

Clinical measurement of proprioceptive function after anterior cruciate ligament reconstruction

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ABSTRACT

Objectives: Proprioception is very important for the integrity and stability of the knee joint. Patients with anterior cruciate ligament (ACL) tear have a decline in proprioceptive functions of the injured knee. However, improvement of proprioceptive functions of the knee after ACL reconstruction is a subject of considerable debate. This study was conducted to evaluate the results of a simple clinical proprioception test developed by the author in patients with ACL reconstructed knees.

Methods: This study was conducted in King Fahd Hospital of the University, Al-Khobar, Kingdom of Saudi Arabia, from January 1996 to June 2002. The proprioceptive function of the knee joint was studied in a group of ACL reconstructed patients (n=22) and compared them with a group of ACL deficient patients

(n=32) and a group of healthy controls (n=30). Proprioception was evaluated based on the performance in a simple clinical test.

Results: There was a significant difference in proprioceptive functions between the ACL deficient knees and the ACL reconstructed group ($p < 0.05$), but there was no significant difference between the ACL reconstructed and the normal control group ($p > 0.05$).

Conclusions: These findings indicate that proprioceptive deficits in ACL deficient knees, as measured clinically using the described test, might improve after ACL reconstruction.

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Repair of the injured anterior cruciate ligament (ACL) is currently a common surgical procedure carried out routinely and arthroscopically at many centers in the Kingdom of Saudi Arabia (KSA). Anatomical reconstruction of the torn ACL using different types of grafts is meant to restore normal functions of the knee. Proprioceptive functions of the knee are very important for the integrity and stability of the joint.¹⁻⁴ Many clinical studies have shown that the knee joints of patients with ACL tear have a decline in proprioceptive functions of the injured joint.^{1,3,5-7} However, improvement of proprioceptive functions of the knee after ACL reconstruction is a subject of considerable debate. While MacDonald et al,⁴ Co et al⁸ and Jerosch and Prymka,⁹ did not show

improvement of proprioception in their patients with ACL reconstruction, other investigators^{2,10-13} found an improvement after reconstruction. Contradictory results were attributed to the method, and the test used to quantify the overall proprioceptive ability of the examined knee.¹⁴ Several tests of knee proprioception have been described, but these tests are mostly experimental and require complex equipments. They evaluate either joint position sense,^{2,10} kinaesthesia (joint motion sense),¹³ or postural control (stabilometric tests)^{15,16} This study was conducted as a continuation of our previous report⁵ to evaluate the results of our simple clinical proprioception test in patients with ACL reconstructed knees.

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Methods. The material comprised 84 subjects, a reconstructed group of 22 patients who had ACL reconstruction using a bone patellar tendon bone graft (Group A), and non reconstructed group of 32 subjects with unilateral ACL rupture (Group B), and 30 healthy controls (Group C). The mean age of patients in this study was 27 ± 1 years. The study was performed in King Fahd Hospital of the University, Al-Khobar, KSA during the period from January 1996 to June 2002. All subjects in the study were males. The postoperative follow up period for Group A ranged from 1-6-years (average 3.6 years). The performance of subjects in groups A and B was evaluated according to Lysholm scoring. An independent observer also tested joint laxity clinically. None of the ACL reconstructed patients required a revision ACL reconstruction surgery, and all the ACL deficient patients had arthroscopic evidence of complete rupture of the ligament. The normal volunteers formed part of our previous study⁵ to verify the accuracy of measurements of proprioception.

The proprioceptive function in the knees for all subjects was assessed with a simple single limb standing test that was described earlier by the author "Al-Othman's et al test"⁵ The test was designed to measure changes in patient capacity to reposition the tested limb accurately. All external clues to limb position or motion were eliminated. Thus, wearing thick cotton socks and separating both lower limbs during the test maneuver neutralized cutaneous sensations. Visual inputs were also removed by using blindfolds. A mean value for the deviations of the tested limb during its repositioning to the reference O-line was recorded for the 3 test trials. A senior physiotherapist carried out testing in a blind manner. Descriptive statistics (mean value and standard deviation) were used to determine the clinical performance and the proprioceptive function of the studied knees in all subjects. Results of the 3

studied groups were compared using t-test and Mann-Whitney test. The correlation between the test results and Lysholm scores for the study groups A and B was tested by Spearman's test. A level of $p < 0.05$ was selected for statistical significance.

