Discoid Meniscus and Meniscoplasty in Children

25

Jin Hwan Ahn, Sang Hak Lee, Rainer Siebold, and Lior Laver

Contents

Electronic supplementary material The online version of this chapter (doi:10.1007/978-3-662-49188-1_25) contains supplementary material, which is available to authorized users.

J.H. Ahn, MD (✉)
Department of Orthopedic Surgery, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, 29 Saemunan-ro, Jongno-gu, Seoul 110-746, Republic of Korea
e-mail: jha3535@naver.com

S.H. Lee
Department of Orthopaedic Surgery, Kyung Hee University Hospital at Gangdong, 892 Dongnam-ro, Gangdong-gu, Seoul 134-727, South Korea

R. Siebold
HKF – Center Hip-Knee-Foot Surgery, ATOS Hospital Heidelberg, Anatomical Institute, University of Heidelberg, Heidelberg 69190, Germany

L. Laver
Department of Orthopaedics and Sports Medicine Service, "Meir" Medical Center and Tel-Aviv University Hospital, Kfar-Saba, Israel

Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel

25.1 Introduction

The discoid meniscus, although a relatively rare congenital anatomic abnormality of the lateral meniscus, is the most common anatomic meniscal variant. First described by Young in 1889 [1], its incidence has been estimated to be around 5 % in the general population, ranging from 0.4 to 16.6 % in different series in the literature [2–4] with a higher prevalence among Asian populations [3–9]. Most discoid menisci are located on the lateral side. However, rare descriptions of medial discoid menisci have been sporadically reported in the literature [5, 8, 10]. The incidence of bilateral discoid lateral menisci (DLM) is estimated to be as high as 20 %; however, the true incidence of bilateral DLM may be underestimated because the contralateral knees in most patients are asymptomatic. In a recent MRI and arthroscopic studies, it was found that the incidence of bilateral DLM ranges from 65 to 90 % [11, 12].

C. Hulet et al. (eds.), *Surgery of the Meniscus*, DOI 10.1007/978-3-662-49188-1_25

Historically, pathogenesis theories ranged from an embryologic arrest in development resulting in incomplete resorption of the central meniscus to theories regarding this anomaly as a congenital anatomic variant, which is currently accepted.

Watanabe et al. presented in 1969 the most commonly used classification system for lateral discoid meniscus, describing three types based on arthroscopic appearance [13]: type I, the most common type in most series, is a complete discoid meniscus which covers the entire tibial plateau with intact peripheral attachments. Type II is an incomplete discoid meniscus, covering a variable percentage of the tibial plateau, with intact attachments. Type III, the least common, is an unstable discoid meniscus, also known as the Wrisberg ligament type, as it is characterized by absent normal posterior attachments with only the meniscofemoral ligament of Wrisberg providing posterior stabilization, resulting in significant meniscal mobility which often manifests clinically. Unstable DLMs are commonly symptomatic and require surgical treatment. In general, discoid menisci with normal peripheral attachments tend to be asymptomatic, and this is the case in many children, therefore requiring no treatment [10, 14, 15]. However, with tissue variability and abnormal knee kinematics with high shear stresses, discoid menisci are at an increased risk for the development of tears, which are often revealed clinically during childhood. Patients often present with mild, vague lateral joint line pain and swelling with or without an inciting event. Mechanical symptoms are present in displaced tears or an unstable variant, manifesting as palpable or audible 'clicking', 'snapping', or 'popping' or even an extension block.

Radiographs are a mandatory part of the evaluation and may reveal widening of the lateral joint space, lateral femoral condyle flattening, concavity of the tibial plateau, meniscal calcification, and tibial spine hypoplasia. Concomitant osteochondritis dissecans of the lateral femoral condyle has also been reported and should be looked for [16, 17]. MRI, aiding not only in diagnosis but also in decision-making and preoperative planning, demonstrates irregular continuity of the anterior and posterior horns of the lateral meniscus (absent 'bow tie') in three or more consecutive 5-mm cuts. Intra-substance tears and displaced flaps are often well visualized; however, unstable type III variants are more difficult to detect on MRI [16, 18]. In these symptomatic cases, surgery is indicated [9], with the goal of symptom relief and meniscal tissue preservation to obtain functionality as well as avoid early degeneration [19].

In the past, total meniscectomy was widely acceptable for the treatment of discoid meniscus [20, 21]. However, later reports showed the advantages of arthroscopic saucerization [22]. Although it is no longer considered an appropriate treatment choice, it is still performed in situations where meniscal preservation is not feasible. The available evidence reveals fair to poor long-term clinical outcomes in patients after total meniscectomy, with radiographic follow-up that has demonstrated high rates of degenerative changes and arthrosis of the involved compartment. These patients should be closely followed for early symptomatic appearance as the option of meniscal transplantation might be considered in these cases.

Currently, treatment guidelines are based on the type of meniscal variant, its stability, presence of a tear, tear type, symptom severity and duration, and the patient's age. Treatment options include observation; partial meniscectomy or saucerization, with or without repair or reattachment of an unstable peripheral rim; and total meniscectomy. Asymptomatic discoid menisci are often identified incidentally (during radiographic or MRI evaluation) and are usually addressed with observation alone. Symptomatic stable discoid menisci (types I and II) are usually treated with arthroscopic 'saucerization' [23–28]. The goal in this procedure is to retain a peripheral rim (ideally, a residual rim width of 6–8 mm) resembling a normal meniscus, in order to more closely reproduce meniscal anatomy and function and to avoid re-tear. If significant instability persists after saucerization, a repair is required to stabilize the unstable residual portion to the capsule. Type III DLM with an unstable rim is ideally treated with combined saucerization

and repair of the peripheral rim to stabilize the reshaped meniscus to the capsule. Addressing these variants commonly requires multiple sutures, as they tend to be highly unstable. Various meniscal repair techniques can be utilized for this purpose, such as the 'inside-out' technique, the 'outside-in' technique, and the 'all-inside' technique. Indications for technique choice are based on repair location, tear type, and the surgeon's preference. Anterior rim instability, i.e. is more easily addressed with an outside-in technique.

This chapter presents an easy and efficient MRI diagnostic classification and describes treatment options and techniques for DLM tears and instability.

