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# Epidemiology and Characteristics of Meniscal Tears in Patients With Combined ACL and Medial Collateral Ligament Injuries Versus Isolated ACL Tears

## A Case-Control Study From the Francophone Arthroscopic Society

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**Background:** The co-occurrence of anterior cruciate ligament (ACL) rupture with medial collateral ligament (MCL) rupture is a compound injury that can be associated with meniscal tears.

**Purpose:** To report the characteristics of meniscal tears in knees with isolated ACL versus combined ACL and MCL injuries, analyzing their frequency, distribution by site, and lesion type.

**Study Design:** Cross-sectional study; Level of evidence, 3.

**Method:** This prospective, multicenter, case-control study, conducted across 10 hospitals in France as part of a symposium of the national French Society of Arthroscopy, compared patients undergoing ACL reconstruction with and without MCL injury. The 2 groups were matched by sex, age (±3 years), and body mass index (±3) to minimize imbalances between groups. All operations were performed by senior surgeons, who systematically explored for ramp, root, and other types of meniscal lesions as well as corner injuries. The primary outcome focused on meniscal injury frequency, with secondary outcomes examining lesion sites and types. A subgroup analysis was performed to compare these outcomes depending on the injury chronicity. Acute ACL injuries were those treated within 3 months of injury, and chronic lesions were those treated after this period.

**Results:** A total of 722 patients were included, with a mean age of 30.32 ± 10.78 years. Meniscal injuries were observed more frequently in the ACL + MCL group, with 217 of 408 patients (53.2%) affected, compared with 130 of 314 patients (41.4%) in the isolated ACL group ($P = .001$). Lateral meniscal lesions were significantly more common in the ACL + MCL group at 41.9% compared with 20.8% in the isolated ACL group ($P < .001$). The same pattern was found independent of chronicity. Medial meniscal lesions were significantly more common in the isolated ACL group regardless of chronicity status. In terms of types of medial lesions, the ACL + MCL group primarily experienced longitudinal (45.9%) and ramp lesions (28.7%), whereas the isolated ACL group experienced mostly ramp lesion (58.3%; $P < .001$). No significant difference was observed in the distribution of lateral meniscal injury types.

**Conclusion:** This study demonstrated a higher prevalence of meniscal injuries associated with ACL + MCL injuries compared with isolated ACL injuries, with lateral meniscal lesions particularly more frequent, independent of chronicity status.

**Keywords:** medial plane injury; ACL reconstruction; anterior cruciate ligament; meniscal injury; multiligamentous injury

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Traumatic meniscal injuries are a significant orthopaedic concern, accounting for approximately 12% to 14% of knee injuries, with an incidence of 60 to 70 cases in every

100,000 people.[1,11,22,23] However, in the context of ligamentous injuries such as anterior cruciate ligament (ACL) rupture, meniscal injuries become particularly prevalent, reaching 22% to 86% in some studies.[1,5,22,23] Acute ACL injuries are more commonly associated with lateral meniscal tears, whereas chronic ACL injuries typically result in medial meniscal tears.[5]

When it comes to more complex injury such as combined ACL and medial collateral ligament (MCL) injury, the cooccurrence of meniscal injury is referred to as the "unhappy triad," which traditionally has been related to poor prognosis. Combined ACL and medial plane injury presents a prevalent and complex clinical challenge, constituting approximately 20% of all ligamentous knee injuries.[9,28] The intricate nature of ACL and MCL injuries is mainly underscored by their association with rotatory knee instability, a significant cause of morbidity for patients.[9,34] The mechanism of injury involves a sudden valgus impact with external or internal rotation, leading to a combination of ACL and MCL injuries.[34] Early studies emphasized a high incidence of meniscal tears within this triad, particularly medial meniscal tears.[18] However, subsequent research introduced a shift in focus, revealing a more dominant prevalence of lateral meniscal injuries in such cases.[15] Additionally, the mechanism of ACL and MCL injuries typically occurs with a combined valgus and external rotational force, contributing to the complexity of these injuries.[6]

Although meniscal tear is a common injury, the literature remains inconclusive about the exact prevalence, mechanism, and characteristics of meniscal tears associated with isolated ACL injuries versus combined ACL and MCL injuries.[26] Moreover, studies have indicated that the presence of meniscal tears is associated with worsened prognoses in knee injuries, raising concerns about the effect of these tears on patient outcomes.[10,13,23] In their systematic review, Gupta et al[13] suggested that meniscal tears may be a prognostic factor for worse patient-reported outcomes 2 to 10 years after ACL reconstruction.

