

Functional outcome and return to sport following surgical treatment of distal hamstring tears

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Background: Distal hamstring tears are rare, but recovery and rehabilitation are long, and this event is associated with a risk of loss of function. Surgery is often necessary for complete tears. The long-term results and the return to sport (RTS) have not been extensively studied in these cases.

Purpose: The goal of this study was to evaluate the functional outcome, the RTS and the complications two years after surgical management of distal hamstring tears. We hypothesized that surgical treatment of these distal tears would be associated with a good functional outcome and a satisfactory RTS with few complications or recurrent tears.

Methods: A retrospective cohort study was performed in 22 patients who underwent surgery for an acute or chronic distal hamstring tear between 2008 and 2022. At least two years after surgery the UCLA, PHAS and Tegner scores were recorded as the primary outcome criteria. The Return to sport rate, the time to return to sport, and any complications were recorded as secondary criteria.

Results: There were two lost to follow-up. Twenty patients were analyzed. The mean follow-up was 4.5 years. Injuries were acute at surgery in 80% of cases. At the final follow-up the median PHAS score was 99.5, the median UCLA score was 10.0 and the median Tegner score was 7.0. Most patients (90%) had returned to their preinjury sport at the same level or higher than before surgery. The mean RTS time was 4.0 months. There was no significant difference between functional scores before and after surgery. One patient presented with a postoperative flexion deformity that was successfully treated with physiotherapy. There were no recurrent injuries.

Conclusion: This retrospective cohort study shows that surgical treatment of distal hamstring tendon ruptures yields good functional results, a high and rapid return to sports, and few complications.

What this study adds: This study provides mid-term outcome data on a rare injury, showing that surgical repair of distal hamstring tendon ruptures results in excellent functional outcomes, a high rate of return to sport (90%), a rapid mean return-to-sport time of 4 months, and a low complication rate without recurrent tears.

Potential impacts on research, practice, or policy: These findings support surgical management—particularly in active patients seeking return to sport—and provide benchmark functional scores and return-to-sport timelines to guide patient counseling and rehabilitation planning.

Study Design: Retrospective cohort study

Level of evidence: Level III

Keywords: Hamstring; Avulsion tear; Reinsertion; Excision; Knee

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Introduction

Hamstring injuries account for approximately 29% of all sports-related muscle injuries, with an estimated recurrence rate of between 12% and 31% [1]. Among the various types of hamstring tendon tears (proximal, at the muscle belly, and distal), distal tears are the least common, but their treatment

now tends toward a surgical approach, although there is no consensus on this to date [2].

The most frequently injured tendons are the semitendinosus (76.5%), then the biceps femoris (17.6%) and less frequently the semimembranosus (5.9%). Full tears are more frequent (89.7%) than partial tears. Although isolated distal hamstring ruptures are rare, their consequences can be serious, particularly in athletes [3][4][5][6]. They require extensive

rehabilitation and have a high risk of recurrence, which can limit the RTS [7].

Magnetic Resonance imaging (MRI) is the reference diagnostic tool for these injuries [8][9][10][11]. While injuries to the muscle belly often respond to conservative treatment, proximal or distal tendon insertion tears may require surgery [5].

Early surgical management of distal hamstring tears is associated with promising results with a RTS of 92.3 % after a mean 4.2 months. Conservative management may result in a delay in the RTS (approximately 7.6 months after the injury) and in numerous cases (53.6%) require secondary surgical treatment [12][13][14].

However, there are very few studies in the literature on the surgical management of hamstring tears, with mainly small series [12][13][15][16][17].

Despite the significant clinical and functional impact of these injuries, studies evaluating the long-term functional outcome and the benefits of different therapeutic strategies are lacking.

Objectives

The goal of this study was to evaluate the functional outcome of the surgical management of distal hamstring

tears and the RTS after two years of follow-up.

