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Medial collateral ligament partial release in knee arthroscopy: different techniques and functional outcomes

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Abstract. – OBJECTIVE: The current study was aimed at reviewing the literature systematically to educe enhanced understanding of various techniques, sequels, as well as complications after percutaneous MCL lengthening through the procedure of arthroscopy of the knee; moreover, we utilize this clinical data that will help surgeons to encompass this technical gesticulation into their day-to-day surgical practice.

MATERIALS AND METHODS: The inclusion criteria were framed as per the internationally standardized PICOS framework, as recommended by PRISMA guidelines. The study population included adults who underwent arthroscopic knee surgery for sMCL lengthening.

RESULTS: After evaluation of 69 papers, only 9 studies were ascertained for analysis after these papers fulfilled both inclusion and exclusion criteria. The patient's age varied from 13 to 60 years at the time of commencement of surgery. There was no record of any perioperative complications in relation to iatrogenic chondral damage, fracture, and there was no report of any additional meniscal injury. The requirement of postoperative bracing was reported in 2 studies, and that was required for a time period of about 4 weeks after lengthening, while various other authors reported no use of postoperative bracing. Furthermore, in relation to postoperative pain, mild pain at the medial needle tract site was experienced by patients in two that lasted up to 15 days. None of the studies reported any case of saphenous vein or saphenous nerve injury. The duration of the final follow-up after surgery varied from 3 weeks to 24 months. No incidence of subjective instability was accounted for.

CONCLUSIONS: Thus, the present study concludes that percutaneous lengthening is effective with well-documented benefits with minimum allied risks and can be recommended for surgeons' who perform arthroscopy of the posteromedial compartment of the knee in the presence of a tight medial compartment. Furthermore, data reveal that healing is not impaired, or the risk of postoperative complications does not upsurge without the use of bracing.

Key Words:
Iatrogenic release, Knee-injury, Meniscus, Pie-crusting.

Introduction

The knee joint comprises of meniscus structure that encompasses both a medial and a lateral module that lies amid the corresponding tibial plateau and femoral condyle[1]. The Menisci are the imperative structure for the normal functioning and good health of the knee joint[2], as well as both menisci are crucial elements of a healthy knee joint, and the medial collateral ligament is one of the chief stabilizing ligaments[1]. One of the most common documented reasons for significant musculoskeletal morbidity is meniscal injuries. Thus, it is one of the daily clinical situations that an arthroscopic surgeon experiences in his or her outpatient department. Moreover, meniscus arthroscopic surgical procedures are considered as one of the most performed surgeries of the knee[3]. Thus, arthroscopy of the knee is amid the utmost common surgical procedures carried out by da Silva Campos et al[4], as well as the most common surgery commenced to treat injuries to the meniscus[5].

However, during arthroscopic surgery, optimum visualization and approach are critical for the diagnosis and management of pathologies of the meniscus. Moreover, in cases with tight medial compartments, access to the posterior or lateral horn of the medial meniscus can be provocative as in these cases, the anterior arthroscopic method can result in iatrogenic chondral injury and undue cutting of the meniscus besides the col-

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lapse of meniscus suture due to narrow medial joint space[6]. Additionally, the implementation of peripheral rotation along with valgus force to the knee enables to open up the medial compartment at the time of performance of knee arthroscopy. In correspondence to any surgical management of the patient under the anesthesia, there is the probability of injury by the imprudent appliance of force and there is also a possibility of a split of the medial collateral ligament by the utilization of this extreme valgus stress, more seemingly when making an attempt in a middle-aged or elderly patient to assess the posterior horn of the medial meniscus in those with a tight medial compartment in which the soft tissues have less flexibility[7].

