



Pie-Crusting The Medial Collateral Ligament in Arthroscopic Surgery to Overcome Difficulties in Bucket Handle Tear of Medial Meniscus Repair: A Case Report

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ABSTRACT

Backgrounds : Around 10% of meniscus tears manifest as Bucket Handle Meniscus Tears (BHMT), where the tear extending from the red-red to red-white zones, leading to joint blockage and locking. Treatment options encompass meniscectomy or repair, with the repair meniscus shown superior outcomes for maintaining joint function and preventing arthritis. **Case Report:** Following a motorcycle accident, a 29-year-old man visited an orthopaedic clinic with left knee pain, swelling, and limited flexion. Physical examination revealed tenderness along the anterior medial border, restricted knee motion, and a low Lysholm Knee Score. MRI confirmed a BHMT in the posterior region. The pie- crusting method, releasing the medial collateral ligament (MCL), widens the joint gap, enhancing surgical visibility. **Conclusion :** This case highlights the successful application of the pie-crusting technique to address challenges linked to medial knee joint space narrowing in a posterior horn BHMT case.

Keyword: Bucket handle meniscus tear, Pie crust medial collateral ligament, Arthroscopy meniscus repair

INTRODUCTION

Incidence of Bucket Handle Meniscus Tear (BHMT) occurs in approximately 10% of total meniscus tear cases. BHMT involves a vertical and longitudinal tear extending from the red-red zone to the red-white zone of the meniscus, allowing the torn fragment to flip into the joint space, causing mechanical obstruction and leading to knee joint locking⁽¹⁾. BHMT presents unique challenges for therapy due to its complex mechanism, tear location, size of the torn fragment, difficulty in fragment reduction, quality of the torn tissue, and the need for stable fixation for healing.

BHMT itself shows a relatively display healing tendency, especially in the peripheral zone (red-red zone), which has abundant blood supply. Treatment options for BHMT include meniscectomy or "meniscal repair." Partial or total meniscectomy in BHMT can alleviate initial symptoms but may lead to premature joint arthritis, as the meniscus plays a role in shock absorption and joint stability. Research and literature suggest that "meniscal repair" showed better outcomes in maintaining knee joint function and results in less osteoarthritis compared to meniscectomy, as "meniscal repair" can prevent cartilage degeneration that occurs after meniscectomy⁽²⁾.

Arthroscopic meniscal repair poses its own challenges in BHMT cases, especially when the tear occurs in the posterior horn. Medial joint space narrowing is often encountered, which can reduce the accuracy of instrument placement during surgery, lead to iatrogenic cartilage injury, excessive meniscal trimming, and meniscal suture failure. The pie-crusting technique of the medial collateral ligament can improve the field of view, enhance access, aid in reduction, and facilitate suture placement.

BHMT itself is relatively rare, and the use of the pie-crusting technique by releasing the superficial medial collateral ligament from the knee joint in BHMT cases has not been reported before. In this case, we report a posterior horn BHMT and utilize the pie-crust technique to overcome the approach difficulties caused by medial knee joint space width (JSW) narrowing.

CASE REPORT

History

A 29-year-old male to the orthopaedic clinic after falling from a motorcycle 1 day before. The patient fell with his left leg bearing the weight of his body and the motorcycle, with the leg slightly rotated inward. He complained of continuous pain in the left knee and

difficulty in bending the left knee. The complaint is also accompanied by swelling. There were no redness, hematoma, and open wounds. Crepitus and deformity were not found.

Physical Examination

Vital signs are within normal limits. General status is normal. Clinical examination of the left knee reveals the presence of non-pitting oedema, without deformities. On palpation, tenderness is positive at the anterior medial border of the right knee. Malalignment was negative. Knee flexion range of motion (ROM) is limited both actively and passively in 30°. Lysholm Knee Score⁽³⁾ 14% provided a description poor knee joint function. Positive results were found in the Mc Murray Test and Apley Grind Test.

The patient underwent a diagnostic examination, including left knee X-ray AP and lateral views showed no pathology. We used DICOM Viewer to estimate the JSW approximate 4.24 mm. A subsequent MRI revealed sign vertical longitudinal tear indicated of BHMT on the posterior site.

