over the past decade on closed kinetic chain (CKC) exercises due to presumably less strain on the graft than with isokinetic open kinetic chain exercises (OKC); however, recent reports suggest that there are only minor differences in ACL strain values between some CKC and OKC exercises. We studied anterior knee laxity, thigh muscle torque, and return to pre-injury sports level in 44 patients with unilateral ACL; group 1 carried out quadriceps strengthening only with CKC while group 2 trained with CKC plus OKC exercises starting from week 6 after surgery. Anterior knee laxity was determined with a KT-1000 arthrometer; isokinetic concentric and eccentric quadriceps and hamstring muscle torque were studied with a Kin-Com dynamometer before and 6 months after surgery. At an average of 31 months after surgery the patients answered a questionnaire regarding their current knee function and physical activity/sports to determine the extent and timing of

their recovery. No significant differences in anterior knee laxity were noted between the groups 6 months postsurgery. Patients in group 2 increased their quadriceps torque significantly more than those in group 1, but no differences were found in hamstring torque between the groups. A significantly higher number of patients in group 2 ($n=12$) than in group 1 ($n=5$) returned to sports at the same level as before the injury ($P<0.05$). Patients from group 2 who returned to sports at the same level did so 2 months earlier than those in group 1. Thus the addition of OKC quadriceps training after ACL reconstruction results in a significantly better improvement in quadriceps torque without reducing knee joint stability at 6 months and also leads to a significantly higher number of athletes returning to their previous activity earlier and at the same level as before injury.

Keywords ACL reconstruction · ACL rehabilitation · Anterior knee laxity · Closed kinetic chain · Isokinetic open kinetic chain

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Introduction

Anterior cruciate ligament (ACL) rupture is one of the most common and most serious traumatic injuries among physically active individuals [8]. The Swedish company Folksam, which insures most Swedish athletes, reports

that ACL injury entails the longest disability period, leads to the highest percentage of permanent sports disability, and is the most expensive injury for the company and for society [8].

There is still no consensus regarding the optimal rehabilitation program following ACL reconstruction except for early motion, which was pointed out some 25 years