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Original article

Impact of preoperative measures on postoperative results in combined anterior cruciate and medial collateral ligament injuries: an analysis from the registry of the francophone arthroscopic society

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ABSTRACT

Background: Combined injuries of the anterior cruciate ligament (ACL) and medial collateral ligament (MCL) are frequent in knee trauma. Treatment approaches vary widely, including surgical and conservative methods. However, the impact of preoperative measures on postoperative outcomes remains unclear.
Hypothesis: Preoperative measures influence on postoperative outcomes for cases involving combined anterior cruciate and medial collateral ligament injuries.
Patients and methods: A prospective, multicenter study was conducted in 8 French surgical centers specializing in knee surgery. Data were collected on patients undergoing ACL reconstruction with concomitant MCL injury over a 12-month period. Inclusion criteria were primary ACL injury associated with MCL injury (Grade I, II or III) and requiring ACL reconstruction, patients aged $\geq$ 15 years. The use and type of preoperative brace, weight-bearing and the time between injury and surgery were assessed. A functional assessment of the IKDC, ACL-RSI, TEGNER and SKV scores was performed at final follow-up. Patients were evaluated with regards of iterative ACL rupture, contralateral ACL rupture and reoperation.
Results: The study included 408 patients with a mean follow-up of 18.5 months. Time between injury and surgery did not significantly affect the risk of iterative rupture, contralateral rupture, or reoperation. No significant impact of preoperative brace type or weight-bearing status on postoperative outcomes was observed. However, patients with higher grade MCL injuries underwent surgery earlier ($p < 0.0001$) and had lower preoperative weight-bearing allowances ($p < 0.05$). Patients with Grade 2–3 MCL injuries had lower functional scores compared to those with Grade 1 injuries ($p < 0.05$).
Discussion: Preoperative measures, including time between injury and surgery, showed no significant influence on postoperative outcomes in combined ACL-MCL injuries. The type of preoperative brace and weight-bearing status did not significantly impact postoperative results. A functional approach with immediate full weight-bearing/recovery of full range of motion and with the use of bracing according to pain and patient apprehension is recommended. Further research is needed to refine preoperative treatment strategies for such injuries.
Level of evidence: IV; prospective study.

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1. Introduction

A combined injury of the anterior cruciate ligament (ACL) and medial collateral ligament (MCL) is a common knee injury. An incidence of concomitant MCL complex injuries in 67% of cases has been suggested [1]. Treatment of combined ACL-MCL injuries remains controversial, with several descriptions of surgical and conservative management options [2–9]. Many authors report no significant difference in outcomes between non-surgical and surgical management of the MCL in patients with a combined ACL-MCL injury treated with ACL reconstruction [2,3,5–7]. Outcome measures or non-surgical and surgical management, are heterogeneous amongst articles [9]. Moreover, preoperative assessment is limited to the grade of MCL into three grades I, II or III [10].

Preoperative management is also highly heterogeneous, depending on the author. Preoperative management includes a short period of rest, ice, a knee brace, range of motion and weight bearing as tolerated [4,7,11,12]. Immobilization in a cast should be avoided in order to decrease the risk of arthrofibrosis, knee stiffness and worse long-term outcomes [11,13,14]. Early, active knee motion significantly reduces laxity and increases the tensile strength of the healing superficial MCL [15]. The number and types of braces is increasing, and they can be non hinged-knee brace, hinged-knee brace or other. No study has investigated the impact of preoperative management on postoperative results after combined ACL-MCL injuries.

Against this background, the research questions that have emerged are as follows:

- Does preoperative measures influence on postoperative outcomes for cases involving combined anterior cruciate and medial collateral ligament injuries?
- Does surgical delay influence results in the ACL-MCL knee injury?
- Does the degree of medial laxity influence preoperative management?
- Does surgical or non-surgical management of Grade II-III LCM lesions have any impact on preoperative behavior?

