

Delta-Grip Stitch for Medial Meniscus Posterior Root Repair



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Abstract: Medial meniscus posterior root tear (MMPRT) is a common medial meniscus injury among elderly patients and often necessitates repair. Although the clinical outcomes of MMPRT repair have demonstrated improvements, subsequent second-look arthroscopy shows poor healing postrepair. Consequently, numerous repair techniques have been reported. Herein, we introduce a simple locking-suture method, the “delta-grip” stitch, for MMPRT repair. This technique exhibited sufficient pullout strength compared with conventional suturing methods, offering promising prospects for enhancing the outcomes of MMPRT repair.

Medial meniscus posterior root (MMPR) tear (MMPRT) is one of the most common meniscal injuries in middle-aged and elderly patients and should be repaired whenever possible.^{1,2} Repairing MMPRT not only improves functional outcomes but also reduces the risk of radiographic knee osteoarthritis (OA) and the need for total knee arthroplasty.^{1,3,4} However, despite these advantages, second-look arthroscopies often reveal inadequate healing after MMPRT repair.^{1,4,5} Consequently, numerous repair techniques⁶⁻¹⁰ and reconstruction methods using autografts have been reported. In our practice, we have been performing a relatively simple locking-suture technique, utilizing all-inside suture passers for MMPRT repair. This method, the “delta-grip” stitch, exhibits sufficient pullout strength compared with conventional suturing methods, and we expect it to improve the results of MMPRT repair in the future. This study was approved by the Institutional Review Board of Hirosaki

University Graduate School of Medicine. Informed consent was obtained from all participants.

Technique

Surgical Indication

Ideal candidates for MMPRT repair include individuals who meet the following criteria: (1) patients treated early after the injury, preferably within 3 months; (2) relatively young and active patients; (3) those without advanced knee OA; (4) those without severe varus knee malalignment; (5) those with a lower body mass index; and (6) those who can adhere to a postoperative rehabilitation program.² Notably, moderate varus alignment of the lower extremity is typically addressed through high tibial osteotomy (HTO) performed concomitantly with MMPRT repair.

Patient Positioning and Diagnostic Arthroscopy

Under general or lumbar spinal anesthesia, the patient is placed supine on a fluoroscopic operating table. A tourniquet is applied, and a support plate is positioned on the proximal thigh to apply valgus stress. Diagnostic arthroscopy is conducted to assess meniscal lesions and knee OA. If the medial meniscus is not suitable for repair, only HTO is performed without meniscal repair.

Surgical Technique

As patients may present with varus alignment or varus stress that causes MMPRT, we often perform MMPRT repair in conjunction with other procedures (Fig 1, Video 1). In cases involving HTO, the medial

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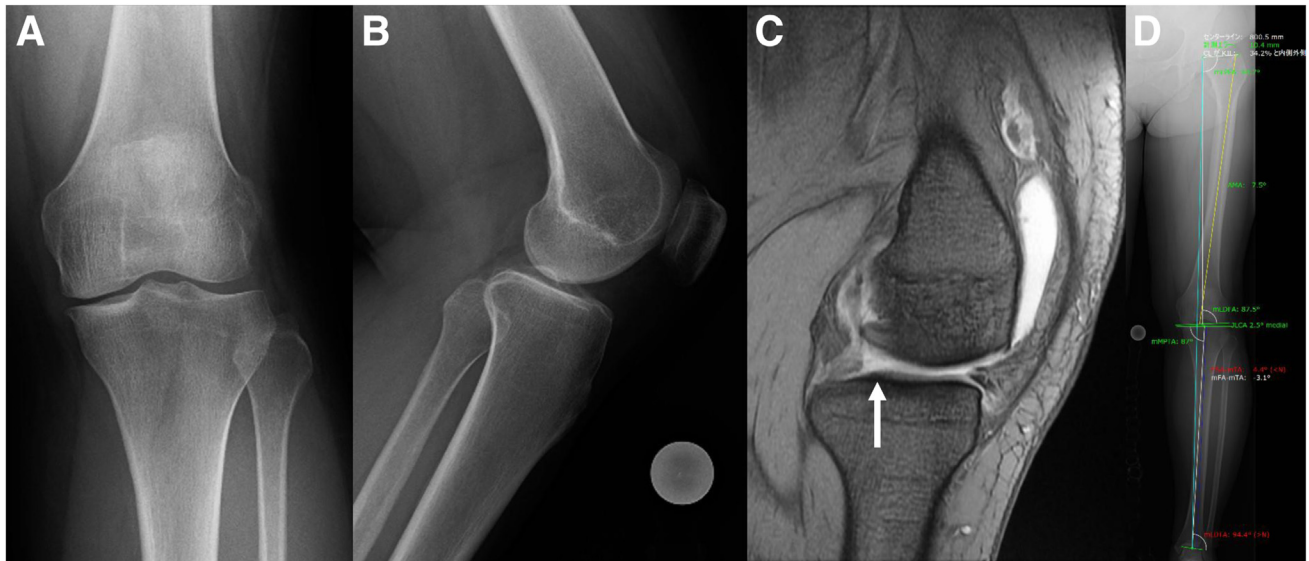