Materials and Methods

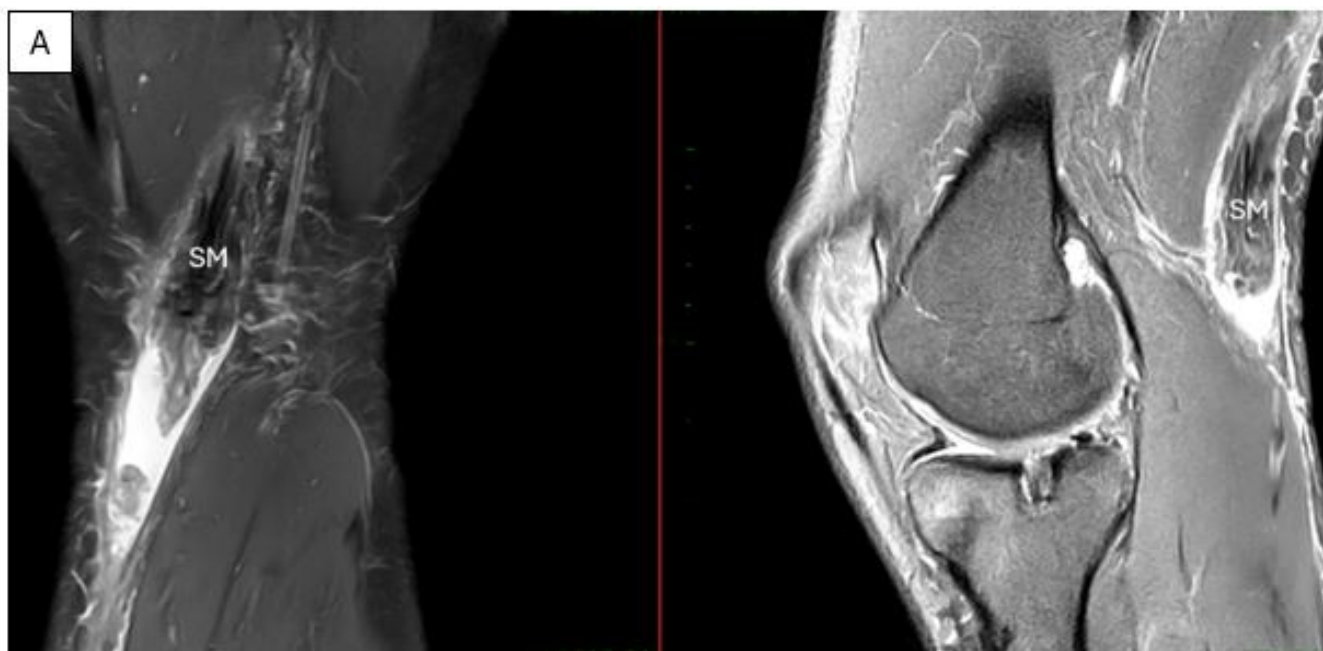
Study design and inclusion

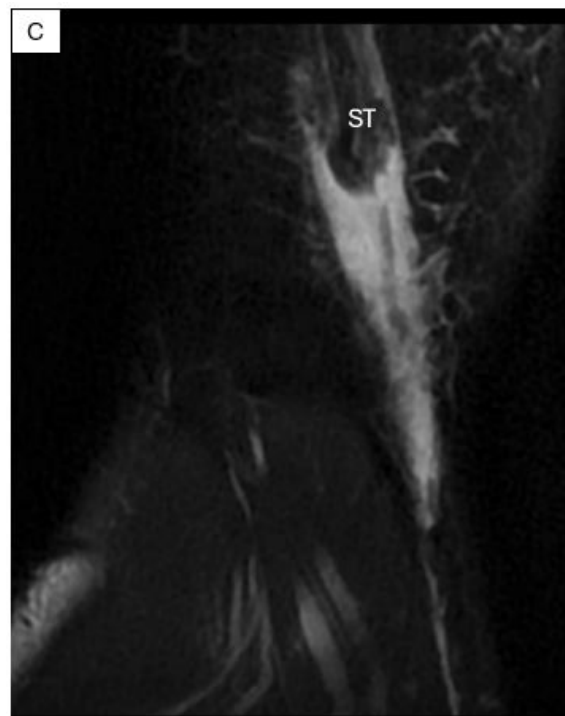
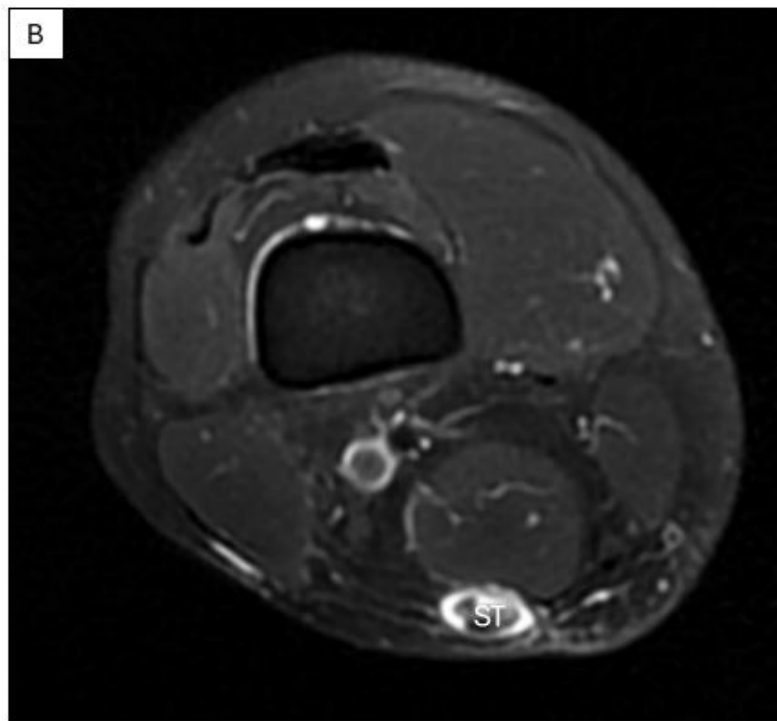
This retrospective cohort study was performed in a reference center specialized in sports surgery between December 2024 and January 2025 for the Proximal Hamstring Avulsion Surgery Cohort Study (PHAS, ClinicalTrials.gov identifier **NCT02906865**).