The aim of this study was to determine the impact of preoperative management on postoperative results after combined ACL-MCL injuries. The objective was to explore the influence of factors such as preoperative brace type, weight-bearing status, and operative delay on the risk of iterative ACL rupture, contralateral ACL rupture, reoperation, and functional scores following surgery.

2. Patients and methods

This is a prospective, multicenter, observational study conducted in 8 French surgical centers specializing in knee surgery during 12-month period. All data were collected on the SFA data platform - DataLake [16,17]. Three major treatment strategies were identified: ACL reconstruction with nonoperative MCL, MCL repair, or MCL reconstruction. A signed consent was obtained for each patient with an approval of an Ethical Committee.

2.1. Inclusion and exclusion criteria

The inclusion criteria were:

- Primary ACL injury associated with MCL injury MRI and clinically confirmed and requiring ACL reconstruction.
- Age ≥15 years
- The exclusion criteria were:
- Previous knee surgery
- Isolated MCL injury
- Mosaicplasty or microfractures performed in the same operation on the operated knee
- Cartilage lesion ≥grade II of the Outerbridge classification

2.2. Clinical assessment

All patients were clinically assessed to quantify the grade of MCL injury at the time of injury. The American Medical Association (AMA) classification of MCL injury into three grades I, II or III was used [18]. We divided patients in two groups for the analysis: a group with ACL + MCL (grade 1, pain without any laxity in flexion nor extension) and a group with ACL + MCL (grade 2−3). The type of preoperative brace (none, non hinged-knee brace, hinged-knee brace or other), weight-bearing (full, partial or none) and the time between injury and surgery were assessed [19]. A functional assessment of the IKDC, ACL-RSI, TEGNER and SKV [20] scores was performed at final follow-up.

Patients were evaluated with regards of iterative ACL rupture, contralateral ACL rupture and reoperation.

2.3. Baseline characteristics

The following baseline characteristics were assessed: age, sex, side of involvement, BMI, meniscal and cartilage lesion, type of ACL graft, type of anterolateral procedure, type of MCL procedure surgery.

2.4. Statistical analysis

All statistics were done using STATA software 18.0 (STATA Corp., College Station, TX, USA).

Quantitative data were presented using the frequency of recorded data, the means and the standard deviations. Qualitative data were presented using number and percentage. Percentages were calculated based on the number of recorded data. Quantitative variables were compared using distribution comparison tests (Student's t-test or non-parametric Mann-Whitney test depending on the conditions), and qualitative variables were compared using percentage comparison tests (chi-square test or Fisher's exact test based on theoretical frequencies). These tests were conducted on the recorded data. The level of significance is $p < 0.05$.

2.5. Demographic data

408 patients with ACL reconstruction associated with an MCL lesion were included in this study with a mean follow-up of 18.6 months (SD: 6.00; min 6.3 – max 45.8). The sex ratio was 2 males to 1 female. The mean age was 29.9 years (SD: 10.4; min 15 – max 66). The mean BMI was 24.3 kg/m^2 (SD: 3.7; min 17 – max 39).

MCL grade at the time of injury was grade 1 in 242 cases (82%), grade 2 in 44 (15%) cases and grade 3 in 10 cases (3%) (112/408 missing). Pre-operative weight-bearing was full in 341 (84%) cases, partial in 56 (14%) cases, and no weight bearing was allowed in 8 (2%) cases (3/408 missing). No brace was used in 80 (20%) cases, and a non hinged-knee brace was used in 39 (10%) cases, a hinged-knee brace in 262 (64%) cases and other in 27 (6%) cases. The following surgical procedures were performed on the MCL: non operative in 310 cases (76%), repair in 33 cases (8%) and reconstruction in 65 cases (16%).

3. Results

3.1. Preoperative measures and postoperative outcomes

At the last follow-up, 8 patients (2%) had an iterative ACL rupture, 6 patients (1.5%) had a contralateral ACL rupture, and 30 patients (7.4%) underwent reoperation. The average IKDC score was 82.28 (SD: 12.59), the average SKV score was 79.71 (SD: 16.02), the average ACL-RSI score was 71.39 (SD: 22.96), and the average Tegner score was 6.41 (SD: 2.22).

