



Meniscus Repair With Anterior Cord Release for Peripheral Tear Type of Discoid Lateral Meniscus

Tomoyuki Suzuki, M.D., Ph.D., Takashi Matsumura, M.D., Ph.D.,
Hidenori Otsubo, M.D., Ph.D., and Miki Kuroda, M.D., Ph.D.

Abstract: With improvement in arthroscopic techniques, partial meniscectomy with repair for symptomatic discoid lateral meniscus (DLM) has been the preferred treatment to restore meniscal function. It was reported that DLM exhibited deformation and extrusion shortly after saucerization with repair. Therefore it is desirable to minimize removal of the DLM. The anterior zone of the DLM is often tighter than that of the normal meniscus and anatomic variant. It is considered that the anterior and anterocentral dislocation types in the majority of symptomatic DLM can be related to both peripheral instability and anterior tightness. We present a technique that, first, the inside-out repair technique is applied from the posterior to middle segment of the DLM; next, the tension of the anterior zone during knee flexion–extension is confirmed to determine the released amount of that part; and, finally, all sutures are tied to reproduce the normal meniscus movement. Meniscus repair with anterior cord release without any meniscectomy could resolve peripheral instability of DLM and prevent degeneration of the articular cartilage.

The prevalence rate of discoid lateral meniscus (DLM) ranges from 0.4% to 17%. It is particularly common in the Asian population.¹⁻⁴ The DLM is larger and thicker than the normal lateral meniscus and susceptible to damage and presents symptoms, such as pain, click, snapping, and locking. Recently, it has been reported that 38% to 88% of symptomatic DLMs exhibit peripheral instability. Especially, the anterior dislocation type is common and has poor prognosis; thus repair at the posterior meniscocapsular junction with saucerization has been recommended over meniscectomy.^{5,6} However, Matsuo et al.⁷ revealed that the DLM exhibited deformation and

extrusion from 2 weeks to 6 months after a saucerization with repair and that the function of load transmission was not maintained appropriately. Another study reported that the thickness and width of the residual DLM decrease over time after partial meniscectomy and arthritic change in the knee progresses.⁸ Therefore it is desirable to minimize removal of the DLM. Peripheral instability extends from the popliteal hiatus, which is exposed to the greatest mechanical and shear stress in most cases because of the thickness of the DLM. Additionally, the anterior zone of the DLM is often tighter than that of the normal meniscus, and anatomic variants, such as cord-like anterior intermeniscus ligament, have been reported.⁹ Therefore this surgical technique aimed to reproduce the normal tension balance of DLM by initially resolving peripheral instability and then releasing anterior tightness without meniscectomy (Video 1).

Surgical Technique

Indications

The indication of this procedure is a diagnosis of DLM and the chief complaint of locking, including a block to extension. Patients indicated for surgery often have a history of locking and clear physical findings, such as McMurray and Thessaly tests. In some cases, the patient can reproduce the locking and snapping, and apprehension is positive in the McMurray test (Table 1). On sagittal magnetic resonance imaging, the signal change

From the Department of Orthopaedic Surgery, Sapporo Maruyama Orthopaedic Hospital (T.S., M.K.), the Department of Orthopaedic Surgery, Obihiro Kyokai Hospital (T.M.), and the Department of Orthopaedic Surgery, Sapporo Sports Clinic (H.O.), Chuo-ku, Sapporo, Hokkaido, Japan.

The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received May 22, 2020; accepted October 9, 2020.

Address correspondence to Tomoyuki Suzuki, M.D., Ph.D. Department of Orthopaedic Surgery, Sapporo Maruyama Orthopaedic Hospital, N7-W27, 1-3, Chuo-ku, Sapporo, Hokkaido 060-0007, Japan. E-mail: tomoyuki-s@sannet.ne.jp

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2212-6287/20999

<https://doi.org/10.1016/j.eats.2020.10.016>

Table 1. Indications and surgical steps of arthroscopic repair with anterior cord release of the discoid lateral meniscus

