

Arthroscopic all-inside ramp lesion repair using the posterolateral transseptal portal view

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Abstract

Purpose The purpose of this study was to evaluate and describe the clinical results and outcomes of a novel method for all-inside suture repair of medial meniscus ramp lesions through posteromedial and posterolateral transseptal portals during anterior cruciate ligament (ACL) reconstruction. Further, this investigation compared the posterolateral view to the notch view for diagnosis and repair.

Methods Between 2011 and 2014, 166 patients had ramp lesions concomitantly with ACL injury; 128 patients (107 men and 21 women) were enrolled in the study after qualification. All patients underwent repair of the posterior horn ramp lesion of the medial meniscus, using a suture hook device with PDS No. 1 through a posteromedial portal while viewing from the posterolateral transseptal portal during ACL reconstruction, with a minimum of a 2-year follow-up.

Results Patients were followed up for a minimum of 2 years (range 24–47 months). Their average Lysholm score increased from 61.7 ± 3.2 preoperatively to 87.8 ± 3.9 at last follow-up ($p < 0.001$). Moreover, their

average IKDC scores also improved from 53.6 ± 2.1 (pre-op) to 82.1 ± 3.5 (at last follow-up) ($p < 0.001$). The peroneal nerve and the popliteal neurovascular bundle were not damaged in any of the patients.

Conclusion This study provides evidence that the posterolateral transseptal technique protects neurovascular structures. This technique may be used safely and easily for repair of the posterior horn ramp lesion of the medial meniscus during ACL reconstruction.

Level of evidence IV.

Keywords Knee · Arthroscopy · Meniscus · Ramp lesion · Meniscal repair

Abbreviations

ACL	Anterior cruciate ligament
MFC	Medial femoral condyle
PHMM	Posterior horn of medial meniscus
PCL	Posterior cruciate ligament

Introduction

Meniscal lesions are commonly found during knee arthroscopy, with reported incidences between 57 and 74% [10]. Meniscus injury frequently occurs concomitantly with anterior cruciate ligament (ACL) injury. A very common intra-articular lesion associated with ACL ruptures involves the posterior horn of the medial meniscus (PHMM) [5]. Clinical studies comparing the long-term outcomes of arthroscopic meniscal repair and arthroscopic partial meniscectomy for traumatic meniscal tears support using the strategy of meniscal repair for osteoarthritis prevention [15].

The firm attachment of the medial meniscus to the posterior margin of the tibial plateau is well recognized. This

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relationship permits the medial meniscus to serve as a secondary knee stabilizer when the ACL is deficient. Repairing the torn meniscus anatomically allows the knee with the reconstructed ACL to be more stable in the cases where meniscectomy is performed for repair [9]. Specific types of medial meniscus lesions such as meniscosynovial or meniscocapsular tears were described in the 1980s by Strobel [12], who termed them “ramp” lesions. A ramp lesion is defined as the detachment of the medial meniscus posterior horn from the meniscocapsular or meniscotibial junction or simply the posterior detachment of the medial meniscus. It was reported that these ramp lesions are associated with 9–40% of all ACL tears [3, 16]. Further, Thauinat et al. [13] have described the five patterns of ramp lesions of the medial meniscus. A lesion at the PHMM increases forces in the ACL by 50%, and conversely, a rupture of the ACL increases forces in the PHMM by 100% [1]. Tears of the PHMM are mostly secondary to ACL ruptures, occurring with further episodes of instability [7]. Longer delays between ACL injury and surgical intervention increase the likelihood of a medial meniscus tear and the incidence of PHMM tears [16].

These lesions require careful intra-operative examination, sometimes necessitating the use of an additional posteromedial portal [11, 14]. This study aimed to describe the clinical results and outcomes of ramp lesion repair from posterior portals concomitant with ACL reconstruction and introduce a novel way to evaluate and repair under direct vision from the posterolateral portal. It was hypothesized that constructing the posterolateral portal would create a better view for the posterior medial meniscus ramp lesion.

