¿Does ACL reconstruction have any influence in meniscal repair?. Sports return, quality of life and failure rate. 2-12 years follow up.

Juan Miguel Rodríguez-Roiz (✉ jmleon42@gmail.com)

Hospital Clinic de Barcelona

Sergi Sastre-Solsona

Hospital Clinic de Barcelona.

Dragos Popescu

Hospital Clinic de Barcelona.

Jordi Montañana Burillo

Hospital Clinic de Barcelona.

Andrés Combalia Aleu

Hospital Clinic de Barcelona

Research article

Keywords: ACL, meniscal repair, meniscal tear, sports return, meniscus

Posted Date: June 17th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-29938/v2>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Objective: few studies have approach in long term follow up of meniscal repair at amateur level, specially studying variables as quality of life and failure rate. We study medium long term clinical results in amateur sports patients, that have required meniscal sutures at our centre, with or without ACL reconstruction. We evaluate the objective function of the knee, as well as patients' return to sports activities, quality of life and the rate of failed repair and study of the possible reasons.

Methods: this was an observational retrospective study, 92 patients were assessed who required a meniscal repair in our centre from april 2007 until april 2018, who regularly perform amateur sports activities (Tegner 4 to 7), minimum follow-up period of 2 years, divided into 2 groups: group 1 isolated meniscal suture (43 cases), group 2 associated to ACL reconstruction (49 cases). Each patient made this tests in 2019: Lysholm and Tegner (validated for spanish) before the meniscal injury and after the surgical procedure, motivation to return to sports activity (Likert scale with 3 items: low, regular or high), quality of life (through SF-12 test).

Results: high return to amateur sports rate (92%), which was even higher in the isolated meniscal repair group in comparison to the group with associated ACL, at a minimum follow-up of 2 years. We have not found statistically significant differences between sports return and: age, gender, injured meniscus, chondral injuries, preoperative Tegner score, or motivation. No significant differences in physical or mental health fields between both groups. Meniscal repair failed in 12 patients (13%), and they finally required a partial meniscectomy, as complications just one debridement for superficial infection of ACL donor zone. Higher rate of failure in isolated bucket-handle tear injuries ($p < 0.0062$). No statistically significant association were found between the other variables studied.

Conclusions: 92% of sports return and low meniscal repair failure rate, even lower when is associated to ACL reconstruction.

1. Background

The meniscus plays a fundamental role in knee biomechanics, acting not only as a joint shock absorber, but also have proprioceptive, lubricating and stability functions. It is well known that after a partial meniscectomy, the incidence rate of knee osteoarthritis increases [1]. Considering this, it is understandable that meniscal repair is the gold standard treatment for damaged menisci in young patients, in repairable cases.

Traumatic meniscus injuries are often associated with anterior cruciate ligament tears, chondral lesions, medial collateral ligament injuries, among others, which can worsen the knee's functional prognosis. In these cases, the objective must be recover function and also the patient's quality of life, a factor which is becoming more and more important and which few studies on this topic take into consideration [1,2].

30% to 60% of anterior cruciate ligament (ACL) tears are associated with meniscal or chondral injuries at the time of their index reconstruction [3,4,5], specifically the lateral meniscus the most common. The lateral meniscus has different structural and functional properties than the medial meniscus than explains this situation, first a lack of attachments to the popliteal hiatus and collateral ligament, a relative greater mobility, that reduce the risk of ruptures, that's the reason this meniscus is rarely affected in a stable knee [6].

Regarding the role of the menisci as secondary stabilizers within the knee, it is well known that the clinical results of anterior cruciate ligament (ACL) reconstruction are markedly impaired by the presence of concurrent meniscal injury. Anterior drawer was not increased significantly after medial meniscectomy when the further increase in tibial anterior translation of up to 5.8 mm [7], thus highlighting the importance of the meniscus-meniscal ligament construct as a secondary joint stabilizer in synergy with the ACL.

Similarly, the meniscus act as secondary restraints to tibial internal–external rotation. Wang and Walker [8] found that meniscectomy increased the range of rotation 5° from a mean of 18–23°, at 0.5 Nm torque. The laxity was further increased if the ligaments were excised: removal of ACL and PCL (posterior cruciate ligament) increased laxity 23°, while removal of both role of this ligament is unclear and its influence on the overall meniscal biomechanics remains elusive. It has been reported to serve in some specimens as the primary attachment of the anterior horn of the medial meniscus and proposed to act as a restraint to anterior subluxation and excessive posterior translation when the menisci are under load [9]. Finally, it is also believed that it acts as a tie between the menisci that controls their relative positioning on the tibial plateau when the tibia rotates.

Failure rates of meniscal repair is "low" (<15%) and is lower when is associated to ACL reconstruction [6]. It has been reported that ACL reconstruction provides a positive biomechanical environment for the meniscus to heal (6). The clinical picture of this situation is controversial [10]. Several studies have reported both higher and similar healing rates with concomitant ACL reconstruction [11-13].

The most of literature about meniscal repair and ACL reconstruction is focused in the professional athlete, that is not the "day by day" patient in clinics worldwide, so maybe the results that we found in literature couldn't be extrapolated to the most of the cases, that situation can raise high expectations for both, surgeon and patient.

The medium follow-up of most of studies about this topic is around 2-5 years, so the long term results, specially in amateur level, hasn't been studied enough and these time periods may represent a range in which also simple partial meniscectomy usually provides acceptable results

Today, variables as quality of life and patients satisfaction, are studied much more than 10 years ago. But about meniscal repair/ACL reconstruction there is just a few studies that review this important outcome.

The purpose of the present study was investigate the medium to long-term (2-12 years) clinical results of amateur sports patients , who underwent isolated meniscal repair or combined with ACL reconstruction, specifically:

- Determine the rate of amateur sports return. Using the Tegner scale for determine the sports than patient practice before injury, and the actual sport, and determine not only if the patient returns, also if them return to the same tegner sports level. We also study if there is a difference in sports return between patients than required an isolated meniscal repair, and the patients that also required an ACL reconstruction. The patient motivation to come back to sports practice is measured.
- Functional results measured by Lysholm score
- Quality of life and satisfaction with the treatment performed, using SF-12 test, evaluating mental and physical scale.
- Failure rate of meniscal repair and the possible reasons to explain that cases of failure, diagnosing the meniscal repair failure combining clinical and MRI results.

