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Younis Mahmoud Akl
Orthopedic Surgery Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Mohamed I. Abulsoud
Orthopedic Surgery Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Hussam El-Deen Eid Haffour
Orthopedic Surgery Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.,
dr.hussam.z1@gmail.com

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ORIGINAL ARTICLE

Open Release of Superficial Medial Collateral Ligament for Arthroscopic Medial Meniscus Surgery in Patient With Tight Medial Compartment

Younis Mahmoud Akl, Mohamed Ibrahim Abulsoud, Hussam El-Deen Eid Haffour*

Department of Orthopedic Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Abstract

Background: **Attachment of the posterior root is necessary for the medial meniscus to function and its tears are common. Arthroscopy must be able to see the medial meniscus' posterior horn to repair it. Even an arthroscopy specialist can damage the articular cartilage in tight knee joints with a tiny medial joint space, increasing the risk of knee osteoarthritis. Pie crusting technique needs multiple punctures to open joints. It raises medial joint structure iatrogenic injury risk.**

Aim: **The purpose of the research was to look for residual laxity of knee following minimally invasive (mini-open) superficial medial collateral ligament (SMCL) release or any other complications.**

Patients and methods: **Thirty individuals with injuries of medial meniscus were identified between March 2022 and December 2022 who had tight knees and the tear's visualization is challenging. These individuals had minimally invasive SMCL release, making meniscal repair or partial meniscectomy safe and easy.**

Results: **Each participant had postoperative discomfort at the release site (grade I MCL sprain), which went away in 1−2 weeks. By the end of the third month postoperatively the mean Lysholm score rose from 50.03 preoperatively to 92.47. None of the patients complained of residual medial laxity after the period of the follow-up was over.**

Conclusion: **Meniscal surgery requires clear visibility of the medial meniscus' posterior horn. The minimally invasive SMCL release is safe and effective for viewing the medial meniscus' posterior horn in tight knees. It prevents medial femoral condyle fractures and iatrogenic chondral damage. The released SMCL recovers without perceived instability.**

Keywords: Arthroscopic medial meniscus surgery, Mini-open superficial medial collateral ligament, Pie crusting, Tight medial compartment

1. Introduction

Meniscal tears often occur in the medial meniscus's posterior horn. To carry out a successful meniscectomy, unrestricted arthroscopic vision of the medial meniscus's posterior horn is essential. The medial femoral condyle causes it to be more challenging to see the medial meniscus's posterior horn and to use equipment in individuals with tight knees. This region is thus said to be one of the main causes of diagnostic mistakes in knees arthroscopy in tight knees.[1,2]

In situations when the knees are tight, vigorous instrument manipulations may result in iatrogenic chondral injury, that might accelerate the formation of osteoarthritis and articular cartilage degradation.[3,4] In addition, because to poor visibility, the left meniscal fragment may cause ongoing discomfort and need a second procedure.[5,6] In addition, this forceful manipulation to release the medial compartment may cause fractures of the femur or a rupturing of the medial collateral ligament (MCL).[7,8]

To maximize medial joint distraction while providing a valgus strain to the knee, it is possible to release the MCL using a number of procedures that have been documented in the literature. A minimally invasive method to access the medial compartment was reported by many authors, and it

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* Corresponding author at: Elmarkaz Street, Shubra Elnamla, Gharbia Government, 31739, Egypt.
E-mail address: dr.hussam.z1@gmail.com (H.E.-D.E. Haffour).

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included percutaneously puncturing the posteromedial capsuloligamentous structures utilizing a needles. There was no information on the damage localization, patterns of healing, or complications, even though they stated that the affected structures recovered without any difficulties.[3,9–12]

There are several known disadvantages to the pie crusting method. Since there is no consistent landmark for the release of MCL, repeated punctures are necessary to achieve a sufficient joint openness. It takes a lot of time and might result in a compromised joint space and insufficient MCL release. The presence of many punctures may lead to overrelease. It increases the risk of iatrogenic damage to the medial joint structures, such as the saphenous vein, medial meniscus, and nerve.[13]

Utilizing a minimally invasive approach at the distal MCL insertion via a small incision that additionally serves for transtibial meniscal root fixing, we describe our expertise in doing superficial medial collateral ligament (SMCL) releases in this work. This SMCL release technique provides a better vision of the medial meniscus's posterior horn and protects the MCL from rupturing. We were also worried about researching the potential side effects, particularly persistent medial laxity.

