Ten year follow-up study comparing conservative versus operative treatment of anterior cruciate ligament ruptures.

A matched-pair analysis of high level athletes

Keywords: anterior cruciate ligament, reconstruction, conservative treatment, long-term, outcome
Abstract

Objective To compare long term outcome of highly active patients with anterior cruciate ligament ruptures treated operatively versus non-operatively.

Design We reviewed high level athletes with an anterior cruciate ligament rupture on either MRI or arthroscopic evaluation more than ten years previously, who were treated conservatively. They were pair-matched with patients who had had an anterior cruciate ligament reconstruction with bone-patella-tendon-bone, with respect to; age, gender and Tegner activity score before injury.

Participants In total 50 patients were pair-matched.

Results In this study we found no statistical difference between the patients treated conservatively or operatively with respect to osteoarthritis or meniscal lesions of the knee, as well as activity level, objective and subjective functional outcome. The patients who were treated operatively had a significantly better stability of the knee at examination.

Conclusion We conclude that the instability repair using a bone-patella-tendon-bone anterior cruciate ligament reconstruction is a good knee stabilising operation. Both treatment options however show similar patient outcome at ten year.
Introduction

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments of the knee. The incidence of ACL injuries is currently estimated at approximately 200,000 annually, with 100,000 ACL reconstructions performed each year in the U.S.A.\(^1\). The prognosis for 2008 in the Netherlands is that 5000 ACL reconstructions will be performed, this is 1 per 3200 habitants\(^2\). In a more active age group the incidence of ACL injuries could be even be as high as 1/556\(^3\). The goal of the treatment of ACL ruptures is to obtain the best functional level for the patient without risking new injuries or degenerative changes in the knee\(^4\). There are many factors to be considered when deciding whether an ACL rupture should be treated surgical or conservatively. Among these factors are the degree of instability, the presence of meniscal lesions, the patient’s level of athletic activity and the patient’s age\(^5\). A widely advocated treatment strategy is to recommend early reconstruction in the highly active patients and to start with a non-surgical treatment for the less active patients.

Injury to the ACL frequently leads to post-traumatic osteoarthritis (OA) and many surgeons had and have hope that ligament reconstruction also would lead to a reduction of post-traumatic OA\(^6\). However the prevalence of degenerative changes after reconstruction of the ACL ranges between 10-87\%\(^7\,8\). This variance is due to operation technique and the presence of accompanying injuries especially meniscal lesions and the time between the actual injury and the operative reconstruction\(^9\). One of the great difficulties in ACL rupture management is that there are no specific management guidelines to decide which patient benefits from operative versus non-operative treatment. This is partly because there are few prospective studies
comparing operative and non-operative treatment of ACL injuries\textsuperscript{10,11}. Linko et al. summarized in a Cochrane review the evidence concerning this issue and found two studies, published in the early 1980's that compared an operative treatment with a conservative treatment of an ACL injury. They found insufficient evidence to show that reconstructing the ACL was better than conservative treatment.\textsuperscript{11-13} Since then the operation technique has improved with the development of reliable fixation devices and the transition from open to arthroscopic surgery. Recently no randomized clinical trials were published, maybe due to ethical concerns.

The purpose of this study was to compare treatment specifically in high level athletes who had sustained an ACL rupture. We specifically chose this high demand group as they are considered a greater risk of failure with non-operative treatment and may have a higher incidence of OA. We evaluated our conservative treatment with the single incision bone-patella-tendon-bone ACL reconstruction. This technique is still considered the gold standard together with the four strand hamstring reconstruction.

The two groups were matched for three important predictors for outcome, namely age, gender and pre injury sport activity level\textsuperscript{14,15}. The patient groups were compared with regard to OA of the knee, meniscal lesions, instability, activity level during the ten year period and objective and subjective functional outcome.

Methods

Patients

For this pair-matched study we used two cohorts. The first cohort were patients who had been treated conservatively for ten years after being diagnosed with an ACL rupture, which was confirmed either by MRI or arthroscopically. These patients were
pair-matched with patients who underwent a reconstruction of the ACL rupture ten years previously, between 1994 and 1996. These patients were reviewed at the outpatient clinic in 2006.