The hypothesis is that patients in both groups (isolated meniscal repair, or with an ACL reconstruction) will have high sports return values, with higher functional and quality of life outcomes in the patients with isolated meniscal repair than the ACL reconstruction group, but with less meniscal repair failure in this last group. Also higher motivated patients will have higher return to sports rates and in less time.

2. Methods

A consecutive series of traumatic meniscal tear cases operated at our centre with arthroscopic meniscal suture with or without ACL reconstruction were assesed retrospectively, between April 2007 and April 2018, a total of 380 patients

Inclusion criteria

- 1) Patients between the ages of 13 and 55 who regularly perform recreational sports activities (Tegner 4 to 7, minimun 3 times/week), with a minimum follow-up period of 2 years
- 2) Patients were divided in 2 groups; group 1 (isolated meniscal repair) and group 2 (meniscal repair with ACL reconstruction), were assessed through online/in-person questionnaires, filled in between April and November 2019, including the following tests: Lysholm and Tegner (validated for spanish) before the injury and after the surgical procedure, motivation to return to sports activity (Likert scale with 3 items: low, regular or high), quality of life (through SF-12 test), and meniscal repair failure (all cases diagnosed by a MRI with compatible symptoms, and a second surgery was required). Data about type of meniscal injury and type of repair, was obtained from surgical report.

3) An observational retrospective study was conducted, according to the WMA Declaration of Helsinki, and was reviewed and approved by our institutional review board (document attached).

Exclusion criteria

- 1) Patients with less than 13 years, or more than 55 years at the time of surgical intervention
- 2) Isolated ACL reconstruction or with a meniscectomy (no repair)
- 3) Sedentary patient or professional athlete
- 4) Prior surgeries on the injured knee
- 5) Degenerative chondral injuries (Outerbridge III or more), including maximum Outerbridge type II chondral injuries.
- 6) Discoid meniscus or multiligamentous injuries
- 7) Postoperative follow-up of less than one year, patients impossible to locate or those who did not want to participate in the study.
- 8) Patients that need meniscal root reinsertion, or meniscal ramp reconstruction.

Finally, 92 patients were included in the study, divided into 2 groups: group 1 corresponded to the patients that required isolated meniscal suture (43 cases), group 2 included the cases that required meniscal suture associated to ACL reconstruction (49 cases).

Group 1 (isolated meniscal suture) included 43 patients, 28 men and 15 women, with an average age of 32.18 years (13-47 years), with an approximate follow-up period of 7 years (2-12.5 years). The interval between injury and surgical intervention was an average of 11.74 months (1-50 months). An average of 2 meniscal sutures (1.93) was used in each case (1 to 3) (Table 1).

Group 2 (ACL reconstruction plus meniscal suture) included 49 patients, 35 men and 14 women, with an average age of 29.71 years (16-54 years), with an approximate follow-up period of 6 years (2-12.5 years). The interval between injury and surgical intervention was an average of 16.48 months (2-80 months). An average of 2 meniscal sutures (1.73) was used in each case (1 to 3) (Table 1).

TABLE 1. Demographic characteristics of both groups

	Group 1 (Isolated meniscal repair)	Group 2 (Concomitant ACL)
Number of cases	43	49
Sex		
Male	28 (65,12%)	35 (71,43%)
Female	15 (34,88%)	14 (28,57%)
Age at the time of surgery	32,19 (13-52)	29,71 (14-54)
Motivation to sports return		
Low	5 (11,63%)	3 (6,12%)
Regular	15 (34,88%)	16 (32,65%)
High	23 (53,49%)	30 (61,22%)
Affected knee		
Right	25 (58,14%)	28 (57,14%)
Left	18 (41,86%)	21 (42,86%)
Meniscal lesions		
Right	28 (65,12%)	38 (77,55%)
Left	15 (34,88%)	9 (18,37%)
Both	0 (0%)	2 (4,08%)
Type of meniscal lesion		
Simple		
Bucket handle		
	33 (76,74%)	45 (91,84%)
	10 (23,26%)	4 (8,16%)
Repair technique		

All inside		
Both	36 (83,72%)	47 (95,92%)
	7 (16,28%)	2 (4,08%)
Number meniscal sutures		
1		
2-3		
4 or more	9 (20,93%)	19 (38,78%)
	28 (65,12%)	24 (48,98%)
	6 (13,95%)	6 (12,24%)
Chondral injuries	3 (6,98%)	1 (2,04%)
Reoperation (second surgery)	7 (16,28%)	5 (10,12%)
Type of second surgery		
Partial Meniscectomy		
Debridement	7 (100%)	4 (80%)
	0	1 (20%)

2.1 SURGICAL TECHNIQUE

All patients were evaluated, as usual, by an internal medicine or anesthesiologist before the surgical procedure. Surgical procedure was performed in supine position, under spinal anesthesia plus endovenous sedation, with the affected knee flexed and with a pneumatic tourniquet cuff on the ipsilateral thigh.

In all cases, arthroscopic meniscal suture was performed through 2-3 conventional arthroscopic portals (anterolateral, anteromedial and accessory anteromedial), and the chosen suture technique was the Fast-Fix type all-inside suture (Smith-Nephew) and outside-in suture specifically for body and anterior horn injuries (less usual). Length of the suture was usually 16mm for internal meniscus and 18 mm for lateral meniscus. In all the cases with internal meniscus injury we perform a "pie-crust" of the superficial internal collateral ligament to have more space and avoid iatrogenic chondral injuries. We usually made a

conscious debridement of meniscal borders before the repair, and also microfractures in the medial femoral condyle on favor to the meniscal healing process.