The aim of this study is to detect the effectiveness of minimally invasive SMCL release for better visualization in arthroscopic medial meniscus surgery in patients with a tight medial compartment and to detect any residual medial laxity or any other postoperative complications.

2. Patients and methods

This study was conducted with the approval of the ethics committee and with written consent from the patient. A prospective case series research was conducted from March 2022 to December 2022 to assess the impact of the minimally invasive SMCL release in patients undergoing medial meniscus arthroscopic surgery having a tight knee medial compartment.

Thirty individuals suffering from a medial meniscus tear and a tight medial compartment of the knee make up the study's sample. All patients were chosen based on the aforementioned criteria.

2.1. Inclusion criteria

Age: 18–55 years, both sexes were included, athletes and nonathletes, confirmed negative varus-valgus test for stress with knee flexion of 30° preoperatively. In the knee's semi-straight posture with a varus angle of less than 5° and arthroscopic examination revealing constriction of the medial joint space, the posterior side of the medial meniscus had not been clearly evident.

2.2. Exclusion criteria

Concomitant ipsilateral multiple ligament injuries, malalignment over 5°, osteoarthritis grade III or more and ipsilateral knee surgery for ligament repair in the past.

2.3. Preoperative evaluation

Taking a thorough history and analyzing the patient's complaint using the Lysholm knee score,[14] thorough clinical assessment and radiographic analysis: incorporates MRI and plain standing radiograph.

2.4. Follow-up evaluation

Full clinical evaluation, radiographic evaluation, postoperative rating scale: Lysholm knee score, and statistical analysis.

2.5. Preoperative evaluation

2.5.1. History

Sex, the side that was injured, and the injury's etiology. There were 18 female participants and 12 male participants. Of the 30 individuals, the right knee was afflicted in 20 individuals whereas the left knee was impacted in 10 individuals. Practice for a sport was the source of the injuries in 16 individuals, whereas nonsports injuries was the culprit in 14 individuals.

2.5.2. Analysis of patient complaint

The Lysholm score assessment was used to analyze the patient's complaint.[14]

2.5.3. Clinical assessment

Both the afflicted knee and the knee on the opposite side underwent a thorough clinical evaluation.

2.5.4. Radiographic assessment

Standard standing radiographs (anteroposterior, lateral views) of both knees: to rule out osteoarthritis or misalignment, and to get an MRI of the injured knee: to identify the meniscal tear's location and type, as well as to look for any additional ligamentous lesions or patellar instabilities.

2.6. Operational approach

2.6.1. Indications for surgeries

In this research, individuals who had meniscal injuries and tightness in the knee' medial compartment with obvious meniscal tear on the MRI were managed with a minimally invasive SMCL release for better arthroscopic visualization.

2.6.2. The surgical procedure

Minimally invasive SMCL release was carried out when visibility or instrumentation of the posteromedial meniscus during valgus stress was insufficient (Fig.. 1A and 2A, B). A ~2–3 cm incision will be made ~1–2 cm medial to the tubercle of the tibia at the estimated site of intended tibial fixing for the meniscal root repair sutures. The tubercle of the tibia and the posteromedial portion of the tibia are palpated. After hemostasis with electrocautery, the sartorial fascia level is reached by sharp dissection.