This study was approved by the ethics committee of our center. Patients provided informed consent during their first medical visit.

Inclusion criteria were the following: acute or chronic distal tear of one or several of the hamstring tendons, confirmed on preoperative MRI (**Figure 1**), and surgical management with a postoperative follow up of at least two years. Patients with associated pathologies affecting lower limb function were excluded.

Injuries were defined as acute if they had occurred less than 4 weeks before surgery or as chronic if they occurred after that.





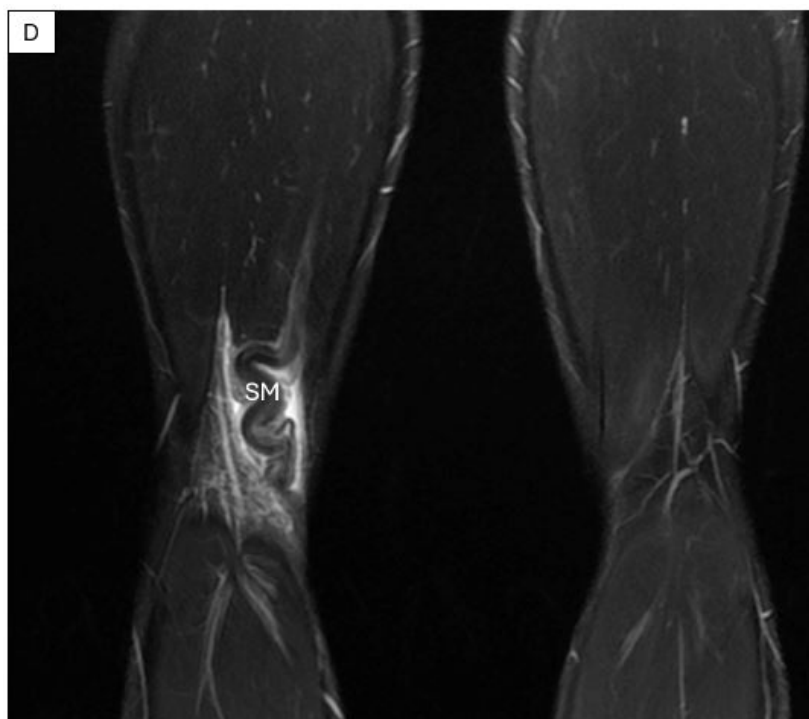


Figure 1. Preoperative MRI. (A) Semimembranosus distal tendon avulsion, (B) Axial MRI avulsion of the semitendinosus, (C) Coronal MRI semitendinosus tear, (D) Coronal MRI semimembranous tear. SM : semimembranous tendon; ST : semitendinosus tendon

Indications, Surgical technique and Postoperative Rehabilitation Protocol

Indications

Surgical indications were acute or chronic complete distal, semitendinosus, biceps femoris or semimembranosus tears confirmed on MRI.