In the cases that required ACL reconstruction, the hamstring autograft was the graft of choice in our study. In all cases, we initially obtained the autograft following the traditional technique with a surgical incision near the anterior tibial tuberosity in the proximal-medial tibia. Graft was measured and bony tunnels were drilled based in that size. An anatomical reconstruction technique was used in all cases.

Femoral tunnel is always drilled in knee hiperflexion ($>110^\circ$) using anteromedial portal and using landmarks to select the anatomical position. In some cases we use a lateral knee X-ray intraoperatively to confirm the position. Endobutton system (Smith-Nephew) was used in all cases for femoral fixation, and for tibial fixation we use bioreabsorbable screws always tightened in knee semi-flexion (15°) and performing a posterior draw force. Surgical closure with stitches as usual, and we usually use 2 drainages for 24 hours, one for graft donor zone and another intra-articular.

2.2 Rehabilitation and postoperative protocol

Patients who underwent isolated meniscal repair and those who underwent meniscal repair with ACL reconstruction completed the same postoperative rehabilitation program.

Patients were discharged home 24 hours after surgery. In all cases, a Don-Joy knee brace was placed maximum at 60° of flexion. For the first 2 weeks, patients make non weight-bearing with help of 2 crutches and begin immediate rehabilitation treatment: local anti-inflammatory treatment + progressive passive knee kinesiotherapy + isometric quadriceps exercises. After 2 weeks, they were authorised to begin walking with progressive partial weight-bearing. One month after surgery, they were authorised to flex to 90° for 1-2 weeks, as well as full weight-bearing. On week 6 after surgery, the brace was maintained without flexion limitation and they began walking independently without crutches.

2.3 OUTCOME MEASURES

LYSHOLM SCORE

The Lysholm Knee Scoring Scale has an extended use beyond evaluating outcomes of knee ligament surgery. It can also be used for meniscal tears, knee cartilage lesions, osteochondritis dissecans, traumatic knee dislocation, patellar instability, patellofemoral pain, and knee osteoarthritis.

Consist of eight items that measure: pain (25 points), instability (25 points), locking (15 points), swelling (10 points), limp (5 points), stair climbing (10 points), squatting (5 points), and need for support (5 points). Every question response has been assigned an arbitrary score on an increasing scale. The total score is the summatory of each response to the eight questions, and may range from 0-100. Higher scores indicate a better outcome with fewer symptoms or disability.

A study developed by Briggs et al [14] showed that Lysholm questionnaire have acceptable test-retest reliability, floor and ceiling effects, criterion validity, construct validity, and responsiveness to change. Finally, the questionnaire itself is relatively easy for patients to complete and does not have a complicated scoring methodology.

TEGNER ACTIVITY SCORE

The Tegner activity scale was first described in 1985 and initially designed for physician administration after ACL and meniscal injuries. To date, the Tegner activity score has been a frequently used patient-administered activity rating system for patients with various knee disorders

The Tegner Activity Scale classifies both sports and work activities into one questionnaire using an 11-level gradient. Competitive sports make up the top three levels (levels 10-8), competitive and recreational sports categories both appear in level 7, and "other recreational sports" make up level 6. Levels 5 through 1 combine work and sports together, and level 0 indicates sick leave or disability because of the knee condition.

MOTIVATION TO SPORTS RETURN

Motivation involves the internal processes that give behaviour its energy and direction. Motivation originates from a variety of sources (needs, cognitions and emotions) and these internal processes energize behaviour in multiple ways such as starting, sustaining, intensifying, focusing, and stopping it. (15)

We use a unipolar Likert scale question type for measure this value. For the question: ¿How much motivated you are for return to your sports activities?. The three options were: 1) Low motivated, 2) More or less motivated, 3) Highly motivated.

SF-12 HEALTH SURVEY TEST

The 12-item Health Survey (SF-12) was developed as a shorter alternative to the SF-36 for use in large-scale studies, and its reliability and validity have been documented [16]. All 12 items are used to calculate the physical and mental component summary scores (PCS-12 and MCS-12) by applying a scoring algorithm empirically derived from the data of a US general population survey. The SF-12 test ranges from 0 to 100, where a higher score implies a better quality of life regarding to health [17,18].

2.3 STATISTICAL ANALYSIS

Statistical analysis were performed using SPSS version 23.0 (IBM. New York, USA). The following descriptive variables were calculated: mean, standard deviation, median, range, frequency and percentage. The normality of the distribution for measured outcome variables was evaluated using the Kolmogorov-Smirnov test. An independent sample t-test was used to detect differences between

preoperative and postoperative outcome scores for all outcomes measured. The alpha level of significance was set at $p < 0.05$.

3. Results

In 92 cases, 7 meniscal repair failures (16.27%) occurred in the group 1 (isolated meniscal repair) and 4 failures (8.16%) in the group 2 (ACL reconstruction plus meniscal repair); the mean time until a tear reoccurred was 2.7 years (range, 1.3-4.4 years) and 5.0 years (range, 0.8-7.5 years), respectively. When analysing subgroups of patients with recurring tears compared to the group of patients that did not require another surgery, we observed that those with a higher frequency of bucket-handle injuries were the ones that failed. No differences have been found with regard to the presence of an ACL injury or the number of sutures used. (Table 2).

In this study the meniscal repair failed in 12 patients (13%). We observed a higher rate of suture failure in isolated bucket-handle tear injuries in comparison to other types of meniscal injuries, which is a statistically significant difference ($p < 0.0062$). We didn't find clinically significant differences with regard to recurring tears when comparing all-inside technique with cases using the hybrid technique (outside-in + all-inside). Statistically significant association between the other variables studied and meniscal repair failure were not found: age, gender, knee laterality, injured meniscus, number of sutures used, preoperative Tegner score, time between injury and surgical intervention or chondral injuries (Table 2).