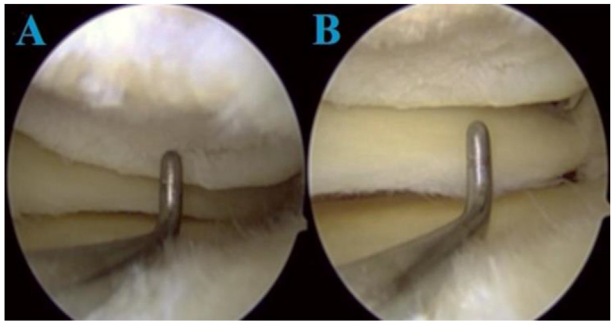

Fig. 1. (A) Tight medial compartment of the knee; (B) opening of the medial compartment after SMCL release. SMCL, superficial medial collateral ligament.

The sartorial fascia is then excised, lifting the fascia as necessary to avoid accidently damaging the SMCL. Subperiosteally elevating the SMCL off the tibia follows. The joint is now re-entered arthroscopically, and the degree of release is evaluated (Fig. 1B).

2.6.3. Postoperative care

The patient was advised to use ice, analgesics: tablets of diclofenac sodium 50 mg twice per day for a week, beginning on the second day, 50–100 mg of pethidine ampoule injectable was administered as necessary for 2–3 days. Antibiotics as prophylaxis: 1 g of intravenous ceftriaxone 12 hourly for 2–3 days. Individuals who had partial meniscectomy are advised to wear a brief knee brace for a period of 4 weeks to avoid future damage to the MCL and are permitted to do entire range of motion and the complete-weight-bearing exercises. Individuals who had meniscal sutures are discharged from the hospital 2 days following the surgery and are unable to bear any weight for 6 weeks. However, they are permitted to move their knees in a hinged brace from postoperative day 1 and from 0 to 90°.

2.6.4. Rehabilitation guidelines

In individuals receiving meniscal repair, the postoperative protocol must take into account limitations on range of motions, bearing weight, and getting back to activities. In individuals having concurrent ACL reconstruction, active bearing weight range of motion is permitted as tolerated, and a conventional postoperative ACL regimen is suitable with a few changes.

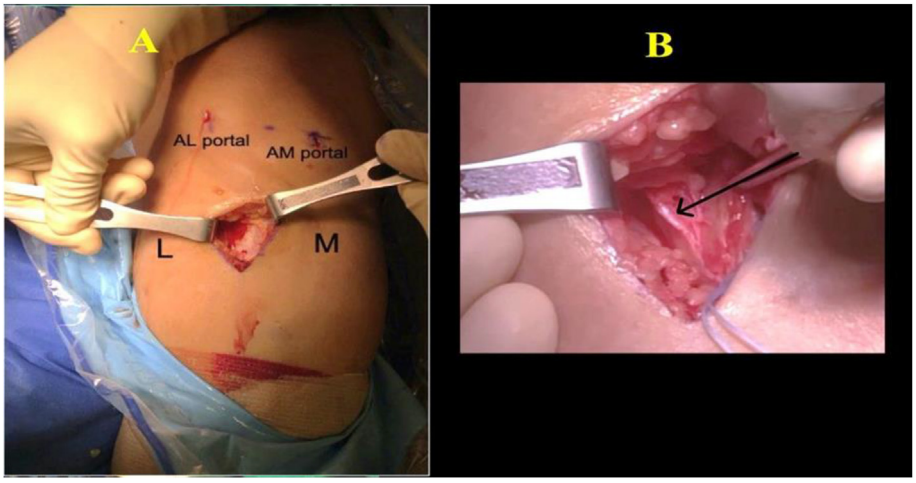

Fig. 2. (A) The patient is lying on his back. The distal MCL and the target position for tibia fixing for meniscal root repair stitches were both visible via the first incision made in the left knee medial to the tubercle of the tibia (M = medial; L = lateral; AM = anteromedial portal; AL = anterolateral portal.) (B) A black arrow in the left knee's MCL. MCL, medial collateral ligament.

For the initial 4–6 weeks, a hinged brace at 0°–90° is advised for exercises. When in a weight-bearing posture, it is especially crucial to prevent motion beyond 90°, and squat ought to be prevented for 5–6 months.

Excessive amounts of hyperextension or flexion are prevented throughout the first 6 weeks while active, nonweight bearing range of motion is progressively increased up to 125°.