Materials and methods

A consecutive series of knees with arthroscopic ACL reconstruction were analysed prospectively between 2011 and 2014. Among the 927 patients who met the study inclusion criteria, 166 patients presented with ramp lesions. Of these, 128 patients (107 men and 21 women) were followed up for a minimum of 2 years (range 24–47 months). The median age of patients was 24 years (range 18–48 years), and the average BMI was 27.5 kg/m² (range 23–35 kg/

m²). All surgeries included in this study were performed by the same consulting surgeon (KS). Inclusion criteria were as follows: ACL deficiency and concomitant ACL reconstruction. Exclusion criteria were as follows: multi-ligament knee injury, age less than 16 or more than 50 years, BMI > 35 kg/m², bony avulsion, ICRS classification grade IIIB cartilage lesions more than 1 cm² in size, revision reconstruction, lateral meniscus tears, and other procedures not related to the meniscal repair or the presence of other significant pathology.

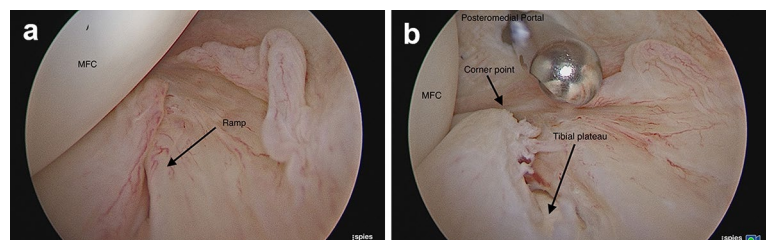
A ramp lesion was defined as a longitudinal tear or detachment of the peripheral rim around the PHMM. The inspection of a ramp lesion was performed using the following three steps. First, far anteromedial and high anterolateral portals were made for concomitant transportal ACL reconstruction. Second, for all patients with or without medial meniscus hypermobility, the posterior compartment was approached by passing a 30° arthroscope from the anterolateral portal through the intercondylar notch medial to the PCL, with the knee slightly flexed while in valgus. In the third stage, if a ramp lesion was noticed, a posterolateral portal for viewing and posteromedial portal for repairing were made (Fig. 1).

Surgical technique

During the procedure, patients were placed supine on the operating table, with a tourniquet placed high on the thigh. The knee was flexed 90° by draping the leg over the edge of the operative table. A standard high lateral parapatellar portal and far medial parapatellar portal were made. Direct visualization of the posteromedial compartment should always be accomplished to diagnose and repair ramp lesions.

A systematic exploration of the posterior segment was performed first by probing the medial meniscus via the anteromedial portal followed by transnotch visualization of the posteromedial compartment. In the case of a tear in the posterior segment, a posterolateral portal was created under direct vision from the anteromedial portal. The transseptal portal is a technically challenging portal to make due to the proximity of the portal to the popliteal neurovascular bundle. Transillumination allowed the surgeon to observe the correct placement of the portal. The knee was flexed at 90°

Fig. 1 **a** Intercondylar view (left knee) and **b** posterolateral transseptal view (left knee)



to avoid affecting popliteal structures. A No. 18 gauge needle was introduced from the outside to just by the lateral condyle, followed by portal creation with a No. 11 blade scalpel under arthroscopic control. Using this technique, we required two arthroscopic sheaths simultaneously with a 30° arthroscopic lens. Subsequently, under direct vision, an arthroscope sheath with a blunt trocar was introduced from the posterolateral portal, just posterior to the PCL. Using direct pressure from the hand and by creating a passage in the anterior part of the septum, the sheath was passed to the medial side without shaving the septum and was kept in place until completion of the surgery to assist in ease of the operation (Fig. 2).

Under direct vision from the posterolateral view, the location of the posteromedial portal was confirmed.

The instrument was introduced from the posteromedial portal without using a cannula. First, the edge of the lesion was debrided with a shaver, rendering it suitable for the vertical mattress suture. A left 90° curved hook was used for the right knee and vice versa. The 90° suture hook (Lasso ConMed-Linvatec, Utica, NY, USA) loaded with a No. 1 polydioxanone (PDS) (Ethicon; Somerville, NJ, USA) was introduced through the posteromedial portal. If the situation permitted, we first began suturing from the posterior corner point. The suture hook was manipulated by hand allowing the sharp tip to penetrate the peripheral wall of the medial meniscus from outside to inside. Next, the suture hook was passed through the central (inner portion) of the medial meniscus; if that was not possible, a nylon shuttle suture was used and replaced by the PDS. Both ends of the PDS were taken out with a suture retriever through the posteromedial portal. A sliding knot (fishing knot type) was applied to the meniscus with the assistance of a knot pusher followed by three simple knots over the sliding knot. This manoeuvre was repeated as required depending on the length of the

tear up to most of the lateral part of medial meniscus near the root attachment (Fig. 3). One knot was inserted every 5–6 mm for tears limited to the posterior segment. Finally, transportal ACL reconstruction was performed.