This study aimed to report on the characteristics of meniscal tears through a large-scale national registry, comparing 2 distinct groups: individuals with isolated ACL injuries and those with combined ACL and MCL injuries. The primary aim was to assess the frequency of meniscal tears within these groups. Secondary aims included characterizing the site of meniscal injuries (medial or lateral) and identifying the type of lesion in the combined ACL and MCL group.

In light of the current understanding and taking into consideration the different mechanisms of injury causing simultaneous ACL and MCL ruptures, we hypothesized that lateral meniscal tears would be more prevalent than medial meniscal tears in the studied population.

## METHODS

### Study Design

This was a prospective, match-paired, multicenter, case-control study conducted between January 2020 and June 2022, targeting patients treated with ACL reconstruction with or without MCL injury in several hospitals in France (Clinique Nord-genou de Lille, Centre ostéoarticulaire des cèdre de Grenoble, Clinique du Sport de Bordeaux). Due to the relative rarity of combined ACL and MCL injuries compared with ACL injuries alone, the inclusion for the combined ACL and MCL group was expanded to include more hospitals (CHU de Toulouse, CHU de Saint Etienne, APHM de Marseille, Centre Orthpédie Santy, Clinique Rhena de Strasbourg, Clinique du Sport de Paris, and les Hôpitaux privés de Rennais). This study was part of the national symposium of the French Society of Arthroscopy.

To minimize imbalances between groups, patients were matched by sex, age (±3 years), and body mass index (±3) with a 1:3 ratio.

### Inclusion and Exclusion Criteria

The inclusion criteria included patients with a primary ACL injury confirmed by magnetic resonance imaging (MRI), whether associated with an MCL injury or not,

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who underwent ACL reconstruction and were aged ≥15 years. The exclusion criteria included previous history of knee surgery, bucket-handle meniscal injury, isolated injury of the medial plane (defined below), mosaicplasty or microfractures performed in the same operative session on the operated knee, other ligament-associated injuries (posterior cruciate ligament, lateral collateral ligament), and articular cartilage lesion of grade 2 or higher according to the Outerbridge classification.[29]

### Definition of Medial Plane Injury

Medial plane injury was defined as injury to the MCL with or without posteromedial corner structure injury. The diagnosis of medial plane or MCL injury was made clinically and confirmed by MRI.[21]

The grading of MCL injuries was based on the extent of fiber damage and abnormal laxity as classified by Hughston et al,[16,17] where grade 1 entailed minor fiber injury with local tenderness but no abnormal laxity, grade 2 involved more extensive fiber damage with tenderness and slight abnormal laxity, and grade 3 was a complete tear with distinct abnormal laxity.

### Surgical Technique

All patients underwent surgery performed by senior surgeons who systematically explored for ramp, root, and other types of meniscal lesions as well as corner injuries. For ramp lesions, defined as longitudinal tears of the peripheral attachment of the posterior horn of the medial meniscus to the tibial plateau,[32] direct visualization was achieved using both anterior and transnotch approaches. The transnotch technique, performed with the knee at 90° of flexion and using the anterolateral portal, allowed for thorough inspection of the posteromedial compartment.[32] A hook probe was used along with valgus stress to carefully palpate and inspect the medial meniscus. Special attention was given to identify by palpation any submeniscal flaps or flaps hidden behind the tibial plateau. The exploration of the lateral meniscus was performed using a hook probe in conjunction with the figure-of-4 position, which places the knee in a valgus stress to open the lateral compartment.