It is advised to carry 50 % of your body weight while using crutches for the first 6 weeks after meniscal repair.

The ACL protocol, which typically involves a complete release to exercise at 6 months, plays a major role in determining return to sports. Similar limitations apply to isolated meniscal repairs, and returning to sports is anticipated in 5 months.

2.6.5. Follow-up evaluation

Each participant had follow-up testing following surgery every 2 weeks until the second postoperative month, and subsequently once a month.

The follow-up time in this trial was 6 months.

The postoperatively rating scales were collected following the clinical and radiological evaluation of the individuals, and all information was collected 3 months following the procedure.

2.6.6. Clinical assessment

Preoperative and postoperative clinical evaluations were comparable. In addition, numbness, discomfort, swelling, tenderness, ecchymosis, and other symptoms at the release point on the medial side of the joint are looked for.

2.6.7. Radiological assessment

Following 3 months, stress valgus radiographs were taken at 30° flexion and full extension, and the results were compared with the contralateral normal limb. The medial joint space aperture on the radiographs was checked. This is how the joint gap width was evaluated. The most distal parts of the femoral condyles were aligned with a horizontal line (the distal femoral line). A perpendicular line was constructed from this line to the medial plateau's most extreme point (Fig. 3A and B).

2.6.8. Postoperative rating scale

After the clinical and radiological assessment, the postoperative evaluation scale was determined. For this, the Lysholm knee score had been utilized.

2.7. Statistical analysis

When applicable, statistics were used to characterize the data in regard to mean, SD, median, minimum, and maximum values as well as frequencies (number of occurrences) and frequency ratios (percentages). The Wilcoxon signed-rank analysis for paired samples was used to compare quantitative factors. Statistical significance was defined as a *P* value below 0.05. SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, Illinois, USA), version 21 was used for all statistical computations.

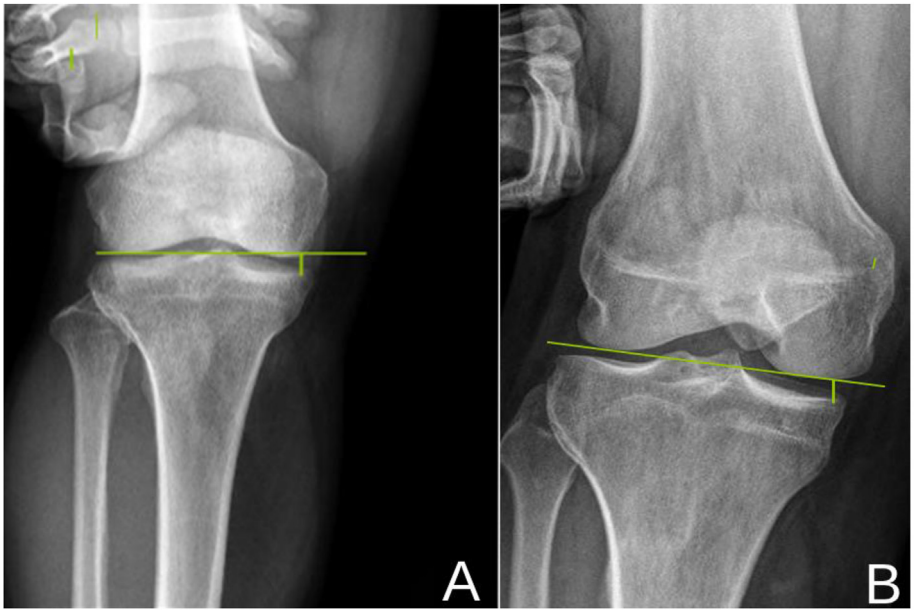

Fig. 3. (A) Stress valgus radiograph in extension, (B) stress valgus radiograph in 30° flexion.

Table 1. Age distribution of the patients.