The various surgical techniques illustrated have similar aim but the contrast in the implementation method (i.e., either outside-in or inside-out), in the liberated structure (dMCL, sMCL, or POL) and in the surgical instrument utilized in the performance of release (18-G needle, electrocautery hook device, banana blade or microfracture awl)[4]. Still, to deal with these problems, current publications[7-12] have revealed that release of MCL locally using various approaches to enlarge the space of the posteromedial compartment, in the manner to improve visual area during surgery and thus the working space under microscopy during operation and attaining adequate clinical outcomes of medial meniscus surgery[13]. Some variations of the conventionally described methods are arthroscopic deep MCL pie-crusting release and inside-out method, which allows the approach to the medial meniscus through the anterior access as described by Atoun et al[6] along with another study by Chung et al[14] who used an open type approach with stripping subperiosteally to release of the sMCL.

Usually reported apprehensions for iatrogenic rupture of MCL, postoperative instability, injury of saphenous, residual laxity along with other possible complications from the percutaneous technique. That could happen and necessitate consideration. The perseverance of this study was to a thorough review of the accessible literature to enhanced understanding of various techniques, outcomes, and possible complications after percutaneous MCL. During arthroscopy of the knee and utilize this clinical data that will help surgeons to encompass this technical gesticulation as a regular practice in their day-to-day surgical procedures.

Materials and Methods

The inclusion criteria were framed as per the internationally standardized PICOS framework, as recommended by PRISMA guidelines.

Participants/Population

The study population included adults who underwent arthroscopic knee surgery for sMCL lengthening.

Intervention

Any surgical treatment that comprises the use of percutaneous sMCL lengthening to increase visualization of medial joint space during arthroscopic knee surgery to treat isolated medial meniscal pathology with reported postoperative outcomes and complications was included in the review.

Comparator(s)/control: Studies of any of the above-mentioned interventions were included, including studies with no comparator group. The key outcomes considered were:

- Applied techniques
- Functional outcome
- Relief of residual pain
- Any reported complications

Study Design

The review included all types of experimental studies, observational studies, and case series which have reported the procedures and outcomes of the above-mentioned procedures.

Inclusion Criteria

Studies conducted anywhere in the world and articles published after 2010 through June 2020 was searched in March 2021 included in the study.

Only those studies published in English language and in academic peer-reviewed journals were included in the review.

Exclusion Criteria

Case studies were excluded from the study.

Studies conducted on cadaveric specimens, using lengthening procedures *via* periosteal stripping, and biomechanical studies were excluded from the study.

Literature Search

A systematic literature search was performed in PubMed, Embase, clinical trial.gov, and Cochrane Library through June 2020 in English by two inde-

pendent authors using a structured search strategy. The searches were screened by the references of selected articles to find those that did not appear in the search databases. Additional references were not obtained by free internet search from Google as the number of studies was large. The detailed search strategy is given in Table I.

Process of Screening and Selection of Articles

All the citations, as well as the title and abstract, were added to a specific endnote library, and duplicates were removed from the final list of studies to be screened for inclusion in the study. Two researchers thoroughly reviewed

Table I. Applied technique and conclusion as reported across the studies.