25.2 Novel MRI Classification

Various DLM classifications based on arthroscopic findings have been reported, and treatment guidelines according to these classifications have been suggested [29–31]. Tear pattern classifications were based on arthroscopic findings and include horizontal tears, peripheral tears, horizontal and peripheral tears, posterolateral corner loss, and others. The magnetic resonance imaging (MRI) classification can provide more information to the surgeon, although the final decision is made during arthroscopy. The MRI classification can aid surgeons in predicting the occurrence of peripheral tears and degree of instability as well as plan the treatment method preoperatively [32]. However, this MRI classification is not sufficient, and other aspects, such as a careful history and physical examination, are always essential.

The novel MRI classification, introduced in 2009, is constructed of four categories: no shift, antero-central shift, postero-central shift, and central shift. In the 'no shift' category, the peripheral portion of the discoid meniscus is not separated from the capsule, and the entire meniscus is not displaced (Fig. 25.1). Even in cases where the thickness of the anterior and posterior horns in the sagittal images exhibit differences and the discoid meniscus appears displaced, they are classified as no shift if the peripheral portion is not separated from the capsule. In the 'antero-central shift' category, the periphery of the posterior horn is detached from the capsule, and the entire meniscus is displaced anteriorly or anterocentrally; in this category, the anterior horn has a thick appearance in the sagittal images (Fig. 25.2). An 'antero-central shift' is therefore defined if the signal loss is observed in more than 2 cuts in the posterior side of coronal images and a 2-fold increase is observed in the sagittal images. In the 'postero-central shift' category, the periphery of the anterior horn is detached from the capsule, and the entire discoid

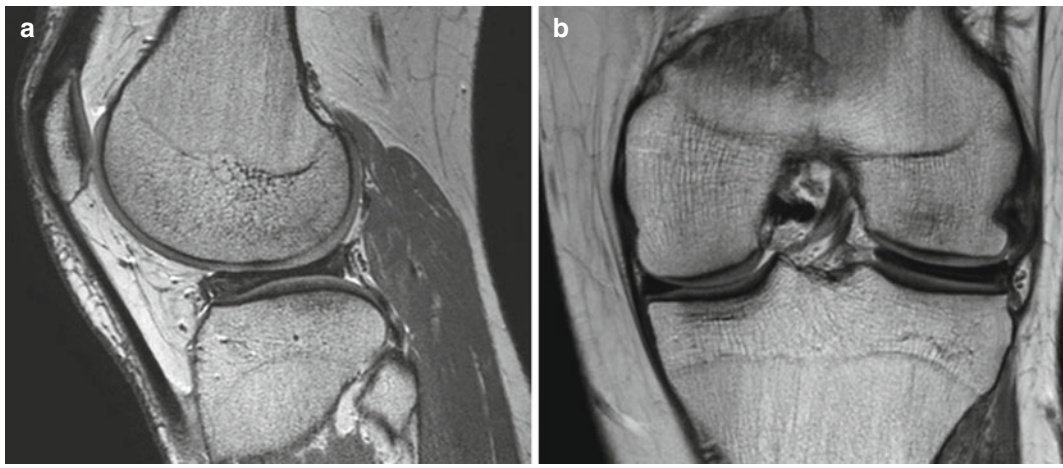


Fig. 25.1 (**a**) Coronal and (**b**) sagittal images show only degeneration of discoid lateral meniscus without shifting

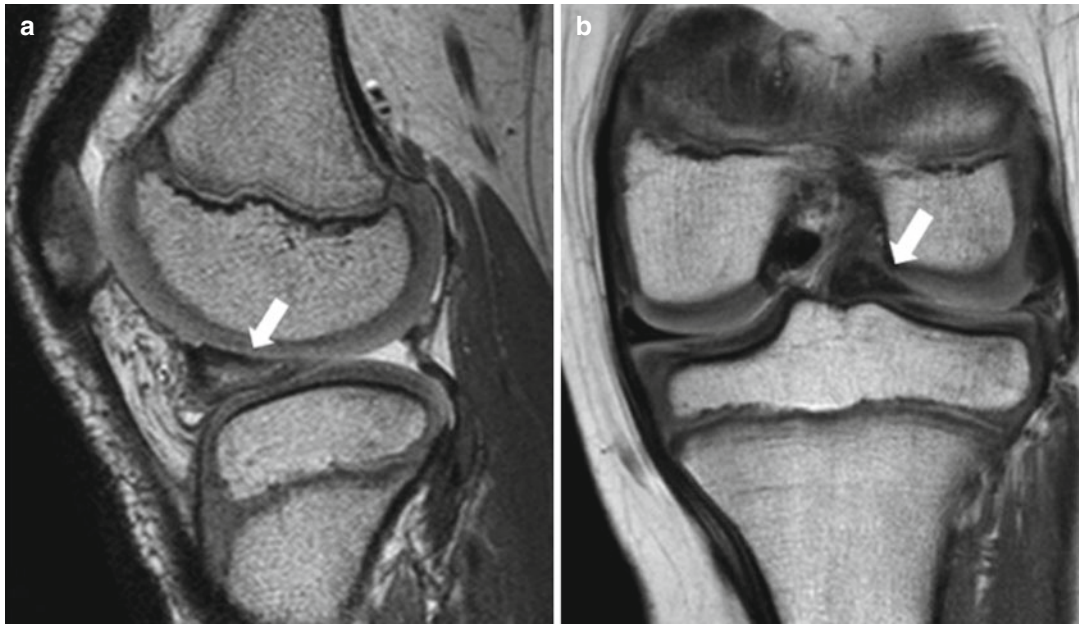


Fig. 25.2 (**a**) Coronal and (**b**) sagittal images show anterior shift of the discoid lateral meniscus (*arrow*). The posterior part of the meniscus is not seen because of an anterior shift of the meniscus