	Mean	SD	Median	Minimum	Maximum
Age	34.17	6.45	35	22.00	45.00

Table 2. Demographic data of the patients.

	n	%
Sex		
Female	18	60
Male	12	40
Preventive knee operation		
No	30	100.0
Cause of injury		
Sports injury	16	53.3
Nonsports injury	14	46.7
Side		
Left	10	33.3
Right	20	66.7
Meniscal tear pattern		
Bucket handle	7	23.3
Radial	9	30
Parrot beak	6	20
Longitudinal	3	10
Complex	5	16.7
Type of meniscal operation		
Partial meniscectomy	10	33.3
Meniscal suturing	20	66.7

3. Results

The demographic data of the patients with continuous variables are found in Tables 1 and 2. The 30 patients ranged in age from 22 to 45, with a mean age of 34.17. There were 18 female individuals and 12 male individuals. Right knees were impacted in 20 cases, whereas left knees were impacted in 10 people. Sports practicing was the source of the injuries in 16 individuals, whereas nonsports injuries was the culprit in 14 individuals. Of the 30 individuals, 20 had meniscal repair, while the remaining 10 received partial meniscectomy since they were deemed unsalvageable. According to their morphology, the tears were distributed into the following categories: parrot beak tear (six), complicated tear (five), longitudinal tear (three), bucket handle tear (seven), and radial tear (nine). All procedures were effectively completed under appropriate vision without iatrogenic chondral damage, and there were no intraoperative problems.

3.1. Lysholm score

The Lysholm score was used to assess individuals. In our research, the preoperative median Lysholm score ranged from 35 to 65 and was 49. At the conclusion of the period of follow-up, the median Lysholm score climbed to 93 (86–98), with a statistically significant *P* value of less than 0.001 (Table 3).

3.2. Stress valgus test

Regarding the stress valgus test, there was no difference between the normal side and the diseased side in extension and in 30° flexion when the follow-up time has passed (Tables 4 and 5).

3.3. Stress valgus radiograph

Regarding the stress valgus radiograph in extension, the mean medial joint space opening was 2.27 mm in the normal side, while it was 2.30 mm in the affected side when the follow-up time has passed (Table 6). The *P* value is 0.317, which does not represent a statistical significance between the two sides.

Regarding the stress valgus radiograph in 30° flexion, the mean medial joint space opening was 3.27 mm in the normal side and in the affected side as well when the follow-up time has passed (Table 7). The *P* value is 1 which does not represent a statistical significance between the two sides.

3.4. Complications

All of the patients complained of pain at the site of release after the operation that lasted for 1–2 weeks postoperatively and resolved spontaneously. No cases complained of postoperative residual medial laxity when the follow-up time has passed. Five individuals complained of postoperative ecchymosis that resolved spontaneously.

3.5. Case presentation

A 40-year-old man who had a root tear in his left medial meniscus as seen by the MRI was admitted (Fig. 4). He had medial joint line locking,

Table 3. Comparison between preoperative and postoperative Lysholm scores.

	Mean	SD	Median	Minimum	Maximum	*P* value
Preoperative Lysholm score	50.03	8.09	49.00	35.00	65.00	<0.001
Postoperative Lysholm score	92.47	3.88	93.00	86.00	98.00	

Table 4. Test for stress valgus 3 months following surgery, a comparing of the normal and afflicted sides is shown in extended.

		Count	%
Stress valgus test after 3 months extension (normal side)	0	30	100.0
Stress valgus test after 3 months extension (affected side)	0	30	100.0

Table 5. Test for stress valgus comparing of the normal and afflicted sides in 30° flexion 3 months following surgery.

		Count	%
Stress valgus test after 3 months flexion 30 (normal side)	1	30	100.0
Stress valgus test after 3 months flexion 30 (affected side)	1	30	100.0

Table 6. Stress valgus radiograph 3 months following surgery, a contrast of the normal and afflicted sides in extension.

	Mean	SD	Median	Minimum	Maximum	*P* value
Stress valgus radiograph after 3 months extension (normal side)	2.27	0.94	2.00	1.00	5.00	0.317
Stress valgus radiograph after 3 months extension (affected side)	2.30	0.95	2.00	1.00	5.00	

Table 7. After 3 months following surgery, a stress valgus radiograph contrast of the normal and afflicted sides is shown in 30° of flexion.

