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Observational Study
Revision Anterior Cruciate Ligament Reconstruction: Return to Sports at a Minimum of Five-Years Follow-Up

Revision ACLR: RTS at 5 years follow up

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Abstract

BACKGROUND
Between 43% and 75% of patients who undergo primary ACL surgery return to sport activity, however, after a revision ACLR rates of RTS are variable. Few publications report return to sports incidence between 56% to 100% after revision ACLR.

AIM
The purpose of this study was to determine return to sports and functional outcomes after a single-stage revision ACL reconstruction with a 5-year minimum follow-up at a single institution.

METHODS
All patients operated between 2010 and 2016 with minimum 5-years follow-up were included. Type of sport, intensity, frequency, expectation, time to return to sport and failure rate were recorded. Lysholm, Tegner and International Knee Documentation Committee (IKDC) forms were evaluated prior to the first ACL reconstruction surgery, at six month after primary surgery and after revision ACLR at 5 years minimum follow up. Objective stability was tested with the knee arthrometer test (KT-1000 knee arthrometer, Medmetric Corp).

RESULTS
A total of 41 patients who underwent revision ACL reconstruction during that period of time were contacted and available for follow-up. Median patient age at time of revision was 29 years old (IQR: 24-36) and 39 (95%) were male. The median time from revision procedure to follow-up was 70 mo (IQR: 58-81). Regarding return to sports, 16 (39%) at the same level compared to preinjury period and 25 patients (61%) returned at a lower level. Sixty-three percent categorized the sport as very important and 37% as important. One patient (2.4%) failed with a recurrent ACL torn. Mean preoperative Lysholm and subjective IKDC scores were 58.8 (SD 16) and 50 (SD 11), respectively. At follow-up,
mean Lysholm and subjective IKDC scores were 89 (SD 8) and 82 (SD 9) (P = 0.0001). Mean Tegner score prior to primary ACL reconstruction was 6.7 (SD 1.3), 5.09 (1.5 SD) prior to revision ACLR and 5.6 (1.6 SD) at follow-up (P = 0.0002).

Overall, KT-1000 measurement showed an average of 6 mm (IQR 4-6) side-to-side difference of displacement prior to revision ACLR and 3mm (IQR 1.5-4) after revision.

CONCLUSION
Almost 40% of patients returned to preinjury sports level and 60% to a lower level. These may be useful when counseling a patient in regards to sports expectations after a revision ACL reconstruction.

Key Words: Return to sport; Revision ACL; Arthroscopy; knee

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Core Tip: This was a retrospective case series with 41 patients seeking to evaluate Return to sports and clinical outcomes after Revision ACL reconstruction at five years minimum follow up. Retrospective analyzed data included physical examination, Tegner activity level, Lysholm, IKDC, type of sport, intensity, frequency, expectation and time to return to sport. Objective stability was tested with the knee arthrometer test (KT-1000). All data was recorded at the base line and at a five years minimum follow up.

INTRODUCTION
Consequent to a substantial increase in the incidence of anterior cruciate ligament (ACL) ruptures, revision ACL reconstruction (ACLR) have also suffered an increase (1). The ACL re-rupture rate is between 4 to 6%, with the event occurring in the
first two years in more than half of the cases (2-4). The rate of a third ACL rupture is
around 13% to 19% according to different publications (5-7). In addition, these patients
also present an increased risk of developing early arthritis (8).

Historically, return to sports (RTS) is defined as the return to the pre-injury
activity in one or two seasons, at the same sporting level (9). A recently published
consensus describes continuous return to sports in three stages: return to participation,
return to sport and return to previous performance. Thus, return to participation refers
to the return to training or to a lower sporting level than the one practiced by the
patient previously. Return to sport refers to the return to the sport previously
performed, although not at the desired level. Return to previous performance refers to
the return to the same level or a higher level than before the injury. (10)

Between 43% and 75% of patients who undergo primary ACL surgery return to
sport activity (11-15), however, after a revision ACLR the reported rates of RTS are very
variable (16). Causes of non-return to sport are multifactorial and include age, gender,
psychological factors, type of sport, number of previous surgeries, time lapse between
surgeries and graft choice (11)(17-26). Few publications report sports return rates after
revision ACLR, both in the medium and long term, and they vary from 56% to
100%.(28-31)

The purpose of this study was to evaluate the rate of return to sport in patients
with revision ACLR after 5 years of surgery. Secondary purpose was to report the
functional outcomes.

MATERIALS AND METHODS

Study group.

