

RESEARCH ARTICLE

Effect of MCL Pie-Crusting Surgery Technique on Knee Stability and Functional Outcomes After Arthroscopic Medial Meniscus Repair

Artroskopik Medial Menisküs Tamiri Sonrasında MCL Pie-Crusting Cerrahi Tekniğinin Diz Stabilitesi ve Fonksiyonel Sonuçlar Üzerine Etkisi

Ahmet YILMAZ², Ömer ESMEZ^{1,a}, Murat GÜRGER³

¹Fethi Sekin Şehir Hastanesi, Ortopedi ve Travmatoloji Kliniği, Elazığ, Türkiye

²Muş Devlet Hastanesi, Ortopedi ve Travmatoloji Kliniği, Muş, Türkiye

³Firat Üniversitesi, Ortopedi ve Travmatoloji Anabilim Dalı, Elazığ, Türkiye

A.Y. 0009-0004-3160-500X, Ö.E. 0000-0002-4475-3501, M.G. 0000-0002-7510-7203.

*Corresponding Author: Ömer ESMEZ (dresmezomer@gmail.com)

ABSTRACT

Objective: This study aimed to compare the postoperative clinical and functional outcomes of patients undergoing arthroscopic medial meniscus repair with and without application of the medial collateral ligament (MCL) pie-crusting technique at our institution.

Material and Method: A retrospective analysis was conducted on 43 patients who underwent arthroscopic medial meniscus repair between January 2017 and January 2021, with a minimum follow-up period of one year. Patients were identified through hospital registries and archive records. Preoperative and final postoperative clinical assessments were performed, including evaluation of functional outcomes. Participants were stratified into two groups: those who underwent meniscal repair with MCL pie-crusting (n = 21) and those who underwent repair without pie-crusting (n = 22).

Results: Comparative analysis of operative duration, time to return to sports, and functional outcomes measured by Lysholm and Cincinnati knee scores revealed no statistically significant differences between the two cohorts. Operative time showed no significant variance (p = 0.318). Similarly, postoperative Lysholm (p = 0.784) and Cincinnati (p = 0.511) scores did not differ significantly between groups. Both cohorts demonstrated significant postoperative improvement relative to baseline functional scores.

Conclusion: The findings indicate that the application of the MCL pie-crusting technique during arthroscopic medial meniscus repair does not significantly impact operative time or postoperative functional outcomes compared to standard repair methods. However, the pie-crusting technique facilitates enhanced visualization of the medial joint compartment, potentially reducing iatrogenic cartilage injury risk. Further prospective studies with larger sample sizes are required to substantiate these findings and optimize surgical protocols for medial meniscus repair.

Keywords: Medial Meniscus Repair, Pie-crusting Technique, Arthroscopic Surgery.

ÖZET

Amaç: Bu çalışmanın amacı, kliniğimizde medial menisküs yaralanması nedeniyle uygulanan artroskopik medial menisküs onarımında, medial kollateral ligaman (MCL) pie-crusting tekniğinin kullanıldığı ve kullanılmadığı hastaların ameliyat sonrası klinik ve fonksiyonel sonuçlarını karşılaştırmaktır.

Gereç ve Yöntem: Ocak 2017 ile Ocak 2021 tarihleri arasında artroskopik medial menisküs onarımı yapılan ve en az bir yıl takip edilen 43 hasta retrospektif olarak değerlendirildi. Hastalar hastane kayıt sistemi ve arşiv dosyalarından belirlendi. Ameliyat öncesi ve son takip muayenelerinde klinik değerlendirmeler yapıldı. Hastalar, MCL pie-crusting tekniği uygulanan grup (n =21) ve uygulanmayan grup (n =22) olarak ikiye ayrıldı.

Bulgular: Ameliyat süresi, spora dönüş zamanı ve Lysholm ile Cincinnati diz skorları açısından iki grup arasında istatistiksel olarak anlamlı fark bulunmadı. Ameliyat süresi $p=0,318$; Lysholm skoru $p=0,784$; Cincinnati skoru $p=0,511$ olarak saptandı. Her iki grupta da ameliyat sonrası fonksiyonel skorlar anlamlı şekilde iyileşti.

