Kinematics and laxity in the knee, before and after Anterior Cruciate Ligament reconstruction

Evaluation using dynamic and static Radiostereometric analysis

AKADEMISK AVHANDLING

för avläggande av Medicine Doktorsexamen vid Göteborgs Universitet kommer offentligen att försvaras i Aulan, Sahlgrenska Universitetssjukhuset/Sahlgrenska, fredagen den 4 april 2008, kl 09.00

Av

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Avhandlingen baseras på följande delarbeten:

I: Early active extension after Anterior Cruciate Ligament reconstruction does not result in increased laxity of the knee
Jonas Isberg, Eva Faxén, Sveinbjörn Brandsson, Bengt I Eriksson, Johan Kärrholm, Jon Karlsson. *Knee Surg Sports Traumatol Arthrosc* 2006;14:1108-1115.

II: KT-1000 records smaller side-to-side differences than radiostereometric analysis before and after an ACL reconstruction
Jonas Isberg, Eva Faxén, Sveinbjörn Brandsson, Bengt I Eriksson, Johan Kärrholm, Jon Karlsson. *Knee Surg Sports Traum Arthrosc.* 2006;14:529-535.

III: Can early ACL reconstruction prevent the development of changed tibial rotation? Kinematic RSA study of 12 patients undergoing surgery with bone-patellar tendon-bone autografts, with a two-year follow-up.
Jonas Isberg, Eva Faxén, Sveinbjörn Brandsson, Bengt I Eriksson, Johan Kärrholm, Jon Karlsson. *Submitted.*

IV: Will early reconstruction prevent abnormal kinematics after ACL injury? Two-year follow-up using dynamic radiostereometry in 14 patients operated with hamstring autografts.
Jonas Isberg, Eva Faxén, Gauti Laxdal, Bengt I Eriksson, Johan Kärrholm, Jon Karlsson
Submitted.

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Introduction: Whether full active and passive extension training, started immediately after an Anterior Cruciate Ligament (ACL) reconstruction, will increase the post-operative A-P laxity of the knee has been the subject of discussion. For many years, many protocols have included full extension with full weight bearing after an ACL reconstruction. This is, however, based on empirical facts and has not been studied well in randomised studies. The A-P laxity of the knee joint is an important parameter when evaluating ACL-injured knees. For instance, it is difficult to find a study dealing with ACL insufficiency or post-operative follow-up after an ACL reconstruction, which does not use the KT-1000 as an evaluation instrument to assess objective outcome. The question of whether the results of KT-1000 measurements are sufficiently accurate and the extent to which they are clinically relevant still remains. Previous studies have shown abnormal kinematics in knees with chronic ACL insufficiency and reconstruction of the ligament using bone-patellar tendon-bone (BPTB) or hamstring autograft has not normalised the kinematics. The aim of *Study I* was to evaluate whether a post-operative rehabilitation protocol, including active and passive extension without any restrictions in extension immediately after an ACL reconstruction, would increase the post-operative A-P laxity. The aim of *Study II* was to compare the KT-1000 arthrometer with RSA, a highly accurate method, to measure A-P laxity in patients with ACL ruptures, before and after reconstruction. The aim of *Studies III* and *IV* was to evaluate whether early ACL reconstruction (8-10 weeks after injury) would protect the knee joint from developing increased external tibial rotation. Twenty-two consecutive patients (14 men, 8 women, median age: 24 years, range: 16-41) were included in *Studies I-II* and were randomly allocated to two groups in *Study I*. Twenty-six consecutive patients (18 men, 8 women; median age 26, range 18-43) were included in *Studies III* and *IV*. All the patients had a unilateral ACL rupture and no other ligament injuries or any other history of previous knee injuries. One experienced surgeon operated on all the patients, using the BPTB or hamstring autograft. We used RSA with skeletal (tantalum) markers to study A-P laxity and knee kinematics. Dynamic RSA was performed to evaluate the pattern of knee motion during active and weight-bearing knee extension. For A-P laxity, we used static RSA and the KT-1000. Clinical tests were conducted using the Lysholm score, Tegner activity level, IKDC, one-leg-hop test and ROM. The patients were evaluated pre-operatively and up to two years after the ACL reconstruction.

Results: The KT-1000 recorded significantly smaller side-to-side differences than RSA, both before and after the reconstruction of the ACL using a BPTB autograft. There were no significant differences in A-P laxity between early and delayed extension training after ACL reconstruction, up to two years post-operatively. Neither ROM, Lysholm score, Tegner activity level, IKDC nor the one-leg-hop test differed. Before surgical repair of the ACL and at the two-year follow-up, there were no significant differences between the injured and intact knees in internal/external tibial rotation or abduction/adduction, when the ACL reconstruction was performed within 8-10 weeks from injury.

Conclusion: Early active and passive extension training, immediately after an ACL reconstruction using BPTB autografts, did not increase post-operative knee laxity up to two years after the operation. The KT-1000 recorded significantly smaller side-to-side differences than the RSA, both before and after the reconstruction of the ACL. Before surgical repair (8-10 weeks after injury) of the ACL, the knee kinematics remained similar on the injured and normal sides. Two years after the reconstruction, the kinematics of the operated knee still remained normal, after using either BPTB or hamstring autografts.

Key words: ACL, KT-1000, early reconstruction, early extension, kinematics, laxity, RSA
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