<u>Table 2. COMPARATIVE BETWEEN CASES WITH MENISCAL FAILED SUTURE VS CASES WITH SUCCEFULL RECONSTRUCTION</u>

-	FAILED MENISCAL SUTURE	SUCCESSFUL MENISCAL REPAIR	P
sex	-	-	<u>0,19</u>
MALE	<u>10 (83,33%)</u>	<u>53 (66,25%)</u>	
FEMALE	<u>2 (16,67%)</u>	<u>27 (33,75%)</u>	
AGE	<u>29,92</u>	<u>31,01</u>	<u>0,67</u>
Motivation to sports return	-	-	<u>0,52</u>
LOW	<u>3 (25%)</u>	<u>5 (6,25%)</u>	
REGULAR	<u>2 (16,67%)</u>	<u>29 (36,25%)</u>	
HIGH	<u>7 (58,33%)</u>	<u>46 (57,5%)</u>	
Knee side	-	-	<u>0,95</u>
right	<u>7 (41,67%)</u>	<u>46 (57,5%)</u>	
left	<u>5 (58,33%)</u>	<u>34 (42,5%)</u>	
injured meniscus	-	-	<u>0,67</u>
internal	<u>9 (75%)</u>	<u>57 (71,25%)</u>	
external	<u>3 (25%)</u>	<u>21 (26,25%)</u>	
both		<u>2 (2,5%)</u>	
type of meniscal injury	-	-	<u>0,0062</u>
simple	-	-	
bucket handle	<u>7 (58,33%)</u>	<u>71 (88,75%)</u>	
	<u>5 (41,67%)</u>	<u>9 (11,25%)</u>	
repair technique	-	-	-
all inside	<u>9 (75%)</u>	<u>74 (92,5%)</u>	<u>0,057</u>
both	<u>3 (25%)</u>	<u>6 (7,5%)</u>	<u>0,29</u>
Number of meniscal sutures	-	-	-
1	-	-	<u>0,68</u>

2-3	<u>2</u> (16,67%).	<u>26</u> (32,5%).	-
4 or>	<u>8</u> (66,67%).	<u>44</u> (55%).	
	<u>2</u> (16,67%).	<u>10</u> (12,5%).	
Chondral injuries	<u>1</u> (8,33%).	<u>3</u> (3,75%).	<u>0,49</u>
LYSHOLM medium score	<u>83,92</u>	<u>87,31</u>	<u>0,51</u>
SF12-MCS (mental)	<u>55,33</u>	<u>54,86</u>	<u>0,81</u>
SF12-PCS (physical)	<u>50,5</u>	<u>52,85</u>	<u>0,4</u>
TEGNER	-	-	-
PREOP	<u>5,33</u>	<u>5,62</u>	<u>0,48</u>
POSTOP	<u>4,08</u>	<u>5,56</u>	<u>0,001</u>
	-	-	-
TIME FROM INJURY TO SURGERY (MONTHS)	-	-	-
	<u>10,92</u>	<u>14,77</u>	<u>0,12</u>

3.1 Lysholm score

Lysholm test was used for objective measure of functional knee results. Group 1 (isolated meniscal repair) have higher medium Lysholm (89,34) than group 2 (meniscal repair with ACL reconstruction) with 84.69 (table 3), but the small difference was not statistically significant (p 0,10). Difference can be easily answered because the association between ACL tear and meniscus usually means a higher joint damage and a more complex surgery and rehabilitation process, than an isolated meniscal tear.

Group 1 (isolated meniscal suture) included 43 patients, 28 men and 15 women, with an average age of 32.18 years (13-47 years), with an approximate follow-up period of 7 years (2-12.5 years). The interval between injury and surgical intervention was an average of 11.74 months (1-50 months) (Table 1). The average Lysholm test was 89.34 (58-100), indicating excellent results (95-100) in 15 patients (35%), good results (84-94) in 20 cases (47%), fair results (65-83) in 6 cases (14%), and poor results (<64) in only 2 cases (4.65%) (Table 1).

Group 2 (ACL reconstruction meniscal suture) included 49 patients, 35 men and 14 women, with an average age of 29.71 years (16-54 years), with an approximate follow-up period of 6 years (1-12.5 years). The interval between injury and surgical intervention was an average of 16.48 months (2-80 months). The average Lysholm test was 84.69 (15-100), indicating excellent results (95-100) in 10 patients (20.40%), good results (84-94) in 27 cases (55.1%), fair results (65-83) in 8 cases (16.32%), and poor results (<64) in only 4 cases (8.16%) (Table 3).

None statistically significant differences between both groups were found (p 0.10).

Table 3. COMPARATIVE PATIENT SCORES BETWEEN BOTH GROUPS.			
-			
-	<u>Group 1 Isolated meniscal repair</u>	<u>Group 2 Concomitant ACL</u>	<u>P</u>
-	-	-	-
<u>Time from injury to surgery (months)</u>	11,74 +/- 11,28	16,49 +/- 13,30	0,06
-	-	-	-
<u>Lysholm score</u>	89,35 +/- 10,66	84,7 +/- 16,10	0,10
-	-	-	-
<u>SF12-PCS (physical)</u>	52,51 +/- 8,5	52,57 +/- 7,01	0,97
<u>SF12-MCS (mental)</u>	55,83 +/- 8,09	54,12 +/- 7,77	0,30
<u>Tegner scale</u>	-	-	-
-	-	-	-
<u>Preoperative</u>	-	-	-
<u>Postoperative</u>	5,11 +/- 1,37	6 +/- 0,98	0,59
	5,46 +/- 1,44	5,31 +/- 1,43	

3.2 Tegner activity score

In group 1, with an average follow-up period of 7 years (2-12.5 years), patients presented a discrete increase in their baseline Tegner score from 5.11 (+/-1.37) to 5.46 (+/-1.44). Of the 43 patients, only 2 did not return to exercise.

In group 2, with an average follow-up period of 6 years (1-12.5 years), patients presented a discrete decrease in their baseline Tegner score from 6 (+/-0.98) to 5.31 (+/-1.43). Of the 49 patients, 5 did not return to exercise.

No statistically significant differences were found regarding to the pre- and postoperative Tegner score in either group (p 0.59), or regarding giving up amateur sports activities (Table 3).