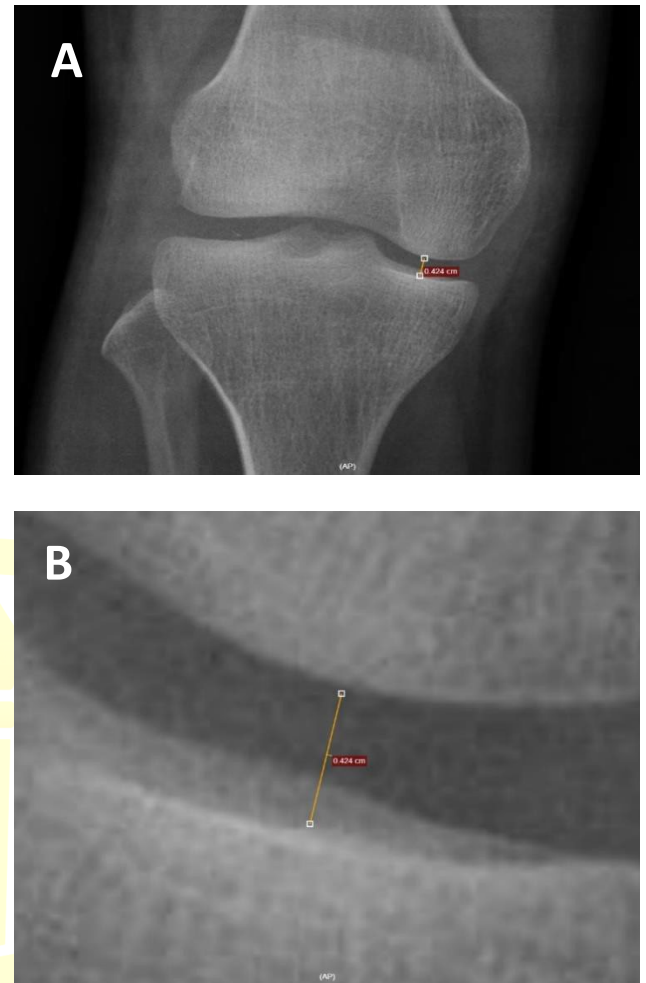


Fig 1. A. Right knee x-ray AP view. Estimated JSW using DICOM Viewer. **B.** Using DICOM Viewer estimate the JSW from medial femoral condyle cortex to medial tibial plateau cortex

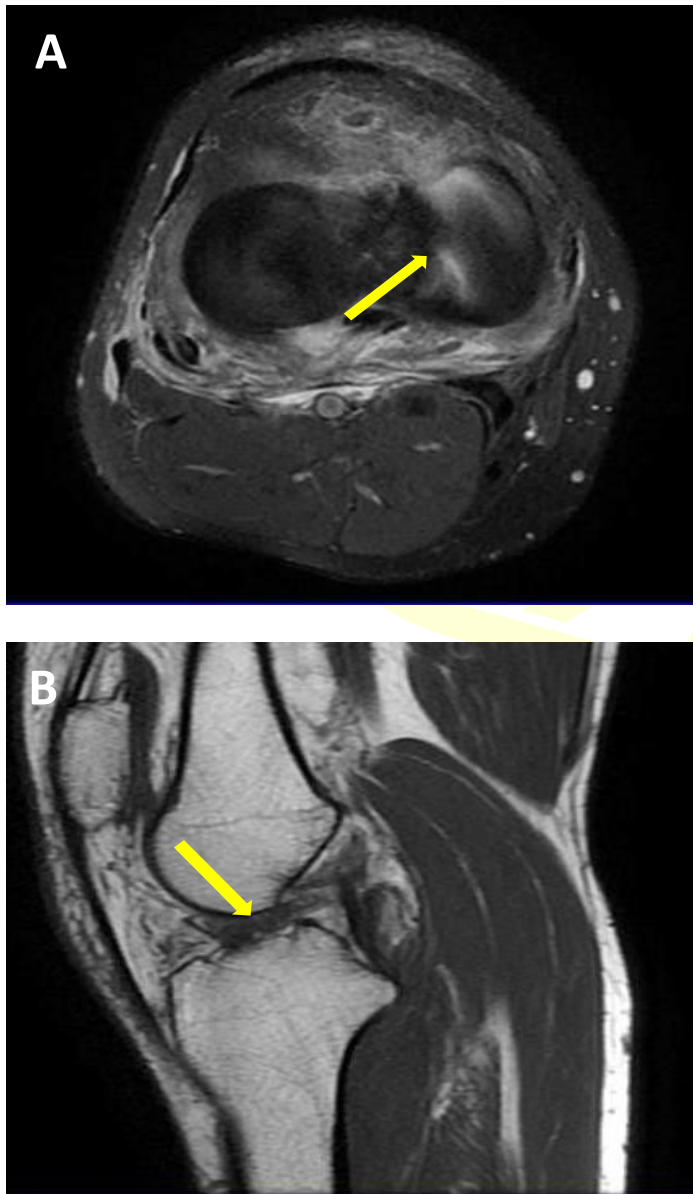


Fig 2. A. MRI coronal view of right knee showed longitudinal tear. B. MRI sagittal view of right knee showed bucket handle meniscal tear on the posterior horn. (JSW, joint space width)