None of the patients had had another intra- or extra-articular knee ligament reconstruction in the past and all patients had sufficient knowledge of the Dutch language to understand the purpose of the study and to fill in the questionnaire. In our hospital all patients with an ACL rupture were referred for a physiotherapist-led rehabilitation program. They were reevaluated after 3 months for knee instability complaints and a non-pivoting activity-lifestyle was offered versus an ACL reconstruction. 16

The patients who were treated conservatively were pair-matched with the patients who underwent a reconstruction with respect to age, gender and Tegner activity score before injury. In total 50 patients were pair-matched for the present study.

Prior to participation, each subject signed an informed consent.

**Treatment**

Conservative therapy consisting of swelling reduction and range of motion exercises were introduced by the physiotherapist. For a minimal period of 3 months an active and intense hamstring and quadriceps strengthening program was followed.

All ACL reconstructions were performed by two orthopaedic surgeons. The interval between the index injury and ACL reconstruction was on average longer than 6 months (range 2-258 months). A single incision, central one third BPTP technique was used. Tunnel placement was aided by Acufex tibial and femoral aimers. Tibial tunnel placement was 7 mm anterior of the posterior cruciate ligament. Femoral tunnel placement was at an eleven o’clock position for the right knee and at one o’clock
for the left knee (Figure 1. X-ray AP view ACL reconstruction, Figure 2. X-ray lateral view ACL reconstruction). Non resorbable interference screws were used for the tibial and femoral bone block fixation. Post-operative rehabilitation was with protected weight-bearing for the first 4 weeks. After which rehabilitation was intensified. Sports return was allowed after 6 months.

**Measurements**

At the ten year follow-up at our outpatient clinic, all patients were reviewed regarding radiological OA of both knees, past meniscal lesions, stability of the injured knee, activity level and objective and subjective functional outcome. The review was performed by an independent surgeon (DM), who was not involved with the previous operative or non-operative treatment.

**Radiological OA.** Weight bearing posterior-anterior and Rosenberg-view radiographs of the knee were taken at follow-up, to assess OA of the injured knee\(^{17}\). Staging of radiographic OA was based on the Kellgren & Lawrence classification\(^{18}\). A person was considered to have radiographic OA of the knee if the Kellgren & Lawrence score was equal to or larger than two. Two experienced readers independently (D.M. and J.V.) evaluated the radiographs, unaware of the clinical status of the patients.

**Meniscal lesions.** For every patient the past medial, lateral and combined meniscal tears were noted.

**Stability of the ACL.** For the present study stability of the knee was evaluated by the pivot shift test and the KT-1000 arthrometer\(^{19}\). The pivot shift test was graded from 0 to 3+. A score of \(\geq 1+\) was defined as an instable ACL. Instrumented laxity testing of the knee was performed with the use of the KT-1000 arthrometer. The side-to-side
difference at the maximal load was measured. A cut-off point of > 3mm side-to-side
difference was used to define an instable ACL.

*Activity level.* The patient’s level of activity was assessed using the classification of
Tegner et al\(^\text{20}\). This a scale of 1-10, where 10 is equivalent to football at international
level.

*Functional outcome.* The subjective functional outcome was assessed using the
Lysholm score and the International Knee Documentation Committee. Both grading
system have a maximum score of 100, which means a perfect knee\(^\text{21-23}\). The objective
functional outcome was evaluated with the one-leg-hop test, which calculates a
quotient between the injured and non-injured leg\(^\text{24}\).

**Statistical analysis**

Distribution analysis of all variables was tested by the Shapiro-Wilk test. For the
normally distributed variables, statistical analysis of the results was performed using
the Independent Sample T-test to evaluate between-group differences and the Paired-
Sample T-test to evaluate within-group differences. For the variables that were not
normally distributed, statistical analysis was performed using the Mann-Whitney-
Wilcoxon U-test to evaluate between-group differences and the Wilcoxon signed rank
test to evaluate within-group differences. For the normally distributed variables, the
mean and standard deviation were presented. For the variables that were not normally
distributed the median and range were presented. Differences were considered
significant at the 0.05 level (two-sided).

We used SPSS version 12.1 (SPSS Inc., Chicago, USA).
Results

Patients

The characteristics of the two study populations are presented in Table 1. The two groups were similar with respect to gender (P-value of 1.000), age (P-value of 0.808), body mass index (P-value of 0.443) and Tegner activity score before injury (P-value of 0.831).