Results. All patients in group A demonstrated a negative or grade I Lachman and pivot-shift tests except for 3 cases, while all patients in group B had at least a grade II Lachman test and a positive pivot-shift test. The ACL reconstructed group obtained a higher Lysholm score (90.5 ± 5.23) compared with the ACL deficient group (74.47 ± 8.20) with a statistically significant difference ($p < 0.05$). In addition, there was a significant negative correlation between the Lysholm score and the test result for both group A and B combined ($r = -0.732, p > 0.001$), (Figure 1).

Proprioceptive testing. The study group (A) and the control group (C) demonstrated virtually identical mean values with a mean variation of 8.65%, and no significant difference (Mann-Whitney test, $p > 0.05$). The ACL deficient knee group (B), however, showed a significantly higher mean value (1.76 ± 1.33) with a statistically significant difference when compared with both the ACL reconstructed group (A) and the control group (C) ($p < 0.05$) (Table 1).

Discussion. Proprioception in the ACL reconstructed knees has recently attracted considerable attention and debate. Several tests of knee proprioception have been described, but there is no standard established consensus or reference.³ These tests are mostly experimental and evaluate joint position sense,^{2,10} kinesthesia (joint motion sense),¹³ or postural control (stabilometric tests).^{15,16} Many authors have made conflicting conclusions on the overall proprioception after ACL reconstruction

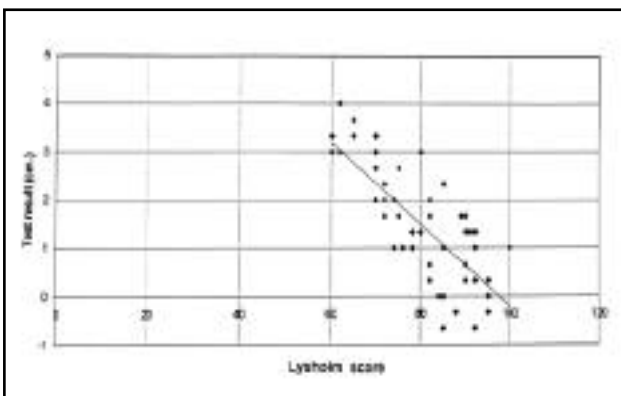


Figure 1 - Correlation between the test results and Lysholm knee scores for Group A and B.

Table 1 - Mean deviation in Al-Othman et al⁵ test in the 3 groups.

Groups	n	Mean \pm SD	p value
Group A*	22	0.95 ± 0.95	< 0.05
Group B†	32	1.76 ± 1.33	< 0.05
Group C‡	30	1.04 ± 0.93	

*anterior cruciate ligament reconstructed knees,
 †anterior cruciate ligament deficient knees,
 ‡control, A and C - not significant

because of using only a joint position sense test,⁹ a kinaesthesia test^{4,8} or a stabilometric test for postural control.¹⁷ Grob et al¹⁴ compared the validity of several frequently used methods to quantify proprioception and concluded that proprioceptive ability cannot be inferred from independent tests of either kinesthesia or joint position sense alone. However, they did not test the validity of any of the stabilometric tests for postural control. These stabilometric tests may be of more value in assessing proprioception after ligament rupture, or reconstruction.^{15,16,18,19} The proprioceptive function of the knees in this study was determined based on a simple clinical single limb standing test developed by the authors.⁵ The capacity of the patient to reposition the examined limb accurately to the reference O-line in this test combine more than one element of proprioceptive functions, namely, postural control, joint position sense and joint motion sense in a standing and dynamic condition. However, further studies are needed to evaluate the correlation between the results of our clinical test and other tests of kinaesthesia, joint position sense and stabilometric tests.

The present study demonstrates significant difference in the proprioceptive functions between ACL reconstructed, ACL deficient group and controls. These results are in accordance with many other studies^{2,11,13,15,16} that have used complex equipments to measure proprioceptive functions. In addition, knee function as measured by Lysholm score was significantly better among the ACL reconstructed group compared to the ACL deficient cases, and it has shown a significant negative correlation with proprioceptive measurements. This indicates that a wide aberration of the test result from the O-reference line signals a decline in proprioception and the knee function as evaluated by Lysholm score. Whether the better proprioceptive function of the surgically treated cases is due to the improvement of the joint stability^{11,20} or due to the regeneration of new sensory nerve endings and mechanoreceptors in the tendon graft^{21,22} is a matter of speculation.

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