

Low revision rate and excellent subjective outcome of primary ACL repair with a minimum follow-up of 5 years

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Summary

Introduction: Due to limitations of ACL reconstruction, primary ACL repair has recently regained research interest. Although abandoned in the past, primary repair with conservation of the original ligament demonstrates considerable advantages compared to reconstruction.

We hypothesized that early repair, strictly limited to patients with a proximal ACL rupture and excellent tissue quality of the remaining ACL stump, would lead to equal revision rates and subjective outcomes as reported for ACL reconstruction after a minimum of 5 years.

Methods: In this questionnaire study, patients who had a primary ACL repair between 2002 and 2009 were invited to participate. Besides any potential revision surgery, the Tegner activity scale and the Knee Injury and Osteoarthritis Outcome Score were included in the evaluation.

Results: Out of 1912 patients who had ACL related surgery during the observation period, 221

(11.4%) had a primary ACL repair. 60 patients (61 knees) were available for follow-up. In 2/61 (3.3%) cases ACL revision surgery was performed and one patient had meniscus surgery of the affected side. The median Tegner activity scale was 6 (range, 3 to 10). The mean KOOS subscores were 88.8% (Function/Sports), 86.6% (Quality of life), 94.6 (Symptoms), 94.0 (Pain) and 97.0 (Activities of Daily Living).

Conclusion: Primary ACL repair, strictly limited to proximal ruptures with good tissue quality leads to revision rates and subjective outcome comparable to ACL reconstruction.

Level of evidence: IV.

KEY WORDS: anterior cruciate ligament, outcome, sports injury.

Introduction

Due to discouraging results of clinical studies from the 1970s and 1980s, primary repair of the anterior cruciate ligament (ACL) was more or less abandoned and replaced by surgical reconstruction with autograft or allograft material as the gold standard from the 1990s onwards¹⁻⁵. The clinical results achieved by ACL reconstruction are generally accepted. Nevertheless evident problems are well known, such as graft failure, donor site morbidity, loss of proprioception and the inexact anatomical form of reconstruction^{6,7}. In addition, despite subjective and objective joint stability following reconstruction, the risk for posttraumatic arthritis remains⁸⁻¹⁰.

Because of these ongoing problems, novel approaches to improve outcomes are developed. Only recently, primary ACL repair has regained increasing research interest. A number of preclinical studies demonstrated the potential role of primary repair in combination with modern surgical techniques and enhancing bioactive materials^{7,11-13}. Taylor et al. mentioned that despite the reported unacceptable high failure rates of previously published clinical studies, there constantly was a subset of patients that met the criteria for clinical success¹⁴. Proximal tears of the ACL, good tissue quality and early surgical repair were the main criteria in those patients that achieved satisfying results. In their thorough review, the Authors concluded that improved surgical techniques and appropriate patient selection may resurrect ACL primary repair as a realistic surgical option.

In our institution, early surgical stabilization of ACL tears, including primary repair, has a long tradition and is offered to the patients within 72 hours of injury. Based on the results of preoperative magnetic resonance imaging (MRI) and the findings during arthroscopy, a decision is made whether a primary repair or a surgical reconstruction of the ACL is performed. The option of primary repair is strictly limited to proximal tears and excellent tissue quality of the ACL stump.

It was the aim of the present study to show the revision rate and subjective outcome following primary ACL repair with a minimum follow-up of 5 years. We hypothesized that early repair, strictly limited to patients with a proximal ACL rupture and excellent tissue quality of the remaining ACL stump, would lead to equal revision rates and subjective outcomes as reported for ACL reconstruction. We also examined demographic factors, age and gender, regarding their influence on the different aspects of the reported outcome.

Material and methods

In this study which meets the ethical standard of this journals, using the institutional data base, all patients who received surgical treatment of an ACL injury between January 1, 2002, and December 31, 2009, were identified¹⁵. Only patients having a primary ACL repair as their initial surgical treatment within 72 hours after injury were considered. Patients with injuries to the posterior cruciate ligament, the lateral collateral ligament and/or the posterolateral corner were not included in this study. The decision to perform a primary repair in contrast to an ACL reconstruction was made by the surgeon based on the MRI appearance of the injured ACL and on the findings during the arthroscopic examination (Fig. 1). The indication was strictly limited to proximal ruptures near the femoral insertion site with adequate integrity of the ligament stump.