	Mean	SD	Median	Minimum	Maximum	*P* value
Stress valgus radiograph after 3 months flexion 30 (normal side)	3.27	0.94	3.00	2.00	6.00	1
Stress valgus radiograph after 3 months flexion 30 (affected side)	3.27	0.94	3.00	2.00	6.00	

tenderness, and positive McMurray's test. He had no other ligamentous injuries or malalignment. His Lysholm score preoperative was 42.

In intraoperative, the medial compartment was tight with difficult instrumentation (Fig. 5A). Minimally invasive SMCL release was done. This was followed by an evident opening in the medial compartment (Fig. 5B). Instrumentation was then easy and adequate root repair was done.

Postoperative, the patient complained of medial-sided knee pain (grade I MCL sprain). He was managed conservatively with ice and bandage. The pain resolved in about 9 days. He also had superficial ecchymosis that resolved after 7 days. Weight-bearing was not allowed for the first 6 weeks. His Lysholm score rose to 91 by the end of the third month. Radiographs of both knees were done at the end of the third month and revealed that there was

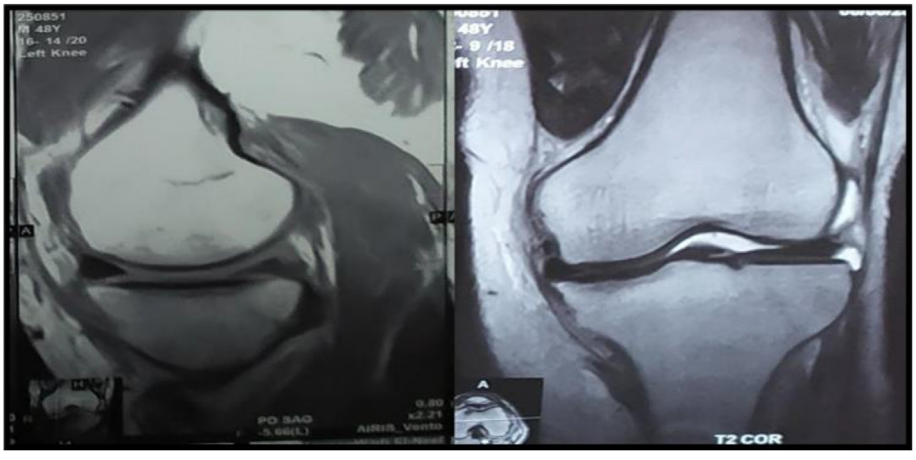

Fig. 4. MRI showing root tear of the medial meniscus.

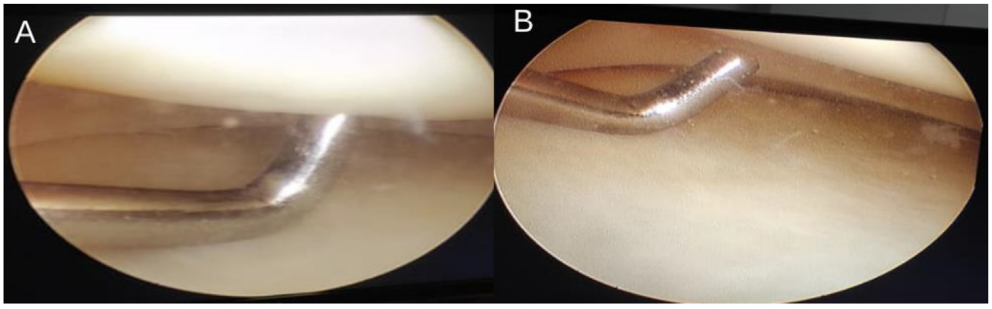

Fig. 5. (A) Tight medial compartment with difficult instrumentation. (B) Widening of the medial compartment after SMCL release. SMCL, superficial medial collateral ligament.

no difference between medial joint space opening of both knees in extension and 30° flexion (Fig. 6).