Surgical Technique

Patient Positioning and Preparation

The patient is positioned in the supine position, with a thigh tourniquet secured, and the leg holder for the operated limb is positioned off the table, enabling unrestricted access to all sides and the posterior aspect of the knee. The BHMT repair is performed while the knee is close to being fully extended.

Diagnostic Arthroscopy

Standard anterolateral (AL) and anteromedial (AM) portal are used. The 30° arthroscopy is inserted through the AM portal to examine the BHMT. Subsequently, the BHMT is evaluated to ascertain its tear pattern, size, complexity, and the possibility of reduction⁽⁴⁾. Using a 4-mm probe passed through AM portal, we observed a narrowing of approximately 4 mm in the affected knee joint space when attempting to reduce the tear. A probe hook was inserted through the AM approach, and its vertical tip was placed against the lowest point of

the femoral condyle cartilage at the narrowest space.

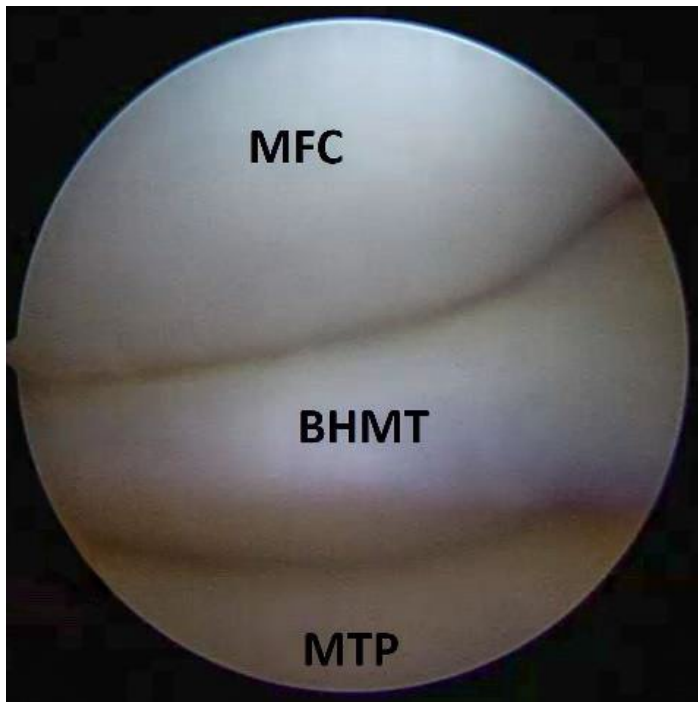


Fig 3. Right knee viewing from AM portal. (MFC, medal femoral condyle; BHMT, bucket handle meniscus tear; MTP, medial tibial plateau)

Anatomical Reduction of Tear

To achieve better visualization and proper reduction, we need a greater joint space width (JSW). We choose to perform a pie crust (PC) procedure to release the superficial medial ligament from the knee using needle 16 G needle. Bancha et al(5) provided a description where we had to perform a pie crust medial collateral ligament to protect the

surrounding structures such as the saphenous nerve and vein. This point was referred to as the 'magic point' where we first determined landmarks on the medial side of the knee joint, such as the adductor tubercle, medial epicondyle, and joint line. With the knee joint in full extension, we identified the posterior tibial shaft cortex and then drew a straight line extending from posterior tibial cortex to the adductor tubercle. They called this line as TU (Thammasat University) line. Based on cadaveric analysis, Bancha et al⁽⁵⁾ found that the "magic point" is 2.8 cm distal to the adductor tubercle, 1.8 cm distal to the medial epicondyle, and 1.2 cm above the medial joint line on the TU line (Fig 3). In Fig 4, we can observe the difference in joint space width (JSW) obtained after the pie crust procedure was carried out to approximately 5 mm.

