

# Meniscal Suture in Athletes: Failure Analysis and Return to Sport

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## ABSTRACT

**Introduction:** Meniscal suturing is a technique increasingly used in patients with meniscal lesions, with good outcomes in the general population. However, research on athletes is limited. Meniscal suture failures and return to sport in athletes were analyzed, and possible contributing factors were identified. **Materials and Methods:** Sixty-one meniscal sutures in athletes (Tegner score  $\geq 6$ ) with a minimum follow-up of 12 months were retrospectively evaluated. Forty-nine were isolated lesions and 12 were associated with anterior cruciate ligament reconstruction. The average follow-up was 61 months and patients were evaluated with Tegner and Lysholm scores. **Results:** Meniscal suture failure was noted in 12 (19.67%) patients; failure occurred, on average, 14 months post-surgery. Nine failures occurred in isolated sutures and 3 were associated with anterior cruciate ligament reconstruction ( $p < 0.05$ ). The meniscus that failed the most was the internal meniscus. Seventy-five percent corresponded to patients who practiced pivot-contact sports ( $p < 0.05$ ). Patients who did not suffer failure were able to continue with the same sporting activity as before the injury and the Lysholm score had significantly improved ( $p < 0.05$ ). **Conclusions:** Failures were significantly more frequent in internal menisci, isolated sutures, bucket-handle injuries, and pivot-contact sports. We believe that meniscal suture is an excellent surgical option for athletic patients because a high percentage of them return to sports.

**Keywords:** Meniscal suture; athletes; meniscal injury; meniscal suture failure.

**Level of Evidence:** IV

## Sutura meniscal en deportistas: análisis de fallas y retorno al deporte

## RESUMEN

**Introducción:** La sutura meniscal es una técnica cada vez más utilizada en pacientes con lesiones meniscales, y se obtienen buenos resultados en la población general. Sin embargo, los estudios realizados en pacientes deportistas son escasos. Se analizaron las fallas de la sutura meniscal y el retorno al deporte en pacientes deportistas, y se identificaron posibles factores asociados. **Materiales y Métodos:** Se evaluaron retrospectivamente 61 suturas meniscales en deportistas (puntaje de Tegner  $\geq 6$ ) con un seguimiento mínimo de 12 meses. Cuarenta y nueve eran lesiones aisladas y 12 se asociaban con plástica del ligamento cruzado anterior. El seguimiento promedio fue de 61 meses y los pacientes fueron evaluados con los puntajes de Tegner y de Lysholm. **Resultados:** Se constató la falla de la sutura meniscal en 12 (19,67%) pacientes; la falla ocurrió, en promedio, 14 meses posquirugía. Nueve fallas se produjeron en suturas aisladas y 3 se asociaron con plástica del ligamento cruzado anterior ( $p < 0,05$ ). El menisco que más falló fue el interno. El 75% corresponde a pacientes que practicaban un deporte de contacto y pivote ( $p < 0,05$ ). Los pacientes que no sufrieron falla pudieron continuar con la misma actividad deportiva que antes de la lesión y el puntaje de Lysholm había mejorado significativamente ( $p < 0,05$ ). **Conclusiones:** Las fallas fueron significativamente más frecuentes en meniscos internos, suturas aisladas, lesiones en asa de balde, y deportes de contacto y pivote. Consideramos que la sutura meniscal es una excelente opción quirúrgica para pacientes deportistas, ya que un alto porcentaje de ellos retorna al deporte.

**Palabras clave:** Sutura meniscal; deportistas; lesión meniscal; falla de sutura meniscal.

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## INTRODUCTION

Meniscus injury is one of the most common conditions in the arthroscopic surgeon's practice and is highly related to sports activity.<sup>1-3</sup> These injuries can occur isolated or associated with other conditions, such as anterior cruciate ligament (ACL) tear (57-80%).<sup>4</sup> The menisci play an important role in load transmission, shock absorption, joint stability and lubrication, and proprioception.<sup>1,2</sup>

