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Ten year follow-up study comparing conservative versus operative treatment of anterior cruciate ligament ruptures. A matched-pair analysis of high level athletes

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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 10 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: 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 10 year follow up.

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 USA.¹ The prognosis for 2008 in The Netherlands is that 5000 ACL reconstructions will be performed, this is 1 per 3200 inhabitants.² In a more active age group the incidence of ACL injuries could even be as high as 1 per 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 surgically 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 patients benefit from operative versus non-operative treatment. This is partly because there are few prospective studies comparing operative and non-operative treatment of ACL injuries.^{10–11} Linko *et al* summarised in a Cochrane review the evidence concerning this issue and found two studies, published in the early 1980s, 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.^{11–13} Since then the operation technique has improved with the development of reliable fixation devices and the transition from open to arthroscopic surgery. There have been no randomised clinical trials published recently, perhaps due to ethical concerns.

The purpose of this study was to compare treatment in high level athletes who had sustained an ACL rupture. We specifically chose this high demand group as they are considered to have 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 (BPTB) 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 sports activity level.^{14–15} The patient groups were compared with regard to OA of the knee, meniscal lesions, instability, activity level during the 10 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 10 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 10 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 programme. They were re-evaluated 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 to 258 months). A single incision, central one third BPTP technique was used. Tunnel placement was aided by Acuflex tibial and femoral aimers. Tibial tunnel placement was 7 mm anterior of the posterior cruciate ligament. Femoral tunnel placement was at a eleven o'clock position for the right knee and at one o'clock for the left knee (figs 1 and 2). Non resorbable interference screws were used for the tibial and femoral bone

block fixation. Post-operative rehabilitation consisted of protected weight-bearing for the first 4 weeks. After which rehabilitation was intensified. Sports return was allowed after 6 months.

Measurements

At the 10 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 osteoarthritis

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 (DM and JV) 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 anterior cruciate ligament

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 >3 mm side-to-side difference was used to define an instable ACL.



Figure 1 x Ray antero-posterior view of anterior cruciate ligament reconstruction.



Figure 2 x Ray lateral view of anterior cruciate ligament reconstruction.

Activity level

The patient's level of activity was assessed using the classification of Tegner *et al.*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 (IKDC). Both grading system have a maximum score of 100, which means a perfect knee.^{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.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 V.12.1.

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 osteoarthritis

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 10 year follow-up (table 2). Radiological assesment 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 three meniscectomies (12%) in the operative group post-reconstruction compared to

Table 1 Patient characteristics at 10 year follow-up evaluation

	Operative treatment (n = 25)	Conservative treatment (n = 25)	p Value
Gender (men/women)	19/6	19/6	1.000
Age (years), mean (SD*)	37.6 (6.2)	37.8 (6.8)	0.808
BMI (kg/m ²), median (min to max)	25.3 (22.2 to 30.9)	24.9 (20.9 to 28.7)	0.443
Preinjury Tegner score, median (min to max)	9 (6.0 to 10.0)	9 (6.0 to 10.0)	0.831

* Standard deviation.

Table 2 Radiological osteoarthritis at 10 year follow-up

Kellgren & Lawrence, grade	Operative treatment (n = 25) number (%)	Conservative treatment (n = 25) number (%)	Contralateral knees (n = 50) number (%)
0	4 (16)	8 (32)	37 (74)
1	9 (36)	10 (40)	11 (22)
2	9 (36)	4 (16)	2 (4)
3	3 (12)	3 (12)	0 (0)
4	0 (0)	0 (0)	0 (0)

the conservatively treated group with 10 patients (40%) with meniscectomies in the last 10 years (p value of 0.024).

Stability

Both groups differ at our 10 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 their ACL lesion. The highest median Tegner score reached, by the reconstructed group, preoperatively was 4 (min 3 to max 9) but all with giving way complaints during this activity level. Which after reconstruction rose significantly (p value of 0.001) again to a Tegner score of 8 (3–10). After the ACL lesion the conservative group achieved a highest median Tegner score of 7 (min 4 to max10) which was comparable to the previously mentioned Tegner score of 8 (3–10) (p value of 0.420) of the ACL reconstructed group. At the 10 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 to max 9) and 5 (min 1 to 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).

DISCUSSION

This study was performed to give more insight into the long term outcome after ACL injury for patients with a high activity level. The relatively long-term follow-up of more than 10 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 10 year follow-up between operative

Table 3 Knee stability at 10 year follow-up

	Operative treatment (n = 25) number (%)	Conservative treatment (n = 25) number (%)	p Value
KT-1000: max side-to-side difference >3 mm	6 (24)	17 (68)	0.002
Pivot shift			
–0	20 (80)	4 (16)	<0.001
$\geq 1+$	5 (20)	21 (84)	

Table 4 Functional outcome at 10 year follow-up

	Operative treatment (n = 25)	Conservative treatment (n = 25)	p Value
Lysholm score, median (min to max)	88.0 (54.0 to 96.0)	85.0 (38.0 to 100.0)	0.442
IKDC subjective score, median (min to max)	77.1 (47.0 to 97.6)	77.1 (25.3 to 100.0)	0.683
One leg hop test:			
Injured/non-injured side, median (min to max%)	93.7% (53.3 to 123.4)	96.7% (52.5 to 112.0)	0.522

IKDC; International Knee Documentation Committee.

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.^{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.^{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.¹⁵ Both groups had a 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 emphasised 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.^{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 10 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.^{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 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 10 year follow-up and 95% at 20 years follow-up.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 radiological OA. At our 10 year follow-up however there is a tendency to have more radiological OA 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 haemarthrosis 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 in 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 those with 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 similarly, except for a higher objectively measurable instability for the conservative group. They however are just as satisfied with their knee without an operation at 10 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.

Competing interests: None.

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