Fig 1. Preoperative images of the medial meniscus posterior root tear (53-year-old woman, left knee). (A, B) Plain x-ray scan, anteroposterior view and lateral view. (C) Magnetic resonance imaging shows white meniscus sign (white arrow). (D) Long leg x-ray image of the left leg shows a slightly varus knee.

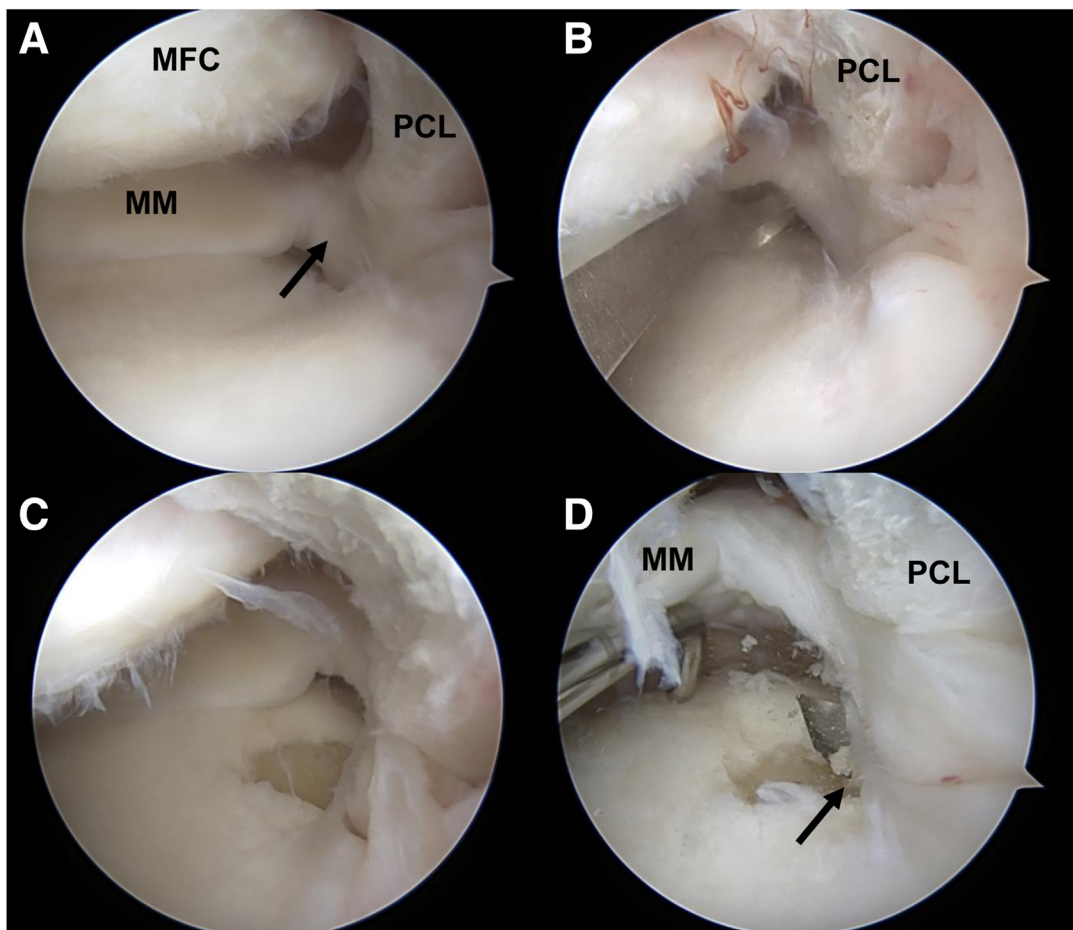


Fig 2. Diagnostic arthroscopy of the left knee (medial compartment) and removal of articular cartilage. (A) Medial meniscus is torn and connected to the PCL by scar tissue (arrow). (B, C) The articular cartilage is excised using a ring curette. (D) A guidewire is inserted into the meniscus insertion (arrow). (MFC, medial femoral condyle; MM, medial meniscus; PCL, posterior cruciate ligament.)