Radiological OA

12 patients (48%) in the operative group had knee radiographic OA with a score of 2 ≥ compared to 7 (28%) in the conservative group. This difference was not statistically significant (P-value of 0.145). The total of 50 contralateral knees showed 4% radiographic OA at the ten year follow-up (Table 2). Radiological assessment showed a interobserver Kappa value of 0.77.

Meniscal lesions

In total 68% of the operative group had a meniscectomy and 80% of the conservative group (P-value of 0.333). There was however a significantly lower amount of 3 meniscectomies (12%) in the operative group post-reconstruction compared to the conservatively treated group with 10 patients (40%) with meniscectomies in the last ten years (P-value of 0.024).

Stability

Both groups differ at our ten-year follow-up in stability of the injured knee assessed with the pivot shift test and the KT-1000 arthrometer (Table 3).

Level of physical activity

Both groups had a drop in activity level after there ACL lesion. The conservative group achieved a highest median Tegner score of 7 (min.4-max.10) after ACL lesion where as the ACL reconstructed group achieved a Tegner score of 8 (3-10) (P-value
of 0.420). At the ten year follow-up the operative group showed no statistical significant difference with a one point higher Tegner score compared to the conservative group 6 (min.3-max.9) and 5 (min.1-max. 9) respectively (P-value of 0.188).

**Functional outcome**

The evaluation of the subjective knee function according to both the Lysholm’s scoring system and the IKDC subjective knee evaluation showed no statistical significant differences between the operative and conservative group (P-value of 0.442 and 0.683 respectively) (Table 4). The quotient of the injured and non injured of the one leg hop test was not statistically different between both groups (P-value of 0.522).

<table>
<thead>
<tr>
<th>Table 1: Patient characteristics at ten year follow-up evaluation.</th>
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<tr>
<td><strong>Gender (men / women)</strong></td>
</tr>
<tr>
<td><strong>Age (years), mean (± SD&lt;sup&gt;∅&lt;/sup&gt;)</strong> 37.6 (6.2)</td>
</tr>
<tr>
<td><strong>BMI (kg/m&lt;sup&gt;2&lt;/sup&gt;), median (min-max)</strong> 25.3 (22.2-30.9)</td>
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<tr>
<td><strong>Preinjury Tegner score, median (min-max)</strong> 9 (6.0-10.0)</td>
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</tbody>
</table>

<sup>∅</sup>SD. = standard deviation
Table 2: Radiological OA at ten year follow-up.

<table>
<thead>
<tr>
<th>Description</th>
<th>Operative treatment (n = 25) number (%)</th>
<th>Conservative treatment (n = 25) number (%)</th>
<th>Contralateral knees (n = 50) number (%)</th>
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<tbody>
<tr>
<td>Contralateral knees</td>
<td></td>
<td></td>
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<tr>
<td>Kellgren &amp; Lawrence, grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4 (16)</td>
<td>8 (32)</td>
<td>37 (74)</td>
</tr>
<tr>
<td>1</td>
<td>9 (36)</td>
<td>10 (40)</td>
<td>11 (22)</td>
</tr>
<tr>
<td>2</td>
<td>9 (36)</td>
<td>4 (16)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>3</td>
<td>3 (12)</td>
<td>3 (12)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>4</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
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</table>

Table 3: Knee stability at ten year follow-up.

<table>
<thead>
<tr>
<th>Operative treatment (n = 25) number (%)</th>
<th>Conservative treatment (n = 25) number (%)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>KT-1000: max side-to-side difference &gt; 3mm</td>
<td>6 (24)</td>
<td>17 (68)</td>
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<tr>
<td>Pivot shift</td>
<td></td>
<td></td>
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<tr>
<td>- 0</td>
<td>20 (80.0)</td>
<td>4 (16)</td>
</tr>
<tr>
<td>≥ 1+</td>
<td>5 (20)</td>
<td>21 (84)</td>
</tr>
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Table 4: Functional outcome at ten year follow-up