Indications
Locking knee with the DLM
Surgical steps
Routine arthroscopy is performed using the standard anterolateral and anteromedial portals, additional far anteromedial portal when suturing the middle segment of DLM.
Locking, popping, and abnormal movement of DLM during knee flexion–extension are examined. Moreover, meniscus tear or peripheral instability are analyzed according to their location, type, and size.
The meniscus tear site and synovial junction are rasped.
A 3-cm lateral skin incision is made just behind the fibular collateral ligament, and the popliteal retractor is inserted between the lateral gastrocnemius and posterior capsule.
Inside-out suture is used for the posterior segment, and meniscus movement is observed with the sutures left untied.
For the antero-central dislocation type, the iliotibial band is split in a line of fibers and retracted for the exit of the needle.
Inside-out suture is used for middle segment, and meniscus movement is observed with the sutures left untied.
Finally, posterior thick and tight portion of the anterior horn of the DLM is released with use step by step.
The degree of release is determined by observing meniscus movement while applying tension to the untied suture.
Tension in each suture and meniscus movement is confirmed arthroscopically; then, the sutures are tied.

DLM, discoid lateral meniscus.

in the meniscocapsular portion, effusion, and accompanying anterior movement in the posterior segment of DLM are identified (Fig 1).

Surgical Approach

The procedure was performed with the patient under general anesthesia in the supine position with a leg

holder allowing full range of motion. Standard anteromedial and anterolateral portals were established, and diagnostic arthroscopy was performed. We identified the tear site and instability by careful probing and then observed the movement of the lateral meniscus during knee flexion–extension.

When the indication for this procedure was decided, a 3-cm skin incision was made just behind the fibular collateral ligament, and the popliteal retractor was inserted between the lateral gastrocnemius and posterior joint capsule (Fig 2). First, vertical divergent suturing was performed on the superior and inferior surfaces of the DLM from the posterior segment using suture with a Henning needle (Stryker Japan KK, Tokyo, Japan) (Fig 3). At this time, the suture was not tied but left so that the tension of suture could be subsequently adjusted. In case of instability in the midbody of the meniscus (anterior popliteal tendon), a far anteromedial portal was created and sutured in the same way without knot tying. Then, the iliotibial band around the exit of the needle was split in a line of fibers, exposing the joint capsule.

Once tension was applied to the suture at the posterolateral tear site of the meniscus, the posterior portion at the anterior horn of meniscus increased the tension. In the posterior part around the anterior horn of the DLM, an abnormally enlarged fibrous continuity was observed to be continuous with the anterior cruciate ligament, apart from the fiber with straight arrangement to the attachment on the tibia. From the anterolateral portal, the free end of the meniscus was gradually released by inserting a scalpel slowly, and tension was applied to the suture. When the

