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Rehabilitation protocol after suturing the medial meniscus of a stable knee, a retrospective series of the Francophone Arthroscopy Society



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ABSTRACT

Introduction: Surgical meniscal lesions are common and 80% of cases involve the medial meniscus of a stable knee. There is a lack of consensus regarding postoperative rehabilitation protocols and a wide variation between restrictive and accelerated rehabilitation protocols exists. The main objective of this study was to report the functional results and the failure rate of the various rehabilitation protocols of the retrospective series of the French Society of Arthroscopy (SFA) after suturing the medial meniscus of a stable knee, considering whether the tear is stable or unstable.

Hypothesis: Our hypothesis was that accelerated rehabilitation was not associated with an increased risk of failure.

Materials and methods: This retrospective, multicenter study was conducted across 10 centers (6 private hospitals and 4 public hospitals) including all patients tested for a medial meniscus suture in a stable knee between January 1, 2005 and November 31, 2017 for a minimum follow-up of 5 years. Demographic, imaging, suturing, rehabilitation protocol, and functional TEGNER and KOOS scores were collected. Failure was defined as performing a secondary meniscectomy.

Results: Three hundred and sixty-seven patients were analyzed with an average follow-up of 82 months. Immediate weight bearing was allowed in 85% of cases, the wearing of a brace was present in almost 74% of cases and flexion was limited in 97% of cases. Inter-group comparisons found a higher suture failure rate in the group with immediate weight bearing (35.6% vs. 20%, $p=0.011$) and in the group with a brace (36.9% vs. 22.4%, $p<0.001$). There was no difference in the 90° flexion group. The TEGNER score was higher in the non-weight bearing group (6.5 vs. 5.4, $p=0.028$) and the KOOS QOL score was higher in the group without a brace (82.2 vs. 66.8, $p=0.025$). According to a multivariate analysis, immediate weight bearing (OR=3.6, [1.62; 7.98], $p=0.0016$) and wearing a brace (OR=2.83, [1.54; 5.02], $p<0.001$) were associated with a higher failure rate. In the group of stable lesions, the use of a brace (OR=3.73, [1.62; 8.56], $p=0.0019$) was associated with a higher failure rate.

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Conclusion: No consensus regarding rehabilitation protocols has been established to date and the results of this retrospective series of the SFA affirm the great variability of practices at a national level. Although accelerated rehabilitation protocols are presently favored, the resumption of immediate full weight bearing should be considered with caution, being associated with a higher risk of failure in this series. Deferring weight bearing for 1 month can be considered in the event of a large tear or in the event of damage to the circumferential fibers. Wearing a brace does not seem to have any influence, while limited flexion achieved a consensus.

Level of evidence: IV, retrospective study.

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1. Introduction

Surgical meniscal lesions are common and affect the medial meniscus of a stable knee in approximately 80% of cases [1]. While some lateral meniscus tears may require functional treatment, all non-degenerative medial meniscus lesions require first-line surgical treatment with sutures [2]. There is no consensus on the postoperative rehabilitation protocol [3] and great variability exists between restrictive protocols and accelerated rehabilitation protocols. The benefit of accelerated rehabilitation protocols, which have been favored in recent years, is to reduce postoperative amyotrophy and minimize loss of strength without increasing the number of complications [4]. Conversely, the more restrictive protocols aim to protect the meniscal repair and reduce the number of suture failures.

To date, the discussion consists of distinguishing stable meniscal tears from unstable ones and using a rehabilitation protocol adapted to the type of tear. In fact, weight bearing seems to reduce vertical longitudinal tears, while increasing weight bearing stress seems to displace radial tears [5].

The main objective of our work was to report the functional results and the failure rate of the different rehabilitation protocols observed in the retrospective series of the French Society Arthroscopy's (SFA) symposium after suturing the medial meniscus of a stable knee. The secondary objective was to look for risk factors for failure according to the type of tear, distinguishing stable tears from unstable tears according to the involvement of the circumferential fibers (radial tears, root tears or complex tears).

2. Material and methods

2.1. Study type

A retrospective multicenter study was conducted in 10 centers (University Hospital Centers of: Lille, Lille Louvière, Strasbourg, Bordeaux Mérignac, Caen, Lyon, Marseille, Versailles, Saint-Étienne, Toulouse) analyzing patients operated on between January 1, 2005 and November 31, 2017, with a minimum follow-up of 5 years. Data from all patients operated on with a medial meniscus suture of a stable knee were collected. The exclusion criteria were: concomitant ligament lesions requiring reconstruction, history of ligament stabilization surgery, history of meniscal surgery. The primary endpoint was suture failure defined by reoperation for meniscectomy. The secondary endpoint was the evaluation of the postoperative protocol. The study was approved by an ethics committee and by the French national data protection commission (CNIL).