Author	Applied technique	Clinical outcome	Functional outcome, Residual pain or related complications
Moran et al[5]	Outside-in, percutaneous release of the superficial MCL (medial collateral ligament)	• IKDC (International Knee Documentation Committee) and PROMIS scores significantly improved from baseline, with increases of 11.7 ± 17.8 and 6.9 ± 12.4, respectively.	• Enhanced visualization and enables instrumentation • No evidence of complications • Iatrogenic laxity resolved clinically and radiographically at 6-weeks postoperatively without the use of postoperative bracing
Han et al[13]	Outside-in controlled multi-point pie-crusting release of the MCL and POL were performed.	• VAS was 1.80 ± 0.51, Lysholm was 80.08 ± 3.74, IKDC 82.17 ± 4.64 and Tegner scores were, 5.48 ± 0.59, revealed significant differences (p< 0.01) in comparison to preoperative scores (5.57 ± 0.69, 48.17 ± 4.22, 51.42 ± 4.02 and 3.20 ± 0.68, respectively.	• Increase in the posteromedial space • Enhancement in the optical field of the knee under arthroscopy • No case of any residual valgus instability of the knee • No reported incidence of iatrogenic cartilage injury • No residual valgus laxity
Polat et al[16]	Outside-in percutaneous "pie crust" release of medial collateral ligament (MCL)	• Lysholm and Tegner scores increased significantly (p < 0.05) at a final visit in comparison to preoperative scores • After pie crusting, medial joint space values increased significantly (p < 0.05) • Controlled release of the MCL in knees provided approx. 2.45 times more revelation and instrumentation in knees	• No pain or tenderness over MCL and there were no signs of saphenous nerve or vein injury
Lons et al[17]	Outside-in medial collateral ligament pie-crusting	• Opening of tibiofemoral joint space increased significantly at 6 weeks. (p<0.0001)	• Significant increase in medial laxity at 6 weeks
Jeon et al[12]	Outside-in percutaneous pie-crusting medial release	• No significant increase in side-to-side changes in the valgus gap (follow-up, -0.1 ± 1.4 mm); was found in comparison to the preoperativet assessmen (-0.1 ± 1.3 mm); in the release group	• Diminishes iatrogenic injury to the cartilage • No residual valgus laxity of the knee

Continued

Table I *(Continued)*. Applied technique and conclusion as reported across the studies.

Author	Applied technique	Clinical outcome	Functional outcome, Residual pain or related complications
Chung et al[14]	Outside-in release and non-release during medial meniscus posterior root tear (MMPRT) fixation of the distal attachment of the superficial medial collateral ligament (MCL)	• In valgus stress tests (30°, 0°), at 3 months, 12% and 2% of patients showed grade 1 laxity and at the final follow-up, 7% had grade 1 laxity in only 30° flexion • No case of subjective valgus laxity • Tourniquet time was significantly ($p < .001$) shorter in the release group (42.4 ± 19.3) in contrast to the non-release group (58.5 ± 9.5)	• Between release and nonrelease groups, Lysholm ($p = .117$) and IKDC scores ($p = .112$) did not differ
Claret et al[8]	Outside-in arthroscopic meniscectomy with or without MCL PC	• The patients with meniscectomy and PC had greater scores on the Lysholm scale, diminished pain at rest later on at two months and at 6 months, gained significantly more pain control during physical activity.	• Safe and effective method to reduce chances of iatrogenic cartilage injury • No reported adverse effect on stability of knee. • Better functional outcomes at two months due to decompression of the medial compartment • Less pain at six months during physical activity
Javidan et al[18]	Inside out superficial medial collateral ligament (MCL) release using "push method" during arthroscopic medial meniscectomy	• Only 1 female patient (volleyball player) underwent a repeat arthroscopy • Clear evidence of MCL healing at 13 months after the initial medial meniscus repair • Second release was again essential to achieve access to the medial compartment.	• No requisite of bracing in the postoperative time or immobilization or any occurrences of chronic MCL valgus laxity
Fakioglu et al[11]	Outside-in superficial medial collateral ligament (MCL) release during arthroscopic medial meniscectomy	• Sufficient visualization of the posterior medial meniscus • No iatrogenic chondral injury revealed • The median medial joint space width on valgus stress adiographs ($p < 0.0001$) was increased by 0.1 mm after 6 months preoperative value. • MRI reported that injured structure was the posterior two-thirds of the MCL.	• Organized release of the MCL in tight knees resulted in easier handling in posterior medial meniscus tears • Allows better perception of tear configurations • Evading iatrogenic chondral lesions. • Uneventful healing of MCL injury

the papers by assessing the titles and reading the abstracts in order to narrow down the studies that are most likely to meet the review's inclusion criteria. Attempts were made to obtain full-text articles for all these shortlisted studies, and a thorough assessment was done for the satisfaction of inclusion and exclusion criteria. Studies not satisfying inclusion criteria were excluded further. The list of excluded studies and the reasons for exclusion were presented in the "characteristics of excluded studies" table. "PRISMA flow chart" was used to evidently represent the screening and selection technique (Figure 1).