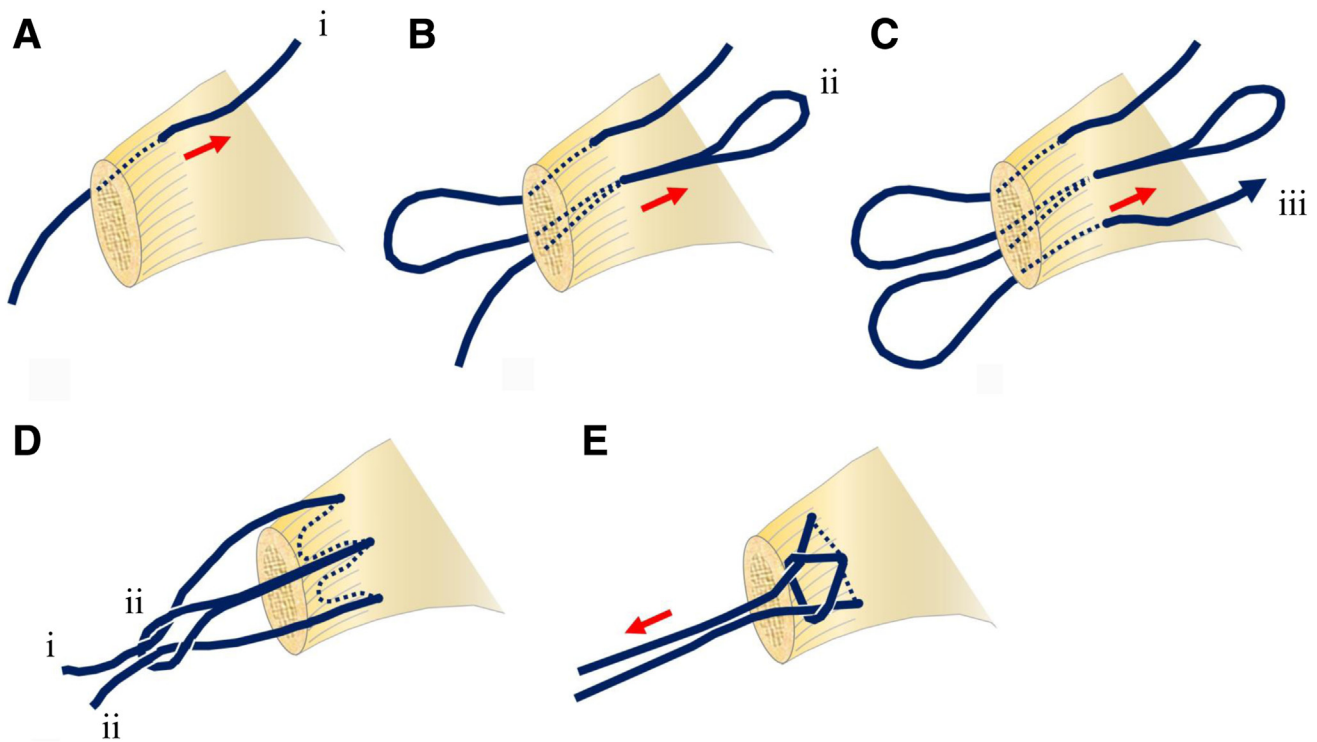


Fig 3. Delta-grip stitch procedure (right knee medial meniscus). (A) One end of the suture (i) is passed through the posterior portion of the MMPR. (B) The middle of the suture (ii) is passed through the middle of the MMPR. (C) The remaining end of the suture (iii) is drawn through the inner portion of the MMPR. (D) Both ends of the suture (i and ii) are passed through the loop at the center of the suture (iii). (E) The slip knot is tightened, similar to a cinch stitch. (MMPR, medial meniscus posterior root.)

collateral ligament (MCL) is transected at the osteotomy level while preserving the pes anserinus. MCL transection easily opens the medial joint space, facilitating MMPRT repair. For patients with neutral alignment not requiring HTO, the outside-in pie-crusting technique is employed for MMPRT repair. Before MMPR suturing, the articular cartilage in the region where the MMPR is dislodged is excised using a curette (Fig 2 A and B). Given that the shiny fiber is often torn or lost in MMPRT, the pullout area should be slightly medial to the original attachment site.

While maintaining arthroscopic visualization through the anterolateral (AL) portal, an all-inside suture passer (FASTPASS MINI; Smith & Nephew or Knee Scorpion; Arthrex) is introduced through the anteromedial (AM) portal. Using a suture passer, 1 end of the suture (No. 2 FiberWire; Arthrex) is passed from the bottom to the top at the posterior portion of the MMPR near the posterior capsule (Figs 3A, 4A). The suture end is temporarily