Sonuç: MCL pie-crusting tekniğinin uygulanması, artroskopik medial menisküs onarımında ameliyat süresi veya ameliyat sonrası fonksiyonel sonuçlar üzerinde anlamlı bir fark yaratmamaktadır. Ancak, bu teknik medial eklem aralığının daha iyi görüntülenmesini sağlayarak iatrojenik kıkırdak hasarını azaltma potansiyeline sahiptir. Bulguların doğrulanması ve cerrahi tekniklerin optimize edilmesi için daha büyük hasta gruplarını içeren prospektif çalışmalara ihtiyaç vardır.

Anahtar Sözcükler: Medial Menisküs Onarımı, Pie-Crusting Tekniği, Artroskopik Cerrahi.

Knee disorders have become increasingly prevalent in contemporary clinical practice. As the largest and most complex joint in the human body, the knee plays a vital role in mobility. One of its key components, the meniscus, is essential for maintaining joint integrity and preventing osteoarthritic changes in the knee (1, 2). The meniscus performs several critical functions, including shock absorption, load distribution, joint lubrication, and proprioception (3). When these functions are compromised, intra-articular pathologies may develop. For instance, the majority of the load on the medial compartment is transmitted to the posterior horn of the medial meniscus. The posterior horn is firmly attached to the tibia and has limited mobility, making it particularly susceptible to degeneration and tears (4).

Moran et al. (5) reported favorable outcomes in patients who underwent the MCL pie-crusting technique, demonstrating significant improvements in Lysholm scores, Tegner Activity Scale, and International Knee Documentation Committee (IKDC) scores at the final postoperative follow-up, compared to preoperative evaluations. Similarly, Claret et al. (6) observed higher Lysholm scores at two months postoperatively in patients treated with percutaneous MCL pie-crusting compared to those without the technique. In a retrospective study, Herber et al. (7) evaluated clinical and radiological outcomes of MCL pie-crusting during isolated medial meniscal root repair. Their findings indicated a lower rate of recurrent tears at six months in patients treated with the pie-crusting technique, without evidence of medial collateral ligament (MCL) laxity.

The aim of this study was to evaluate the impact of the MCL pie-crusting technique on knee stability and functional outcomes during arthroscopic medial meniscal repair in patients with narrow medial joint spaces and limited access to the medial meniscus, particularly in cases involving posterior horn tears.

MATERIAL AND METHOD

Research Type, Population and Characteristics

The study included patients who underwent arthroscopic medial meniscal repair at the Orthopaedics and Traumatology Clinic between January 1, 2017, and January 1, 2021. All patients

underwent clinical and radiological evaluations and had a minimum follow-up period of one year. Data were collected through preoperative and postoperative assessments, including demographic information, physical examination findings, symptom duration, and intraoperative details. The patients' ages ranged from 19 to 48 years.

Exclusion criteria included patients with anterior cruciate ligament (ACL) injuries, isolated lateral meniscal tears, combined medial and lateral meniscal or cruciate ligament tears, cases treated with meniscectomy, patients lost to follow-up, and those who underwent further surgery on the same knee.

Of 203 patients who underwent arthroscopic surgery, 48 met the inclusion criteria as having isolated medial meniscal tears without additional pathology. Five of these were excluded due to loss to follow-up, leaving 43 patients for analysis. Of these, 21 underwent intraoperative MCL pie-crusting surgery technique, while 22 underwent standard repair without it.

Postoperatively, all patients began quadriceps strengthening and active/passive knee motion exercises. Follow-up visits were scheduled at 15 days, 1 month, 45 days, 3 months, and 1 year after surgery. Patients were advised to avoid full weight-bearing for one month and use crutches. Physical therapy was initiated for patients with restricted range of motion during follow-up.

Patient data were retrieved from hospital records and files. Current clinical status was assessed through physical examination, and Lysholm and Cincinnati scores were recorded both preoperatively and at the final follow-up. Postoperative evaluations included physical exams and routine radiographs.