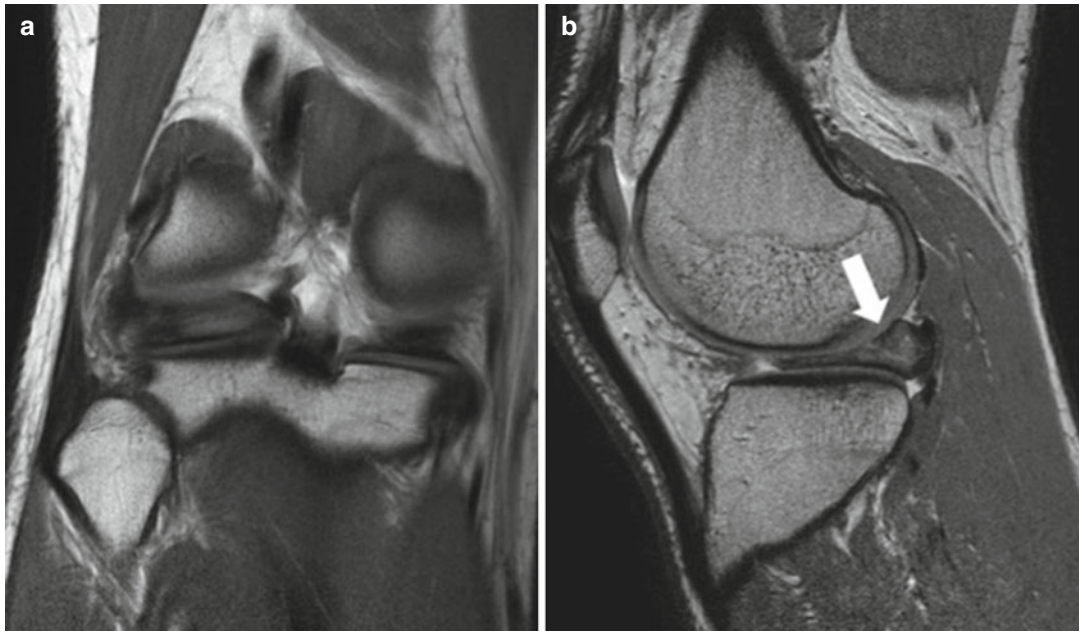


Fig. 25.3 (**a**) Coronal and (**b**) sagittal images show a posterior shift of the discoid lateral meniscus (*arrow*). The anterior part of the meniscus is not seen because of a posterior shift of the meniscus

meniscus is displaced posteriorly or postero-centrally. In this category, the posterior horn has a very thick appearance in the sagittal images (Fig. 25.3). A 'postero-central shift' is therefore defined if the signal loss is observed in more than 2 cuts on the anterior side of the coronal images and a 2-fold increase is observed in the sagittal images. In the 'central shift' category, the

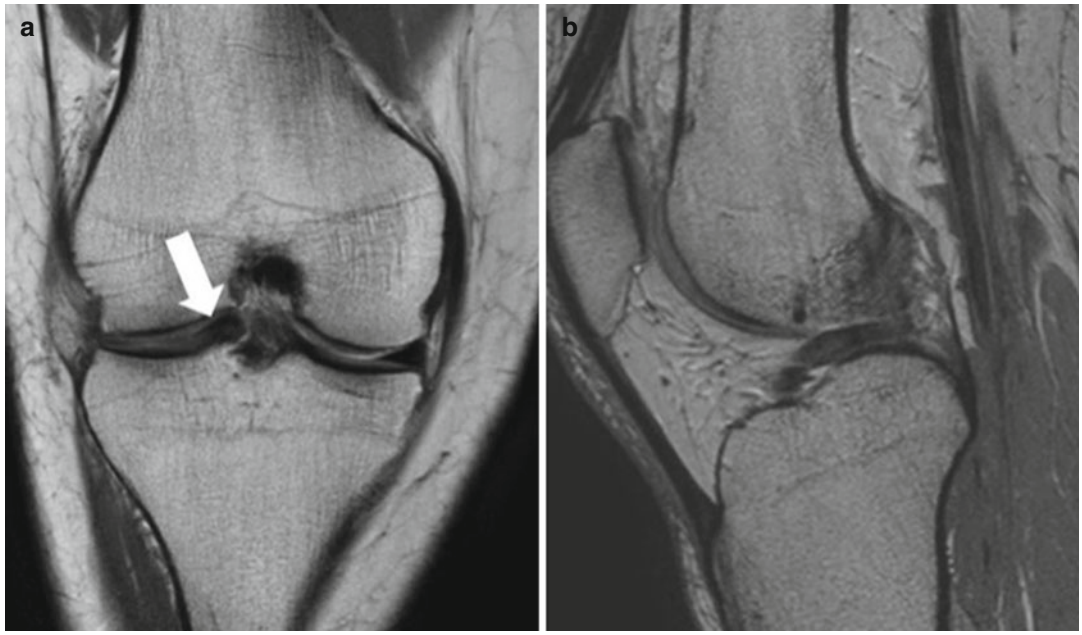


Fig. 25.4 (**a**) Coronal and (**b**) sagittal images show degeneration of the discoid lateral meniscus (*arrow*) without anterior or posterior shifting (central shift type)

periphery of the posterolateral portion is torn or lost, and the entire discoid meniscus is displaced centrally towards the intercondylar notch (Fig. 25.4). Central shift is therefore defined if central displacement with signal loss of the peripheral portion is noticed.

In a study of 82 knees utilizing the novel MRI classification, 43 knees were diagnosed as 'no shift', 6 as 'antero-central shift', 15 as 'postero-central shift', and 12 as 'central shift' [32]. Shift-type knees had a significantly larger number of peripheral tears, and repairs were performed in the shift-type knees (55 %) more frequently than in the no-shift-type knees (28 %) (Fig. 25.5). Among 82 knees, 31 were repaired simultaneously after a central partial meniscectomy. Therefore, the novel MRI classification presented here was useful in terms of preoperative planning of saucerization and detecting/identifying peripheral rim instability prior to arthroscopic surgery (Video 25.1). However, this MRI classification is not sufficient and other aspects must be considered as follows: A DLM with a peripheral tear might appear as having no shift, if it is reduced at the time the MRI is performed. It is therefore still important to correlate/incorporate clinical findings with the imaging findings. If a loud click is present in cases of DLM, a peripheral tear must be suspected and should be addressed by careful arthroscopic examination. In addition, DLMs frequently have horizontal and inferior tears that are not easily identified with arthroscopy and can be often missed without suspecting these possibilities and without a thorough arthroscopic examination. MRI can provide valuable information about the existence of horizontal tears that cannot be obtained from arthroscopy. Careful arthroscopic evaluation should be made because these types of tears are commonly associated with all types of DLM. Also, a peripheral longitudinal tear starts from the popliteal hiatus and extends to the posterior or anterior horn. The entire DLM is moved to the intercondylar notch and is easily reduced to its anatomic position with a loud click or clunk during knee flexion and extension, in the early stage of the peripheral tear. However, in the late stage the displaced DLM may be fixed at the intercondylar notch, thus redefined as a 'shift-type knee'. In such cases limitation in knee range of motion – especially a flexion contracture – will be evident on physical examination. After considering all the factors, the novel MRI classification