drawn through the AL portal to prevent joint tangling. The middle of the suture is then passed in the same manner as the middle of the MMPR and drawn out through the AL portal (Figs 3B, 4B). The remaining end of the suture is passed through the inner section of the MMPR (Fig 3C), and the first suture end

and the center of the looped suture are pulled back through the AM portal. Similar to a cinch stitch, both ends of the suture are threaded through the loop (Fig 3D), and the slip knot is tightened (Fig 3E). Typically, a cinch stitch is added at the end of MMPR (Fig 4C).

The tip of the transtibial guide is inserted through the AM portal and positioned slightly medial to the original attachment (Fig 2D). A guidewire is introduced from the AL side just below the Gerdy tubercle and overdrilled using a 4.5-mm cannulated drill. This step is implemented to prevent a killer turn at the tibial aperture, allowing the MMPR to be pulled more naturally into the bone tunnel. A suture retriever (Smith & Nephew) is then inserted through the cannulated drill, and the suture ends of the delta-grip and cinch stitches are pulled out through this tunnel. Using these sutures, the MMPR end is drawn into the tibial tunnel (Fig 4D). These sutures are secured to the tibial cortex using a suture button at 45° of knee flexion (Fig 5).

Postoperative Rehabilitation

The patients begin ambulation with crutches and are nonweightbearing initially. Partial weightbearing is initiated in the third week, with full weightbearing permitted after 4 to 6 weeks. Mildly limited knee