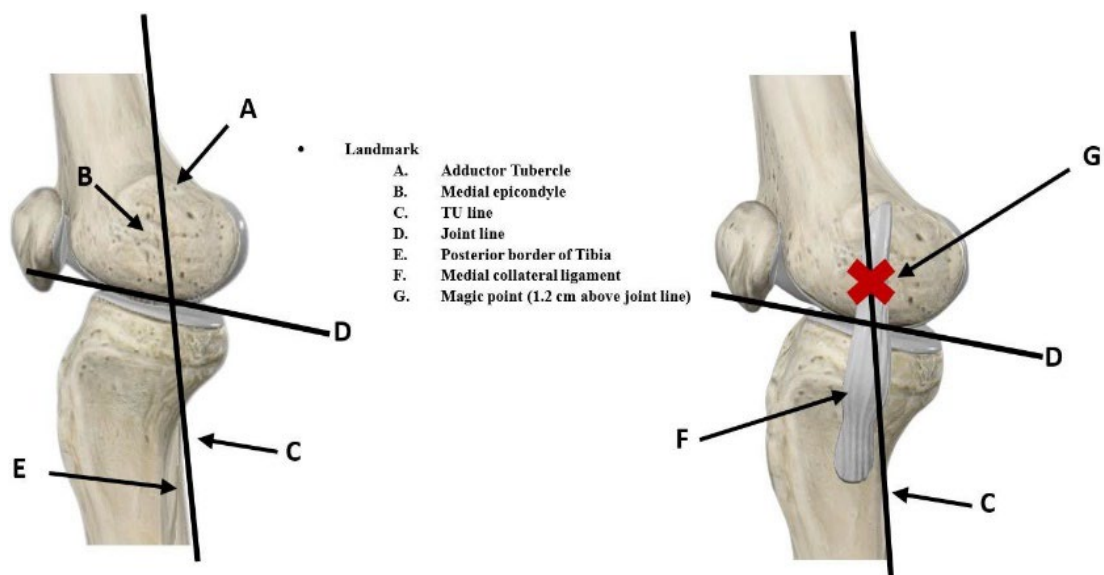


Fig 4. Magic point refers to the red cross which was the point in the TU line (C) and 1.2 cm above the Joint line (D).

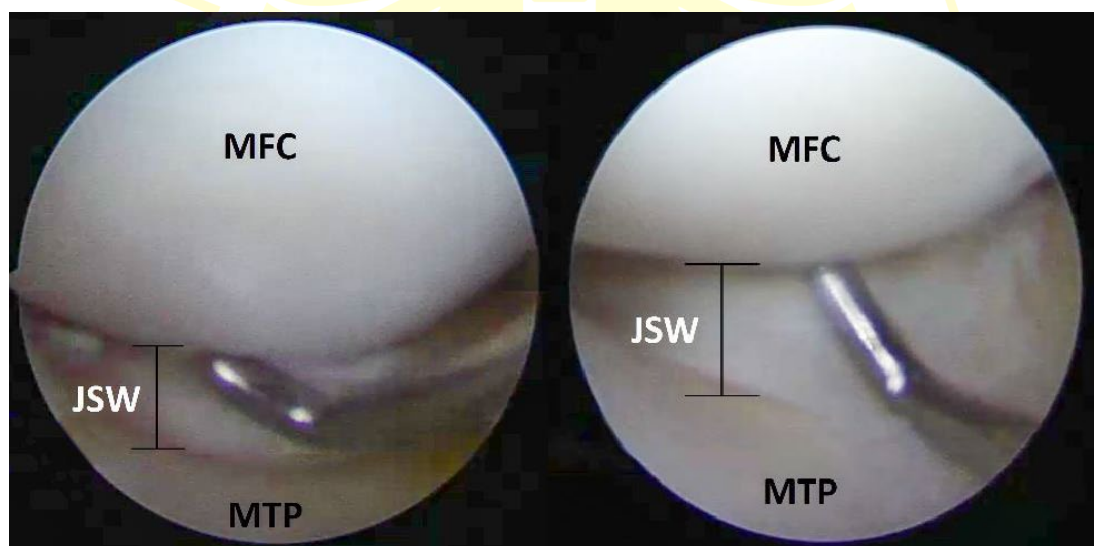


Fig 5. A. Before PC using 4mm probe; **B.** After PC. (MFC, medal femoral condyle; JSW, joint space width; MTP, medial tibial plateau)

Placement of the suture performed using the "all inside meniscus repair" technique utilizing the FAST-FIX 360 Meniscal Repair System (Smith & Nephew, London, United Kingdom)⁽⁴⁾. For medial BHMT, viewing is performed through the AL portal to place the stitch in the posterior horn via the AM portal. We only use 2 stitches placed in the posterior site of the meniscus.