### Outcome Measures

The primary outcome measure was the frequency of meniscal injuries in each group. The secondary outcome measures were the site of meniscal injuries (medial or lateral) and the type of lesion (radial, longitudinal, ramp, horizontal). The type of tear was determined via arthroscopy. A subgroup analysis was performed comparing these outcomes depending on the injury chronicity. Acute ACL lesion was defined as patients treated within 3 months of injury. Chronic ACL lesion was defined as patients treated after 3 months of injury.[25]

### Data Collection

All data were collected prospectively using an internet-based software (Datalake) that was accessed and completed by surgeons for physical examination and imaging and perioperative findings. Collected data include demographic characteristics, characteristics of the ACL lesion, history, and preoperative physical examination finding in addition to the above-cited outcomes of interest.

Testing of valgus laxity in flexion and extension was performed clinically, and laxity was rated. In case of abnormal laxity (grade 3 MCL injury), the degree of laxity was graded as 1+ for 3 to 5 mm of laxity, 2+ for 5 to 10 mm of laxity, and 3+ for >10 mm of laxity.[16,17,21]

### Participants and Sample Size

Of the total 728 consecutive, matched patients who underwent surgery during the study time frame, 6 were excluded for having bucket-handle meniscal tear, leaving 722 eligible participants. These participants were divided into 2 groups: the isolated ACL group, with 408 patients, and the ACL + MCL group, comprising 314 patients.

### Statistical Analysis

All statistical analyses were performed using Stata software 18.0 (Stata Corp). Quantitative data are presented as mean and standard deviation. Qualitative data are shown as counts and percentages, calculated from the number of reported values.

The comparison between the isolated ACL group and combined ACL + MCL group was based on distribution comparison tests (Student *t* test or Mann-Whitney test as appropriate) for quantitative variables and percentage comparison tests (chi-square or Fisher exact test as appropriate) for qualitative variables. The significance level was set at $P < .05$.

## RESULTS

### Patient Characteristics

The age at operation was comparable between the groups, with a mean of 30.32 ± 10.78 years. Sex distribution was also comparable, with women constituting 38.1% of the total cohort. Body mass index showed a similar trend across both groups, with the overall mean being 24.11 ± 3.60. However, a significant difference was observed in the history of contralateral ACL rupture, with a higher incidence in the isolated ACL group (9.2%) compared with the ACL + MCL group (2.0%; $P < .0001$). The time from injury to surgery and results of Lachman test and preoperative pivot shift were comparable across both groups (Table 1).

### Physical Examination Findings in the ACL + MCL Group

Valgus stress test in 30° of flexion was negative (0) in 12 patients out of 362 (3.3%) and showed severe laxity in 28 patients (7.7%), whereas most patients had mild to

TABLE 1
Patient Characteristics[a]

| Characteristic | Isolated ACL Group n = 314 (43.5%) | ACL + MCL Group n = 408 (56.5%) | *P* | Total N = 722 (100.0%) |
|---|---|---|---|---|
| Age at operation, y | 30.92 ± 11.29 | 29.86 ± 10.35 | .188 | 30.32 ± 10.78 |
| Sex | | | .926 | |
| Female | 119 (37.9) | 156 (38.2) | | 275 (38.1) |
| Male | 195 (62.1) | 252 (61.8) | | 447 (61.9) |
| Body mass index, kg/m$^2$ | 23.81 ± 3.48 | 24.34 ± 3.67 | .051 | 24.11 ± 3.60 |
| ≥30 | 21 (6.7) | 32 (7.8) | .555 | 53 (7.3) |
| <30 | 293 (93.3) | 376 (92.2) | | 669 (92.7) |
| Side | | | | |
| Right | 161 (51.3) | 209 (51.4) | .983 | 370 (51.3) |
| Left | 153 (48.7) | 198 (48.6) | .983 | 351 (48.7) |
| History of contralateral ACL rupture | | | <.0001 | |
| Yes | 29 (9.2) | 8 (2.0) | | 37 (5.1) |
| No | 285 (90.8) | 400 (98.0) | | 685 (94.9) |
| Time from injury to surgery, mo | 5.80 ± 10.00 | 4.65 ± 6.55 | .729 | 5.07 ± 7.99 |
| Chronicity | | | .965 | |
| Acute <3 mo | 112 (54.1) | 196 (54.3) | | 308 (54.2) |
| Chronic >3 mo | 95 (45.9) | 165 (45.7) | | 260 (45.8) |
| Lachman test result | | | .404 | |
| Mild (1 + ) | 52 (21.0) | 70 (17.2) | | 122 (18.7) |
| Moderate (2 + ) | 168 (67.7) | 281 (69.2) | | 449 (68.7) |
| Severe (3 + ) | 28 (11.3) | 55 (13.5) | | 83 (12.7) |
| Preoperative pivot shift | | | .251 | |
| No pivot | 1 (0.4) | 6 (1.5) | | 7 (1.1) |
| Mild (1 + ) | 55 (22.2) | 77 (18.9) | | 132 (20.2) |
| Moderate (2 + ) | 163 (65.7) | 288 (70.8) | | 451 (68.9) |
| Severe (3 + ) | 29 (11.7) | 36 (8.8) | | 65 (9.9) |