Data Extraction

Data were read thoroughly and included studies extracted manually onto a structured data extraction form. The basic demographic features (average age, gender), duration of follow-up, and patient-related outcomes were collected.

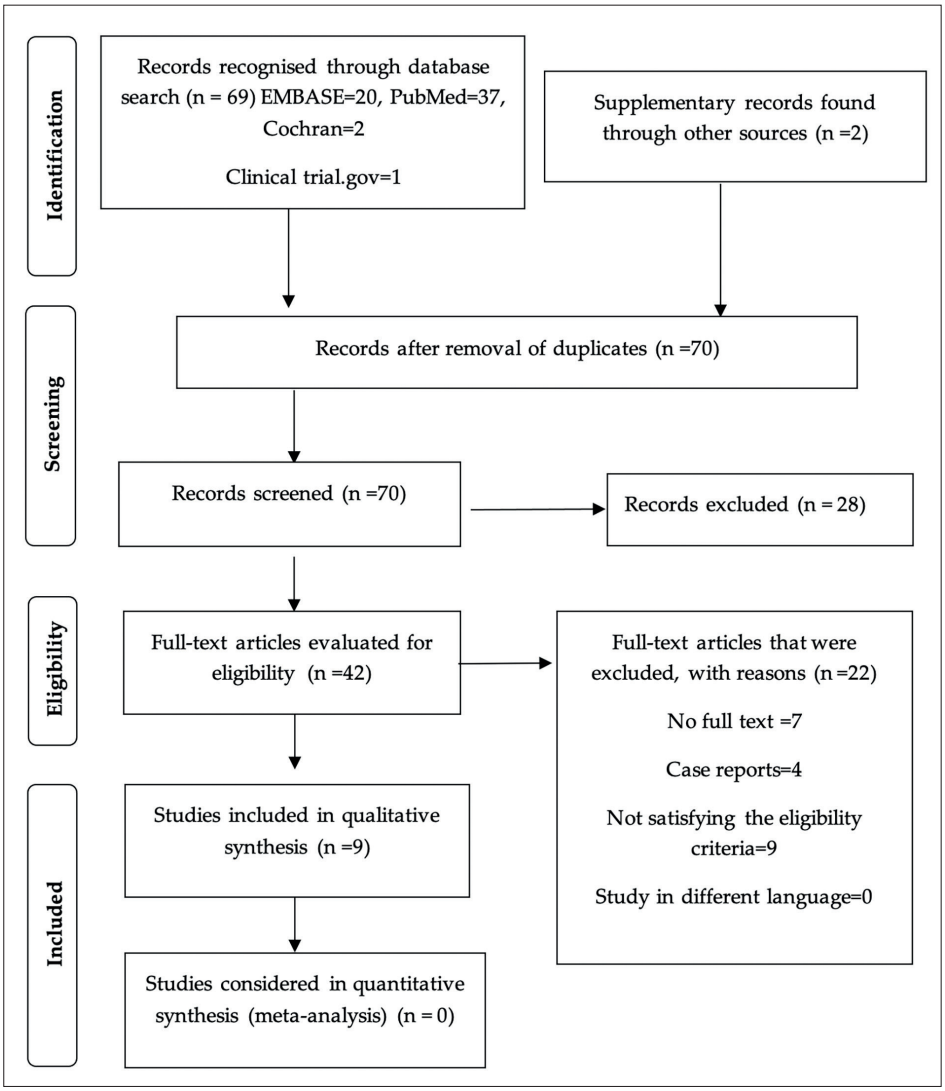

Figure 1. PRISMA 2009 flow diagram.