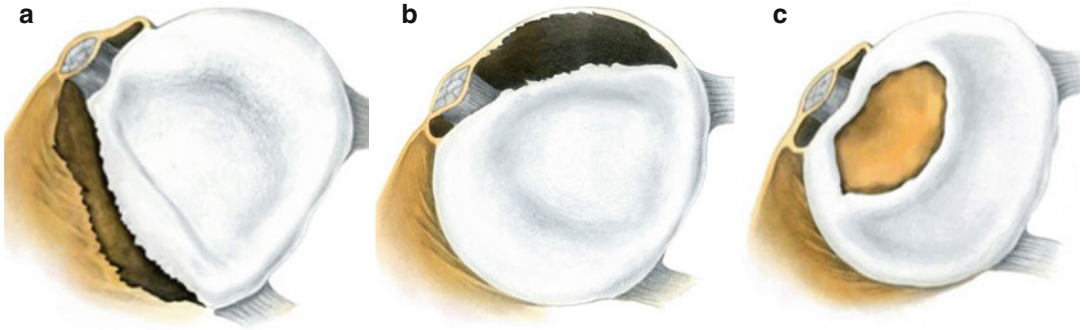


Fig. 25.5 Three types of the discoid lateral meniscus based on arthroscopic findings. (**a**) Meniscocapsular junction, anterior horn type (MC-A type); the drawing shows a peripheral tear of the anterior horn. (**b**) Meniscocapsular junction, posterior horn type (MC-P type); the drawing shows a peripheral tear of the posterior horn. (**c**) Posterolateral corner loss type; the drawing shows posterolateral corner loss of the discoid lateral meniscus

provides more information to surgeons in choosing the appropriate treatment method, although the final decision regarding the appropriate procedure is made during arthroscopy after a thorough analysis of the tear.

25.3 Arthroscopic Partial Meniscectomy with Repair of the Peripheral Tear for Discoid Lateral Meniscus in Children

25.3.1 Diagnostic Arthroscopic Examination

A standard arthroscopic diagnostic examination is initially performed under general anaesthesia, using a 4.0 mm arthroscope [33, 34]. The 2.7 mm arthroscope is rarely used only if the joint cavity is insufficient to allow diagnosis with a standard arthroscope. Routine diagnostic examination is performed using the standard anterolateral viewing portal. For simplified evaluations and to access the anterolateral compartment, the arthroscope is moved to the antero-medial portal, enabling a more thorough inspection as thick meniscal tissue may disturb optimal visualization of the DLM. Careful probing is performed to identify discoid meniscus type and tear shape and to evaluate the stability of the peripheral rim [11, 34, 35]. In cases of DLM, it is often difficult to visualize peripheral longitudinal tears at the posterior horn through the standard anterior portals due to the thick meniscal tissue. Peripheral rim tears at the posterior horn of the lateral meniscus could be examined with the arthroscope inserted through the antero-medial portal and passed through the intercondylar notch between the anterior cruciate ligament and the lateral femoral condyle. A 70° arthroscope could be used for better visualization. Also, switching the scope to a posterolateral portal enables peripheral rim tears of the posterior horn to be positively verified.

25.3.2 Partial Central Meniscectomy

Partial central meniscectomy is performed in a '1-piece' fashion or 'piecemeal technique'. The goal of partial central meniscectomy is to remove the central portion of the thickened meniscus and the torn unstable portion and to leave a stable rim of more than 6 mm from the peripheral capsular attachment. In children, inspection of the medial meniscus could be helpful to determine the size of the remaining peripheral rim after saucerization (Fig. 25.6). Sometimes the meniscal morphology could not be properly verified owing to peripheral rim instability, and a single-stitch suture is then performed to reduce

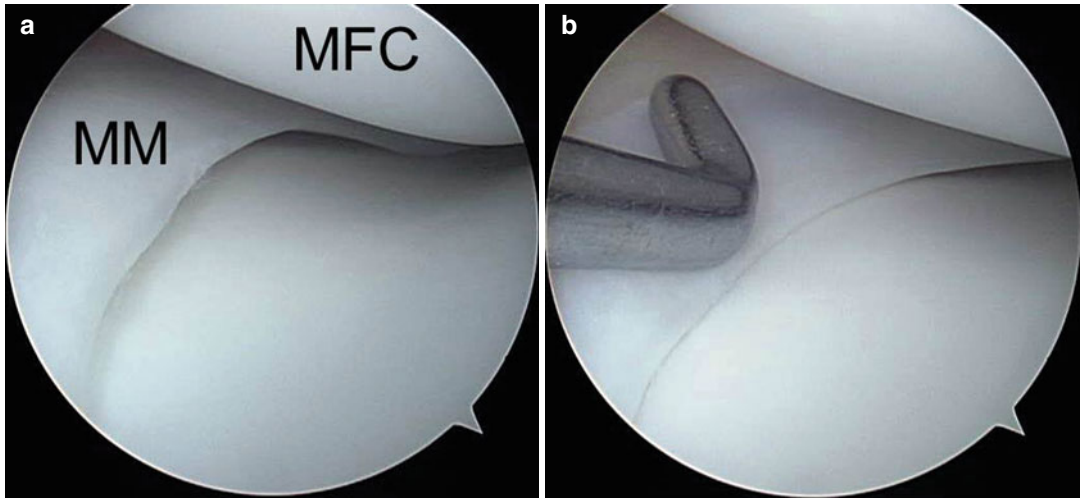


Fig. 25.6 Arthroscopic findings show the width of the medial meniscus that can be measured with probe (*MFC* medial femoral condyle, *MM* medial meniscus)

the meniscus prior to the central partial meniscectomy (Fig. 25.7). Using Iris scissors through the anterolateral portal, the anterior and mid portion of the discoid meniscus is cut leaving a margin of more than 6 mm from the periphery of the meniscus and the posterior portion of the discoid meniscus is cut to similar margins from the periphery of the meniscus using arthroscopic scissors or basket forceps through the anterolateral portal (Fig. 25.8). Iris scissors are useful to cut the anterior or mid portion of the discoid meniscus and trim the thickened portion of the discoid meniscus. After extracting the central portion of the discoid meniscus in one piece, the inner rim of meniscus is smoothed with a basket forceps or a motorized shaver. For horizontal tears, since the lower leaf is usually unstable, only the lower leaf is resected. Once the desired amount of meniscal tissue has been removed, the thickness of the inner edge is much greater than that after routine partial meniscus excision. Additional remaining thickened portions of meniscus are also trimmed using a basket forceps or Iris scissors, to avoid potential extension block. In order to remove a flap tear of the inferior rim of the anterior horn, the use of a basket forceps or a shaver through the submeniscal portal could be useful (Fig. 25.9).