The Lysholm score and Tegner activity scale are widely used to assess outcomes after arthroscopic knee surgery. These subjective tools evaluate function and activity limitations and are valuable for monitoring treatment efficacy (8). The Cincinnati Knee Scoring Form assesses occupational and sports-related function, symptoms, and daily activity limitations (9).

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics Version 22.0 package program. Categorical variables were summarised as frequencies and percentages, while continuous variables were summarised as means and standard deviations (or

medians and minimum-maximum values when appropriate). The Kolmogorov-Smirnov test was employed to ascertain whether the continuous measurements were consistent with the assumption of normal distribution. The Mann-Whitney U test was employed to evaluate the numerical measurements that did not demonstrate a normal distribution between the two groups. All tests were conducted with a statistical significance level of 0.05.

Ethical Approval

Approval for the research project was granted by the Clinical Research Ethics Committee on 01/07/2021, with the decision number 2792. Written informed consent was obtained from all patients prior to their inclusion in the study.

RESULTS

A total of 43 patients were included in the study, with a mean age of 31.2 years (range: 19-48). The postoperative follow-up ranged from one to three years. Among the patients, 32 had sports-related medial meniscal injuries. The interval between injury and surgery ranged from 4 months to 4 years, with an average of 1.5 years.

The mean surgical duration was 60 minutes (range: 45-75) in the pie-crusting group and 58 minutes (range: 47-74) in the non-pie-crusting group, showing no significant difference ($p = 0.318$). Pain was the most common symptom (100%), followed by knee locking (45%) and swelling (3%).

At six weeks postoperatively, 51% of patients in both groups were asymptomatic, while the rest reported pain during daily activities. No valgus instability was noted at any follow-up, despite initial joint space opening during pie-crusting. Tenderness in the medial knee was seen in 12 patients at two weeks, which resolved entirely by week six.

In the first postoperative year, 74% of patients in each group were asymptomatic. Mild exercise-related pain was reported by 8 patients (19%), and knee locking recurred in 3 patients (7%).

The mean Lysholm score improved significantly from 74 to 94 postoperatively ($p < 0.001$) in the whole cohort. In the pie-crusting group, the score increased from 76 to 94, and in the non-pie-crusting group, from 72 to 94. The between-group difference was not significant ($p = 0.236$) (Table 1, 2).

Table 1. Preoperative and final follow-up lysholm scores in patients undergoing medial meniscus repair with the pie-crusting technique.

Lysholm scores	Preop	Final control	Conclusion
95-100	0	16	Perfect
85-94	2	5	Good
65-83	14	0	Fair
≤64	5	0	Bad

Table 2. Preoperative and final follow-up lysholm scores in patients undergoing medial meniscus repair without pie-crusting technique.

Lysholm scores	Preop	Final control	Conclusion
95-100	0	17	Perfect
85-94	1	5	Good
65-83	14	0	Fair
≤64	7	0	Bad

Similarly, the Cincinnati knee scores improved significantly in both groups ($p < 0.001$). In the pie-crusting group, the score increased from 17.1 to 24.3; in the non-pie-crusting group, from 17.3 to 24.4. The difference between the two groups was not statistically significant ($p = 0.511$) (Table 3, 4).

Table 3. Preoperative and final follow-up cincinnati scores of patients undergoing medial meniscus repair using the pie-crusting technique.

Cincinnati Scores	Preop	Final control	Conclusion
26	0	13	Perfect
21-25	2	8	Good
16-20	15	0	Fair
≤15	4	0	Bad

Table 4. Preoperative and final follow-up cincinnati scores of patients undergoing medial meniscus repair without the use of the pie-crusting technique.

Cincinnati Scores	Preop (n =22)	Final control (n =22)	Conclusion
26	0	13	Perfect
21-25	1	9	Good
16-20	16	0	Fair
≤15	5	0	Bad

Range of Motion (ROM):

At the fourth-week follow-up, joint motion limitation was observed in 11 patients-6 who underwent medial meniscal repair with pie-crusting and 5 without. All were referred to physical therapy following early detection at initial outpatient visits. At final follow-up, no ROM deficits were noted in any of these patients.