3. Methods

Clinical and demographic data were collected: age, gender, smoking status, arterial hypertension, body mass index, circumstances of the lesion occurrence. Preoperative and postoperative

Tegner [6] and KOOS [7] functional scores were analyzed. The intra-operative data collected included the type and number of sutures, the use of reaming and other associated procedures. The data of the postoperative protocol concerned the wearing of the brace, the authorization of weight bearing and the limitation of flexion. Meniscal tears were classified into 2 groups according to their type, stable (horizontal, vertical, ramp) and unstable (bucket handle, radial, root, complex).

3.1. Statistics

Statistical analysis was performed using the EasyMedStat online application version 3.22.

Numerical variables were expressed as mean (\pm SD) and discrete results as absolute and relative frequencies (%). We carried out 3 analyzes of two groups according to the values of weight bearing, brace use and flexion. Group comparability was assessed by comparing baseline demographics and the length of follow-up between groups. Normality and heteroscedasticity of continuous data were assessed by Shapiro–Wilk's and Levene's tests respectively. Continuous results were compared using an unpaired Student's *t*-test, Welch's *t*-test, or Mann–Whitney U-test depending on the distribution of data. Discrete results were compared using the Chi² or Fisher's exact test. The alpha risk was set at 5% and two-sided tests were used.

Multivariate logistic regression was performed to assess the relationship between suture failure and the explanatory variables: weight bearing, lesion type, and brace. The Belsley–Kuh–Welsch technique was used to verify the multicollinearity of the data. Residual heteroscedasticity and normality were assessed by White's test and Shapiro–Wilk's test, respectively. A *p*-value < 0.05 was considered statistically significant. Patients with missing data were excluded from the analysis.

4. Results

4.1. The series

At a mean follow-up of 82 months (62–111), 367 patients (99 women, 268 men) fulfilled the inclusion criteria with a ratio of nearly 3 men per each woman and the presence of sport-related trauma in 62% of cases (Table 1). Data regarding the series rehabilitation protocol and statistical analyzes are presented in the Appendix (Tables 2–6).

4.2. Weight bearing

Weight bearing was authorized immediately after surgery in 85% of cases (*n* = 312). Inter-group comparisons found a higher rate of suture failure in the group with immediate weight bearing (35.6% vs. 20%, *p* = 0.011). The TEGNER score was higher in the non-weight bearing group (6.5 vs. 5.4, *p* = 0.028). Multivariate analysis demon-

Table 1
Demographic characteristics.

		Min–Max
Age \pm SD, years	28 \pm 10 (n = 367)	20–35
Sex ratio M/F	2.7/1	
BMI \pm SD, kg/m ²	23 \pm 3 (n = 302)	16–39
Hypertension	7 (3%)	
Tobacco %	28% (n = 81/291)	
Sports trauma %	62% (n = 141/227)	
Average follow-up (months)	82	62–111

M: male; F: female.

strated that immediate weight bearing was associated with a higher rate of meniscal suture failure (OR = 3.6, [1.62; 7.98], $p = 0.0016$).

4.3. The brace

Wearing a brace occurred in nearly 74% of cases ($n = 272$). Inter-group comparisons found a higher failure rate in the brace group (36.9% vs. 22.4%, $p < 0.001$). The KOOS QOL score was higher in the group without a brace (82.2 vs. 66.8, $p = 0.025$). Multivariate analysis demonstrated that wearing a brace (OR = 2.83, [1.54; 5.02], $p < 0.001$) was associated with higher failure rates. For the stable lesions group considered in isolation, the brace (OR = 3.73, [1.62; 8.56], $p = 0.0019$) was also associated with higher failure rates.

4.4. Flexion

Flexion was limited in 97% of cases ($n = 356$). Inter-group comparisons found no difference between the 90° flexion and full flexion groups for failure or for functional scores. Multivariate analysis was not feasible for the flexion criterion due to insufficient numbers in the complete flexion group.

5. Discussion

This study analyzes medial meniscus sutures of a stable knee in a large homogeneous cohort, allowing a national trend to be established for the rehabilitation protocol used over the study period, with immediate weight bearing authorized in 85% of cases, brace usage in 74% of cases and limited flexion in 97% of cases.

The current trend is in favor of accelerated rehabilitation protocols offering rapid weight bearing and mobilization depending on the type (stable vs. unstable) and size of the lesions [8–12]. No consensus has been established to date concerning rehabilitation protocols after isolated meniscal suture [3,13–15] and no study considers the medial meniscus exclusively despite its major role in anteroposterior stabilization of the knee. [16].