Surgical Technique

- Repair technique (**Figure 2**)

Insertion tears were reinserted on surgical anchors:

Patients were in the supine position. One of two approaches was used depending on tendon retraction. The first approached was centered on the retracted stump and the second on the pes anserinus or the fibular head for biceps femoris injuries. The stump was resected, then, if necessary, tunneled from the proximal approach towards the pes anserinus or the fibular head, depending on the injury.

The tendons were then reinserted on absorbable suture anchors (Mitek Lupine™ Loop Anchor). A complementary staple can be added.

Overlap sutures were used for muscle belly tears:

The patient is in the supine position. The approach is centered on the tear. Both ends of the tear are dissected then sutured with 3cm of overlap suture using braided absorbable sutures (Ethicon).

- Stripping technique

Chronic retracted tears of the semitendinosus were treated by stripping the tendon stump. In fact, in these chronic cases, tendon retraction and tissue degeneration of the tendon stump make surgical reinsertion impossible. The patient is in the prone position. The incision is made at the posteromedial thigh at the tendon stump. The retracted stump is dissected, and the stump is stripped distally to proximally.

Postoperative Rehabilitation Protocol

Postoperative rehabilitation in patients who underwent surgical reinsertion and the overlap suture technique included protection of the suture with an adjustable articulated knee brace in 50° flexion position, in which flexion was progressively reduced for 6 weeks, with no stretching for 12 weeks, and no proprioception exercises for 4 months. The splint in the knee flexion position protected the tendon reinsertion by reducing tension on the reinserted tendon.

Patients who underwent stripping were not immobilized and began rehabilitation more quickly with immediate mobilization of the knee without limitation.





Figure 2. Reinsertion of semitendinosus on anchors and staple. ST : Semi tendinosus tendon