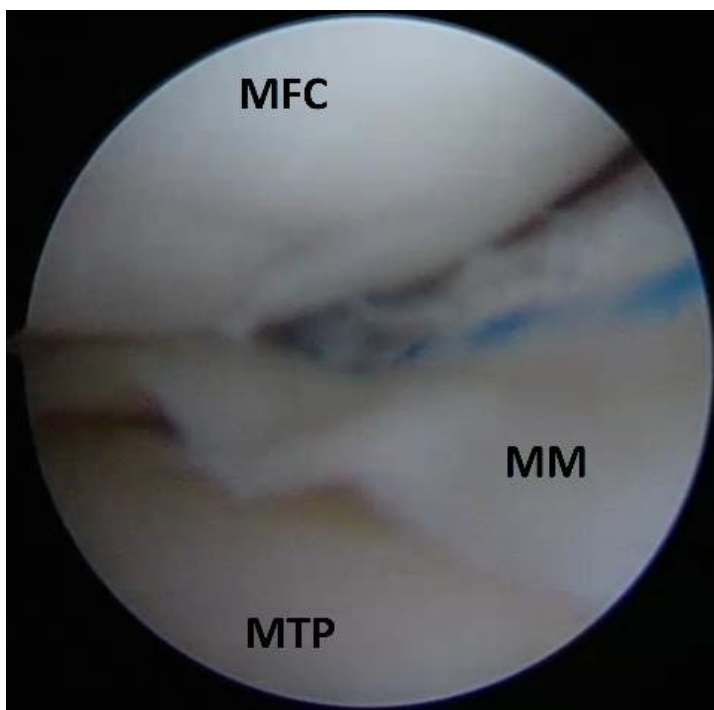


Fig 6. Right knee, viewing from the AL portal. The initial stitch placement using the all-inside meniscus device, FAST-FIX 360, is introduced through the anteromedial portal. It's positioned horizontally at the juncture of the posterior horn and body of the medial meniscus, with a depth limiter set to 18 mm. (MFC, medal femoral condyle; MTP, medial tibial plateau; MM, medial meniscus)

Postoperative Protocol

Following the BHMT repair, the patient was fixated with a knee brace and allowed a range of motion from 0° to 90° for a duration of 6 weeks. This restriction aims to prevent deep knee flexion. During this period, the patient was instructed to avoid putting full weight on the knee. He was advised to practice non-weight-bearing or protected weight-bearing for the same 6-week period. Afterward, they can gradually increase weight-bearing as tolerated and regain full range of motion following the initial 6 weeks⁽⁶⁾.

Outcome & follow up

At the 8-week post-operative follow-up, the patient was still using a knee brace for support and was undergoing routine physiotherapy sessions twice a week. Patient can achieve full range of motion in flexion and extension of the knee. The obtained Tegner Lysholm Knee⁽³⁾ score was 77%, indicating reasonably good overall function. However, the patient occasionally experienced slight instability and locking during the transition from flexion to extension movement, but these issues were infrequent.

DISCUSSION

In BHMT injuries with clinical symptoms, minimally invasive arthroscopic surgery is often required. During the procedure,

accessing the posteromedial compartment can be challenging due to the narrow joint gap, resulting in limited visibility of the posterior meniscus and insufficient space for surgical instrument manipulation under arthroscopy. As a result, it is crucial for orthopaedic arthroscopic surgeons to explore alternative methods to expand the posteromedial space of the knee joint. One such technique is the pie-crusting release, which involves releasing the medial knee structures, specifically the medial collateral ligament (MCL) under arthroscopy to increase the medial joint gap. This enhancement can improve the field of view and facilitate access to the posterior medial aspect of the knee joint⁽⁶⁾.

Before 2020, the MCL pie crust technique did not have a clear reference point for the incision location. In the year 2020, Banacha et al⁽⁵⁾. published about the pie crust technique, emphasizing the location for the release from the MCL, where we can avoid important structures like veins and nerves. This location is referred to as the “magic point”, which is 1.2 cm above joint line at the TU line. The pearls and pitfalls of this procedure are shown in Table 1.