Risk of Bias in Individual Studies

The methodological quality of studies included in the systemic review was considered according to Fowkes and Fulton's quality assessment[15].

Study Outcomes

After a preliminary assessment of the literature, 11 studies were eliminated because they did not report postoperative results, were started on cadaveric specimens, used deep MCL lengthening or open sMCL lengthening through periosteal stripping, or lacked an English language translation of the article.

After applying the inclusion and exclusion criteria, all included 9 studies were identified for further review. A total of 597 individuals had percutaneous medial collateral ligament partial release in knee arthroscopy in the nine studies that met the inclusion criteria.

The patients' ages ranged from 13 to 60 years old at the time of surgery. There were no perioperative problems related to iatrogenic chondral damage, fracture, or further meniscal injury. In a study carried out by Moran et al[5]. using outside-in, the percutaneous release of the superficial MCL revealed that PROMIS scores increased to 6.9±2.4 and IKDC (International Knee Documentation Committee) score to 11.7± 17.8 significantly improved from baseline. Han et al[13] reported a VAS score of 1.80 ± 0.51, Lysholm as 80.08 ± 3.74, IKDC as 82.17 ± 4.64, and Tegner scores as 5.48 ± 0.59, mentioning significant differences in comparison with the preoperative scores (p-value< 0.01).

Controlled MCL release, according to Polat et al[16], resulted in 2.45 times wider instrumentation and visualization in knees. Similarly, Lons et al[17] found that at 6 weeks, the tibiofemoral joint space opened much more. Chung et al[14] examined Lysholm (p-value =.117) and IKDC (p-value =.112) scores between release and non-release groups and found no significant differences. At the final visit, the Lysholm score varied from 84 to 94, and no surgical problems were observed in these patients (Table I).

Moran et al[5] and Lons et al[17] reported using postoperative bracing for a mean of four weeks following lengthening, while studies conducted by Han et al[13], Jeon et al[12] and Javidan et al[18] reported no use of postoperative bracing. In terms of postoperative pain, two investigations found that minor postoperative pain at the medial needle tract site could linger up to 15 days following surgery. Similarly, Polat et al[16] also reported no tenderness or pain over MCL, as well as there was no sign of any saphenous nerve or vein injury. Whereas, as per Chung et al[14], 15% of patients reported pain, and 18% complained of tenderness at 3 months; however, none of the patients had symptoms at 12 months in the release group. As per a study conducted by Claret et al[8], mild pain attracts of medial needle was reported by 28 patients, which lasted for up to 15 days.

Regarding saphenous nerve or saphenous vein injury and subjective instability, no cases were reported. The length of the final follow-up after surgery ranged from 3 weeks to 24 months.

Discussion

The current systemic review reported that the most performed technique was the percutaneous pie-crusting technique and male patients underwent this procedure more than females with ages ranging from 13 to 60 years. Furthermore, arthroscopic meniscectomy of the medial part was performed more commonly than the repair of the meniscus. In relation to functional outcome, minimal residual joint laxity was performed using testing with valgus stress revealed that in comparison to preoperative evaluation and there was no incidence of postoperative complications or subjective instability except in the case of a study conducted by Javidan et al[18] where reportedly one female patient aged 22-year-old who was a volleyball player underwent a repeated arthroscopy. In this patient, there was a clear indication of MCL healing at the time period of one year and one month after the initial repair of the medial meniscus, and further release was again needed to gain an approach to the medial compartment. In the study carried out by Chung et al[14] no patients had symptoms at one year in the release group, however pain was revealed by 15%, and tenderness was found in 18% of individuals at 3 months.

In the study conducted by Moran et al[5], preoperative medial compartment width was increased by approximately 5.14± 0.42 mm intraoperatively after MCL release. Furthermore, at the follow-up period of 6-weeks, PROMIS score increased to 6.9 ± 12.4, and IKDC score increased to 11.7 ± 17.8, which revealed a significant improvement from the baseline scores.