25.3.3 Meniscus Suture Repair for Peripheral Tears

Once the central portion of the meniscus has been removed, the remaining peripheral rim must be carefully probed to ensure that there are no additional tears and that the rim is balanced and stable. At this point, when the peripheral rim tear of the DLM is reducible with a probe, the suture repair is performed. In cases where posterolateral corner loss of the DLM is too extensive and irreducible with a probe, subtotal or total meniscectomy should be considered. The number of sutures needed for repair could be used as a measure for tear size as the actual measurements are usually difficult to perform. Although not optimal, this provides a rough estimate of tear size, as stitches are placed at roughly 3- to 4-mm intervals. Our preferred repair technique is performed using absorbable sutures (No. 0 PDS: Ethicon, Somerville, NJ, USA) after debridement of the tear sites using a motorized shaver. In order to suture tears from the anterior horn to the posterolateral corner, a modified outside-in technique is preferred using a suture hook (Linvatec, Largo, FL) with a straight neck and a spinal needle preloaded with a No. 0 nylon, enabling to pull out the PDS [36]. This technique is performed using

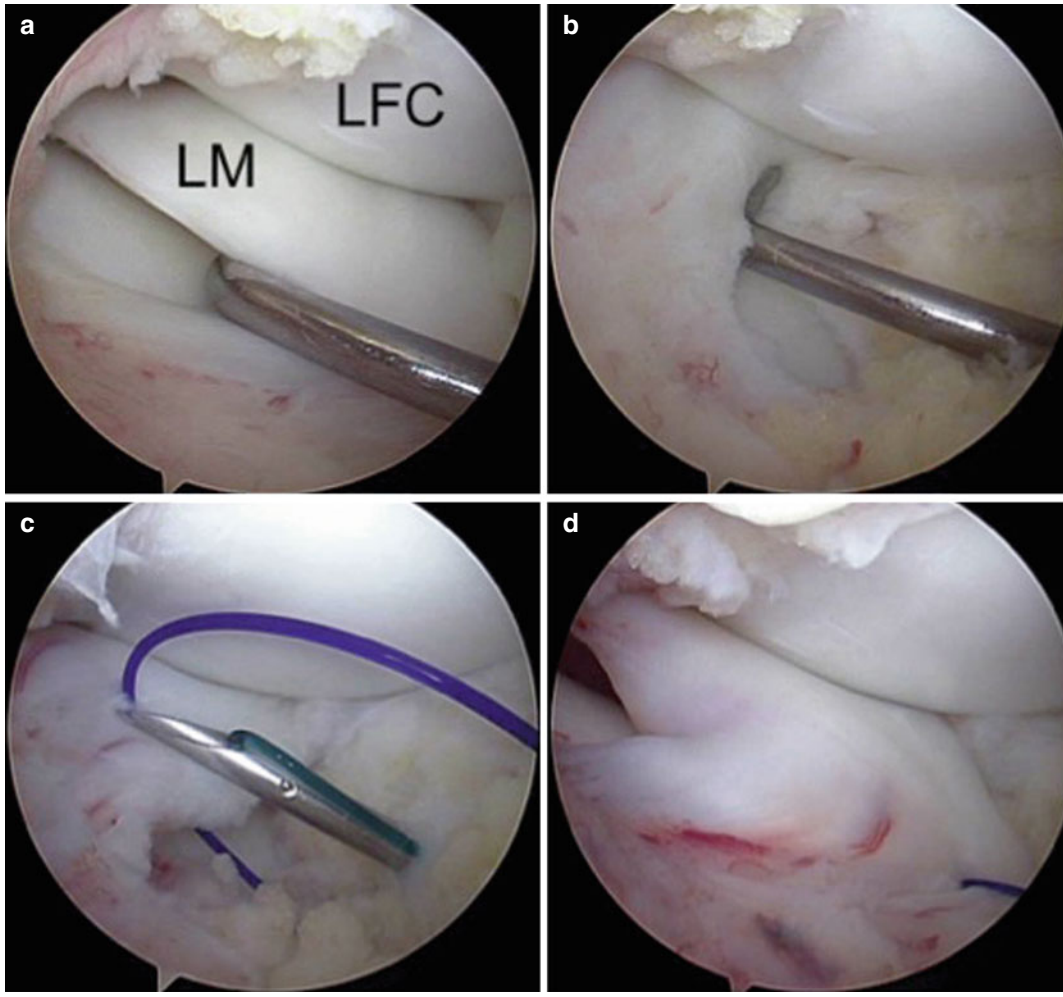


Fig. 25.7 Arthroscopic findings show (**a**) complete discoid lateral meniscus and (**b**) a meniscocapsular junction tear between the lateral meniscus anterior horn and the joint capsule. (**c**, **d**) A polydioxanone suture for reduction purposes, is placed to verify meniscal morphology, before undertaking central partial meniscectomy (*LFC* lateral femoral condyle, *LM* lateral meniscus)

a small posterolateral incision for easy retrieval and suture tying. In order to suture tears in the posterior horn, a modified all-inside technique is preferred using a suture hook with a 45° curved neck through a single posterolateral portal. If a tear could not be repaired due to posterolateral corner loss of more than 1 cm, an arthroscopic subtotal meniscectomy is performed.