Surgical technique and postoperative protocol

All surgeries were performed by the senior Author. Technically, the repair was performed arthroscopically. In general, two PDS suture loops were used to reattach the ACL stump to its femoral insertion site. The sutures were stitched through the ACL stump in a 90° angle to each other and then separately guided in an "over the top" direction towards the proximal lateral aspect of the knee joint. The knee was brought near extension, the sutures were tensioned and then tied over a bridge of the iliotibial band that was formed by two separate longitudinal incisions. The procedure was completed by microfracturing of the femoral insertion site of the ACL to stimulate healing response. The postoperative protocol allowed for immediate weight bearing and unrestricted range of motion as tolerated by the patient. In case of concomitant medial collateral ligament injury, brace immobilization for four weeks with free range of motion was



Figure 1. MRI demonstrates a proximal ACL tear. The ligament stump appears to be of adequate length and integrity. Additional arthroscopic examination of the remaining ligament will guide the decision making if a primary ACL repair is possible.

performed. Physiotherapy started immediately, cyclic activities were allowed after 6 weeks and high pivoting activities were prohibited for 4 months.

Questionnaire

The patients were contacted by mail between February 1 and April 30, 2015 and invited to participate in the study. After giving written consent, they were asked to complete a three part questionnaire:

Potential Revision Surgery: The answer was dichotomized (yes/no). Furthermore the time and the type of potential revision surgery was asked (ACL reconstruction, meniscus, other).

Tegner Activity Scale (TAS): The TAS is a standardized scale to grade work and sporting activities. The score varies from 0 to 10. A score of 0 represents disability pension or sick leave because of knee problems, and a score of 10 corresponds to competing at national and international level¹⁶.

The Knee Injury and Osteoarthritis Outcome Score (KOOS): The KOOS evaluates knee-related function on five subscales: symptoms, pain, activities of daily living (ADL), function in sport and recreation (Function/Sports), and knee related quality of life (QoL). A subscore is calculated for each subscale, ranging from 0 (worst) to 100 (best)¹⁷.

Statistical analysis

Mean and standard deviation as well as median were used for descriptive statistics. Data were tested for normal distribution. As all data were non-normal distributed, non parametric Mann Whitney U-test was used for gender comparison regarding TAS and KOOS subscores. A correlation analysis of TAS and KOOS subscores using Spearman’s RHO test was performed to test for any correlation to age.

Results

A total of 1912 patients received surgical treatment of an ACL injury during the observation period. 1688 patients had an ACL reconstruction and were excluded from this analysis. 224 of these patients (11.7%) had a primary ACL repair with the surgical technique as described above and met the inclusion criteria for this study. Out of this group, 60 patients (1 bilateral, 61 knees) were available for follow-up and completed the questionnaire, resulting in a response rate of 26.8%. A detailed overview, including demographics and site of injury is presented in Table I.

2/61 (3.3%) cases had revision surgery of the primarily repaired ACL and consequently received an ACL reconstruction. In one case this was done 23 months after the initial ACL repair, in the other case, this was done after 35 months. One patient had additional meniscal surgery on the affected site, and another two patients answered “yes” because of unrelated surgery in other body regions during the follow-up period. The median TAS was 6, ranging from 3 to 10. Figure 2 presents the results of the KOOS subscores. The mean subscores for “Function/Sports” and “Quality of Life” which are considered to be the most responsive after ACL surgery were 88.8%, and 86.6% respectively. There was no significant gender related

differences of TAS (p=0.08) or of the KOOS (p=0.82). Correlation analysis did not reveal any significant influence of age on the TAS (p=0.95) or on any of the KOOS subscores (p>0.05 for all subscores).