3.3 SF-12 Health Survey Test

Our study revealed no statistically significant difference both physical and mental areas from SF-12 (p 0,97 and p 0,30) between the group of patients with isolated meniscal suture or ACL reconstruction when it comes to quality of life (SF-12) with similar results , with little influence from chondral injuries also, although it must be noted that our study only included Outerbridge stage 2 chondral injuries at the most (Table 2).Chondral injuries at the time of ACL reconstruction have more medium-term impact on quality of life (quantified by SF-12) and functional recovery (WOMAC) than meniscal injuries; subsequently, patients with chondral injuries also have worse results for these variables [6,18,19,20].

In group 1, all patients except three declared they were very satisfied with the postoperative outcome in both physical and mental health fields (ranging from 30.8 to 63.5 and 32 to 68, respectively), and further indicated they would practice the same procedure under the same circumstances if needed (Table 3).

In group 2, all patients except six were very satisfied with the postoperative outcome in both physical and mental health fields (ranging from 26.93 to 63 and 26 to 68,respectively) (Table 3).

No significant differences were found between both groups regarding to physical or mental health fields (Table 3).

3.4 COMPLICATIONS AND RE-INTERVENTIONS

The principal cause for re-intervention in our series was due to meniscal suture failure, and one case of local debridement (donor zone) with no other relevant complication requiring further surgery (septic arthritis, ACL re-rupture, etc.). We considered meniscal suture failure in patients with persistent or recurrent symptoms attributable to meniscal injury worthy of another surgical intervention. In all cases, the clinical diagnosis was confirmed with an MRI and a partial arthroscopic meniscectomy was subsequently performed on the failed repair area. In group 1, out of 43 patients, the meniscal suture failed in 7 cases (16.28%); 6 cases of medial meniscus repair (2 bucket-handle tears), 1 case of lateral meniscus repair. There were 4 cases of all-inside suture, and 3 cases of hybrid technique (all-inside and inside-out). In 4 cases 2-3 sutures had been used, in 2 cases, 4 sutures or more, and in 1 case, one suture.

The average time between both surgeries was 3.17 years (8 months-11 years), with an average age group of 33 years (17-47 years).

In group 2, out of 49 cases, the meniscal suture failed in 5 cases (10.20%); 2 cases of lateral meniscus repair, 3 cases of medial meniscus repair (1 bucket-handle tear). In all cases an all-inside suture had been performed: in 1 case with 1 suture, and in 4 cases with 2 to 3 sutures. The average time between both surgeries was 3.6 years (1 -7 years), with an average age group of 26 years (18-32 years).

All cases of meniscal suture failure required a partial meniscectomy, and were reevaluated at 2 years later with the same initial tests.

Cumulative incidence values for failure were determined along with their 95% CIs for the various demographic predictors analysed during Cox proportional hazards regression (Table 2). No single variable was found to predict increased failure incidence over time.

4. Discussion

Good clinical results after meniscal repair with or without ACL reconstruction were obtained, with a low suture failure rate and few complications. We found a statistically significant difference ($p < 0,001$) in meniscal repair failure between groups. In group 1 (isolated meniscal repair) 7 of 43 repairs fail and required a partial meniscectomy, in group 2 (ACL reconstruction associated) just 4 of 49, therefore ACL reconstruction must have a "protective influence" on meniscal repair. A systematic review by Paxton et al [21] showed an overall reoperation rate of 24% after meniscal repair compared with 14% when performed in conjunction with ACL reconstruction, and this relation was maintained even when analyzed by specific repair methods and devices.

In a study of reoperations after meniscal repair, with and without concomitant ACL reconstruction, Wasserstein et al [22]. concluded that meniscal repair performed in conjunction with ACL reconstruction carries a 7% absolute and 42% relative risk reduction of reoperation after 2 years compared with isolated meniscal repair.

Potential explanation for better results when meniscal repair is associated to ACL reconstruction, both in literature and in our study, could be the blood and bone marrow cells that are liberated after drilling bony tunnels, the biomechanical stability that ACL reconstruction gives to the knee explains that results, the relatively limited patient activity, and maybe the less aggressive rehabilitation after combined procedures. Also we found a higher failure for internal meniscus repair (9 failures in 66 repairs) than external (3 fails of 24 repairs), not significant difference, but can be explained by the stability of meniscus, external meniscus have higher mobility on the tibial plateau so it has more resistance to shear forces [23,24].

The outside-in suture has traditionally been considered the gold standard of meniscal repair, although recent studies have found similar results with all-inside suture techniques, and, specifically in bucket-handle tears, no clinically significant differences have been found in the medium term between all-inside

or inside-out meniscal sutures [10,11]. Biomechanical studies show the same resistance to load-bearing in both repair techniques [24,25].

The literature reports an incidence of meniscal retears ranging from 20% to almost 40%. The risk factors for meniscal retears were the size (length of the tear), the presence of a complete tear, and a positive pivot-shift test finding (residual instability) [26].

Traditionally, many experts consider age to be a key factor, ruling out the possibility of meniscal repair in patients over 50 years of age. A recent meta-analysis did not find differences between repair and recurring meniscal tear rates in patients over 40 years of age in comparison to younger patients [27]. We agree with recent literature; we have not observed statistically significant differences between the patient's age and the failure rate of meniscal repair (Table 2).

The type of repair is also important, with several studies proving higher resistance and lower recurring tear rates in vertical sutures compared to horizontal sutures [2,8,14]. Indeed, perhaps this is one of the reasons behind the low recurring tear rate in our series, since in almost all cases we tended to use vertical sutures.

In all the patients who presented a meniscal suture failure that required partial meniscectomy, we observed a statistically significant ($p < 0.001$) logical decrease in the Tegner scale (with regard to the initial preoperative score), and an equally lower return rate to sports activities. Nevertheless, when assessing medium to long term, we observed in our series that from functional (Lysholm) and quality-of-life (SF-12) point of view, patients in this group ended up with very similar results to those with a successful meniscal suture. For this reason, we consider selective partial meniscectomy to be a valid option to be considered in cases of failed suture.