Operative delay meaning time between injury and surgery was not found to contribute to the risk of iterative rupture ($p = 0.585$),

contralateral rupture (p = 0.149) or the risk of reoperation (p = 0.574). The type of preoperative brace and preoperative weight-bearing was not found to statistically contribute to the risk of iterative rupture, contralateral rupture, the risk of reoperation or better functional score (Table 1).

The types of reoperations were Cyclops syndrome (15 patients), arthroscopic arthrolysis (6 patients), mobilization under general anesthesia (1 patient), meniscectomy (3 patients), screw removal (2 patients), and infection (1 patient).

3.2. Non operative vs surgical treatment in group ACL + MCL (grade 2-3)

Among the group ACL + MCL (grade 2–3) 17 (31%) patients were treated non operatively with the MCL and 37 (69%) operatively. There was no significant difference in operative delay between non operative or surgical treatment (p = 0.171). There was no significant difference in pre-operative immobilization between non operative or surgical treatment (p = 0.054). Patients treated surgically had a significantly greater preoperative full weight-bearing to patients treated non-surgically (p = 0.028) (Table 2).

3.3. ACL + MCL (grade 2–3) group vs ACL + MCL (grade 1) group

When comparing the two groups, ACL + MCL (grade 2–3) group underwent surgery significantly (p < 0.0001) earlier (mean = 2.79 months, sd: 3.34) than the ACL + MCL (grade 1) group (mean = 4.93 months, sd: 7.32). In the ACL + MCL (grade 1) group, 205 patients (84.7%) used a brace compared to 49 patients (90.7%) in the ACL + MCL (Grade 2–3) group (p = 0.250). Similarly, no significant difference was found between the two groups in terms of brace type (p = 0.457). Full weight-bearing was significantly less restricted in the ACL + MCL (Grade 2–3) group when compared to the ACL + MCL (Grade 1) group (p = 0.049). ACL + MCL (Grade 1) group have better post-operative functional score (SKV, ACL-RSI, IKDC) compared to ACL + MCL (Grade 2–3) group (Table 3).

4. Discussion

Preoperative measures does not influence on postoperative outcomes for cases involving combined anterior cruciate and medial collateral ligament injuries. The operative delay did not significantly affect the risk of iterative rupture, contralateral rupture, or the need for reoperation with a mean follow-up of 18.6 months. The type of preoperative brace and weight-bearing status also did not significantly impact post-operative results. The Grade 2–3 MCL group underwent surgery significantly earlier than the Grade 1 MCL. The Grade 2–3 MCL group achieved lower functional scores compared to the Grade 1 group. In our study, we observed that the type of preoperative brace did not significantly impact postoperative outcomes in cases of combined ACL-MCL injuries. The use of various types of braces, including non-hinged knee braces, hinged knee braces, or other types, did not show a statistically significant difference in terms of iterative ACL rupture, contralateral ACL rupture, reoperation, or functional scores. This finding suggests that

Table 2
Comparison of preoperative management between non operative and surgery treatment in ACL + MCL (grade 2–3) group.

	Non operative	Surgery	p
n (%)	17 (31,5%)	37 (68,5%)	
Weight bearing n (%)			.028
Full	8 (47.1)	30 (81.1)	
Partial	7 (41.2)	5 (13.5)	
None	2 (11.8)	2 (5.4)	
Brace Type n (%)			.054
Non hinged-knee brace	0 (0.0)	4 (12.1)	
Hinged-knee brace	11 (68.8)	26 (78.8)	
Others	5 (31.2)	3 (9.1)	
Operative delay (months)			.17
n/missing	12/5	31/6	
Mean (SD)	3.19 (4.02)	2.63 (3.10)	

Table 3
Comparison of preoperative management and postoperative results between ACL + MCL (grade1) group and ACL + MCL (grade 2–3) group.