Thigh Atrophy:

Thigh circumference was measured bilaterally at final follow-up. Among patients who underwent repair with the pie crusting technique, thigh atrophy was <1 cm in 15 patients, 1-2 cm in 5, and >2 cm in 1. In the non-pie-crusting group, 17 had <1 cm atrophy, 3 had 1-2 cm, and 2 had >2 cm (Table 5).

Table 5. Femoral atrophy results of our patients.

Thigh Atrophy	Pie-crusting made	Without Pie-crusting
<10 mm	15	17
10-20 mm	5	3
>20 mm	1	2

Mean thigh atrophy was 8.3 mm in the pie-crusting group and 8.2 mm in the non-pie-crusting group. The difference was not statistically significant ($p=0.346$).

DISCUSSION

The knee joint is the most commonly injured joint in sports, with the anterior cruciate ligament (ACL) and meniscus being the most frequently affected structures (10). Minimally invasive arthroscopic techniques have become increasingly popular for meniscal surgery (10). Posterior meniscal injuries present a challenge due to limited visualization and narrow joint space, which restricts instrument maneuverability (11). To address this, surgeons use methods such as the arthroscopic pie-crusting technique to expand the posteromedial joint space, improving visualization and instrument access (11). Bellemans et al. (12) reported an average medial joint space increase of 2.4 mm using needle pie-crusting of the medial collateral ligament (MCL). Similarly, Ming Lei and Chiang Hua (13) evaluated 61 patients, comparing those with and without MCL release via pie-crusting. Both groups showed improved Lysholm scores at three months postoperatively. MCL injuries were mostly mild (Grade 0-I), with no Grade III injuries, and no significant difference in MCL status was observed at one month. The authors concluded that pie-crusting facilitates surgery by increasing operative speed, reducing time, and preventing cartilage damage. Our study found no significant difference in operative times between groups.

Choi et al. (14) routinely applied pie-crusting regardless of medial compartment tightness, observing no saphenous nerve or vascular injury. All patients exhibited Grade I MCL laxity, which resolved by three months. Functional outcomes and pain scores were comparable between groups. Advantages included ease of learning, fewer required

instruments, reduced operative time, and decreased risk of cartilage injury, while potential drawbacks involved the risk of full-thickness MCL rupture and unpredictable medial compartment expansion.

In a retrospective study by Arıcan et al. involving 86 patients, the use of the pie-crusting technique was compared in patients with a medial joint space less than 5 mm. Clinical (Kujala, IKDC, Lysholm, Tegner scores) and radiological (medial joint space, valgus laxity) evaluations showed a significant increase in medial joint space at 1 and 6 months postoperatively ($p < 0.05$), while no significant difference was found at 12 months ($p > 0.05$). Valgus laxity angle and clinical scores improved significantly in both groups, with no difference between them. These results indicate that the PC technique safely improves medial joint visualization without causing persistent valgus laxity (15).

Previous studies have documented transient MCL partial tears post-pie-crusting, with medial joint space increases diminishing from 2 mm at one week to 0.1 mm at three months (11). Immediate postoperative medial opening was under 5 mm at 20° flexion, resolving by six weeks without medial instability (11).

Our findings align with these results, demonstrating a statistically significant medial joint space increase following MCL release with pie-crusting. No saphenous nerve injury or full-thickness MCL rupture occurred. Patients showed complete resolution of medial knee tenderness and no medial instability during follow-up. No iatrogenic cartilage damage was observed in either group. Both groups exhibited significant postoperative improvements in Lysholm and Cincinnati scores compared to baseline.

Conclusion

This study showed significant improvements in Lysholm and Cincinnati scores in both groups, with no differences between them in surgical time or return-to-sport timelines. The pie-crusting technique effectively increases posteromedial knee space, enhancing visualization and instrument use, potentially reducing the risk of cartilage injury. Additionally, it prevents residual valgus instability and does not adversely affect clinical outcomes at final follow-up.

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