Discussion

The results support the hypothesis that primary ACL repair, strictly limited to proximal ruptures and good tissue quality of the remaining ligament leads to revision rates and subjective outcome comparable to ACL reconstruction. Only 3.3% (2/61) underwent revision surgery and consequent ACL reconstruction during the observation period. Gifstad et al. reported on the revision rates of nearly 46.000 patients using the Scandinavian ACL registries¹⁸. Five years after primary ACL reconstruction, the revision rate was 2.8% for patellar tendon autografts and 4.2% for hamstring autografts. Although their registry based study primarily focused on the revision rates comparing patellar tendon and hamstring autografts, the large number of prospectively gathered patients definitely represent the results of the current gold standard in the treatment of ACL injuries. Other studies using ACL registries showed revision rates between 1.8 and 10.4%¹⁹⁻²². In terms of subjective outcome, the KOOS subscores in the present series, all achieved comparable or higher scores to other ACL outcome studies with a similar observation period. Kvist et al. reported on the subjective results of the Swedish ACL registry using the KOOS²³. Five years after primary ACL reconstruction, the subscores ranged from 66 for “Quality of Life” to 69 for “Function/Sports”. A further breakdown of their study regarding graft choice did not demonstrate any differences in the KOOS subscores. The registry based outcome studies, constantly revealed a higher revision rate of young com-

Table I. Demographic overview of patients available for 5-year minimum follow-up.

	Male	in %	Female	in %
No.	21	35	39	65
Site of surgery				
left	11	52	20	51
right	9	43	19	49
bilateral	1	5	0	0
Age at surgery				
10 - 20	0	0	2	5
20 - 30	1	5	2	5
30 - 40	5	24	4	10
40 - 50	8	38	12	31
50 - 60	4	19	12	31
60 - 70	3	14	7	18

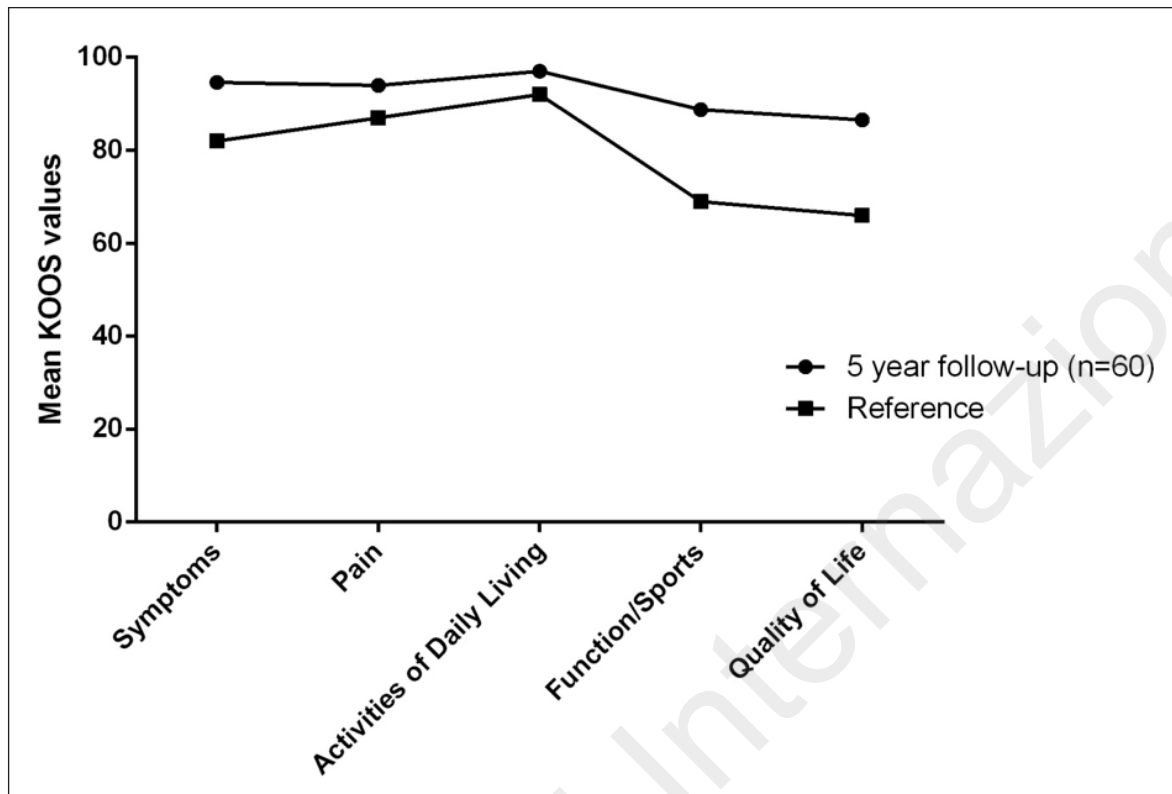


Figure 2. Knee Injury and Osteoarthritis Outcome Score (KOOS) subscores after 5 years minimum follow-up. In comparison to the results of primary ACL reconstruction of a large Scandinavian registry, comparable or higher scores were achieved.