This study was approved by the Ethics Committee of our hospital. A
retrospective study was performed including all patients who underwent a revision
ACLR between 2010 and 2016. The inclusion criteria were patients with traumatic or
atraumatic knee instability with a displacement equal to or larger than 5 mm
anteroposterior compared to the contralateral knee measured with the KT-1000 arthrometer after primary ACL surgery and older than 18 years.

Patients with multiligament injuries (more than 2 Ligaments injured at the same time), second ACL revision and patients with osteotomies at time of revision ACLR surgery were excluded. (Table 1)

Surgical Technique

A single stage revision ACLR was performed in the whole series. A diagnostic arthroscopy was performed in every case and, if necessary, associated meniscal and cartilage lesions were treated. In five patients, allografts were used. Fixation technique was with 2 titanium screws for Bone Tendon Bone (BTB), and in cases of hamstrings or anterior tibial allograft; fixation was performed with a cortical button in the femur and a biocomposite interferential screw in the tibia.

Postoperative Rehabilitation

All patients entered the same rehabilitation protocol with rearrangements for individual needs. Partial loading was allowed for the first three weeks. Passive flexion and extension ROM were carried out. In special cases with complex meniscal sutures or cartilage treatment with mosaicooplasty, full loading was delayed until week six. From the fourth month onwards, low impact workout exercises and progressive muscle strengthening were started. Return to sports was allowed from 10 mo depending on the sport practiced prior to the revision ACLR and based on an evaluation by our rehabilitation team.

Evaluation

Assessment was performed by a single evaluator in this study. Age, gender, follow-up time, injury mechanism prior to revision ACLR, time between primary surgery and re-rupture, time between revision ACLR and return to sport, technique used in both primary surgery and revision ACLR, and associated procedures were recorded.
All patients were asked about the type and level of sport practiced, the motivation to return to sport and the expectation of returning to sport in the three instances: prior to the first ACL reconstruction surgery, after primary surgery and after revision ACLR and the return to sport (RTS). Return to sporting activity was considered to be the return to their sport prior to the last injury, at the same level or below the previous level. Motivation was classified as: very important, important, moderately important, minimally important or not important. The expectation as regards return to sport was classified as: return to the same sport level, return to a lower level or not returning to the same sport. The number of sports practices per week before and after the revision ACLR was recorded.

Using the Tegner score; the type of sport was classified into high impact, moderate and low impact, according to the classification published in 2015 by the American Heart Association (AHA) (32, 41); high impact was considered those with Tegner greater or equal to 7, moderate impact with Tegner between 4 to 6 and low impact with Tegner between 1 to 3.

As regards subjective scores, Lysholm and International Knee Documentation Committee Knee (IKDC) scores were used prior to the revision ACLR and at the last follow-up. For an objective assessment, the KT-1000 arthrometer (Medmetric Corp) was used at the last follow-up.

We defined failure of revision ACLR surgery as ACL re-rupture, whether traumatic or atraumatic, associated with positive pivot shift and a difference in arthrometry with KT-1000 greater than or equal to 5 mm requiring new surgery.

Statistical Analysis

Due to the small sample of patients non sample size calculation were conducted. Continuous variables were described as median and interquartile ranges. Categorical variables were reported as proportions with their absolute frequency. Stata 14 software was used for the analysis. Statistical significance was considered to be $P = 0.05$. 
RESULTS

A total of 87 revision ACLR were performed in the study period, 16 were excluded because of multiligamentary lesions, 8 were second revisions and 10 were associated with osteotomy. Of the 53 patients who met the inclusion criteria, 12 patients were lost during follow-up.

The series consisted of 41 patients with a median follow-up of 70 mo (IQR: 58-81) (Figure 1). Thirty-nine patients were male with a median age of 29 years (IQR: 24-36). Table 1 shows the demographic data.

Surgical data:

A total of 27 (65.8%) patients had concomitant meniscal lesions. The medial meniscus was more frequently injured ($n = 26$), 20 (77%) were treated with meniscectomy, 6 (19%) with repair and 1(4%) meniscal transplantation. Lateral meniscus was injured in 14 patients, all treated with partial meniscectomy. Chondral lesions were found in 5 (12%) patients, 3 (60%) were treated with microfractures and 2 (40%) with chondroplasty (Table 2).

Return to sport:

Prior to the first injury, 35 (85%) patients practiced high impact activities, 5 (12%) moderate and 1 (3%) low impact. After the first ACL surgery, 26 (63%) patients practiced high impact, 12 (29%) moderate and 3 (8%) low impact; 5 years after ACL revision, 19 (46%) continued to perform high impact, 20 (49%) moderate and 2 (5%) low impact (Figure 2). Prior to revision ACLR they practiced: 24 (59%) soccer, 9 (22%) running, 3 (7%) gym, 2 (5%) rugby, 1 (2%) tennis, 1 (2%) cycling and 1 (2%) other.