Some surgical options are: partial and total meniscectomy, and meniscal repair techniques that, in recent years, have acquired greater prominence.<sup>4,5</sup> There are several studies that compare the clinical results of total and partial meniscectomy and show the importance of the menisci and their protective function for joint preservation.<sup>1,2</sup> It has been published that, although more than 30% of meniscal tears can be repaired, less than 10% of these are finally sutured.<sup>4</sup>

The meniscal suture options are: inside-out, outside-in, and all-inside.<sup>1,3,6</sup> The failure rate of these techniques ranges from 10% to 25% in the general population<sup>4,7-9</sup> and, in numerous studies, a lower failure rate has been reported in lateral menisci and those associated with ACL plastic surgery.<sup>3,9</sup> Athletes represent a group of patients that imposes a greater demand on the menisci and, consequently, a maximum stress on the meniscal suture.<sup>2</sup> Few published studies have evaluated the results of meniscal suture in this type of patient.

The objective of this study was to evaluate a population of athletes who received a meniscal suture. By comparing the data obtained with those of the national and international literature, we sought to specifically analyze suture failures, and identify possible associated factors, return to sport, and functional outcomes.

## MATERIALS AND METHODS

Between July 2005 and June 2020, 1,473 knee arthroscopies were performed and, in 104 of them, a meniscal suture was performed, either alone or associated with another procedure. The patients were evaluated and classified retrospectively, according to the Tegner activity score, defining as athletes those patients with a score  $\geq 6$  before the injury.

The inclusion criteria were: Tegner score  $\geq 6$ , lesions in the red-red or red-white zones, without degenerative changes verified by both magnetic resonance imaging and arthroscopy, operated by the same surgical team and with a minimum follow-up of 12 months. Patients with a Tegner score  $< 6$ , degenerative lesions, lesions in the white-white zone, follow-up  $< 12$  months, and limb alignment disorders were excluded.

Regarding surgical techniques, the outside-in suture was used for lesions of the body and anterior horn, and the all-inside suture for posterior horn lesions. If the lesions were combined, the hybrid technique was used. The all-inside systems used in our study were: Meniscal Cinch (Arthrex, Naples, FL, USA), RapidLoc (DePuy Mitek Inc, Raynham, MA, USA), Viper (Arthrex, Naples, FL, USA), Fast Fix (Smith & Nephew, Andover, MA, USA) and True Span (DePuy Mitek Inc, Raynham, MA, USA) (Figure 1).



**Figure 1.** Radial tear of the lateral meniscus diagnosed by magnetic resonance and arthroscopic images before suturing with the hybrid technique (two all-inside sutures and one outside-in suture) and after.

The sample was made up of 61 athlete patients, 54 (88.5%) were men and seven (11.5%) were women, with an average age at surgery of 26 years (range 14-53). The time elapsed between the meniscal tear and surgery was variable, between three days and three months (average 26 days). The average follow-up was 60 months (range 12-36). 12 months, max. 191 months). The external meniscus was the most affected (35 patients, 57.38%), while lesions to the internal meniscus were 26 (42.62%). Meniscal injuries were isolated in 49 cases (80.33%) and were associated with ACL tears in 12 (19.67%). Regarding the techniques used: 31 (51%) patients were treated only with the outside-in technique; nine (15%), with the all-inside technique and 21 (34%), with the hybrid technique, and the average number of suture stitches was 2.4 (range 1-6). Regarding the sports practiced, contact and pivot sports (43 cases) predominated, such as soccer (31 patients), rugby (10 cases) or hockey (2 patients).

During the postoperative period, offloading with crutches was indicated for two weeks and immobilization with a knee extension splint for four weeks. In the first six weeks, joint flexion was limited to 90° to avoid increasing tension in the joint capsule and, at week 16, return to previous sports activity was authorized. Patients who had an ACL lesion underwent meniscus suture and ACL plastic surgery at the same surgical stage, with its own treatment protocol.

The patients were evaluated with the Tegner and Lysholm scores before and after surgery. The criteria applied to define the failure were: pain in the joint line, joint effusion, blockage and positive Murray test. The presence of at least one of them was sufficient to consider meniscal repair as failed, according to the Barrett et al. criteria.<sup>8</sup> All failures were confirmed by arthroscopy during a second surgery.