During the first 2 weeks post-surgery, toe-touch weight bearing and passive range of motion 0°–45° were permitted, followed by 0°–90° passive range of motion with partial weight bearing during weeks 2–4 post-surgery, and full weight bearing and range of motion after 6 weeks. After 6 weeks, return to activity was allowed as determined by the ACL reconstruction protocol.

This study was approved by the Ethics Committee of Akhtar Orthopedic Training and Research Hospital (ID 9745).

Statistical analysis

The Lysholm score and IKDC score were used to evaluate the clinical outcome preoperatively and post-operatively. Statistical analyses were performed with SPSS software version 21 (IBM; Armonk, NY, USA). Data were analysed using the Wilcoxon test for comparing the preoperative and post-operative Lysholm and IKDC scores. Statistical significance was considered to be $p < 0.05$.

Based on the results of a pilot study with 30 patients ($SD = 5.9$) and the smallest expected clinically relevant difference of $SD = 2.5$, the estimated sample size was at least 116 patients.

$$1 - \alpha = 0.95 \Rightarrow z_{1-\frac{\alpha}{2}} = z_{0.95} = 1.96$$

$$1 - \beta = 0.90 \Rightarrow z_{1-\beta} = z_{0.90} = 1.28$$

$$d = \text{clinical difference post-pre} = 2.5_{\text{score}}$$

$$SD = 5.9_{\text{score}}$$

Fig. 2 **a** Trocar passage posterior to the PCL and **b** posterolateral view

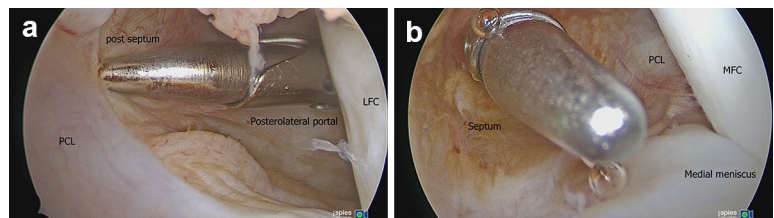
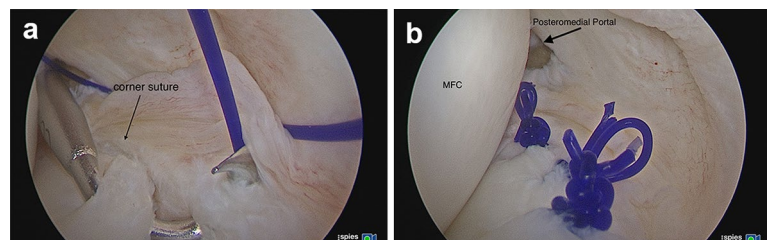


Fig. 3 Central suture passage (left knee)



$$n = \frac{2 \times \left(z_{1-\frac{\alpha}{2}} + z_{1-\beta} \right)^2 \times SD^2}{d^2}$$

$$= \frac{2 \times (1.96 + 1.28)^2 \times 5.9^2}{2.5^2} = 116$$

Based on these results, 128 patients were enrolled in the study.

Results

Among the 128 patients who met the study inclusion criteria, the Lysholm score improved from 61.7 ± 3.2 preoperatively to 87.8 ± 3.9 at the last follow-up, which was statistically significant ($p < 0.001$). Likewise, the IKDC scores also improved from 53.6 ± 2.1 (pre-op) to 82.1 ± 3.5 (at the last follow-up) ($p < 0.001$).

This study shows that the prevalence of ramp lesions increases significantly over time after the initial ACL injury (Fig. 4).

The peroneal nerve and the popliteal neurovascular bundle were not damaged in any of the patients.