	Grade 1	Grade 2–3	p
n (%)	242 (82%)	54 (18%)	
Weight bearing n (%)			.049
Full	193 (80.1)	38 (70.4)	
Partial	44 (18.3)	12 (22.2)	
None	4 (1.7)	4 (7.4)	
Brace Type n (%)			
Non hinged-knee brace	24 (11.7)	4 (8.2)	.457
Hinged-knee brace	162 (79.0)	37 (75.5)	
Others	19 (9.3)	8 (16.3)	
Operative delay (months)			<.0001
n/missing	227/15	43/11	
Mean (SD)	4.93 (7.32)	2.79 (3.34)	
Postoperative Functional Score mean (SD)			
SKV	81.33 (13.72)	76.60 (15.38)	.031
IKDC	83.00 (12.85)	78.03 (14.52)	.016
ACL-RSI	74.01 (20.64)	65.94 (24.00)	.015
Tegner	6.54 (2.28)	6.47 (2.30)	.839

Table 1
Preoperative measures and postoperative outcomes.

	Iterative ACL rupture			Reoperation			Contralateral ACL rupture		
	Yes	No	p value	Yes	No	p value	Yes	No	p value
n (%)	8 (2.0)	400 (98.0)		30 (7.4)	378 (92.6)		6 (1.5)	394 (98.5)	
Weight bearing n (%)			.665			.175			.645
Full	8 (2.3)	333 (97.7)		22 (6.5)	319 (93.5)		6 (1.8)	327 (98.2)	
Partial	0 (0.0)	56 (100.0)		7 (12.5)	49 (87.5)		0 (0.0)	56 (100.0)	
None	0 (0.0)	8 (100.0)		1 (12.5)	7 (87.5)		0 (0.0)	8 (100.0)	
Preoperative immobilization n (%)			.050			.136			.097
Yes	4 (1.2)	324 (98.8)		21 (6.4)	307 (93.6)		3 (0.9)	317 (99.1)	
No	4 (5.0)	76 (95.0)		9 (11.2)	71 (88.8)		3 (3.8)	77 (96.2)	
Brace Type n (%)			1			.667			.495
Non hinged-knee brace	0 (0.0)	39 (100.0)		4 (10.3)	35 (89.7)		1 (2.6)	38 (97.4)	
Hinged-knee brace	4 (1.5)	258 (98.5)		16 (6.1)	246 (93.9)		2 (0.8)	253 (99.2)	
Others	0 (0.0)	27 (100.0)		1 (4.3)	26 (95.7)		0 (0.0)	26 (100.0)	
Operative delay (months)			.585			.574			
n/missing	7/1	354/46		27/3	334/44		6/0	348/46	
Mean (SD)	2.92 (1.70)	4.69 (6.60)		3.50 (2.71)	4.75 (6.76)		2.13 (0.91)	4.73 (6.64)	.149

the choice of preoperative brace may be less critical in determining postoperative outcomes, highlighting the importance of other factors such as surgical timing and the severity of the MCL injury. While braces are commonly used in the preoperative management of knee injuries to provide stability and support, our results suggest that their specific type may not significantly influence surgical outcomes. If a brace needs to be applied, we suggest using a hinged brace to limit the risk of stiffness. Further research is warranted to explore the role of braces in preoperative management and their potential impact on postoperative recovery in combined ACL-MCL injuries.

The operative delay did not significantly affect the risk of iterative rupture, contralateral rupture, or the need for reoperation. This suggests that the timing of surgery may not be a critical factor in determining postoperative outcomes in combined ACL and MCL injuries. However, the study did find significant differences between the two groups based on the grade of MCL injury. The timing of surgery raises questions about the optimal window for intervention. Delaying surgery may allow for natural healing and resolution of acute inflammation but could also lead to prolonged instability and functional limitations [21,22]. In case of surgery for chronic cases, a reconstruction of medial structures is mandatory and results are worse than for repair [23]. Conversely, early surgical intervention may mitigate the risk of chronic instability but could increase the potential for surgical complications or compromise tissue healing [24–26]. Non-surgical approaches in treating the medial structures within a combined ACL-MCL injury are potential effectiveness [3,5,8,27–32]. Research has demonstrated that delaying surgical intervention for 4–6 weeks yields comparable outcomes to immediate treatment [3,12].