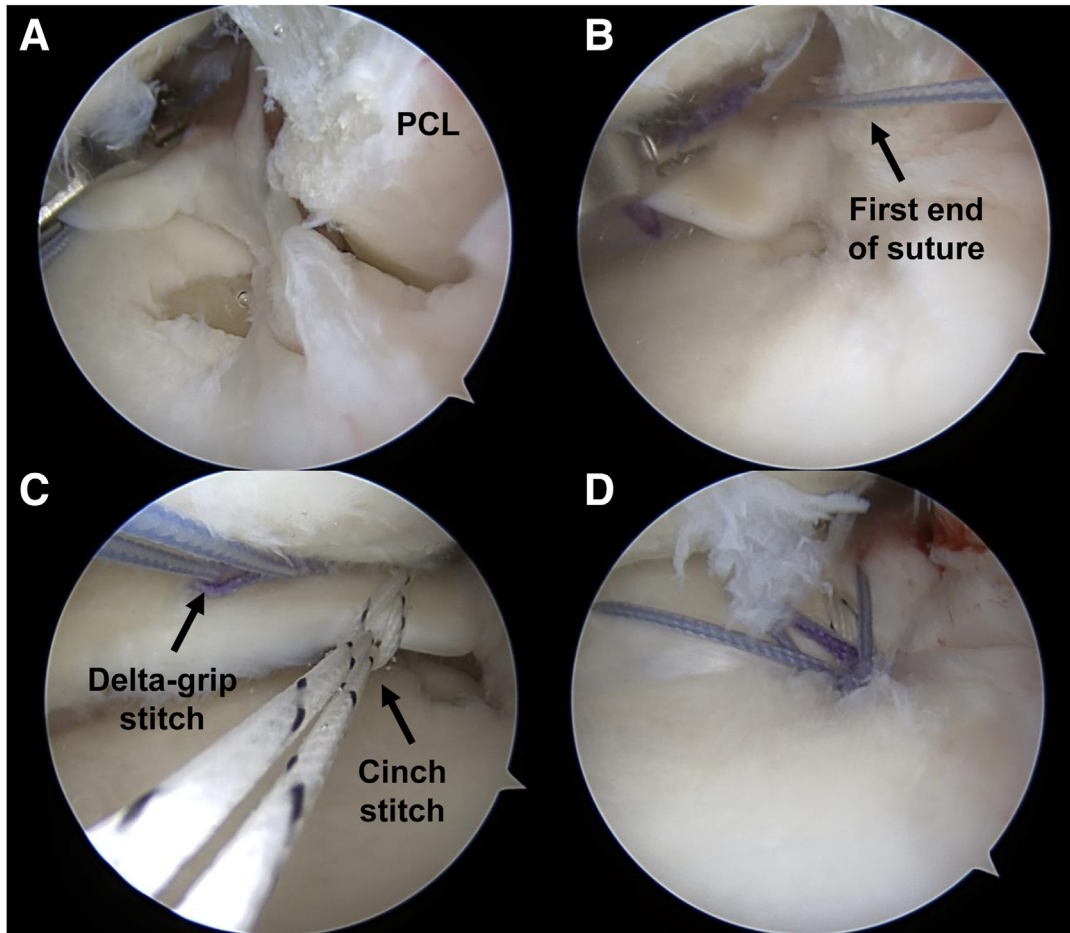


Fig 4. Arthroscopic findings of the delta-grip stitch procedure (left knee medial meniscus). (A) The first end of the suture is passed through the posterior portion of MMPR using a suture passer. (B) The middle of the suture is drawn through the middle of the MMPR. (C) A cinch stitch is placed after making the delta-grip stitch. (D) Arthroscopic view after MMPRT repair. (MMPR, medial meniscus posterior root; MMPRT, medial meniscus posterior root repair; PCL, posterior cruciate ligament.)

flexion exercises commence immediately after surgery, allowing full range of motion after 8 weeks. Patients can return to normal activity after 3 months.

Discussion

Herein, we introduced a simple locking suture method, the delta-grip stitch, for MMPRT repair. This technique is easy to execute using a suture passer and ensure robust initial fixation. In the past, our primary approach involved double- or triple-cinch stitches for MMPRT repair; however, they frequently experienced intraoperative pullouts. Subsequently, the delta-grip stitches were developed and have since been the preferred method. Following this procedural change, there have been no reported postoperative delta-grip failures. We anticipate that the delta-grip stitch will enhance the healing and clinical outcomes of MMPRT repair.

Conventional repair techniques, such as simple sutures and horizontal mattress sutures, are easy to perform but exhibit biomechanical weakness.⁶ Although the modified Mason-Allen stitch has been reported to provide superior biomechanical strength, it is more complex and challenging to perform. Mitchell et al.⁶ developed a locking loop stitch (LLS), which is similar to our method but is challenging to perform. Our preliminary study, using a porcine meniscus (unpublished data), demonstrated that the delta-grip stitch exhibits significantly greater initial fixation strength compared with simple conventional suture methods, achieving comparable levels with the LLS. Krych et al.⁸ recommended simple cinch stitches, given their similar ultimate load-to-failure strength compared with the more complex LLS. However, in their study, sutures were placed orthogonally to the meniscus' longitudinal fibers, negating any presumed differences.