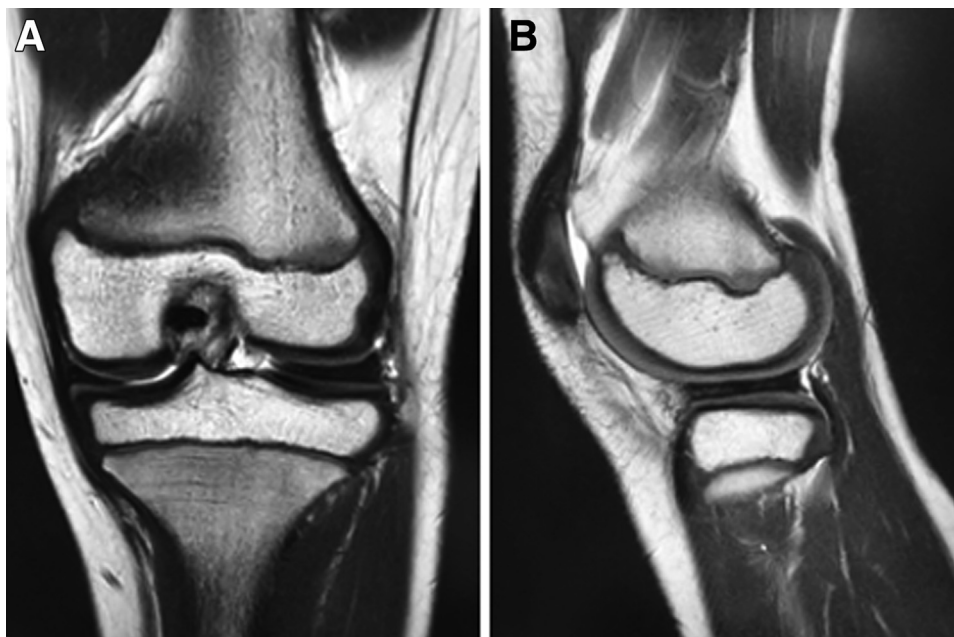
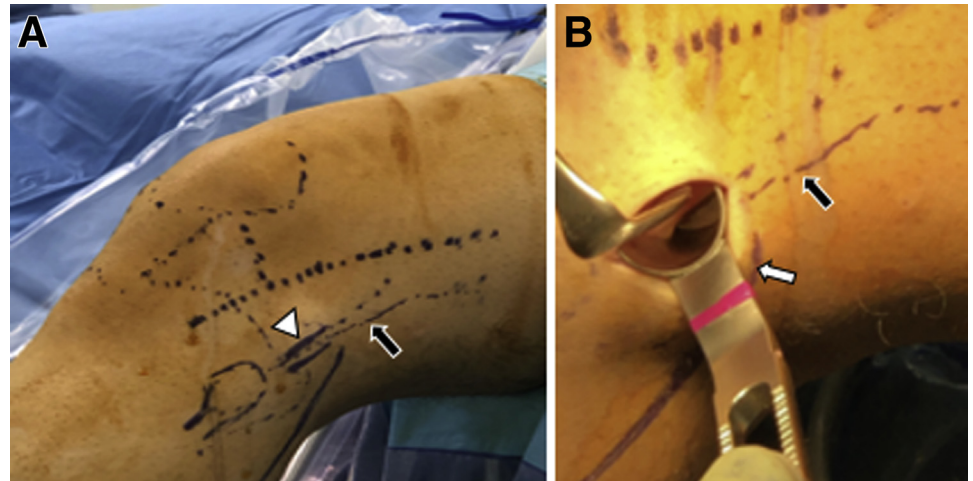


Fig 1. (A) Coronal magnetic resonance imaging of left knee in a 9-year-old girl shows an incomplete-type discoid meniscus. (B) Sagittal magnetic resonance imaging shows an antero-central shift-type discoid meniscus.

Fig 2. (A) Left knee, lateral side. A 3-cm skin incision is made just behind the fibular collateral ligament (triangle). (B) The interval between the biceps femoris tendon and iliotibial band is incised (black arrow), and the retractor is inserted between the posterior capsule and lateral gastrocnemius (white arrow). The retractor should be positioned anterior to the gastrocnemius.



DLM was reduced posteriorly and laterally, the released part was opened, and a smooth line was drawn (Fig 4). It is confirmed that normal movement of the lateral meniscus during knee flexion–extension

(posterior movement in flexion and anterior movement in extension) can be reproduced and that dislocation does not occur; then, a meniscus suture was tied (Fig 5).

