

# Functional Results after Anterior Cruciate Ligament Reconstruction using the bone-patella Tendon-bone Method

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## ABSTRACT

This study evaluates the outcome of anterior cruciate ligament (ACL) reconstruction with arthroscopy using the bone-patella tendon-bone method. We performed this procedure in 24 patients with the average age of 33.1 years (range: 17-51 years) between 2004 and 2006. Sixteen of the 24 patients were available for evaluation using the Lysholm Knee Score and International Knee Documentation Committee (IKDC) system. Based on the Lysholm score, there was a statistically significant improvement in knee function when comparing pre- and post-surgical scores ( $p < 0.001$ ). Using IKDC guidelines, a majority of the patients have regained near normal to normal knee function. We conclude that ACL reconstruction using the bone-patella tendon-bone method can provide good functional outcome based on objective and subjective assessments.

## Key Words:

*ACL reconstruction, Knee*

## INTRODUCTION

It is well documented that the anterior cruciate ligament (ACL) plays an important role in maintaining anterior stability of the knee. ACL laxity is a prelude to mechanical instability and degeneration of the joint<sup>1,2,3</sup>. Integrity of the ACL is particularly crucial for athletes whose sports activities include running and jumping sports. There exist several published reports on ACL reconstruction, looking at various outcome measures in relation to the surgical technique, type of graft, biomaterials, rehabilitation protocol and even the validity of the outcome measured.

The aim of this retrospective study is to determine objective, subjective and functional outcomes following ACL reconstruction with allograft for patients with preoperative knee instability. The hypothesis is that following this procedure, patients should have satisfactory overall knee function and relief of symptoms.

## MATERIALS AND METHODS

Case notes of patients who underwent ACL reconstruction with bone-patella tendon-bone (BPTB) and interference screw fixation between 2004 and 2006 were reviewed. Indications for the procedure were episodes of recurrent instability despite intensive rehabilitation. Exclusion criteria included unstable contra-lateral knee, re-ruptured ACL during the follow-up period and history of major soft-tissue trauma to the involved lower extremities. All patients had previously participated in rehabilitation postoperatively using closed kinetic chain exercise<sup>4</sup>. Selected patients were invited to return for evaluation as part of this study (Table I).

All surgeries were performed using a single-incision arthroscopic ACL reconstruction<sup>5</sup> on ipsilateral knee. Concomitant meniscal injuries were addressed with total meniscectomies during reconstruction. After notchplasty, roofplasty, and drilling of the tunnels, the autograft (which was prepared on the table) was passed through the tunnels and secured using interference screws (metallic or biodegradable). All patients followed the same postoperative rehabilitation protocol, closed kinetic chain exercise which is a particularly weight bearing exercise. Movement at several joints is required to complete the exercise. The distal segment is usually fixed to a supporting surface and the resistance may be applied proximally and distally<sup>6</sup>. Patients were also encouraged to perform squatting exercises, another example of closed kinetic chain exercise.

For the purposes of this study, an orthopaedic specialist, who was not the surgeon for the reviewed patients, performed the physical examinations. Each patient was evaluated using the International Knee Documentation Committee (IKDC) and Lysholm scoring systems<sup>7,8</sup>. Functional performance was also evaluated using the one-leg hop test<sup>9,10</sup>. Range of movement (ROM) was measured by using a goniometer graded in single degrees.

Loss of motion  $>5^\circ$  in flexion and  $>15^\circ$  in extension compared with the non-injured knee was classified as loss of motion (LOM)<sup>11,12</sup>. Anteroposterior translation of both knees

was examined and data were reported as the difference between the injured and uninjured knee. A positive value indicated more translation on the injured site. According to the IKDC, any displacement of more than 5 mm compared to the uninjured site is considered as abnormal, as is a decrease of 3 mm or more in anteroposterior translation compared to the uninjured site. In addition, both end points must be firm to qualify as normal or near normal. Results were recorded as normal to severely abnormal according to these guidelines. Patients also answered two sets of Lysholm score questionnaires (pre- and post-operatively), and were also asked to subjectively classify the outcome of the ACL reconstruction as normal, nearly normal, abnormal and severely abnormal.

Thus, the Lysholm score, IKDC rate (at present), anterior posterior translation of the injured relative to the uninjured knee as well as 1-leg hop test were considered as the outcome measures. Paired T –test was used for statistical analysis of the parametric data. A p value < 0.05 was considered to be statistically significant.

## RESULTS

Twenty-four patients underwent ACL reconstruction procedure in the 2-year period under consideration in this study. Of the 20 patients who fulfilled the inclusion criteria, 16 returned for the evaluation for purposes of this study. Even though four patients did not undergo evaluation as a study participant, review of these 4 patients' follow-up notes after the surgery showed no evidence of graft failure or instability. The study group consisted of 15 men and one woman. Average patient age was 33.1 years (range: 17-51 years). Surgeries were performed 10 right knees and 6 left knees. The average duration from injury to operation for the 16 patients was 35.4 months (range: 1-120 months). The causes of ACL injury were contact sports in 15 study participants and a fall during work for one study subject. (Table I). All patients had arthroscopically diagnosed ACL tears, six with associated meniscal or chondral injury.