After primary ACL surgery, 13 (31%) returned to the same level of sport, 26 (64%) to a lower level and 2 (5%) did not return to sport. The rate of return to sport for revision ACLR was 16 (39%) returning to the same level of sport and 25 (61%) to a lower level (Table 3). The time to RTS for both post primary surgery and revision ACLR was 13 mo (IQR 11-15) (Figure 3).
Eighty percent (12/15) of patients without associated procedures and 73% (19/26) of patients with associated procedures returned to the same sports level, with no statistically significant differences ($P = 0.61$). Similarly, we found no association ($p > 0.44$) between the associated procedures performed at the time of revision ACLR surgery and the type of sport.

Regarding impact activity after revision surgery, it is interesting to note that 13% (7) modified their sports practice. When classifying sport according to impact based on Tegner, we recorded a 40% decrease in terms of impact; going from high impact to moderate impact activity and a 2.2% decrease from moderate to low impact at 5 years of follow-up after revision ACLR (Table 4)(Figure 2). Of those who played soccer, one patient changed to tennis, one to functional and one to running. Of those who performed running, one began to perform a pivoting activity (soccer) and the other two modified it to a low-impact activity (bicycle and yoga). This result was not modified for patients older than 40 years, in contrast to what it may be thought that in older patients (older than 40 years) the chances of modifying or abandoning sport is higher.

The frequency with which they practiced sports in a week before and after the revision ACLR was maintained over time, being an average of twice a week (range 1-3); 26 (63%) patients practiced activities twice a week before the revision ACLR and 21 (51%) in post-surgery.

When assessing motivation, 26 (63%) classified it as very important and 15 (37%) as important. When the patients were asked about their expectations regarding the return to sports after their primary ACL surgery, 33 (80%) patients described their intention to return to the same sports level and 8 (20%) to return to a lower level. Regarding their expectation after revision ACLR surgery, 16 (39%) patients intended to return to the same level and 25 (61%) to a lower level. (Table 3)

**Clinical Evaluation:**

According to AHA’s classification in relation to Tegner score, a 40% decrease in impact activities at 5 years postoperatively was registered. Tegner score prior to primary ACL surgery showed that 80.5% performed recreational physical activity, 9.8%
performed their usual light work and 9.8% performed competitive sports activity. After primary ACL surgery, 58.5% performed their usual work, 36.6% performed recreational physical activity and 4.9% performed competitive sports activity. Post revision ACLR, 53.7% performed recreational physical activity, 41.5% performed their usual work/task and 4.9% performed competitive sports activity.

Prior to revision ACLR surgery the Lysholm score was good in 1.9% of the series, 35.8% was fair and 62.3% was poor. For postoperative revision ACLR the score was excellent in 31.7% of the series, good in 56.1%, 7.3% fair and 4.9% poor. The Tegner, Lysholm and IKDC scores are summarized in Table 5.

With the differential KT-1000 arthrometer the median values prior to ACL revision were 5 mm (IQR 4-6) and at last follow-up 3 mm (IQR 1.5-4). Finally, one patient had a failure after ACL revision surgery (2.4%) at 72 mo postoperatively.

DISCUSSION

The main finding of this study was that all patients returned to their sports practice after revision ACLR, 61% at a lower level and 39% of the series returned to the same level prior to revision ACLR surgery.

The rate of return to full sport, according to a systematic review of 48 studies with 5,770 patients, is 82% in patients with primary ACL surgery. Only 63% returned to the same pre-injury sport, but 44% were able to do so at a competitive level (19). Although the literature is more limited for return to sport in revision ACLR surgery, a systematic review of 23 studies with a total of 1090 patients indicated that 85% of patients returned to sport, 53% to their previous sport and 51% returned to a competitive level (16). According to another systematic review, the rate of return to sport in patients with revision ACLR surgery ranges from 56% to 100% (33); similar findings to our series.

There are several factors that influence the return to sport: social, psychological and demographic factors. Age and gender are important factors; men have a 10% higher
rate of return than women and young people (<25 years) have a rate higher than 30% compared to adult patients (19) (20) (31) (33). The longer the time between ACL re-rupture and revision surgery, the lower the rates of return to sport, as well as an increase in associated injuries as revision surgery is delayed (19). In the same way, the graft choice could be a determining factor in the return to sport; however, it has not been deeply studied (27).