## RESULTS

Failure of the meniscal suture was confirmed in 12 patients (19.67%). 75% were men and the average age was 28 years (range 16-53), slightly higher than that of the patients without failures (25 years) ( $p > 0.05$ ). The failure was located in the internal meniscus, in eight cases (66.66%) and in the external one, in four ( $p < 0.05$ ). In nine (75%) patients, the failure presented as an isolated injury, while in the remaining three, it was associated with ACL tears. Regarding the type of injury, seven (58.33%) were bucket handle injuries ( $p < 0.001$ ) and the rest were horizontal-vertical injuries. Failure of all the techniques used was recorded: five (41.66%) outside-in sutures, three (25%) all-inside sutures, and four (33.33%) with the hybrid technique. The average number of suture stitches in these patients was 2.6 (range 1-6), which did not represent a determining factor for failure ( $p > 0.05$ ). 75% of the failures occurred in patients who practiced contact and pivot sports ( $p < 0.05$ ): 50% (6 patients) practiced soccer; 16.7% (2 cases), rugby and the remaining four, volleyball, dancing, hockey, and climbing (Table 1).

**Table 1.** Summary of patients with meniscal suture failure

n	Sex	Age (years)	Sport	Follow-up (months)	Meniscus	ACL	Suture	Number of sutures	Re-tear	Postoperative time
1	M	35	Football	141	Internal	Yes	Outside-in	1	Traumatic	14
2	F	16	Hockey	126	Internal	Yes	Hybrid	3	Spontaneous	8
3	M	30	Football	137	Internal	No	Outside-in	2	Spontaneous	16
4	M	26	Rugby	86	Internal	Yes	Outside-in	2	Traumatic	19
5	M	31	Football	57	External	No	Outside-in	2	Traumatic	48
6	M	21	Rugby	61	External	No	All-inside	2	Traumatic	16
7	M	53	Football	61	External	No	All-inside	1	Spontaneous	10
8	M	18	Football	49	External	No	Hybrid	6	Traumatic	7
9	M	30	Climbing	24	Internal	No	Hybrid	3	Traumatic	12
10	F	19	Dancing	16	Internal	No	Outside-in	1	Spontaneous	9
11	F	26	Football	14	Internal	No	Hybrid	5	Traumatic	5
12	M	34	Volleyball	12	Internal	No	All-inside	3	Spontaneous	6

M = male; F = female; ACL = anterior cruciate ligament.

Failure occurred, on average, 14 months after surgery (range 5-48). The Kaplan-Meier graph shows the estimated average survival for the study sample, which was 134 months, with a survival rate of 95% at 12 months and 94% at 24 months (Figure 2). Seven of the 12 patients (58.33%) with failure reported a new traumatic episode, all related to sports, while the remaining five (41.67%) consulted for pain in the joint line at variable times after surgery, without an associated traumatic episode. Treatment of the failure consisted of segmental partial meniscectomy of the unstable fragments (11 patients, 91.66%) and a new meniscal suture in the remaining case (8.33%).