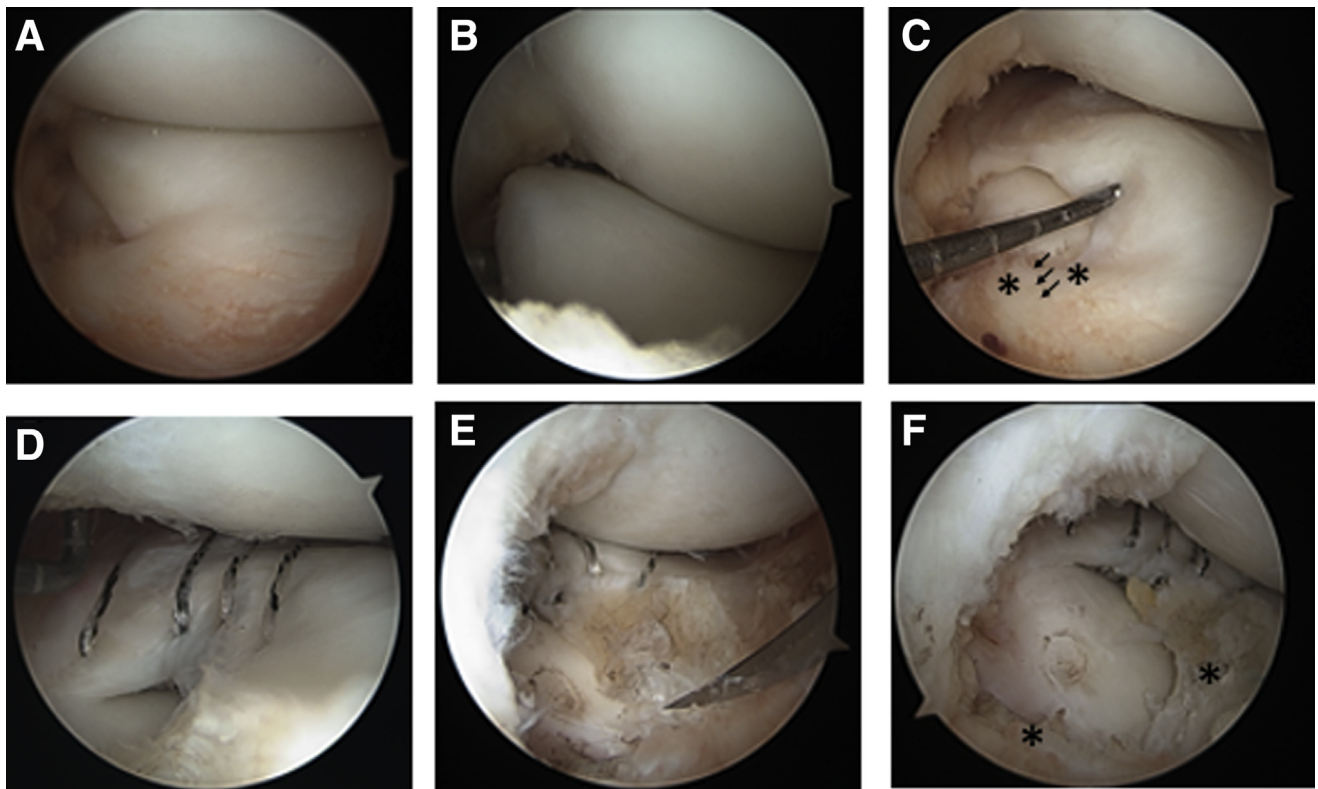


Fig 3. Left knee view from the anterolateral portal in a 14-year-old boy. (A) At first glance, it looks like a complete discoid lateral meniscus (DLM), but it is a peripheral tear of incomplete DLM. (B) Anterocentral dislocation at deep knee flexion. (C) A probe is inserted from the anteromedial portal to push the meniscus body posterolaterally. Then, we recognize that the anterior part of the meniscus is thicker and tighter than the normal meniscus (arrow, asterisk). (D) Initially, peripheral tears in the posterior segments are repaired with an inside-out technique using a Henning’s instrument (Stryker, Kalamazoo, MI) through the anteromedial portal. (E) A scalpel is inserted from the anterolateral portal to gradually release the anterior medial cord-like fiber. (F) The middle segment was sutured from the far anteromedial portal, and tension is applied to the suture to determine the degree of release and at tying the suture. The released stump opens (asterisk).