4. Discussion

Despite significant advancements in arthroscopic procedures and tools, the medial meniscus's posterior horn continues to be the single biggest cause of lapses in knee arthroscopy. The majority of mistakes are made in tight knees with concealed lesions at the medial meniscus's posterior horn's periphery.[15–18]

Even an expert in arthroscopy runs the danger of damaging cartilage when performing resection procedures on knee joints with a small space of medial joint. Even minor cartilaginous injuries induced by tool strikes or scratches that impact the

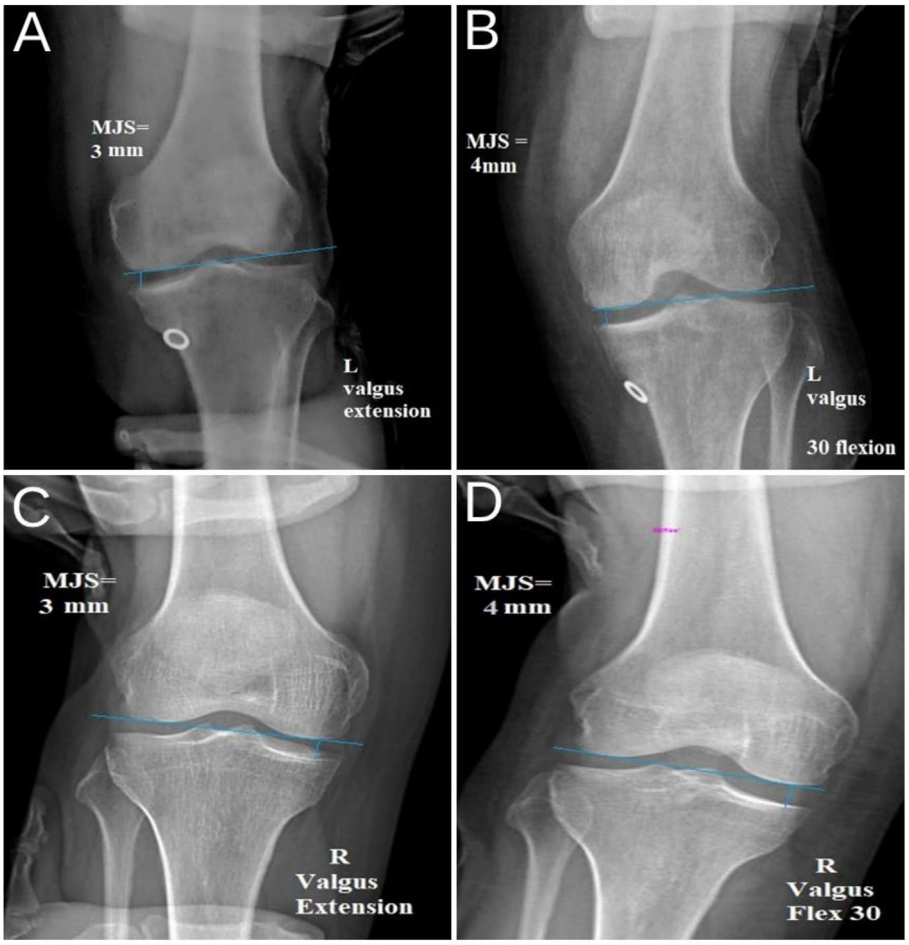

Fig. 6. (A) Valgus stress radiograph of the left knee in extension; (B) valgus stress radiograph of the left knee in 30° flexion; (C) valgus stress radiograph of the right knee in extension; (D) valgus stress radiograph of the right knee in 30° flexion.

tibial plateau and the posterior femoral condyle are unable to heal with healthy hyaline cartilage. They could increase the risk of developing osteoarthritis in the knee, particularly if substantial partial meniscectomy is done at the same time.[19]

According to biomechanical studies, the medial side of the knee's principal stabilizer is the SMCL. The largest strains in the MCL can be seen in the posterior portion of the ligament close to the joint aligned with the knee extended during valgus loading.[20,21] As a result, it is believed that this region serves as the main inhibitor of medial knee opening throughout valgus strain in arthroscopy.