In our series the time to return to sport was the same (13 mo) with no significant differences found when dividing the series into those older than 25 years and those younger than 25 years, as well as when differentiating between gender. The median time between ACL re-rupture and revision ACLR was 21 mo (IQR: 3-24). For patients who took more than one year to undergo a revision ACLR, the return to sports was also at 13 mo on average (7 to 26) with no significant differences with the overall rate of sports return (P = 0.64).

Focusing on the graft choice, according to a meta-analysis of 32 studies comparing hamstring and BTB for revision surgeries, an increase in the IKDC, Lysholm, Tegner scores and a decrease in complications and reoperations was observed in favor of hamstrings. (40) In contrast to this, the authors of the study recommend that the graft choice should be based on the circumstances of each patient; to the technique preferred by each surgeon, to the tunnel widening, to the type of graft previously used and the possible availability of allografts, and not so much on the rate of return to sport according to the type of graft. (40) All patients in our series were treated with autografts with the exception of five patients where allograft were used. We did not find significant differences in the time to return in patients where allograft was used, being 13 mo for both groups. The preference of the authors of this study is to use autograft from the same injured knee. This is due to the fact that, according to literature, series of patients with revision surgeries in which autograft was used showed faster rates of return to sport in comparison with those in which allografts were used. (38) (39) The use of contralateral hamstring tendons for revision ACLR surgeries presented similar subjective and objective rates at 5.2 years of follow-up compared to revision surgeries in
which patellar or Achilles tendon allograft was used. (39) In our series we do not have patients operated with contralateral knee grafts.

Several authors recommend that, when evaluating series to assess the return to sports, the Lysholm score should be used together with the Tegner score to be able to more effectively evaluate the sports activity. (34) In our series, Lysholm score after revision ACLR increased by 30% for excellent results considered as greater than 95 points (0% preoperative - 31% postoperative) and decreased by 50% for poor results (62% preoperative - 4.9% postoperative).

For the Tegner scale we observed a decrease of 1.7 points between preoperative primary ACL surgery and postoperative revision ACLR (P = 0.002) showing the decrease in impact activity between primary surgery and revision ACLR. When comparing our series with the literature for both the Lysholm, Tegner and IKDC scores we found results that are close to the mean. (Table 6)

When evaluating the expectation of patients regarding their intention to return to sport after primary ACL surgery, 80% of our series intended to return to the same sport level, while 39% reported this intention prior to revision surgery. (Table 7, case examples). This 40% decrease in the expectation of return to sport is consistent with the literature as shown by a study of 675 patients with a return expectation after primary surgery at one year of 84% and 63% for revision ACLR surgeries (P <0.001 and P = 0.08 respectively). A multivariate logistic regression showed 2 determinant factors for abandoning sports practice, which were having suffered a revision ACLR (P < 0.0001) and being female (P = 0.02); in our series, all of them returned to sports and we did not obtain representative casuistry to make a comparison between genders. (34)

The association between chondral and meniscal lesions showed poor functional results in patients with revision ACLR surgery; the association of chondral lesions at the time of revision surgery showed lower values according to Lysholm score in comparison with patients who did not present it. In the same way, patients who presented this lesion modified their intensity in the return to sports (35-37). Another study showed poor results in Marx, KOOS-QOL and IKDC activity scores after revision
ACL surgery in patients with chondral lesions and low scores for the Marx and KOOS-QOL scores in patients with medial meniscus lesions. (29) The level of return to sports practice was equal or lower in patients who had associated injuries vs patients who did not have associated injuries at the time of revision ACLR surgery. Twelve patients returned to the same level; 3 patients returned to a lower level out of a total of 15 patients who underwent an associated procedure. In our series, 80% (12/15) of the patients without associated procedures and 73% (19/26) of the patients with associated procedures returned to the same sports level, with no statistically significant differences ($P = 0.61$).

Limitations

Among the limitations of our retrospective study, there was no control group of patients with high sports performance, nor a numerical scale detailing the level of return to sports practice, being this a subjective response of patients. No pre- and postoperative strength or resistance test was performed to determine the "level of muscle strength at their return". The series has a heterogeneous group of patients in terms of age and type of sport performed. Although the size of the series is close to those reported in international literature, the number is small. The strength of the study is that is a case series operated in a single institution with a 5-year follow-up after revision ACLR were evaluated.

CONCLUSION

After 5 years of a revision ACLR, 39% returned to the same level than the one before revision ACLR surgery and 61% to a lower level. The 13.2% ($n = 7$) of the series changed their sports practice being a 40% decrease for high impact activity at the time of return. These data could be used to advise patients on the level and timing of sports return.
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