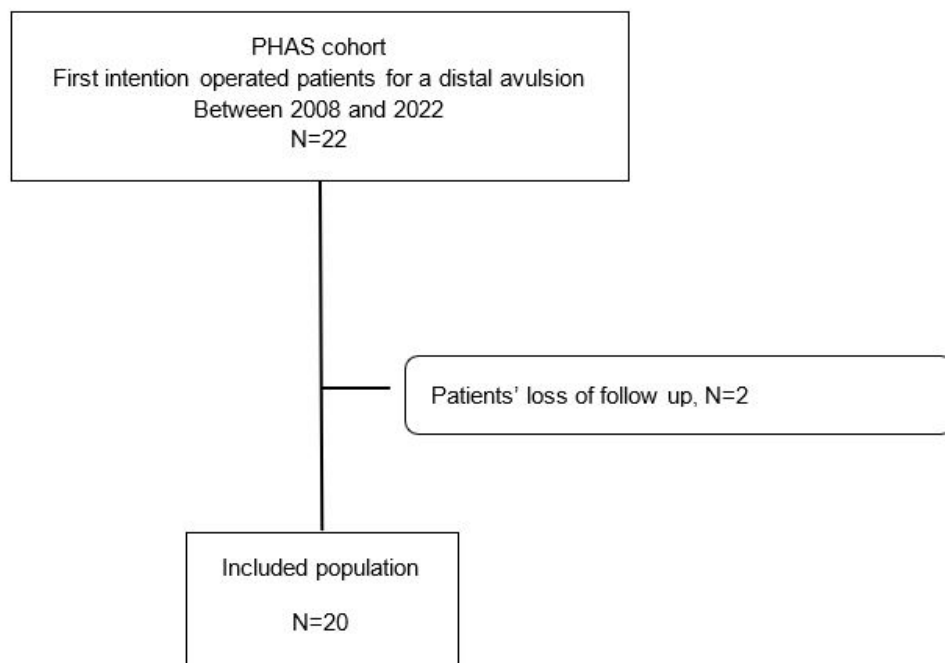


Figure 3. Study population

Table 1. Descriptive Analysis of the Population Before Surgery

	N = 20
Age (years), mean (sd)	34.2 (10.2)
Gender	
Male	20 (100.0%)
BMI (kg/m^2), mean (sd)	25.6 (2.7)
Side of the injury, N(%)	
Right	8 (40%)
Left	12 (60%)
Sports type, N (%)	
Contact pivot (foot, hand, rugby, basket, judo)	13 (65%)
Noncontact pivot (tennis, ski, badminton, volley...)	1 (5.0%)
Non pivot (jogging, cycling, swimming)	5 (25%)
No sport	1 (5.0%)
Level of sport	
Professional	10 (50.0%)
Competitive	5 (25.0%)
Regular leisure	4 (20.0%)
Occasional leisure	1 (5.0%)
Accident circumstances	
Sport accident	18 (90%)
Work accident	1 (5.0%)
Domestic accident	1 (5.0%)
Tendon, N(%)	
Semi tendinosus	11 (55.0%)
Biceps	5 (25.0%)
Semimembranosus	2 (10.0%)
Semitendinosus, Semimembranosus	1 (5.0%)
Biceps, Semimembranosus	1 (5.0%)
Type of injury	
Acute < 4 weeks	16 (80.0%)
Chronic > 4 weeks	4 (20.0%)
Median TEGNER score before injury (IQR)	7.0 (7.0,10.0)
Median UCLA score before injury (IQR)	10.0 (9.0,10.0)

BMI : Body mass index

Outcome measures

The main outcome criteria were the postoperative functional score results 2 years after surgery. The PHAS (Parisian Hamstring Avulsion Score) [18] score is a tool to evaluate function in patients after surgical reinsertion of the hamstrings. Although this functional score is validated for proximal hamstring tendon avulsions, it appears that its items, particularly pain, muscle weakness, and their impact on daily life and sports, as well as an assessment of overall functional quality, make it relevant for evaluating patients with distal hamstring tendon injuries. The Tegner score [19] is a scale that complements the functional score and classifies professional and athletic activities numerically. The UCLA [20] score is a subjective scale that measures an individual's level of physical activity after orthopedic surgery

Secondary outcome criteria were the rate of patients with a RTS at the preinjury level at the final follow-up RTS rate and the time to the postoperative RTS at the preinjury level.

Data collection

Data were collected using the medical data collection software, WebSurvey. Retrospective data were collected from November 2024 to January 2025, and mainly included data provided by patients at the final follow up for the PHAS, Tegner and UCLA scores as well as their sports activity.

Participants and sample size

Our PHAS cohort included 22 patients operated for a distal hamstring injury between 2008 and 2022. We had 2 lost to follow-up patients that were not analyzed (**Figure 3**). Our study population included 20 patients (**Table 1**).

Statistical analysis

Percentages were used to describe categorical variables and continuous variables were described using means and standard deviations (SD) or medians and interquartile intervals (IQR), depending on whether the variable was normally distributed (evaluated by the Shapiro-Wilk test). Comparisons between functional scores at different time points for the same population were made using paired Mann-Whitney-Wilcoxon tests, as the variables of interest were not normally distributed. $P < 0.05$ was considered to be significant for all comparisons.

R Software was used to perform all analyses (version 4.2).

Results

Demographic characteristics (Table 1)

The mean age at surgery was 34.2 years old (SD 10.2). All patients were men. A contact pivot sport was played by 13/20 (65 %) patients, in particular, 10/20 (50 %) played soccer. Half of the patients were professional athletes. A sports injury was the cause of the tear in 18/20 (90 %) patients while 5% of cases were non-sports work-related accidents and 5% were domestic accidents.

Characteristics of distal hamstring injury (Table 1)

In 18/20 (90%) cases, only one tendon was involved. Isolated semitendinosus injuries were found in 11/20 (55.0%) cases, an isolated biceps tendon injury in 5/20 (25.0%) and semimembranosus injuries in 2/20 (10 %). The remaining cases involved several associated tendon injuries. Surgery was performed on acute tears in 16/20 (80%) cases. Surgical management included reinsertion on a suture anchor in 11/20 (55 %) cases, direct sutures in 5/20 (25 %) cases, and stripping in 4/20 (20 %) cases.

The median preinjury Tegner score was 7.0 (IQR 7.0,10.0) and the median preinjury UCLA score was 10.0 (IQR 9.0,10.0).