The average range of knee movement was 110 to 160 degrees. All patients were able to fully extend the operative knee as compared to the nonoperative knee. However, 7 patients developed limited range of flexion. Ten patients had a negative Lachman test while in six patients the test was positive. For the anterior drawer test, varus and valgus instability tests, only one patient demonstrated mild degree of instability (Table II). Seven patients complained of anterior knee pain at the donor site of the BPTB.

According to IKDC classification, preoperative functional level was class I in one patient, class II in six patients and class III in nine patients. The mean Lysholm Score for the 16 patients was 89.1 (range: 47 to 100) at follow-up as compared to 52.4 (range: 12 to 76) before surgery. Nine

patients had a score  $\geq 95$  ("excellent" range) postoperatively; four between 84 and 94 ("good" range); one, between 65 to 83 ("fair" range); and two,  $\leq 64$  ("poor" range). The three patients rated as fair or poor reported pain during walking and occasionally a feeling of instability while climbing stairs. One of them underwent an ipsilateral meniscectomy after ACL reconstruction (Table II).

Postoperatively, twelve of the 16 patients returned to what they considered an acceptable level of recreational activity. Six patients returned to football and physical occupational activity, seven to badminton and tennis, two to running or jogging and one preferred a more sedentary lifestyle. For the latter patient, pre-operative level of recreational activity (level III) included light jogging. (Table III)

## DISCUSSION

The principal finding of this study is that the final results of anterior cruciate ligament (ACL) reconstruction with arthroscopy using bone–patella tendon–bone were satisfactory in the majority of the patients (IKDC groups A and B approximately 87.5%), a result similar to a previous study by Ejerhed *et al*<sup>13</sup>. Based on IKDC evaluation, 81.3% of the patient can attained level I and II activities postoperatively.

One interesting finding was that the loss of motion (LOM) found in 7 of the patients was not associated with other pathology such as meniscus injury, a finding that differs from previous findings<sup>14,15,16</sup>. Seven patients reported anterior knee pain at the donor harvest site (most of them complaints of discomfort) that occasionally caused difficulty in kneeling. It is well known that difficulty in kneeling may significantly affect some occupations, and religious and/or recreational activities<sup>11</sup>. An alternative graft choice, such as hamstring tendon, might reduce the number of patients with these problems<sup>17,18</sup>, although such a procedure is usually more expensive and the graft fixation is less secure. We previously performed ACL reconstruction using hamstring graft for patients more than forty years old, but have found early evidence of patello-femoral degeneration in these patients.

Many patients in the study were noted to have minimal to moderate quadriceps muscle wasting, however further questioning revealed that most did not follow the rehabilitation program strictly either due to insufficient awareness of the importance of rehabilitation or for other logistics reasons. As we are using Lysholm scoring which mainly involves memory recall, bias may be present in that some of the patients underwent operation more than two years before answering questionnaire items. Use of a combination of evaluation tools such as Tegner score and Lysholm score may be more sensitive for evaluation of activities of daily living and recreational or competitive

**Table I:** Demographic and physical characteristics of the study group

Age	33.1 (17-51)
Gender (M/F)	15/1
Uninjured contralateral side	16/16
Injured Side (R/L)	10/6
Mechanism of Injury	
• Sports	15
• Work	1
Time Between Injury and Reconstruction	Average 35.4m (Range 1-120m)
Single-incision arthroscopic ACL reconstruction	
Activity level prior to operation	16/16
• Class I (Jumping, pivoting, hard cutting, football, soccer)	1
• Class II (Heavy manual work, skiing, tennis)	6
• Class III (Light manual work, jogging, running)	9

**Table II:** Objective Results

Lysholm Score (points)*	
• Pre-operation	52.4 (12-76)
• Post-operation	89.1 (47-100)
Full ROM	9/16 (56.3%)
LOM Extension	0/16 (0%)
LOM Flexion	7/16 (43.7%)
One-leg hop (% of the non-injured side) (Two patients could not perform the test)	91.7% (56-116%)
Anterior Posterior Translation	
• Normal	10 (62.5%)
• Nearly Normal	2 (12.5%)
• Abnormal	3 (18.7%)
• Severely Abnormal	1 (6.3%)

\*Difference in preoperative vs. postoperative Lysholm Score (using paired T-test analysis) is statistically significant (P<0.001).

**Table III:** Functional Result After Treatment

Patellofemoral Pain, Yes/No	2/14 (12.5%/87.5%)
IKDC Activity Levels (present)	
• IKDC I	6 (37.5%)
• IKDC II	7 (43.7%)
• IKDC III	2 (12.5%)
• IKDC IV	1 (6.3%)
Patients' Subjective Functional assessment	
• Normal	3
• Nearly Normal	11
• Abnormal	2
• Severely Abnormal	0

sports. Measuring tools such as KT-1000 would provide more accurate physical evaluation results.

**CONCLUSION**

Reconstruction of the anterior cruciate ligament with the patella ligament provides good outcome based on physical

and functional evaluation. The frequency of postoperative anterior knee pain should a consideration in patients who are required to kneel for religious or occupational activities, and alternative grafts may be considered in these cases. Although there are recent advances in ACL reconstruction using hamstring tendon graft, allograft or other synthetic materials, reconstruction with BPTB in still considered the gold standard.

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