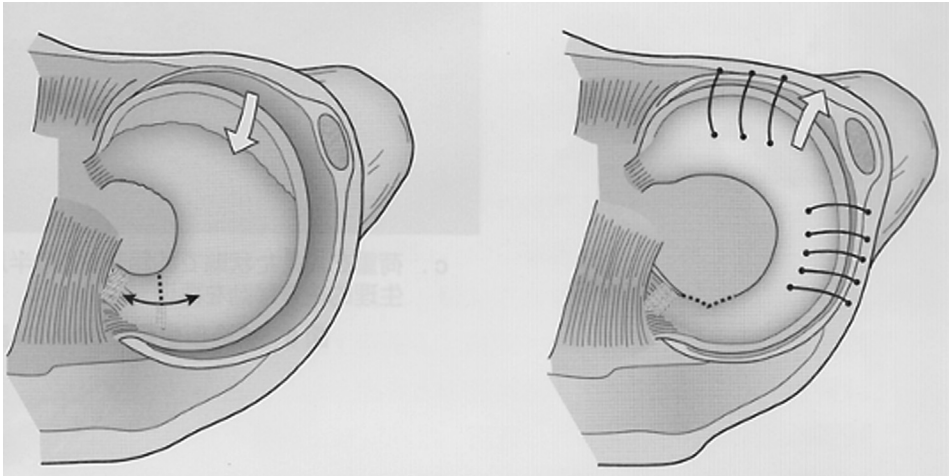


Fig 4. Cross-section showing anterocentral dislocation of discoid lateral meniscus (DLM) of left knee. When tension is applied to the suture by releasing from the free edge of thick anterior horn, the DLM is reduced, and the release stump (broken line) is opened. Reduction and confirmation of meniscus movement during knee flexion–extension is repeated, and the release is advanced step by step. Modified from Suzuki,¹¹ with permission from Nankodo.

Postoperative Rehabilitation

After surgery, the knee was immobilized using a brace in full extension for 4 weeks. Partial weightbearing was allowed after 1 week, progressing to full weightbearing as tolerated for 2 weeks. Range of motion should focus on achieving 0° to 90° for the first 4 weeks and progressing to normal range of motion thereafter. Squatting was restricted for at least 3 months. Return to sports was allowed at 4 months, provided patients

had achieved full range of motion, strength, and neuromuscular control.

Discussion

With improvement in arthroscopic techniques, partial meniscectomy with repair for symptomatic DLM has been the preferred treatment to restore meniscal function. The described technique was developed through the authors' experiences in the treatment of