In the MCL pie-crusting procedure by Fakioglu et al.,[22] the medial collateral ligament was selected for release in the posterior 1/3 of the SMCL. Using an out-in, 16-G needle, this was accomplished. The needle puncturing, however, was discovered in the middle and posterior thirds of the MCL in 14 instances who had postoperative sagittal MRI sections; nevertheless, in four individuals, the damage was limited to the middle third. In coronal sections, the damage was found to be close to the medial meniscus in all cases.[22]

A modified MCL pie-crusting approach was used by Park et al.[18] and Atoun et al.[23] to concentrate on the posterior MCL directly over the joint line using an 18-G needle that was pushed in and out.

In contrast to Fakioglu et al.,[22] who used an automated apparatus to generate a particular quantity of valgus stress force, we utilized manual valgus stress in our investigation.

We utilized the Lysholm score as our study's scoring method. Before the surgery, the median Lysholm score was 49 (range: 35–65). At the conclusion of the period of follow-up, the median Lysholm score climbed to 93 (86–98), with a statistically substantial *P* value of less than 0.001.

The Lysholm scale was used as a scoring system by Fakioglu et al.[22] in their study. Before the surgery, the median Lysholm knee score was 42 points (24–64 points), and it climbed to 94 points (88–100 points) at the last follow-up, with a statistically substantial *P* value of less than 0.0002.

We were not faced with any intraoperative problems in our research, like MCL rupturing or medial femoral condyle fractures. In spite of postoperative discomfort (grade I MCL sprain) that persisted for 1–2 weeks in all of the individuals, those who had partial meniscectomy were nevertheless able to bear weight on their own or with the use of crutches.

When performing an arthroscopic medial release to reach the medial meniscus's posterior horn in stiff knees, Park et al.[18] noted little postoperative instability. The ACL in particular makes up for the functional deficiency of the transected MCL in the healthy knee tissues.[18]

The inside-out pie-crusting approach is advised by Atoun et al.[23] since MCL pie crusting causes patients discomfort due to repeated skin punctures.

For the pie-crusting method to provide a sufficient joint opening, many punctures are necessary. It takes a lot of time and might result in a compromised joint space and insufficient MCL release. The presence of many punctures may lead to over-release. It increases the risk of iatrogenic damage to the medial joint structures, such as the saphenous vein, saphenous nerve, and medial meniscus.[13]

In the present research, we succeeded to show that the SMCL release utilizing a minimally invasive approach (mini-open) at the distal insertion of the SMCL through a small incision that is additionally utilized for transtibial meniscal root fixing are both safe procedures that, at the conclusion of the period of follow-up, have no adverse effects on the integrity of the knee or medial joint components.

The most significant finding of this research is the safety of minimally invasive SMCL release for good visibility of medial meniscus injuries in tight knees. It is additionally safe to use the tools correctly without risking iatrogenic chondral damage.

4.1. Conclusion

For effective meniscal surgery to be carried out, the medial meniscus's posterior horn must be well seen. The minimally invasive (mini-open) SMCL release is secure and effective for seeing the medial meniscus's posterior horn in circumstances when the knees are tight. It enables the prevention of medial femoral condyle fracture or iatrogenic chondral injury. After the SMCL release, the medial collateral ligament gradually recovers in all individuals without resulting in any subjective instability.

4.2. Limitations of the study

The fact that the MCL release was carried out at the surgeon's discretion rather than at random, and the lack of a control group are the study's principal weaknesses. There was no validated measuring procedure used to gauge the intraoperative breadth of the medial compartment joint space. In our small sample size of participants, we have not seen any issues, but a bigger series is required to identify any potential uncommon consequences. Due to ethical and financial reasons, not all patients had their follow-up MRIs evaluated.

Authors' contribution

Younis M. Akl: idea formulation, data collection, analysis, and writing. Mohamed I. Abulsoud: supervision, writing, and revision. Hussam E.-D.E. Haffour: data collection, supervision, writing, and revision.

Conflicts of interest

There are no conflicts of interest.

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