[a]Data are expressed as mean ± SD or n (%). ACL, anterior cruciate ligament; MCL, medial collateral ligament. Some variables were not recorded for the entire cohort due to missing data.

TABLE 2
Physical Examination Findings in ACL + MCL Group (n = 408)[a]

| Variable | Statistic | Total |
|---|---|---|
| Valgus testing in flexion | n/missing | 362/46 |
| 0 | n (%) | 12 (3.3) |
| + | n (%) | 202 (55.8) |
| + + | n (%) | 120 (33.1) |
| + + + | n (%) | 28 (7.7) |
| Missing | n (%) | 46 (11.3) |
| Valgus testing in extension | n/missing | 296/112 |
| 0 | n (%) | 69 (23.3) |
| + | n (%) | 173 (58.4) |
| + + | n (%) | 44 (14.9) |
| + + + | n (%) | 10 (3.4) |
| Missing | n (%) | 112 (27.5) |

[a]ACL, anterior cruciate ligament; MCL, medial collateral ligament

moderate laxity. Similarly, valgus stress testing in extension was negative (0) in 69 of 296 (23.3%) and showed severe laxity in 10 patients (3.4%), whereas most patients had mild to moderate laxity (Table 2).

## Meniscal Lesion

*Rate of Meniscal Injury.* Meniscal lesions were more prevalent in the ACL + MCL group at 53.2% (217/408) compared with 41.4% (130/314) in the isolated ACL group ($P = .001$) (Table 3).

*Laterality of the Lesion.* The site of meniscal lesions varied between groups ($P < .0001$). Lateral meniscal lesions were more common in the ACL + MCL group at 41.9% (91/217) compared with 20.8% (27/130) in the isolated ACL group. Medial meniscal lesions were observed in 53.1% (69/130) of the isolated ACL group and 32.3% (70/217) of the ACL + MCL group. Lesions in both the medial and lateral menisci were found in 26.2% (34/130) of the isolated ACL group and 25.8% (56/217) of the ACL + MCL group (Table 3).

*Type of Meniscal Lesion.* In the context of medial meniscal lesions, significant variations were observed between groups. The ACL + MCL group predominantly experienced longitudinal lesions, reported in 56 cases (45.9%), and ramp lesions in 35 cases (28.7%) (Figure 1). These types of lesions were less often encountered in the isolated ACL group, where longitudinal lesions were found in 3 over 24 recorded cases (12.5%) and ramp lesions in 14 over 24 recorded cases (58.3%) (Table 3). Conversely, the isolated ACL group showed a higher prevalence of ramp