Patient reported outcome measures

At the final follow-up the median Tegner score was 7.0 (IQR 5.0,9.0), the median UCLA score was 10.0 (9.0,10.0), and the median PHAS score was 99.5 (IQR 95.0,99.5).

There were no recurrent tears (**Table 2**). One patient with a postoperative flexion deformity was successfully treated with rehabilitation by physical therapy with extension posture work.

The preoperative and postinjury PHAS, Tegner and UCLA scores, were significantly lower than those at the final follow-up ($p < 0.05$) (**Figure 4**).

There was no significant difference between the preinjury and final postoperative follow-up Tegner and UCLA scores (**Table 3, Figure 4**), were not significantly different.

Return to sports

The mean postoperative follow-up was 4.5 years (SD 3.0) (**Table 2**). Patients returned to their preinjury sport in 18/20 (90%) of cases. Two patients did not return to their initial sporting activity after the injury. The first, a 33-year-old professional athlete, chose to end his sporting career following surgery. The second, who practiced judo as an amateur, stopped this discipline but turned to soccer, with excellent functional results. Sixteen of the 18 patients who returned to their preinjury sport (88.9 %) RTS at an equivalent or higher level and 2 (11.1%) RTS at a lower level.

Patients returned to sport after a mean 4.0 months (SD 3.5).

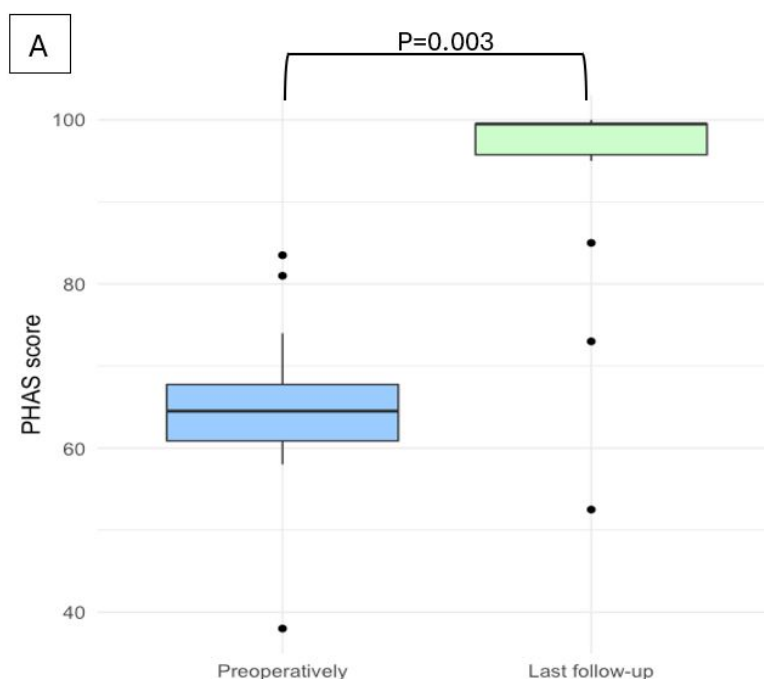
Table 2. Final follow-up, RTS and functional scores

	N=20
Follow-up in years, mean (sd)	4.5 (3.0)
Median TEGNER score at final follow-up (IQR)	7.0 (5.0,9.0)
Median UCLA score at final follow-up (IQR)	10.0 (9.0,10.0)
Median PHAS score at final follow-up (IQR)	99.5 (95.0, 99.5)
Return to preinjury sport RTS rate	
Yes	18 (90.0%)
No	2 (10.0%)
If yes, level of return	
Same or higher	16 (88.9%)
Lower	2 (11.1%)
Mean time to return to sport in months RTS time (sd)	4.0 (3.5)

RTS R: Return to sport rate; RTP T: Return to sport time; IQR : interquartile range; sd : standard deviation

Table 3. Preinjury and Final Follow-Up Functional Score Comparisons

	Preinjury	Final Follow-Up	p-value
Median UCLA score (IQR)	10.0 (9.0,10.0)	10.0 (9.0,10.0)	0.84
Median TEGNER score (IQR)	7.0 (7.0,10.0)	7.0 (5.0,9.0)	0.50