When comparing the two groups, the Grade 2−3 MCL group had less restricted weight-bearing preoperatively and the Grade 2−3 MCL group underwent surgery significantly earlier than the Grade 1 MCL. These findings suggest that the severity of the MCL injury may influence preoperative management decisions about weight-bearing. We could explain this by the fact that grade 2−3 MCL injuries will either undergo surgery promptly for some or delayed with a brace allowing earlier knee support and mobility to reduce the risk of post-operative stiffness. Patients with Grade 2−3 MCL injuries underwent ACL reconstruction significantly earlier than those with Grade 1 MCL injuries. This point could be explained by the fact that Grade 3 MCL injuries are more serious injuries with a laxity in extension with recommendations in the literature for a surgery before the third week to repair the medial structures and to avoid a chronic medial laxity. Numerous studies have reported that the outcomes of patients receiving functional treatment for Grade I and II MCL in conjunction with ACL reconstruction are similar to those of patients without MCL injury [31,33,34]. Non-operative management of a grade III MCL injury in parallel with ACL reconstruction may increase the risk of ACL revision [28]. However, surgical treatment of the grade III MCL injury was associated with a worse two-year patient reported knee function [28].

Despite variations in weight-bearing allowances preoperatively, there was no statistically significant impact on the risk of iterative rupture, contralateral rupture, or the need for reoperation. This observation underscores the importance of considering individualized approaches to weight-bearing based on patient characteristics and injury severity. While weight-bearing status did not emerge as a significant predictor of postoperative outcomes in this study, its role in guiding preoperative management decisions remains critical for optimizing patient outcomes and functional recovery. Further research is warranted to refine preoperative treatment strategies and enhance our understanding of the factors influencing postoperative outcomes in these complex injuries.

The study's prospective design involving multiple surgical centers lends credibility to the findings by capturing a diverse patient population and minimizing bias associated with retrospective studies. With 408 patients included in the study, the sample size is relatively large, which increases the statistical power and generalizability of the findings. In this study, the complication rate is relatively low regarding both ipsilateral and contralateral ruptures, as well as the rate of secondary surgeries. The study addresses a significant research gap by specifically investigating the impact of preoperative measures on postoperative outcomes in combined ACL-MCL injuries, an area where previous literature is limited. Despite being prospective, the study may still be susceptible to selection bias, as patients were recruited from specialized knee surgery centers, which may not fully represent the general population with ACL-MCL injuries. The relatively short mean follow-up period of 18.5 months may not capture long-term outcomes and complications associated with combined ACL-MCL injuries, potentially limiting the study's ability to assess the full impact of preoperative measures. There were instances of missing data, particularly regarding the grade of MCL injury, which could introduce bias and affect the robustness of the analysis.

Comparing these results to previous literature, the study adds valuable insights into the management of combined ACL-MCL injuries. While previous studies have investigated surgical and conservative management options, none have specifically examined the impact of preoperative management on postoperative outcomes.

5. Conclusion

Preoperative measures about time between injury and surgery, no or full weight-bearing and use or no use of a brace no impacted postoperative outcomes for cases involving combined ACL and MCL injuries. For such cases, our recommendation involves immediate adoption of full weight-bearing and full recovery of range of motion, with the use of bracing depending on the pain, and consideration given to using a hinged knee brace as necessary. This study emphasizes the need for further research to refine preoperative treatment strategies for cases involving combined ACL and MCL injuries.

CRediT authorship contribution statement

All the authors gave substantial contributions to this work.

Declaration of Generative AI and AI-assisted technologies in the writing process

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Nicolas Bouguennec: Consultant for FH, SBM et Stryker.

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