TABLE 3
Meniscal Lesion Characteristics Across Groups[a]

| | Isolated ACL Group n = 314 (43.5%) | ACL + MCL Group n = 408 (56.5%) | *P* | Total N = 722 (100.0%) |
|---|---|---|---|---|
| Presence of meniscal lesion | 130 (41.4) | 217 (53.2) | .001 | 347 (48.1) |
| Lateral | 27 (20.8) | 91 (41.9) | <.001 | 118 (34.0) |
| Medial | 69 (53.1) | 70 (32.3) | <.001 | 139 (40.1) |
| Both | 34 (26.2) | 56 (25.8) | .943 | 90 (25.9) |
| Lateral meniscal lesion | | | | |
| Radial | 2 (12.5) | 17 (13.2) | ≥.999 | 19 (13.1) |
| Flap | 2 (12.5) | 16 (12.4) | ≥.999 | 18 (12.4) |
| Complex | 1 (6.2) | 18 (14.0) | .695 | 19 (13.1) |
| Longitudinal | 2 (12.5) | 36 (27.9) | .239 | 38 (26.2) |
| Root-radial | 4 (25.0) | 12 (9.3) | .079 | 16 (11.0) |
| Root avulsion | 1 (6.2) | 6 (4.7) | .567 | 7 (4.8) |
| Partial, stable/healed | 3 (18.8) | 20 (15.5) | .720 | 23 (15.9) |
| Other | 1 (6.2) | 3 (2.3) | .377 | 4 (2.8) |
| Postmeniscectomy | 0 (0.0) | 1 (0.8) | ≥.999 | 1 (0.7) |
| Medial meniscal lesion | | | | |
| Radial | 0 (0.0) | 5 (4.1) | .591 | 5 (3.4) |
| Flap | 5 (20.8) | 1 (0.8) | <.001 | 6 (4.1) |
| Ramp | 14 (58.3) | 35 (28.7) | .005 | 49 (33.6) |
| Complex | 1 (4.2) | 6 (4.9) | ≥.999 | 7 (4.8) |
| Longitudinal | 3 (12.5) | 56 (45.9) | .002 | 59 (40.4) |
| Partial, stable/healed | 1 (4.2) | 10 (8.2) | .692 | 11 (7.5) |
| Other | 0 (0.0) | 7 (5.7) | .600 | 7 (4.8) |
| Postmeniscectomy | 0 (0.0) | 2 (1.6) | ≥.999 | 2 (1.4) |

[a]Data are expressed as n (%). ACL, anterior cruciate ligament; MCL, medial collateral ligament.

lesions, the most common type for this group in 14 cases (58.3%).

Radial lesions were the least often encountered, with none reported in the isolated ACL group and only 5 cases (4.1%) observed in the ACL + MCL group (Table 3).

## Comparison of Meniscal Lesion Characteristics Depending on Chronicity

Subgroup analysis based on injury chronicity revealed a higher prevalence of meniscal injuries in the ACL + MCL group during the acute phase ($P < .0001$), without a significant difference in chronic injuries ($P = .524$). Medial meniscal injuries were the predominant type in the isolated ACL group, regardless of chronicity status. Lateral meniscal injuries were more common in the combined ACL + MCL group across both acute and chronic phases (Table 4).

## DISCUSSION

The main finding of this study was a higher prevalence of meniscal injuries in knees with ACL + MCL injuries compared with those with isolated ACL injuries. Furthermore, lateral meniscal injuries surpassed medial meniscal injuries in the ACL + MCL group, independent of the chronicity of injury. This contrasts the frequent association of medial meniscal injuries with acute ACL + MCL ruptures found in older literature when the unhappy triad was first described.[33]

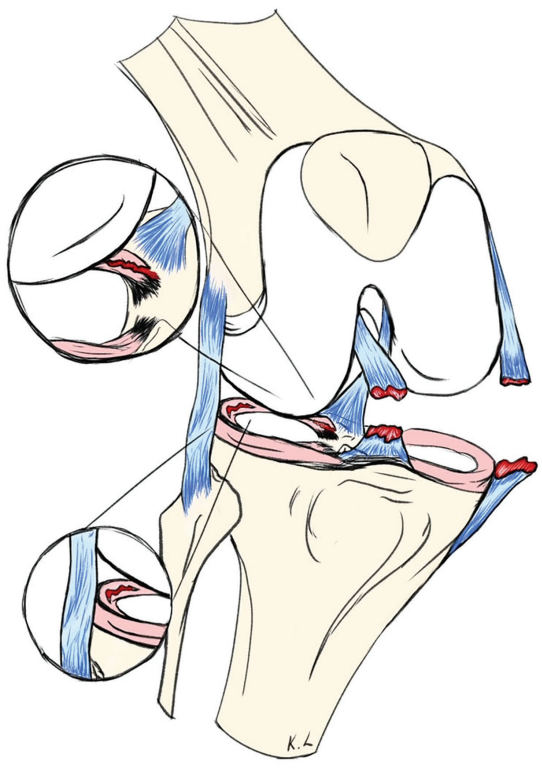


**Figure 1.** Drawing of the right knee showing the most common meniscal lesion types associated with combined anterior cruciate ligament and medial collateral ligament injury.