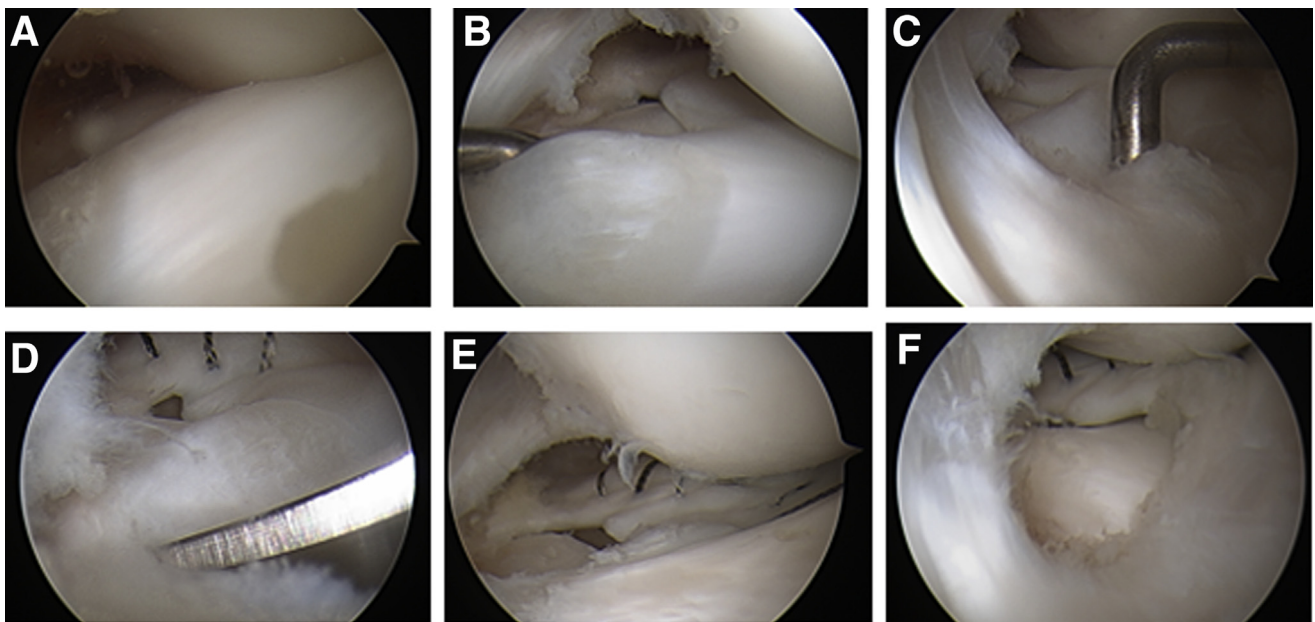


Fig 5. (A) Left knee view from the anterolateral portal in a 9-year-old girl. (A) Snapping phenomenon at deep flexion angles: locking, anterocentral dislocation. (B) Snapping again at knee extension: reduce, reposition. A probe from the anteromedial portal is inserted, and the thick fibers posterior to the anterior horn of the discoid lateral meniscus (DLM) are identified. (C) View from the anteromedial portal. The probe shows the border of thick fibers of the free edge of the DLM and the fiber with straight arrangement to attachment on the tibia. (D) A scalpel is inserted from the anterolateral portal to gradually release the thick fibers posterior to the anterior horn. (E) The released stump is opened, and the snapping phenomenon during knee flexion–extension disappears from the anterolateral portal. (F) View from the anteromedial portal. Normal meniscus movement and crescent shape are reproduced without meniscectomy.

Table 2. Advantages, Limitations, Pearls, and Pitfalls

Advantages
This technique is able to preserve the meniscus as much as possible.
Since it preserves the inner femoral surface without meniscectomy, it contributes to not exposing the vulnerable middle portion of the discoid meniscus.
The double-stacked vertical suture had a higher failure strength treatment for peripheral instability. In addition, the vertical suture orientation mimics the function of the radial collagen fibers within the meniscus, which can improve its load-carrying capacity.
This technique can reproduce proper meniscus movement and restore its normal hoop stresses.
Limitations
Requires posterolateral incision.
Pearls
When suturing the middle segment, the sutures are inserted through the far anteromedial portal and tied anterior to the popliteus tendon. An assistant confirms that the suture needles do not penetrate the fibular collateral ligament. Iliotibial band should be split in a line of fibers.
Pitfalls
Many sutures may become entangled because the anterior cord release is added at the end without the sutures tied.

symptomatic DLM with the anterior and anterocentral dislocation type. (1) In the second-look arthroscopic evaluation after saucerization with repair, articular cartilage damage progressed even after 1 year. (2) We tried to resolve peripheral instability by itself, but there was recurrence of locking after surgery. In the arthroscopic findings, we observed rupture of the suture site and greater tightness in the anterior zone of the DLM. Therefore it is considered that the anterior and anterocentral dislocation types of DLM can be related to both peripheral instability and anterior tightness of DLM.

A previous histologic study on collagen fibril texture of DLM showed that the femoral surface of the DLM is covered by dense and well-arranged thick fibrils. In the central layer, its medial zone shows thin, loosely, and irregularly arranged fibrils without bundle formation.¹⁰ Therefore, in the treatment of DLM, if meniscectomy is performed before repair, there is a problem that the stout femoral surface of the free edge could be disrupted and this vulnerable inner zone of DLM could be exposed. The surgeon will often encounter horizontal tears in the medial middle zone because of meniscectomy and thus may have removed more than the intended amount for resection. The collagen fibrils with straight arrangement in the radial direction in the anterior and posterior zones allow the meniscus to strongly attach to the tibia.¹⁰ However, it is occasionally observed that all these fibrils are not attached to the tibia, and the free edge behind the anterior horn of DLM is relatively thick, which is considered to be the

anatomic variant of anterior tightness of DLM with anterior and anterocentral dislocation.

The described technique has several advantages (Table 2). The limitations are related to the Henning suture procedure. It is recommended to insert a popliteal retractor to protect the peroneal nerve and to suture anterior to the fibular collateral ligament through the far anteromedial portal. Additionally, this method is limited to DLM Ahn classification of antero dislocation and anterocentral dislocation type. Careful anterior release is required for the amount of release because of individual differences. If the release is excessive, lateral meniscus extrusion or DLM tibial attachment damage may be a concern. Meniscus repair with anterior cord release without any meniscectomy could resolve peripheral instability of DLM and prevent the degeneration of the articular cartilage.

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