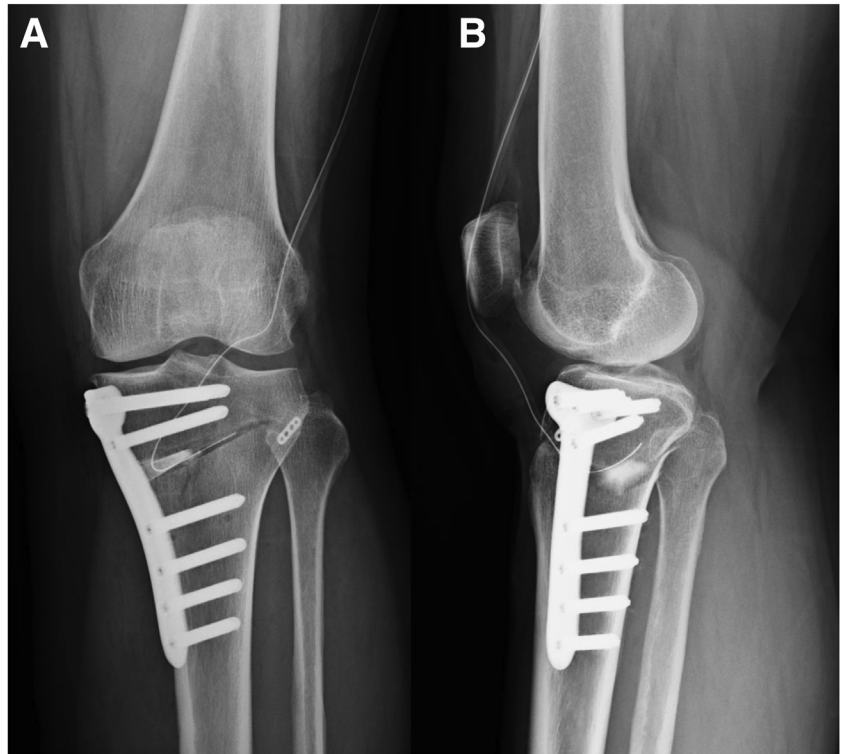


Fig 5. Postoperative x-ray scan after medial meniscus posterior root repair and high tibial osteotomy of the left knee. (A) Anteroposterior view. (B) Lateral view.

Due to the inherent narrowness of the medial joint space, accessing the MMPR can be challenging. Therefore, we preferred to perform HTO concomitantly with MMPRT repair. This technique is reasonable because it facilitates MMPRT repair. Moreover, a meta-analysis demonstrated that simultaneous HTO with MMPRT repair results in improved patient-reported outcomes.⁴ If patients had normal or valgus alignment, surgeons should not hesitate to employ pie-crusting techniques, as this approach does not exacerbate knee valgus instability or affect clinical outcomes.

A comprehensive summary of the advantages and disadvantages of this procedure can be found in [Tables 1 and 2](#).

Table 1. Advantages and Disadvantages of the Delta-Grip Stitch for Medial Meniscus Posterior Root Repair

Advantages	Disadvantages
Horizontal mattress suture	Requires a suture passer
Easy to perform using suture passer	Transtibial technique
Strong initial fixation	
Less expensive (no need of all-inside suture device)	

Disclosures

The authors (Y.I., E.S., Y.K., T.T.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 2. Pearls and Pitfalls of the Delta-Grip Stitch for Medial Meniscus Posterior Root Repair

Pearls	Pitfalls
Removal of articular cartilage at the insertion site	Cartilage damage of femoral condyle
Suture is passed from under the meniscus using a suture passer	Breakage of the suture passer needle
Tightening the slip knot is similar to a cinch stitch	Suture tangling
Guidewire is inserted and overdrilled using a cannulated drill	Poor sliding (suture tape is not recommended)
Suture ends removed through the tibial tunnel	Interference with screws for HTO
Sutures fixed at 45° of knee flexion to avoid overtension of stitches	Failure of fixation site

HTO, high tibial osteotomy.

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