TABLE 4
Comparison Meniscal Lesion Characteristics Depending on Chronicity[a]

| | Isolated ACL Group | ACL + MCL Group | *P* | Total |
|---|---|---|---|---|
| Acute, <3 months | 112 (36.4) | 196 (63.6) | | 308 (100.0) |
| Time from injury to surgery, mo | 1.83 ± 0.74 | 1.79 ± 0.73 | .661 | 1.81 ± 0.73 |
| Presence of meniscal lesion | 40 (35.7) | 116 (59.2) | <.0001 | 156 (50.6) |
| Lateral | 9 (22.5) | 50 (43.1) | .020 | 59 (37.8) |
| Medial | 20 (50.0) | 38 (32.8) | .052 | 58 (37.2) |
| Both | 11 (27.5) | 28 (29.1) | .672 | 39 (25.0) |
| Lateral meniscal lesion | | | | |
| Radial | 1 (14.3) | 8 (11.1) | .586 | 9 (11.4) |
| Flap | 0 (0.0) | 12 (16.7) | .587 | 12 (15.2) |
| Complex | 1 (14.3) | 11 (15.3) | ≥.999 | 12 (15.2) |
| Longitudinal | 1 (14.3) | 21 (29.2) | .666 | 22 (27.8) |
| Root-radial | 3 (42.9) | 6 (8.3) | .029 | 9 (11.4) |
| Root avulsion | 1 (14.3) | 4 (5.6) | .379 | 5 (6.3) |
| Partial, stable/healed | 0 (0.0) | 10 (13.9) | .586 | 10 (12.7) |
| Medial meniscal lesion | | | | |
| Radial | 0 (0.0) | 1 (1.6) | ≥.999 | 1 (1.4) |
| Flap | 1 (12.5) | 0 (0.0) | .111 | 1 (1.4) |
| Ramp | 5 (62.5) | 19 (29.7) | .107 | 24 (33.3) |
| Complex | 1 (12.5) | 3 (4.7) | .382 | 4 (5.6) |
| Longitudinal | 1 (12.5) | 29 (45.3) | .128 | 30 (41.7) |
| Partial, stable/healed | 0 (0.0) | 6 (9.4) | ≥.999 | 6 (8.3) |
| Other | 0 (0.0) | 5 (7.8) | ≥.999 | 5 (6.9) |
| Postmeniscectomy | 0 (0.0) | 1 (1.6) | ≥.999 | 1 (1.4) |
| Chronic, >3 months | 95 (36.5) | 165 (63.5) | | 260 (100.0) |
| Time from injury to surgery, mo | 10.49 ± 13.32 | 8.05 ± 8.49) | .666 | 8.94 ± 10.55 |
| Presence of meniscal lesion | 43 (45.3) | 68 (41.2) | .524 | 111 (42.7) |
| Lateral | 10 (23.3) | 27 (39.7) | .073 | 37 (33.32) |
| Medial | 25 (58.1) | 23 (33.8) | .012 | 48 (43.2) |
| Both | 8 (18.6) | 18 (26.5) | .340 | 26 (23.4) |
| Lateral meniscal lesion | | | | |
| Radial | 1 (25.0) | 6 (15.8) | .532 | 7 (16.7) |
| Flap | 1 (25.0) | 3 (7.9) | .341 | 4 (9.5) |
| Complex | 0 (0.0) | 6 (15.8) | ≥.999 | 6 (14.3) |
| Longitudinal | 1 (25.0) | 11 (28.9) | ≥.999 | 12 (28.6) |
| Root-radial | 0 (0.0) | 4 (10.5) | ≥.999 | 4 (9.5) |
| Root avulsion | 0 (0.0) | 1 (2.6) | ≥.999 | 1 (2.4) |
| Partial, stable/healed | 0 (0.0) | 5 (13.2) | ≥.999 | 5 (11.9) |
| Other | 1 (25.0) | 1 (2.6) | .184 | 2 (4.8) |
| Postmeniscectomy | 0 (0.0) | 1 (2.6) | ≥.999 | 1 (2.4) |
| Medial meniscal lesion | | | | |
| Radial | 0 (0.0) | 1 (2.6) | ≥.999 | 1 (2.0) |
| Flap | 3 (30.0) | 1 (2.6) | .023 | 4 (8.2) |
| Ramp | 5 (50.0) | 8 (20.5) | .104 | 13 (26.5) |
| Complex | 0 (0.0) | 3 (7.7) | ≥.999 | 3 (6.1) |
| Longitudinal | 1 (10.0) | 21 (53.8) | .015 | 22 (44.9) |
| Partial, stable/healed | 1 (10.0) | 3 (7.7) | ≥.999 | 4 (8.2) |
| Other | 0 (0.0) | 1 (2.6) | ≥.999 | 1 (2.0) |
| Postmeniscectomy | 0 (0.0) | 1 (2.6) | ≥.999 | 1 (2.0) |