Returning to sports activities is one of the fundamental objectives of meniscal reconstructions, with or without ACL reconstruction. The literature describes a very high percentage of patients that return to sports activities satisfactorily [28,29]. Our series also revealed a high return rate (92%), which was even higher in the group 1 (isolated meniscal repair) in comparison to group 2 (ACL associated) (Table 4), which can be explained by the further complexity of ACL injuries, but no statistically difference were found ($p = 0.38$).

Known factors affecting sports return include graft type, patient age, baseline activity level, sport type, and athletic experience within the sport.

No statistically significant association were found between returning to sports activities and: age, gender, injured meniscus, lysholm score, chondral injuries, preoperative Tegner score, or motivation to return to sports activities (Table 4).

As a curiosity, we find higher Lysholm medium score in patients than abandoned sports (91,5) than who returned (85), difference no statistically significant (table 4, $p = 0.51$). This shows that sports return is

somewhat complex, and need more than just a good functional knee, motivation and another psychosocial factors made an important influence[30].

Table 4. COMPARATIVE BETWEEN PATIENTS THAT RETURN TO SPORTS AND THOSE WHO ABANDONED.

-	ABANDONED SPORT	SPORTS RETURN	P
NUMBER OF CASES	<u>7</u> (7,6%).	<u>85</u> (92,4%).	-
sex	-	-	
MALE	<u>4</u>	-	
	-	<u>59</u>	
FEMALE	<u>3</u>	<u>26</u>	
AGE	<u>31,85</u>	<u>30,78</u>	-
Motivation to sports return	-	-	<u>0,18</u>
LOW	<u>1</u>	<u>7</u>	
REGULAR	<u>4</u>	<u>27</u>	
HIGH	<u>2</u>	<u>51</u>	
Affected knee	-	-	-
right	<u>7</u>	<u>46</u>	
left	<u>0</u>	<u>39</u>	
injured meniscus	-	-	-
internal	<u>6</u>	<u>60</u>	
external	<u>1</u>	<u>23</u>	
both	<u>0</u>	<u>2</u>	
type of meniscal lesion	-	-	-
simple	-	-	
bucket handle	<u>4</u>	<u>74</u>	
	<u>3</u>	<u>11</u>	
repair technique	-	-	-
	-	-	-
all inside	<u>6</u>	<u>77</u>	
both	<u>1</u>	<u>8</u>	
Number of meniscal sutures1	-	-	<u>0,68</u>
2-3	-	-	-
4 or>	-	-	
	<u>2</u> (16,67%).	<u>26</u> (32,5%).	
	<u>2</u> (16,67%).	<u>44</u> (55%).	

		<u>10 (12,5%).</u>	
Chondral injuries	<u>1 (8,33%).</u>	<u>3 (3,75%).</u>	<u>0,49</u>
LYSHOLM	<u>91,5</u>	<u>85</u>	<u>0,51</u>
SF12-MCS (mental)	<u>54,65</u>	<u>58,14</u>	<u>≤0,001</u>
SF12-PCS (physical)	<u>52,72</u>	<u>50,43</u>	<u>≤0,001</u>
TEGNER score	-	-	-
PREOP	<u>5,33</u>	<u>5,62</u>	<u>0,48</u>
POSTOP	<u>4,08</u>	<u>5,56</u>	<u>0,001</u>
	-	-	-
TIME FROM INJURY TO SURGERY (MONTHS)	-	-	-
	<u>10,92</u>	<u>14,77</u>	<u>0,12</u>
GROUP	-	-	-
Group 2 ACL+meniscal repair	-	-	-
	<u>5</u>	<u>44</u>	<u>0,38</u>
Group 1 Isolated meniscal repair	-	-	-
	<u>7</u>	<u>36</u>	<u>0,38</u>

Preop and postop Tegner score with small difference in both groups and no statistically significant difference (p 0,59) (table 3), Tegner activity scores decrease specially in group 2 (from 6 +/- 0,98 to 5,31 +/- 1,43) for reasons unrelated to the potential function of the knee (we obtained high lysholm scores postop) , that is, by factors unrelated to knee function such as a different social setting in midlife with less time for amateur sports and more focus on family and career.

We obtain similar Lysholm scores than literature. Zheng X et al [31] reported Lysholm values of 87.7 + 8.5 with a medium follow-up of 2 years in ACL reconstruction with autograft. Shirish et al [32] found a medium lysholm score of. 91,4 at 2 years follow up of meniscal repair and ACL reconstruction.

About quality of life, Fuch et al found high outcomes in quality of life in isolated meniscal repair, with a follow up of 3 years , measured by KOOS QOL, with a medium score of 81.8 ± 12.1. [33].

In a recent retrospective study by Cinque et al [34] in 85 patients with ACL reconstruction with or without meniscal repair, they found similar outcomes in quality of life than our study, using SF-12 they found in

physical components medium value of 52,8, and in mental components they found 53,2 as medium value. Therefore they didn't found a statistically significant difference between age and quality of life outcomes.

Motivation for sports return is fundamental in the rehabilitation of this knee injuries, because is a hard process, both physically and mentally, so if the patient is "goal oriented" to come back to sport, is pretty sure this gonna boost the process. The problem is that maybe highly motivated athletes can push too further the process and maybe early overload the knee and potentially damage the meniscal repair. We didn't find statistically significant difference between motivation and meniscal successful repair or failure ($p = 0,34$) (table 2).

51 of the 53 highly motivated patients return to sports, but 7 of 8 low motivated also return. We didn't find either a statistically significant difference ($p = 0,18$).

Brewer et al [35] prospectively examined the relationship between psychological factors and rehabilitation outcomes after ACL reconstruction in 95 patients. Self-motivation, athletic identity, and psychological distress were significant preoperative predictors of objective outcomes such as knee laxity. However, postoperative rehabilitation adherence did not affect rehabilitation outcomes.

Nwachukwu et al [36]. in a recent systematic review find that the ideal psychological measure of sports return should consider factors including willingness, motivation, and fear of returning both preoperatively and postoperatively.

More studies are necessary to establish the validity and general usability of such questionnaires in patient populations of different sporting activity levels

4.6 LIMITATIONS

The limitations of our study need to be acknowledged. First, the strict inclusion criteria meant that the cohort sizes were fairly small. Larger sample sizes would be required to match patients based on additional criteria, such as number of sutures.