<table>
<thead>
<tr>
<th></th>
<th>Operative treatment (n = 25)</th>
<th>Conservative treatment (n = 25)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysholm score, median</td>
<td>88.0 (54.0 –96.0)</td>
<td>85.0 (38.0 –100.0)</td>
<td>0.442</td>
</tr>
<tr>
<td>(min-max.)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IKDC subjective score,</td>
<td>77.1 (47.0 – 97.6)</td>
<td>77.1 (25.3 – 100.0)</td>
<td>0.683</td>
</tr>
<tr>
<td>median (min.-max.)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>One leg hop test:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Injured/non-injured side,</td>
<td>93.7% (53.3 - 123.4)</td>
<td>96.7% (52.5 – 112.0)</td>
<td>0.522</td>
</tr>
<tr>
<td>median (min.-max.)</td>
<td>123.4)</td>
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**Discussion**

This study was performed to give more insight in the long term outcome after ACL injury for patients with a high activity level. The relatively long-term follow-up of more than ten years of two groups of high level athletes with a previous ACL injury can give us more knowledge to further advance our decision making. As expected there was a clear difference in stability in favour of the reconstructed group. However our study showed no significant difference at ten year follow-up between operative treatment or conservative treatment in prevalence of knee OA, meniscal lesions and Tegner score. Neither functional objective (one leg hop) nor subjective scoring (IKDC subjective score, Lysholm) was significantly different. This is in contrast to some other reports showing differences in persistent giving way complaints in two thirds of the ACL ruptured patients.\textsuperscript{25, 26}
There have been relatively few publications about the long term follow-up and the one-incision bone-patella-tendon-bone ACL reconstruction with interference screw fixation compared to conservative treatment\textsuperscript{10,11,27}. None was a randomised clinical trials with operative techniques used nowadays to clarify this problem. This is probably due to patient or surgeons’ treatment preference and ethical concerns. Because of these issues we opted for the presented design, a matched case control study correcting for the three possible known risk factors for outcome; age, gender and activity level\textsuperscript{15}. Both groups had an median pre-trauma Tegner score of 9. This is compatible to a high level competitive pivoting sport such as football. The functional outcome of these two groups showed no difference in the Lysholm and the subjective IKDC scores. This is emphasized by an equal functional level shown by the one leg hop score. These results are similar to previous results from other research done for either conservatively treated or reconstructed ACL injuries\textsuperscript{7,12,26-34}. There is a significant difference between these two groups in the greater objectively measurable instability of the non-operative group at the ten year follow-up. The reconstructed group showed a positive pivot shift in 20\% of the cases, which is compatible with other long term results of present day ACL reconstruction\textsuperscript{35,36}. This high level of rotational instability of the non-operative group with a 84\% positive pivot shift, signifies the severity of instability of this group. This is however, not shown clinically in a difference in co-morbidity, as there is no significant difference in total meniscal lesions 72\% for the reconstructed group and 76\% for the conservatively treated group. This is high number of meniscal lesions has been generally seen in the literature in for instance a 35 year follow-up study of olympic East-German athletes with ACL injury showed a meniscectomy rate of 79\% at ten year follow-up and 95\% at twenty years follow-up \textsuperscript{34}. Our study however shows a significant reduction of the
risk of subsequent meniscal injury in the reconstructive surgery group. One might expect that as a consequence of this there would be a lower ROA. At our ten year follow-up however there is a tendency to have more ROA in the reconstructed group 48% versus 28% in the conservative group. This discrepancy can not be explained at present by the difference in meniscal lesions. A possible explanation could be the operatively induced haemarthos and the intraarticular tunnel bone marrow.

The aim of each individual knee instability treatment is to restore as much as possible the homeostasis of this joint. This will enable each patient to undertake the activities that were previously possible without an increased risk for comorbidity at the short and long term. At present it is still not fully clear which individual will benefit most on the long term with operative or conservative treatment. This study shows that an ACL reconstruction is a good operation to stabilise the knee. This study also shows that a conservative ACL treatment gives these patients the same feeling and functional result as a stable knee.

**Conclusion**

In this pair-matched study of high level athletes with ACL rupture, both the conservatively treated as the operated group, performed similar, except for a higher objectively measurable instability for the conservative group. They however are just as satisfied with their knee without an operation at ten year follow-up. Showing no difference in radiologic OA, meniscal lesions, activity level and functional outcome subjectively and objectively. Therefore conservative treatment should still be considered a treatment option for an ACL insufficient knee, even with a high level athlete.
References