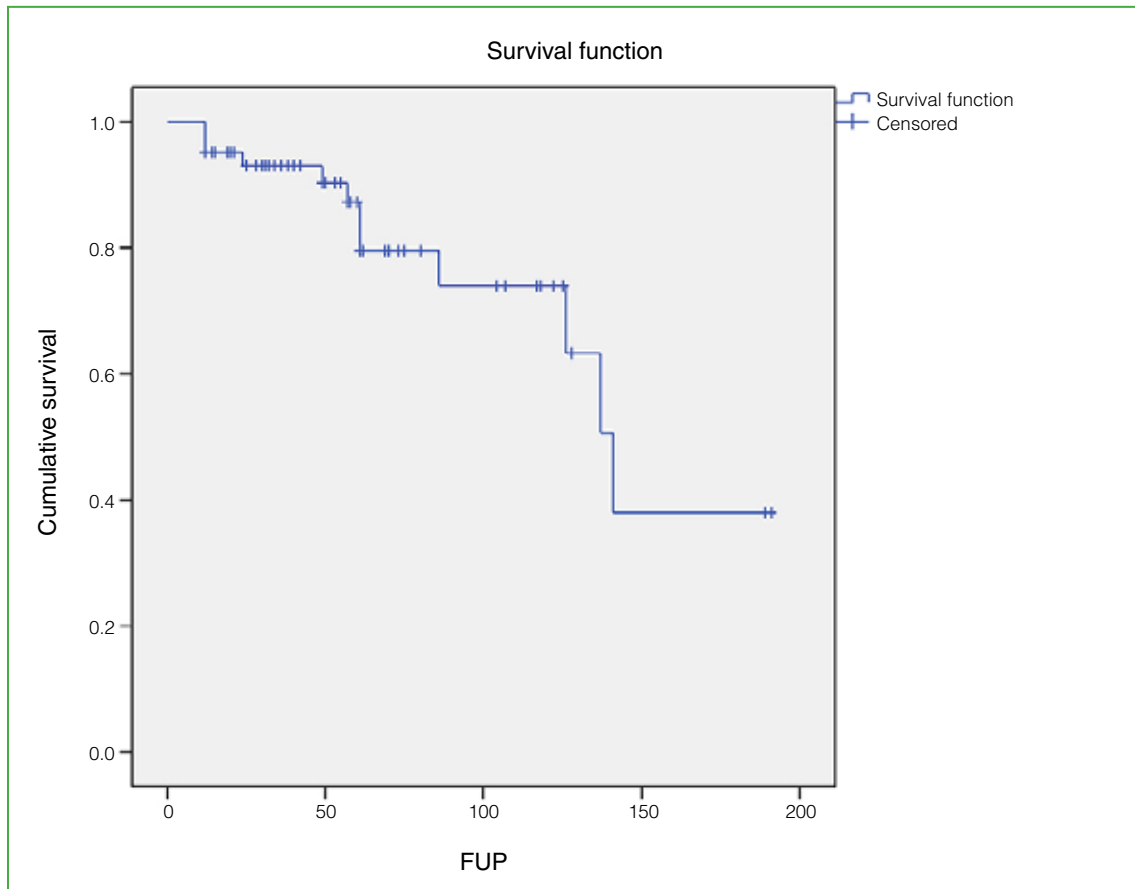


Figure 2. Kaplan-Meier survival plot.

In relation to the return to sport, the Tegner score decreased from 7.02 (range 6-9) to 6.94 (range 6-9) in the 49 patients who had no failure ( $p > 0.05$ ), that is, most of them continued to practice the same sport as before surgery, or one of similar intensity. In contrast, the same score decreased from 6.75 to 4.41 in patients without failure, a decrease of 2.34 points ( $p < 0.05$ ).

The functional outcomes were evaluated with the Lysholm score and revealed an average improvement of 26.31 in the patients without failure ( $p < 0.05$ ), while in the patients with failure the improvement was only 2.09. ( $p > 0.05$ ) (Table 2).

**Table 2.** Comparison of scores in patients with or without failure of the meniscal suture.

	Patients WITHOUT failure (n = 49)		Patients WITH failure (n = 12)	
	Preoperative	Postoperative	Preoperative	Postoperative
Tegner score	7.02	6.94	6.75	4.41
Difference	-0.8		-2.34	
Lysholm Score	71.55	97.86	67.33	69.42
Difference	26.32		2.09	

## DISCUSSION

Due to the degenerative changes reported in patients undergoing partial or total meniscectomy, the number of meniscal repairs has increased markedly in the last two decades.<sup>10</sup> This is due to the attempt to carry out a biological repair in order to preserve as much of the meniscal surface as possible, thus restoring the biomechanical properties of the joint.<sup>1,2</sup> In various international studies, successful outcomes have been obtained in 70-90% of the general population,<sup>6,11</sup> and these outcomes have been even superior when compared to partial meniscectomy.<sup>12,13</sup> In national studies, the success rate is similar: between 72% and 85%.<sup>14-16</sup>

Several risk factors responsible for meniscal failure have been published, such as chronic injuries, size and area of the injury, among others.<sup>2,4</sup> Some of them were refuted in various investigations, since it was verified, for example, a great healing potential even in patients with bucket-handle injuries, longitudinal >10 mm injuries, and radial injuries in zones I and II.<sup>4</sup> Our sample is represented by a wide variety of injuries, either by type or size, which require different types of suture for repair. However, we have not obtained significant differences in the failure rate when analyzing factors such as type of suture, technique or number of sutures used ( $p > 0.05$ ). On the contrary, we have found factors associated with the incidence of meniscal suture failure ( $p < 0.05$ ), such as injuries to the medial meniscus, isolated meniscal sutures, bucket-handle injuries, and contact and pivot sports.