The study was retrospective in nature, and thus, analysis was limited to the data available in the medical record database, and with potential for selection bias. Second we define a meniscal successful repair as the absence of meniscal symptoms or a normal MRI, but we don't have second-look arthroscopy confirmation, this was only performed in the cases than repair failed.

Third we don't use objective probes (as KT-1000, etc) to test the knee stability, specially after ACL reconstruction, we just use Lysholm as the indicator for instability. We assume that sports return and absence of symptoms is good enough, but studies with larger sample of amateur sports players, and

more objective test will be needed to confirm our results. Another weakness of the study is the lack of radiographic evaluations that might have correlated with the patient reported outcome scores.

Despite these limitations, our study focused specifically on the isolated repair of meniscal tears in ACL-intact knees versus repair with concomitant ACL reconstruction at amateur level.

Conclusions

In our study, patients that required meniscal suture presented good clinical progress, both from the point of view of returning to sports activities, quality of life (measured by SF-12), and the functional condition of the knee in the medium and long term. The failure rate of meniscal suture is relatively low (12% in our study), and is even lower when associated to ACL reconstruction, so this must have a protective function from a mechanic and also biological way, we found higher meniscal repair failure in isolated internal meniscus repair than external meniscus, and this specially in bucket-handle injuries. Age and time from injury until surgery doesn't seem to influence in meniscal repair failure.

Abbreviations

ACL: ANTERIOR CRUCIATE LIGAMENT

Declarations

Availability of data and materials: not applicable

Acknowledgements: not applicable

Authors contributions:

JMRR determines the idea and design of work, also acquisition of data, data analysis, work with SPSS, and intensive literature review

DP obtained the cases, made intensive literature review

JMB helps with the design of work, with the statistics analysis and interpretation of data, and used software SPSS.

SS obtained the cases, helps with the idea and design of work

AC helps with the idea and design of the study, also provides the university resources for literature review.

Each author read, revised and approved the manuscript.

Ethics approval and consent to participate: informed consent for participation in the study from patients under 16 years old, was obtained from their parent or guardian.

This study was performed in accordance with the [Declaration of Helsinki](#) and have been approved by the hospital ethics committee with data january 2019 (document attached).

Competing interest: no author have any kind of competing interest.

Funding: no funding available for this study

Consent for publication: not applicable.

References

- 1) Barber FA, Herbert MA, Richards DP. Load to failure testing of new meniscal repair devices. *Arthroscopy* 2004;20(1):45-50.
- 2) Barber FA, Herbert MA, Schroeder FA, Aziz-Jacobo J, Sutker MJ. Biomechanical testing of new meniscal repair techniques containing ultra high-molecular weight polyethylene suture. *Arthroscopy* 2009; 25(9):959-967
- 3) Boenisch UW, Faber KJ, Ciarelli M, Steadman JR, Arnoczky SP. Pull-out strength and stiffness of meniscal repair using absorbable arrows or ti-cron vertical and horizontal loop sutures. *Am J Sports Med* 1999;27:626–31.
- 4) Cinque ME, Chahla J, Mitchell JJ, et al. Influence of Meniscal and Chondral Lesions on Patient-Reported Outcomes After Primary Anterior Cruciate Ligament Reconstruction at 2-Year Follow-up. *Orthop J Sports Med*. 2018;6(2).
- 5) [Everhart JS](#), [Higgins JD](#), [Poland SG](#), [Abouljoud MM](#), [Flanigan DC](#): Meniscal repair in patients age 40 years and older: A systematic review of 11 studies and 148 patients. [Knee](#). 2018.;25(6):1142-1150.
- 6) Haklar U, Donmez F, Basaran SH, Canbora MK. Results of arthroscopic repair of partial- or full-thickness longitudinal medial meniscal tears by single or double vertical sutures using the inside-out technique. *Am J Sports Med*. 2013;41(3):596-602.
- 7) [Allen CR](#), [Wong EK](#), [Livesay GA](#), [Sakane M](#), [Fu FH](#), [Woo SL](#). Importance of the medial meniscus in the anterior cruciate ligament-deficient knee. [J Orthop Res](#). 2000 Jan;18(1):109-15.
- 8) Wang CJ, Walker PS. Rotatory laxity of the human knee joint. *J Bone Joint Surg Am*. 1974; 56: 161–170.
- 9) Nelson EW, LaPrade RF. The anterior intermeniscal ligament of the knee: an anatomic study. *Am J Sports Med* 2000; 28:74–76.
- 10) Epple JJ, Dunn WR, Wright RW. Meniscal repair outcomes at greater than five years: a systematic literature review and meta-analysis. *J Bone Joint Surg Am* 2012;94(24):2222-2227.