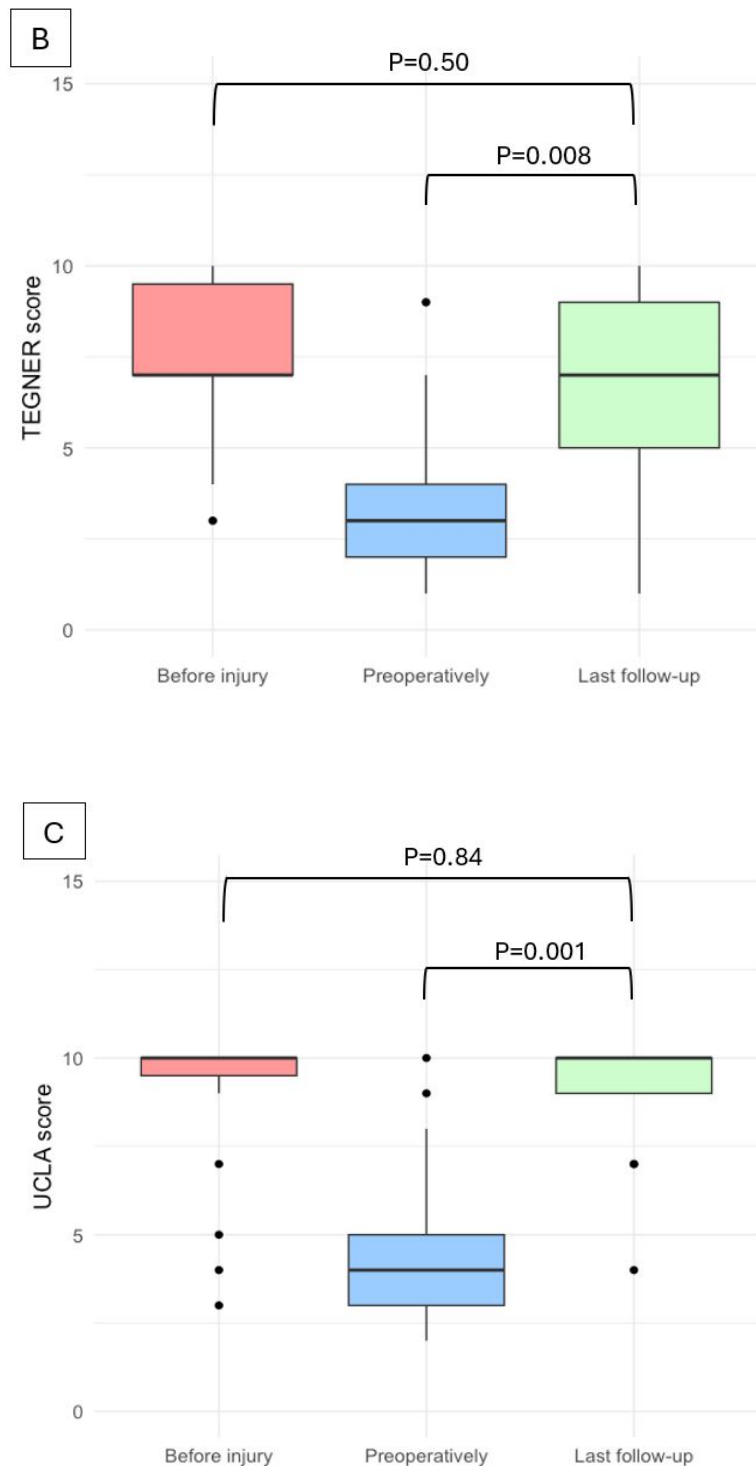


Figure 4. Pre-injury vs. last follow-up comparison. PHAS : Parisian Hamstring Avulsion Score; UCLA : of California Los Angeles Shoulder Score

Discussion

The results of this study show that surgery results in a good long term function outcome with a mean PHAS score of 99.5, UCLA of 10.0, and a Tegner score of 7.0. These results are associated with a RTS rate of 90 % after a mean RTS time of

4.0 months with no recurrence after a mean follow-up of 4.5 years.

The results of our study are original for their detailed measurement of long-term functional scores, which has not been reported in the literature for hamstring tears. Most studies have concentrated on parameters such as RTS rate or RTS time without specifically analyzing standardized

functional scores [12]. For example, the study by Lempainen [13] reported that 14 out of 18 patients RTS at their preinjury level after a mean 4 months but did not provide a detailed analysis of the functional outcomes.