Fig. 25.9 In order to remove a flap tear of the inferior rim of the anterior horn, a basket forceps or a shaver through the submeniscal portal can be used (*LFC* lateral femoral condyle, *LM* lateral meniscus)

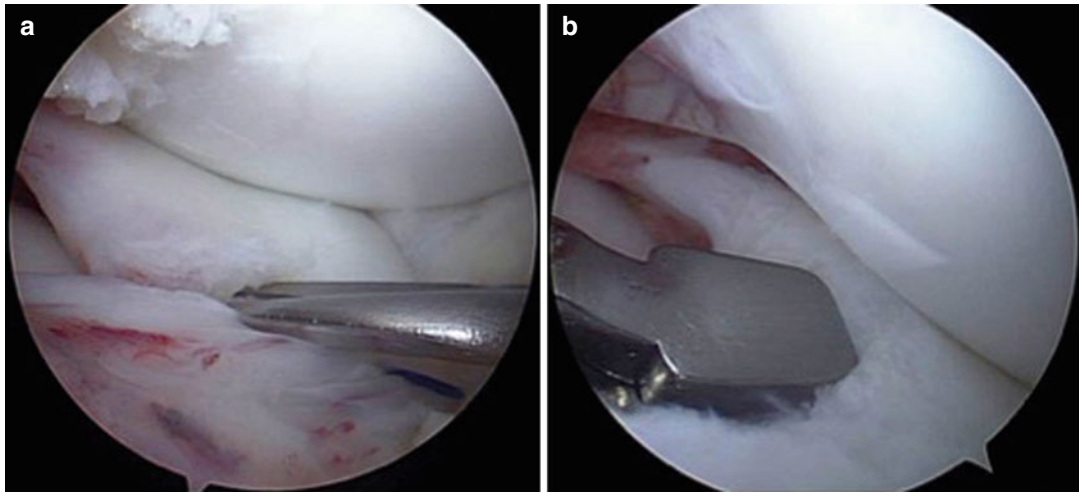
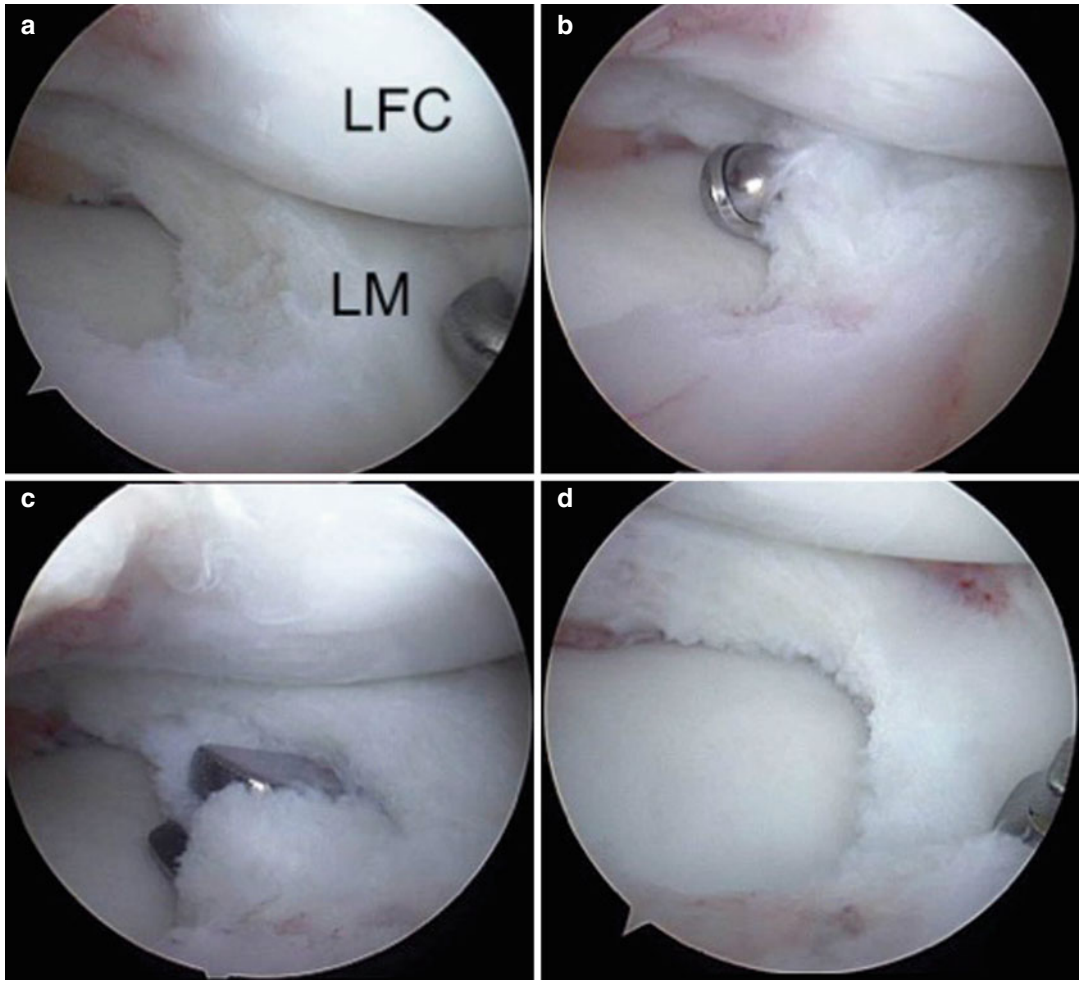


Fig. 25.8 (**a**) The discoid meniscus was cut with an Iris scissors through the anterolateral portal or (**b**) basket forceps inserted from the antero-medial portal



25.3.4 The Modified Outside-In Technique for Tears from the Anterior Horn to the Posterolateral Corner

The modified outside-in suture technique is performed using a spinal needle which is used in the standard outside-in suture technique [37] and a suture hook (Linvatec TM; Largo, FL, USA) which is generally used for the all-inside suture technique (Video 25.2). First, an arthroscope is introduced through the antero-medial portal, and a semilunar-shaped straight suture hook (Linvatec TM) is inserted through the anterolateral portal. First, the meniscus is pierced from the lower surface to the upper surface by orienting the suture hook in a vertical direction (Fig. 25.10). Next, the No. 0 PDS (Ethicon, Somerville, NJ, USA) suture material is advanced through the cannulated suture hook. After withdrawing the suture hook from the joint, the suture ends are retrieved through the ipsilateral portal using a suture retriever (Fig. 25.11).