Regarding the healing capacity, several studies indicate a greater regenerative capacity of the external meniscus over the internal one, and the latter has a higher failure rate.<sup>3,6,17,18</sup> Ronnblad et al. retrospectively evaluated 918 cases of meniscal suture with a minimum follow-up of three years and obtained failure rates four times higher in the internal meniscus than in the external one.<sup>19</sup> This agrees with the results of our study, in which the internal meniscus failed significantly more than the external one ( $p < 0.05$ ).

Different studies have evaluated the outcomes of meniscal sutures performed together with plastic surgery of the ACL; in these cases, the success rates were higher than those obtained with isolated sutures.<sup>3,6,10,20-22</sup> This is mainly due to the release of stem cells from the bone marrow originating from the femoral tunnel.<sup>6</sup> One of them is the study by Cannon and Vittori published in 1992,<sup>6</sup> in which they compared meniscal sutures performed together with ACL plastic surgery and isolated meniscal sutures and obtained success rates of 93% and 50%, respectively. These results are consistent with those of our study, in which significantly better outcomes ( $p < 0.05$ ) were achieved in patients who underwent meniscal suture together with ACL repair.

Age has been suggested as a risk factor for failure of meniscal repairs. Barrett et al. studied meniscal repairs in a population of patients >40 years of age and obtained 87% good clinical outcomes at two years of follow-up.<sup>8</sup> Lyman et al. also achieved significant improvements in sutures performed in patients >40 years. These outcomes would be explained by the lower demand that these patients place on the suture.<sup>9</sup> In our study, age did not behave as a risk factor for meniscal suture failure, since the age difference between patients with failure and those without failure was only 2.5 years higher ( $p > 0.05$ ).

Meniscal injuries are common in young patients and athletes, and due to their mechanism, they are even more prevalent in contact and pivot sports.<sup>2</sup> In this type of patients, they represent a challenge in terms of treatment, rehabilitation and return to sport.<sup>2,23</sup> It is believed that, due to the greater demand and stress to which meniscal

sutures are subjected, the failure rate in athletes should be higher than in the general population. According to different international studies, the failure rate of meniscal sutures in athletes ranges from 7% to 24%.<sup>2,20,23,24</sup>

In our country, published studies are scarce. Villalba et al. evaluated 11 contact sports patients, with a minimum follow-up of two years and the failure rate was 9%.<sup>25</sup> On the other hand, Bitar et al. evaluated 41 athletes with bucket handle injuries, and their failure rate was 15.2%.<sup>26</sup> With a bigger sample, our failure rate was 19.67%, which was greater than the previously indicated figure but coincided with the global figure.

80.33% of the patients managed to resume the sports activity they practiced before the injury, maintaining practically the same Tegner score. This is slightly lower than what has been published in several studies, in which the average return to sport varies between 86% and 100%.<sup>23,24</sup>

The limitations of this study include its retrospective nature, the lack of a control group or an arthroscopic examination to confirm the meniscal repair, and the inclusion of individuals with varying levels of sports intensity. Future studies could look into the relationship between the outcomes of meniscal suture failure in athletes and non-athletes. As a strength, we can state that it is a novel subject, having only examined athlete patients, which comprised the greatest sample size in our country, and that the results were comparable to those published in the international literature.

## CONCLUSIONS

In the series analyzed, the meniscal suture failure rate in athletes coincides with that reported in the literature. Failures were statistically more frequent in internal menisci, isolated sutures, bucket handle injuries, and contact and pivot sports.

Based on the results of our study, we consider that the meniscal suture is an excellent surgical option for athletes, since it achieves a high rate of return to sport. However, the lack of a control group does not allow us to be conclusive on this point.

Conflict of interest: The authors declare no conflicts of interest.

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