- 11) Uzun E, Misir A, Kizkapan TB, Ozcamdalli M, Akkurt S, Guney A. Factors affecting the outcomes of arthroscopically repaired traumatic vertical longitudinal medial meniscal tears. *Orthop J Sports Med.*2017;5(6).
- 12). [Vaquero-Picado A](#), [Rodríguez-Merchán EC](#). Arthroscopic repair of the meniscus: Surgical management and clinical outcomes. *EFORT Open Rev.*2018; 8;3(11):584-594.
- 13)Wasserstein D, Dwyer T, Gandhi R, Austin PC, Mahomed N, Ogilvie-Harris D. A matched-cohort population study of reoperation after meniscal repair with and without concomitant anterior cruciate ligament reconstruction. *Am J Sports Med.* 2013;41: 349-355.
- 14) Karen K. Briggs, Mininder S. Kocher, William G. Rodkey, J. Richard Steadman. Reliability, Validity, and Responsiveness of the Lysholm Knee Score and Tegner Activity Scale for Patients with Meniscal Injury of the Knee., *J Bone Joint Surg Am* 2006, 88 (4) 698-705.
- 15) Ross, M. Relation of implicit theories to the construction of personal histories. *Psychological Review* 1989, 96, 341-357
- 16) Ware JE, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996; 34:220-233.
- 17) [Hagino T](#), [Ochiai S](#), [Senga S](#), [Yamashita T](#), [Wako M](#), [Ando T](#), [Haro H](#). Meniscal tears associated with anterior cruciate ligament injury. *Arch Orthop Trauma Surg* 2015; 135(12):1701-1706.
- 18) Han SB, Shetty GM, Lee DH, Chae DJ, Seo SS, Wang KH, [Yoo SH](#), [Nha KW](#). Unfavorable results of partial meniscectomy for complete posterior medial meniscal root tear with early osteoarthritis: a 5- to 8-year follow-up study. *Arthroscopy* 2010.(26):p.1326–32.
- 19) Akoto, R., Albers, M., Balke, B Bouillon, J Hoger. ACL reconstruction with quadriceps tendon graft and press-fit fixation versus quadruple hamstring graft and interference screw fixation – a matched pair analysis after one year follow up. *BMC Musculoskelet Disord* 2019. **20**, 109.
- 20)Michalitsis S, Vlychou M, Malizos KN, Thriskos P, Hantes ME. Meniscal and articular cartilage lesions in the anterior cruciate ligament-deficient knee: correlation between time from injury and knee scores. *Knee Surg Sports Traumatol Arthrosc* 2015;23(1):232–9.
- 21)Paxton ES, Stock MV, Brophy RH. Meniscal repair versus partial meniscectomy: A systematic review comparing reoperation rates and clinical outcomes. *Arthroscopy* 2011;27:1275-1288.
- 22) Wasserstein D, Dwyer T, Gandhi R, Austin PC, Mahomed N, Ogilvie-Harris D. A matched-cohort population study of reoperation after meniscal repair with and without concomitant anterior cruciate ligament reconstruction. *Am J Sports Med* 2013;41:349-355.

- 23) Popescu D, Sastre S, Garcia AI, Tomas X, Caballero M. [MR-arthrography assessment after repair of chronic meniscal tears](#). *Knee Surg Sports Traumatol Arthrosc* 2015;23(1):171-7.
- 24) Rimmer MG, Nawana NS, Keene GC, Percy MJ. Failure strengths of different meniscal suturing techniques. *Arthroscopy* 1995;11:146–50
- 25) Miao Y, Yu JK, Ao YF, Zheng ZZ, Gong X, Leung KK. Diagnostic values of 3 methods for evaluating meniscal healing status after meniscal repair: comparison among second-look arthroscopy, clinical assessment, and magnetic resonance imaging. *Am J Sports Med* 2011;39:735-742
- 26) Matsushita T, Nagai K, Araki D, et al. Factors associated with the status of meniscal tears following meniscal repair concomitant with anterior cruciate ligament reconstruction. *Connect Tissue Res* 2017;58:386-392.
- 27) Nepple JJ, Dunn WR, Wright RW. Meniscal repair outcomes at greater than five years: a systematic literature review and meta-analysis. *J Bone Joint Surg Am* 2012;94:2222–7.
- 28) [Rodríguez-Roiz JM, Caballero M, Ares O, Sastre S, Lozano L, Popescu D](#). Return to recreational sports activity after anterior cruciate ligament reconstruction: a one- to six-year follow-up study. [Arch Orthop Trauma Surg](#) 2015.;135(8):1117-22.
- 29) [Samuelsen BT, Johnson NR, Hevesi M, Levy BA, Dahm DL, Stuart MJ, Krych AJ](#). Comparative Outcomes of All-Inside Versus Inside-Out Repair of Bucket-Handle Meniscal Tears: A Propensity-Matched Analysis [Orthop J Sports Med](#) 2018. 15;6(6).
- 30) Lentz TA, Zeppieri G Jr, George SZ, et al. Comparison of physical impairment, functional, and psychosocial measures based on fear of reinjury/lack of confidence and return-to-sport status after ACL reconstruction. *Am J Sports Med*. 2015;43:345-353.
- 31) [Zheng X, Hu Y, Xie P, Li T, Feng YE, Gu J, Gao S](#). Clinical outcomes and second-look arthroscopic findings of anterior cruciate ligament reconstruction with autograft, hybrid graft, and allograft. [J Orthop Surg Res](#). 2019 Nov 21;14(1):380.
- 32) Shirish Pathak, M.S., Abhinav Bharadwaj, M.S., Prateek Patil, M.S., Sudarshan Raut, M.S., Srikanth RV. Functional Outcomes of Arthroscopic Combined Anterior Cruciate Ligament Reconstruction and Meniscal Repair: A Retrospective Analysis. *Arthroscopy, Sports Medicine, and Rehabilitation* 2020; 2(2): e71-e76.
- 33) Andreas Fuchs, Ferdinand Kloos, Gerrit Bode, Kaywan Izadpanah, Norbert P. Südkamp, Matthias J. Feuch. Isolated revision meniscal repair – failure rates, clinical outcome, and patient satisfaction. *BMC Musculoskeletal Disorders* (2018) 19:446
- 34) Mark E. Cinque, Jorge Chahla, Gilbert Moatshe, Nicholas N. DePhillipo, Nicholas I. Kennedy, Jonathan A. Godin, Robert F. LaPrade. Outcomes and Complication Rates After Primary Anterior Cruciate Ligament Reconstruction Are Similar in Younger and Older Patients. [Orthop J Sports Med](#). 2017 Oct 2;5(10)

- 35) Brewer BW, Cornelius AE, Van Raalte JL, Tennen H, Armeli S. Predictors of adherence to home rehabilitation exercises following anterior cruciate ligament reconstruction. *RehabilPsychol* 2013;58:64-72.
- 36) Benedict U. Nwachukwu, Joshua Adjei, Ryan C. Rauck, Jorge Chahla, Kelechi R. Okoroha, Nikhil N. Verma, Answorth A. Allen, Riley J. Williams. How Much Do Psychological Factors Affect Lack of Return to Play After Anterior Cruciate Ligament Reconstruction? A Systematic Review [Orthop J Sports Med](#). 2019 May 22;7(5)