[a]Data are expressed as mean ± SD or n (%). ACL, anterior cruciate ligament; MCL, medial collateral ligament.

## Laterality of the Meniscal Lesion and Potential Mechanism

Our results align with the research conducted by Shelbourne et al,[27] who also observed a greater incidence of lateral meniscal injuries in patients with ACL + MCL injuries. Shelbourne et al suggested that the classic unhappy triad described by O'Donoghue,[27] involving ACL, MCL, and medial meniscal tears, is actually a less typical presentation of meniscal injury in combined ACL + MCL injuries.

Evidence from various studies consistently underscores the substantial association between chronic ACL rupture and medial meniscal tear. In their study on adolescent ACL ruptures, James et al[18] found that the risk of developing a medial meniscal tear nearly doubled with a 12-month

delay in intervention, with no concurrent alteration in the risk associated with the lateral meniscus. Similar results were found by Anstey et al,[2] who concluded that a delay in ACL reconstruction for >6 months carried a relative risk of 4.07 for increase of medial meniscal tear. Keyhani et al[19] found an association of chronic ACL ruptures with medial meniscal tear in 44% of their cases. There is a contradiction between the results obtained in our studies and those presented in this context; data from our study demonstrate that lateral meniscal lesions were notably more frequent in the ACL + MCL group, regardless of chronicity status. However, the cited studies have certain limitations, notably in terms of methodological variability and the populations studied, with few studies specifying the presence or absence of associated ligamentous injuries that may alter the biomechanics of lesions, such as an injury to the MCL, which theoretically could increase external stresses and thus favor lateralization. Moreover, this pattern can be attributed to the valgus mechanism typically involved in medial plane injuries. This mechanism exerts tension on the medial side, causing medial plane damage while concurrently compressing the lateral knee compartment. This biomechanical process likely increases strain on the lateral meniscus, leading to more frequent lateral injuries. Last, the quality of the studies, although robust, varies, ranging from randomized controlled trials to retrospective studies, which could affect the interpretation of the data.

Another point of divergence from the literature in our study is the higher prevalence of medial meniscal injury in knees with acute isolated ACL injury, contrary to literature reporting a higher incidence of lateral meniscal injury.[2,18,19] One explanation of this finding is the standardization of meniscal inspection implemented in this study,[32] implicating higher sensitivity for lesions that are known for their potential to be overlooked, such as ramp lesion, also known as the "hidden lesion."[30] However, even when we exclude ramp lesions, the data still show a higher prevalence of medial meniscal tears compared with lateral meniscal tears in the isolated ACL group.

## Type of Meniscal Lesion on the Medial Side

Interestingly, when looking at the medial meniscal lesions, our results revealed ramp lesions to be the most common pattern in the isolated ACL group (58.3%), compared with longitudinal tears remaining the most common pattern in the ACL + MCL group (45.9%) followed by ramp lesions in 35 cases (28.7%).