In this study, the resumption of immediate weight bearing, as well as the wearing of a brace, are associated with higher suture failure rates for stable tears (vertical, horizontal, ramp) and unstable tears (bucket handle, radial, root, complex). The definition of the stable or unstable character of the tears varies according to the authors, some considering that only the preservation of the circumferential fibers establishes the stability of a lesion [17]. Others consider that the tear size must also be considered in the choice of rehabilitation protocol (3 cm for horizontal tears according to Kocabey et al.). We have chosen to classify bucket handles as unstable tears given their size and particularly high suture failure rate [18]. While some authors establish high success rates for meniscal suture after resuming immediate weight bearing [19], biomechanical studies confirm that the load modifies the positioning of the femoral condyle during flexion-extension, while its position remains unchanged in case of complete unloading [20]. Furthermore, the load simulation in biomechanical studies mainly corresponds to partial weight bearing and the tears studied are

stable [21,22] which does not reflect all clinical situations. On the functional level, the TEGNER score is higher for the group without weight bearing, establishing a better functional result. This is related to the incidence of suture failures, which is higher in the weight bearing group.

In this study, wearing a brace is associated with a higher rate of failure according to multivariate analysis. Considering the stable tear group in isolation, wearing a brace continues to be associated with a higher failure rate. This element of the rehabilitation protocol is not analyzed in the literature as a variable independent of the other measures that justify its use, such as the limitation of flexion at 90°. Our hypothesis is that this result could be attributed to confounding, as the wearing of the brace is associated to immediate weight bearing in 82% of cases.

In our study, flexion was limited to 90° in 97% of cases. Multivariate analysis was not feasible due to a low number of cases in the free flexion group. This flexion limitation consensus is based on biomechanical studies, which establish an increase in the load on the menisci with knee flexion (85% of the load at 90°, < 50% in extension) [23]. On the other hand, no difference is established in the literature concerning the limitation of flexion at 90°, which could, according to certain authors, be raised to 110° [21] or beyond [24]. The various meta-analyses published on the subject conclude that it is difficult to establish an agreed upon protocol given the great heterogeneity of the literature and the low level of evidence of the various studies which report success rates of 25 to 100% [3,13]. The vast majority of studies correspond to non-comparative retrospective analyzes where joint mobilization is started from the first postoperative week, but where the time taken to allow flexion beyond 90° varied between 3 and 6 weeks. The majority of authors agree that rehabilitation that should begin as soon as possible to limit the development of edema, promote muscle activation, prevent stiffness and limit atrophy. Lind et al. undertook the only randomized controlled trial on this subject [11] whereby patients operated on for a vertical meniscal lesion using the “all inside” technique were compared with a “free rehabilitation” group (free mobilization 0–90°, weight bearing according to tolerance) and a “restricted rehabilitation” group (articulated brace with gradual mobilization up to 90°, toe touch weight bearing for 6 weeks). The authors found that there was no difference in the meniscal suture failure rate, nor the functional results at 2 years.

Even though this study constitutes one of the largest series in the literature concerning medial meniscus suturing, its retrospective character involves an inherent measurement bias. Furthermore, the small sample size prevents conclusions being made about the limited flexion component. In addition, there is a confounding bias regarding the wearing of a brace, which is paradoxically associated with a higher rate of suture failure.

The size of the overall sample nevertheless makes it possible to formulate a warning against the resumption of immediate weight bearing after suturing the medial meniscus. The latter is solicited in anteroposterior translation by weight bearing and the failure rates established for both stable and unstable tears are in favor of partial weight bearing, contrary to the current trend. A long-term prospective study remains necessary to establish a consensual protocol, taking into account the type and size of the sutured tears to specify whether they are stable or unstable.

6. Conclusion

No consensus concerning rehabilitation protocols following suturing of the medial meniscus has been established to date and the results of the retrospective series of the SFA testify to the great variability of practices at the national level. Since accelerated rehabilitation protocols are currently prevalent, the immediate

resumption of full weight bearing should be considered with caution, as it was associated with a higher risk of failure in this series. Deferred weight bearing for 1 month should be considered in the event of large tears or in the event of damage to the circumferential fibers. Wearing a brace did not seem to have any influence, while limited flexion achieved a consensus.

Disclosure of interest

SP is a Corin consultant. OC, BF are Arthrex consultants. VP is a Smith and Nephew consultant. The other authors declare that they have no competing interest.

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None.

Author contribution

All co-authors contributed to the data collection. HF, GM and CP participated in the statistical analyzes and the drafting of the article.

Appendix A. Supplementary data

Supplementary data (Tables 2–6) associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.otsr.2023.103651>.

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