pared to old patients. In the present series, the 2 patients that received revision surgery and ACL reconstruction were 43 and 52 years old when their ACLs were repaired initially. Although this may represent an interesting detail for further consideration, in terms of indication and age limitation, our study population is certainly too small to be able to draw any real conclusions out of this observation.

To our knowledge, the present series is the first in the current literature to report on primary ACL repair with a minimum follow-up of 5 years. There are only a few recent similar studies that describe the clinical results of primary ACL repair. Buechler et al. reported on 45 patients who received an acute ACL repair using a dynamic intraligamentary stabilizing device²⁴. Within 12 months, 3 patients had to undergo revision surgery. The median Tegner score was 7 and the median IKDC was 89.5. Objective stability testing revealed excellent results after 12 months. DiFelice et al. presented a series of 11 patients with a minimum follow-up of two years²⁵. In their series, the ACL was repaired with suture anchors that were inserted in the femoral footprint of the ligament's origin. 10 out of the 11 patients had good subjective and clinical results, with a mean subjective IKDC score of 86.4 and an objective IKDC score of A in 9 of 11 patients. The objective stability testing revealed less than 3 mm side to side difference in all but one patient.

In a systematic review, Taylor et al. pointed out that appropriate patient selection among acute ACL injuries is of crucial importance and should be strictly limited to proximal ruptures with good tissue quality¹⁴. In our series, 224 out of 1912 patients who received surgical treatment of their ACL injury were selected for primary repair. In our opinion, the here presented ratio of around 11.7% that qualified for primary repair in our patient population may serve as a guideline or at least as a reference to compare to for future studies. Achtnich et al. presented a study in which 41 out of 420 ACL related surgeries were considered for primary repair (9.8%)²⁶. 19 patients had their ACL repaired within 6 weeks of injury. In the series of DiFelice et al., 11 out of 190 ACL surgeries were performed as primary repair (5.8%). Their mean delay from injury to surgery was 39 days (range, 10 to 93), whereas in the present series, all primary repairs were done within 72 hours after the injury. The lower ratio of primary repair may be explained by the longer time to surgery. We consider an early surgical repair as being crucial for this treatment regimen, although the ideal treatment window has not yet been demonstrated.

Obviously, there are some considerable drawbacks in our study. First, apart from the revision rate within five years after surgery, we were only able to report on the subjective outcome following primary ACL re-

pair. Objective manual or apparative stability testing could not be included in the present series. The main reason for this is based on the fact that our patient population mainly consists of tourists vacating in the neighbouring ski resorts. Given the present encouraging results of a 5-year revision rate that is comparable to that of the conventional ACL reconstruction, it is certainly our intention to include objective stability testing as well as follow-up MRI studies in any future evaluation within the group of patients that can be reached more easily. On the other hand, measuring different aspects of subjective outcome following ACL surgery using the KOOS has been proven to be a very valuable and effective tool in numerous studies. Second, the present questionnaire study had a low response rate of 26.8% (60/224). However, in comparison with other studies that measured patient-reported outcomes after ACL surgery, our response rate was fairly similar. Bojic et al. compared paper based and electronic surveys following ACL reconstruction using the KOOS²⁷. After 5 years their response rate was 20.9% in the paper-based survey and reached 35.4% in the electronic version.

Conclusion

Early primary ACL repair, strictly limited to proximal ruptures with good tissue quality, resulted in a 5-year revision rate that is comparable to ACL reconstruction. Subjective outcome was equal or better than reported for ACL reconstruction. Further studies that include objective stability testing and imaging are certainly needed to assess ligament healing and mechanical integrity.

Conflict of interest

None of the Authors has any conflict of interest regarding the presented work.

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