Medial meniscal ramp tears have been reported to have an incidence rate ranging from 2.65% to 16% in association with ACL injuries.[3,8,12,24] Indeed, their incidence in our population was higher than that reported in the literature. In their series on 301 ACL reconstructions, DePhillipo et al[8] found that ramp lesions were present in 17% of cases. Cristiani et al[7] reported an incidence of 39% in their series of 253 patients, whereas Gracia et al[12] found only 22% of cases associated with ACL rupture. However, these studies included older patients, in whom associated ligamentous injuries are less frequent, which yields lower percentage rates. The mechanism of injury of ramp lesions involves special biomechanics.[3,8,12,24] The sudden contraction of the semimembranosus muscle, along with traction on the posterior horn of the medial meniscus, creates tension within the posterior meniscocapsular complex, leading to ramp lesions.[3,8,12,24]

Of note, bucket-handle meniscal tears were excluded from this study due to their nature requiring urgent surgical intervention. Including bucket-handle tears in the study could have distorted the analysis related to injury chronicity and delay in treatment.

## Type of Meniscal Lesion on the Lateral Side

In the isolated ACL group, radial meniscus root lesions were the most common type on the lateral side (25% compared with 9.3% in the ACL + MCL group), whereas longitudinal tears dominated in the ACL + MCL group (27.9% compared with 12.5% in the ACL group), although the difference was not statistically significant. It is established that meniscus root tears occur in young patients after a traumatic event, most probably involving a rotatory blow to the flexed knee.[14] The same mechanism is found to cause ACL rupture.[31] This elucidates the higher prevalence of root tears with isolated ACL injuries, given their shared mechanism of injury during flexion. Conversely, in the ACL + MCL group, where a valgus force, typically occurring in semiflexion or extension, is needed to induce the medial plane injury, the incidence of root tears diminished in favor of longitudinal tears. The accurate diagnosis of root tears plays a crucial role in determining the treatment outcome for knees afflicted with multiligament injury. Biomechanical studies have proven that root tears are the equivalent of a total meniscectomy.[4,20] By decreasing compressive load distribution and increasing contact pressure in the injured tibiofemoral compartment, also known as point loading, meniscus root tears contribute to cartilage damage. Moreover, nonanatomic repairs of root lesions may lead to worse outcomes in the long term.[4,20]

## Valgus Stress Test

Our data showed that the valgus stress test in extension was negative in 23.3% of patients, aligning with existing literature which posits that the posterior cruciate ligament as well as posterior capsule, tight in extension, can compensate for MCL deficiency in extension even in the absence of the ACL, resulting in a negative test.[17] Similarly, when the knee is flexed, the proportion of negative tests decreases dramatically to 3.3%.

## Limitations

The present study has several limitations that warrant consideration. Our study included only patients who underwent surgery, which means that patients treated nonsurgically were overlooked. The sample size may pose limitations in generalizing findings to broader populations. However, the sample size is also one of the study's strengths, because this is one of the largest studies on

the topic. Missing data further add a layer of complexity to result interpretation, especially regarding lesion types. Despite the standardized protocol for diagnosing meniscal lesions in this study, the involvement of multiple centers and operators could have led to detection bias due to variability in performance among surgeons.

Despite these limitations, our study is one of the largest to detail the associated meniscal lesions in knees with combined ACL + MCL injuries, stratified between acute and chronic cases, within a matched case-control design, offering valuable insights into the prevalence and characteristics of meniscal injuries associated with isolated ACL and combined ACL + MCL injuries.

## CONCLUSION

Meniscal injuries were significantly more common in the ACL + MCL group compared with the isolated ACL group. Lateral meniscal lesions were notably more frequent in the ACL + MCL group, regardless of chronicity status. Medial meniscal injuries were more common in the isolated ACL group independent of chronicity status. Medial meniscal lesion types varied significantly between groups, with longitudinal lesions predominating in the ACL + MCL group. Conversely, ramp lesions were the more common medial meniscal lesion in the isolated ACL group.

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