Under arthroscopic vision, a spinal needle, with a preloaded MAXON 2-0, is inserted above

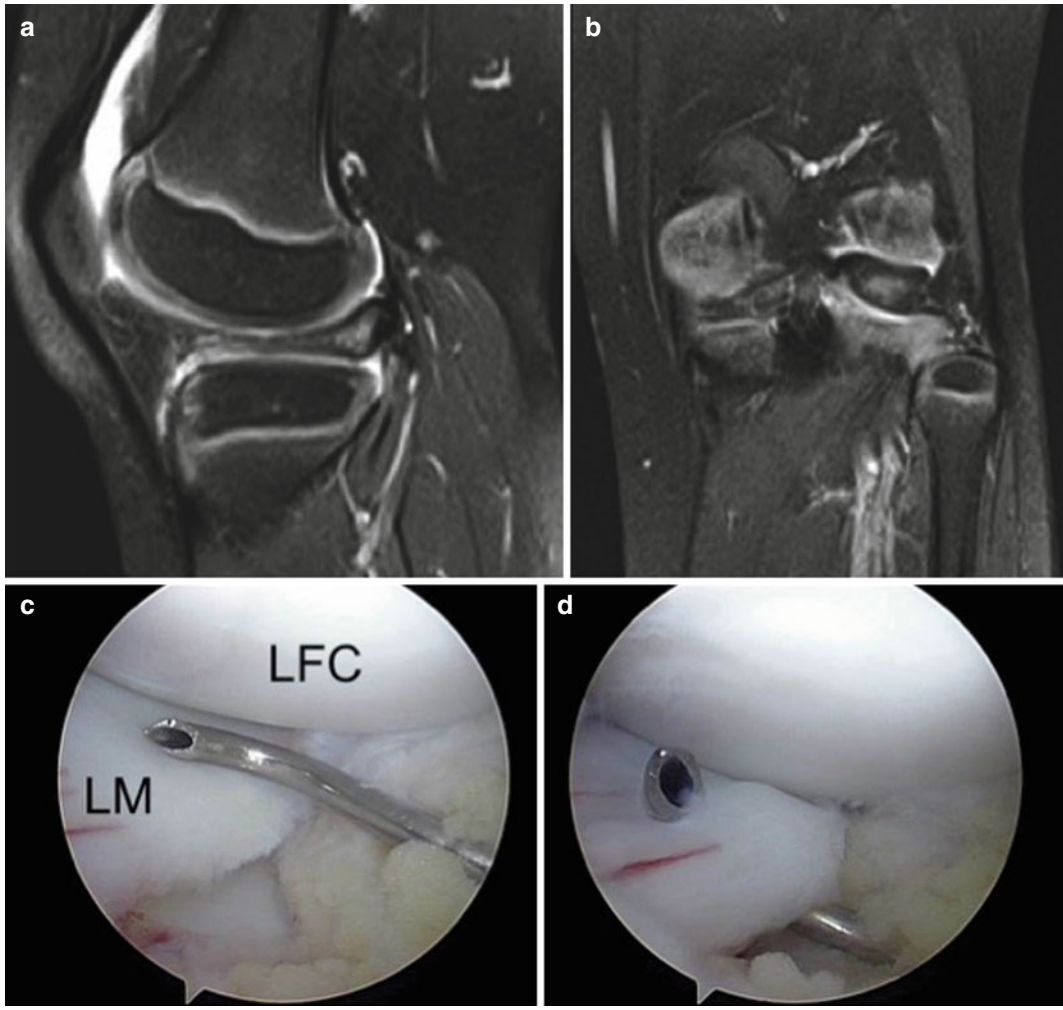


Fig. 25.10 (**a**) Sagittal and (**b**) coronal images of an 8-year-old boy show postero-central shift type of the discoid lateral meniscus in right knee. (**c**) Arthroscopic photograph showing a meniscocapsular junction tear between the anterior horn of the lateral meniscus and the joint capsule. (**d**) Suture hook inserted into the anterolateral portal is penetrated through the anterior horn of the lateral meniscus (*LFC* lateral femoral condyle, *LM* lateral meniscus)

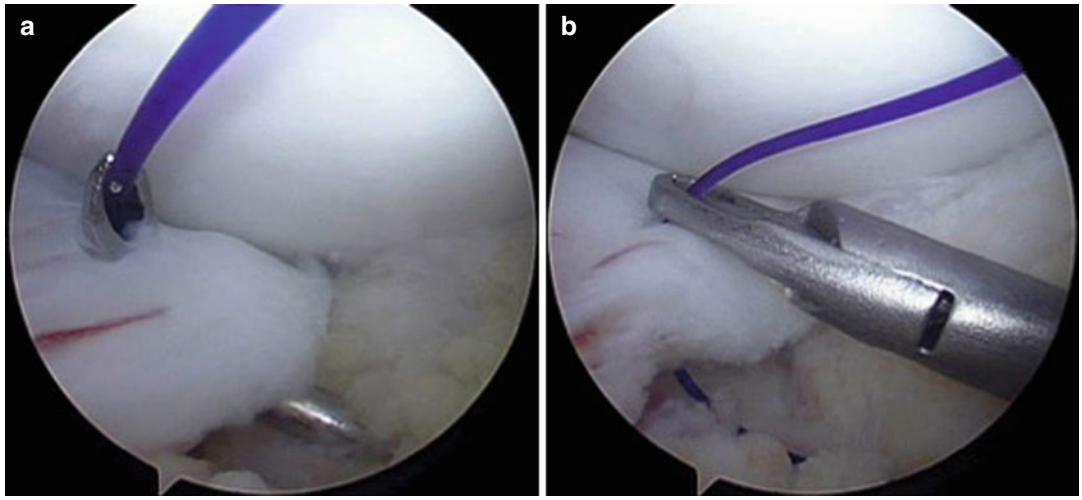


Fig. 25.11 (**a**) After passing the PDS suture, (**b**) the suture end is retrieved through the anterolateral portal using a suture retriever

the meniscus in order to pull out the previously inserted PDS through the torn meniscus (Figs. 25.12 and 25.13). The MAXON 2-0 loop is then manipulated so that it is oriented in front of the No. 0 PDS. The No. 0 PDS is retrieved through the MAXON loop with a suture retriever and the suture ends are pulled outside the capsule by pulling the MAXON loop outwards. An additional spinal needle, preloaded with a MAXON 2-0, is reinserted – this time below the meniscus – in order to pull out the other end of the previously passed PDS through the torn meniscus. The loop is positioned in front of the PDS suture end below the meniscus. This end is now retrieved through the MAXON loop and is then pulled outside the capsule by pulling the MAXON loop outwards. The torn meniscus is reduced by pulling both ends of the No. 0 PDS, which now holds the circumferential fibres of the meniscus (Fig. 25.14).

A 1–2 cm-sized skin incision is made close to the two ends of the PDS suture. Using a curved haemostat, the area is dissected down to the level of the retinaculum. The two PDS suture ends are then retrieved through the incision confirming there is no soft tissue interposed between the free ends of the PDS, apart from the retinaculum. After reduction of the meniscus, both suture ends are tied with optimal tension, achieved by manipulating a probe inserted through the anterolateral portal. After placement of the sutures, the gap between the meniscus and the joint capsule is closed.