In another study, carried out by Han et al[13], the pie-crusting percutaneous release was performed under valgus stress at the posterior, as well as medial part of the knee joint using the half-extension position of the knee, and the outcome of this emancipation was assessed on the optical area of the posteromedial space of the knee joint; it was found that VAS (pain score) was 1.80 ± 0.51 (1-3), Lysholm score was 80.08 ± 3.74 (70-85), IKDC score was 82.17 ± 4.64 (75-90), and Tegner score was 5.48 ± 0.59 (4-7) revealing significant differences (p-value < 0.01) in comparison with the preoperative scores.

During medial meniscus arthroscopic surgery, Todor et al[19] performed outside-in deep medial collateral ligament liberation and described how the needle should be introduced tenderly until the perfect mark is positioned between the medial meniscus and the tibial plateau in the corner. To avoid over-release, it is necessary to determine the area in the medial compartment using a probe between punctures. After this point is achieved, the needle should not be retracted completely, and it is required to perforate 3-4 times in this area. Atoun et al[6] used the method which is commenced through the standard anteromedial portal under direct visualization, i.e., arthroscopic inside-out pie-crusting method. The posterior section of the deep MCL is freed under careful control while the surgeon applies valgus stress to the knee until the entire posterior horn of the medial meniscus is visible, and arthroscopic instruments may be inserted without causing injury to the chondral tissue. ⁋ Chernchujit et al[3] carried a study among patients undergoing arthroscopic medial meniscus surgery using an outside-in percutaneous release of MCL technique by searching the magic point, which on the

basis of cadaveric analysis, the authors reported that this magic point is located 2.8 cm distal to the adductor tubercle, 1.8 cm distal to the medial epicondyle and above the joint line medially on the TU (Thammasat University) line at about 1.2 cm. No effect on clinical outcome and the valgus laxity was revealed. This method was considered consistent and useful in cases with narrow medial joint space undergoing arthroscopic surgery of the knee. Also, their study acknowledged that with this procedure, there is minimal chance of injury to the medial meniscus as well as structures related with saphenous.

Roussignol et al[20] performed a cadaveric analysis for arthroscopic estimation of the opening of the medial tibiofemoral compartment of the superficial medial collateral ligament (MCL) later to pie-crusting release (PCR) at its insertion on the tibia distally and revealed that the great saphenous vein which is positioned approximately between 1.4-2.0 cm at a mean of 1.7 cm and lies behind the posterior verge of the sMCL. The saphenous nerve and its branches lie away from the distal tibial insertion of the sMCL; on the contrary, a branch of the saphenous nerve was constantly situated at the level of joint space of the medial tibiofemoral. In the current review, no cases of saphenous vein or nerve injury were reported.

According to Polat et al[16], Lysholm and Tegner's scores (*p*-value- 0.05) increased considerably at final follow-up compared to preoperative scores, and there was no pain or tenderness over the MCL region and no signs of saphenous nerve or vein injury. Todar et al[19] investigated the percutaneous outside-in technique, which used a needle to pie-crust the posteromedial capsuloligamentous structures and found it to be safe and effective with no immediate or long-term problems. The outside-in approach, on the other hand, has the theoretical disadvantage of potentially harming other structures such as the saphenous vein and nerve despite the fact that, according to several research included in the current systemic review, this has never been a clinical issue.

The limitation of this study is the small sample size, and the few investigations examining various other sMCL techniques limited any evaluation on consequences between techniques.

Conclusions

Percutaneous lengthening is an effective procedure with well-documented advantages and minimal associated risks, and it can be recommended for surgeons who perform arthroscopy of the posteromedial compartment of the knee when the medial compartment is too tight to perform arthroscopy of this compartment. Furthermore, data show that bracing does not hinder healing and does not increase the risk of postoperative complications when compared to other methods of treatment.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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