In this series the patients returned to their preinjury sport in 18/20 (90%) cases. Sixteen of the 18 patients that returned to their preinjury sport (88.9 %) returned to the same or a higher level of play and 2 (11.1%) returned to a lower level. The mean time to RTS was 4.0 months (SD 3.5). These results are similar to those in the meta-analysis by Firnin et al. [12] who reported a RTS of 92.3% after a mean 4.2 months in patients following primary surgical treatment.

This study gives us a better understanding of the epidemiology of these distal hamstring injuries. Our series mainly consisted of men in their thirties who played contact sports, often at a professional level, with a high proportion of soccer players. The mechanism of these injuries is well documented in Frimin's meta-analysis, with 46% of injuries occurring during a sprint, 15% during a knee hyperextension movement, and 4% during a kick of the ball causing a high-speed eccentric contraction [12].

Although there is a tendency to manage distal hamstring and semitendinosus tears surgically [12], there is currently no expert consensus on the specific management of each type of tendon based on the patient's profile. Four of our patients were treated by stripping of the semitendinosus tendon, a procedure that was only indicated for irreparable tears of this tendon. Nevertheless, certain authors recommend non-surgical treatment in these cases [21][22], while others, like Cooper et al. report that medical treatment fails in 42%, resulting in pain at the tendon stump, and requiring secondary surgery. These authors, like our group, recommend first intention surgical management by tenodesis or tenotomy depending upon the presence or not of tendon damage [15][16][23][24][25].

This is also true for conservative management of tears of the distal semimembranosus complex which may result in a palpable painful mass in the posterior compartment of the knee and delayed neuropathies of the saphenous nerve from perineural scarring of the tendon stump [17][26].

Isolated tears of the distal insertion of the biceps femoris are also a subject of debate because certain authors recommend conservative management [27][28] while others propose surgery [29]. These are all isolated case studies. There are no published cohorts to date that are large enough to establish high level guidelines.

Certain authors even recommend surgical management of myoaponeurotic injuries if medical treatment fails [30]. According to these authors, surgery is a viable option if

conservative treatment of myotendinous hamstring tears fails, in particular in professional athletes, allowing a RTS at the preinjury level.

This study has several strong points, in particular the mean long-term follow-up of 4.5 years allowing a reliable evaluation of long-term outcome, as well as an in-depth analysis of functional outcomes. Moreover, the long follow-up in our patients tends to negatively affect functional scores, because of the natural aging of patients and a possible decline in the sports career at the final follow-up.

This study has certain limitations, in particular the size of the population. Although it is one of the largest groups ever studied with this rare injury, the population is small which may make it difficult to generalize these conclusions. Thus, although we did not find any significant difference between the preinjury and postoperative functional scores at the final follow-up, these results should be interpreted with caution because of the small size of the population. Moreover, the retrospective design of the study could result in potential biases in data collection and limit the possibility of objective comparisons. The absence of a no surgical control group makes it impossible to analyze the direct benefits of surgery. The heterogeneity of surgical procedures may also skew the results. Finally, the functional PHAS, UCLA and Tegner scores have not been validated in the scientific literature for the evaluation of distal hamstring tears. Despite these limitations, the results obtained were coherent and support the benefits of surgical management of this entity.

Studies with a larger group and an analysis of subgroups could improve the comparison of functional outcome by considering key variables such as the specific tendon injury, (semitendinosus, semimembranosus or biceps femoris), the surgical technique (reinsertion, suture, stripping, etc.), the level of play of the patients (leisure, competitive, or professional) and the patients' age. These analyses could be used to draft specific guidelines on the most well adapted surgical technique for the type of injury and the patient's profile.

Conclusion

This study seems to indicate that the functional outcome following surgical management of distal hamstring tears is good after more than 2 years of follow-up, with a high RTS and a correct time to RTS with very few complications or recurrence. These results suggest that surgery is an effective and safe option to restore function and for a RTS at the preinjury level.

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Conflict of interest

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List of abbreviations in the text

- IQR : interquartile range
- MRI : magnetic resonance imaging
- BMI : body mass index
- RTS : return to sport
- RTS R : return to sport rate
- RTS T : return to sport time
- UCLA : of California Los Angeles Shoulder Score
- PHAS : Parisian Hamstring Avulsion Score
- SD : standard deviation

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