Three patients complained of pain over the medial joint line and locking. During examination of the patients, McMurray test was positive and bucket handle meniscal tear apparent on MRI evaluation. Partial meniscectomy was then performed.

Discussion

The present study's most important finding provides evidence that delayed ACL reconstruction can increase the incidence of additional medial meniscus injuries such as

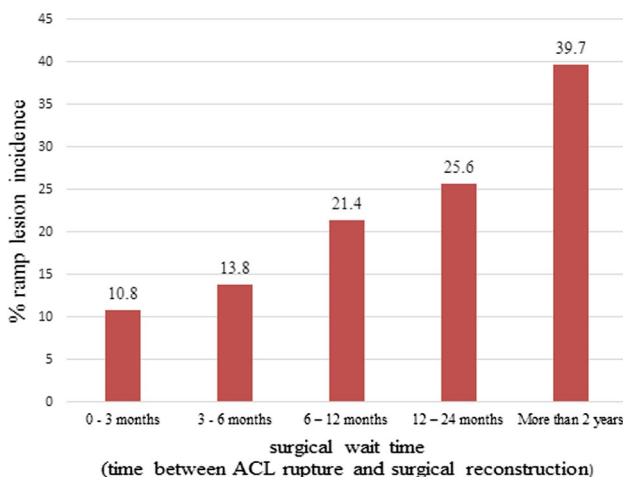


Fig. 4 Ramp lesion incidence and time to surgical intervention

ramp lesions. Papastergiou et al. [6] have reported a significant increase in the prevalence of meniscal tears in patients who underwent ACL reconstruction at 3 months after injury and recommend that ACL reconstruction be carried out within 3 months of injury to minimize the risk of developing secondary meniscus tears. Similarly, Zoller et al. [16] have shown that further medial meniscal damage is common if surgery is delayed by more than 6 months.

Thaunat et al. [13] demonstrated that arthroscopic meniscal repair of ramp lesions during ACL reconstruction through a posteromedial portal provides a high rate of meniscal healing, and this was confirmed by Ahn et al. [1] using second-look arthroscopy. While visualization through the posterolateral portal allows for a good view of the lesion (particularly the corner point), the rupture can be treated completely from the posteromedial portal with vertical mattress sutures (which have the strongest biomechanical strength) under direct vision [8]. Using the classical notch view, a failure to completely visualize the corner point of the posterior medial meniscus may result in underestimation and insufficient repair of the lesion.

Ahn et al. [2] have used two posteromedial portals for PHMM repair. The close distance between these two portals may pose difficulties for surgeons, especially if working with a cannula. By using both a posteromedial and a posterolateral portal, manoeuvring the suture hook through the posteromedial portal is much easier and allows the surgeon to suture the meniscus without the need for an assistant to hold a camera.

Morgan [4] described the first all-inside suture technique from the posteromedial portal through a cannula. In this technique, the cannula was not used because of the technical challenges in manipulating a suture hook through a cannula and the higher risk of articular cartilage damage. In our experience using this technique, a rotational manoeuvre was not required to improve the view of the meniscal lesion and we had an excellent view of all posterior meniscal lesions.

This study has some limitations. Second-look arthroscopy was not performed, and thus, it is possible that repaired menisci healed incompletely. We had only a small number of patients within the series with a relatively short follow-up. Different outcomes may be observed with longer follow-up.

This study incorporates a novel and practical approach at a low cost for arthroscopic repair of the peripheral attachment on the PHMM to facilitate surgery and better visualization using vertical mattress and corner sutures to retain the functional integrity of the meniscus. This technique is clinically relevant in that making a posterolateral transseptal can be safely used for complete inspection and repair of a meniscal ramp lesion during ACL reconstruction.

Conclusion

Creation of a posterolateral transeptal viewing portal during arthroscopic surgery for ACL reconstruction can safely assist in better visualization, easier access, and subsequent repair of PHMM ramp lesions. This study shows beneficial clinical results with low complication rates.

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Authors' contributions SK developed the original idea and the protocol and defined the intellectual content. MA developed the protocol. RV and JHA supervised the study. MS prepared and drafted the manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Ethical approval This study was approved by the ethics committee of Akhtar orthopedic training and research hospital (ID 9745).

Informed consent Informed consent was obtained from all individual participants included in the study.

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