Table 1. Pearls and Pitfalls with Pie Crust MCL Release by finding the Magic Point during arthroscopic Bucket Handle Medial Meniscus Tear repair

Pearls	Pitfalls
Draw a straight line from the posterior tibial cortex to intersect with the adductor tubercle at the knee joint's full extension position.	Iatrogenic injury to articular cartilage, rarely medial meniscus and saphenous structures.
At the tip of the puncture site, you will feel resistance from bone, not joint space.	Complete release of the MCL with multiple punctures.
A single, bold puncture is needed approximately 1.2 cm above the joint line on the TU line.	
Visible or palpable click or cracking sound occurs, indicating the release of MCL.	
Measure the medial joint space before and after the release.	
Less chance of structural injury e.g., artery, vein, and nerve branches, as the magic point is well above the joint.	
Inform the patient that there is a possibility of experiencing pain on the medial side where the pie crust procedure is performed	
MCL, medial collateral ligament	

There are general concerns about iatrogenic medial instability persist due to the release of the medial collateral ligament, most clinical studies report no significant laxity or subjective instability after knee arthroscopy with medial release⁽⁷⁾. Although Griffith et al⁽⁸⁾. emphasized that the MCL as a primary stabilizer against valgus forces in their anatomical study, attributing it to most of the resistance against valgus stress in the knee. Robinson et al⁽⁹⁾. highlighted the importance of the distal tibial insertion of the MCL in preventing valgus laxity.

Li et al⁽¹⁰⁾ report their experience of over two decades of percutaneous release of MCL with no cases of clinically medial instability. Most clinical studies report no significant residual laxity or subjective instability after knee arthroscopy with medial release.

Erdem et al⁽¹¹⁾⁽¹²⁾, in their study, portrayed positive outcomes with low complication and failure rates after medial meniscal repair using inside-out suturing and the pie-crusting technique on the medial collateral ligament, with no control group. They also emphasized the main indication for using the pie-crusting technique, which is adequate visualization, especially in patients with tight medial compartments, to avoid iatrogenic chondral injury due to the narrow joint space. However, the extent to which the compartment

space can be expanded or needs to be expanded remains uncertain. Theoretically, excessive space expansion may lead to instability, while insufficient expansion may hinder surgical techniques. Thus, striking a balance between increasing joint space too much or too little is essential. Although literature on the minimum required joint space width (JSW) for meniscal repair is lacking, the normal JSW minimum averages 4.8 mm for healthy women and 5.7 mm for healthy men. While in our case the maximum JSW we can achieve to 5 mm.

In general, at least 5 to 6 all-inside stitches at intervals of 3 to 5 mm are required for adequate repair of the BHMT⁽⁴⁾. This case only uses 2 stitches with interval 4 mm due to cost problem. This presumably be the aetiology of the occasionally instability and locking of the knee.

This procedure is the often produce postoperative pain on the medial side after the release, which may be more pronounced compared to patients without medial release. Several studies have reported short-term pain at the release site in patients undergoing MCL release. Jeon et al⁽¹³⁾ compared patients with and without percutaneous MCL release and found higher visual analogue scale (VAS) scores for patients with MCL release on the first postoperative day. Claret et al⁽¹⁴⁾, in their study of 140 patients, showed

that the results of 70 patients who underwent MCL release regarding pain and function at two and six months were more successful than the 70 patients who did not undergo MCL release. In this case, pain on the medial side of the knee persisted for approximately two weeks after the operation with improvement of the knee function.

This procedure can help the orthopaedic surgeon in the future to overcome the difficulties in BHMT repair. The advantage advantages and disadvantages are shown in Table 2.

CONCLUSION

Arthroscopic meniscal repair for BHMT is challenging, especially for posterior horn tears, with medial joint space narrowing. The pie-crusting technique, releasing the superficial medial collateral ligament, is an innovative approach to address these challenges in BHMT cases. The case presented here exemplifies the successful utilization of the pie-crusting technique to overcome the challenges posed by medial knee joint space narrowing in a posterior horn BHMT case, contributing to our understanding of innovative approaches in managing this condition.

Table 2. Advantages and Disadvantages of Pie Crust MCL Release by finding the Magic Point during arthroscopic Bucket Handle Medial Meniscus Tear repair

Advantages	Disadvantages
Simple and effective technique allowing easy access for the diagnosis and treatment of medial meniscus pathologies	Beginners may find it difficult to locate the magic point
Rarely saphenous nerve and vein injury occur	Over-release due to multiple punctures
Very few complications and less chance of residual MCL laxity	The increase in joint space width (JSW) cannot be predicted; it's possible that the added width might still not be sufficient for repair.
Reduces the iatrogenic injury to the articular cartilage.	Postoperative pain on the medial side of the knee

MCL, medial collateral ligament

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