25.3.5 The Modified All-Inside Technique for Posterior Horn Tears

In DLM, it is very difficult to find the peripheral longitudinal tear at the posterior horn through standard anterior portals due to thick meniscal tissue that often obstructs optimal visualization and inspection of this portion of the meniscus [36] (Video 25.3). The posterolateral (PL) compartment can be approached by passing a 30° arthroscope between the anterior cruciate ligament and the lateral femoral condyle (Fig. 25.15). Once a peripheral longitudinal tear of the lateral meniscus posterior horn (LMPH) is identified via standard diagnostic arthroscopy, a 70° arthroscope can be used for better visualization (Fig. 25.16). Various anatomic structures in the PL compartment, such as the LMPH, the PL capsule, and the lateral femoral condyle, are examined using a 30° arthroscope inserted at the antero-medial portal and passed through the intercondylar notch.

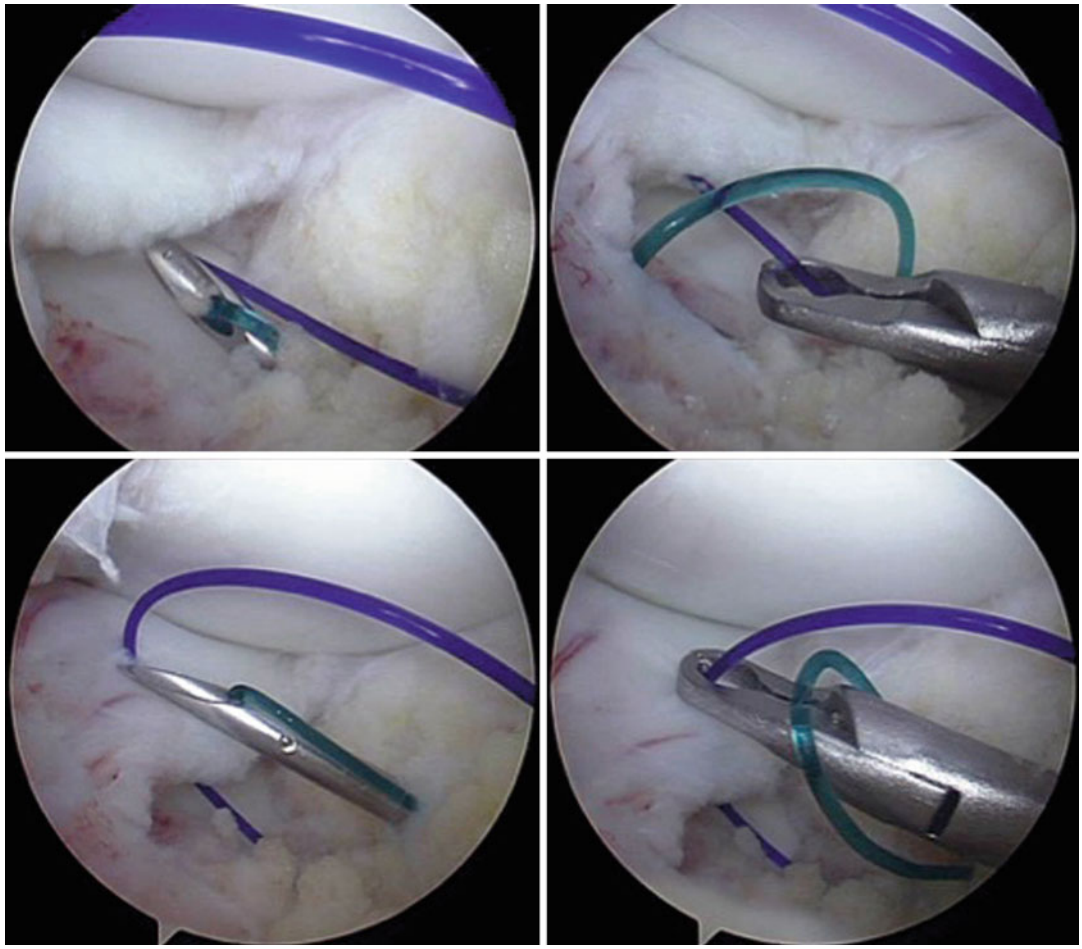


Fig. 25.12 Both suture ends are retrieved through the MAXON loop with a suture retriever

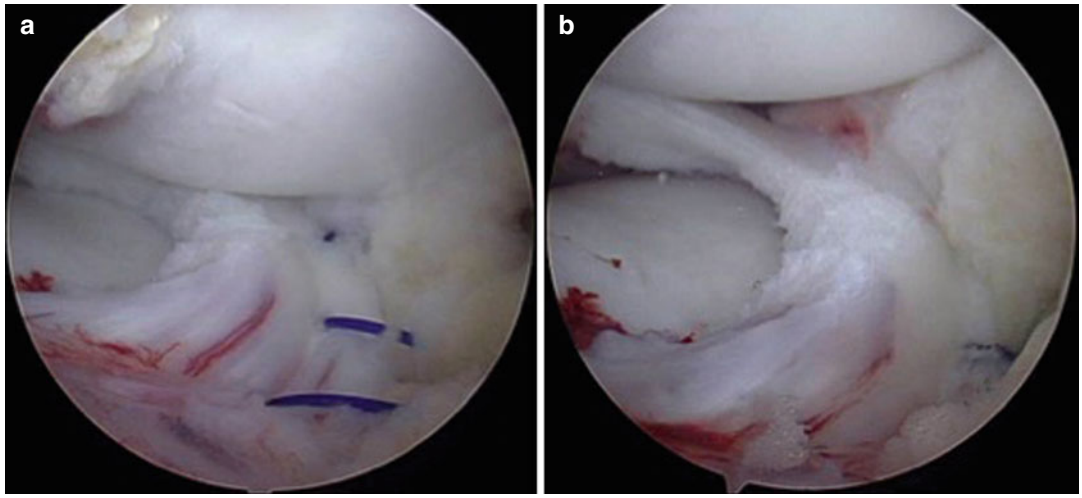


Fig. 25.13 (**a**) The torn meniscus is reduced by pulling both ends of the No. 0 PDS, which now holds the circumferential fibres of the meniscus. (**b**) After tying, anatomic coaptation of the lateral meniscus anterior horn tear is seen with 3 vertical sutures

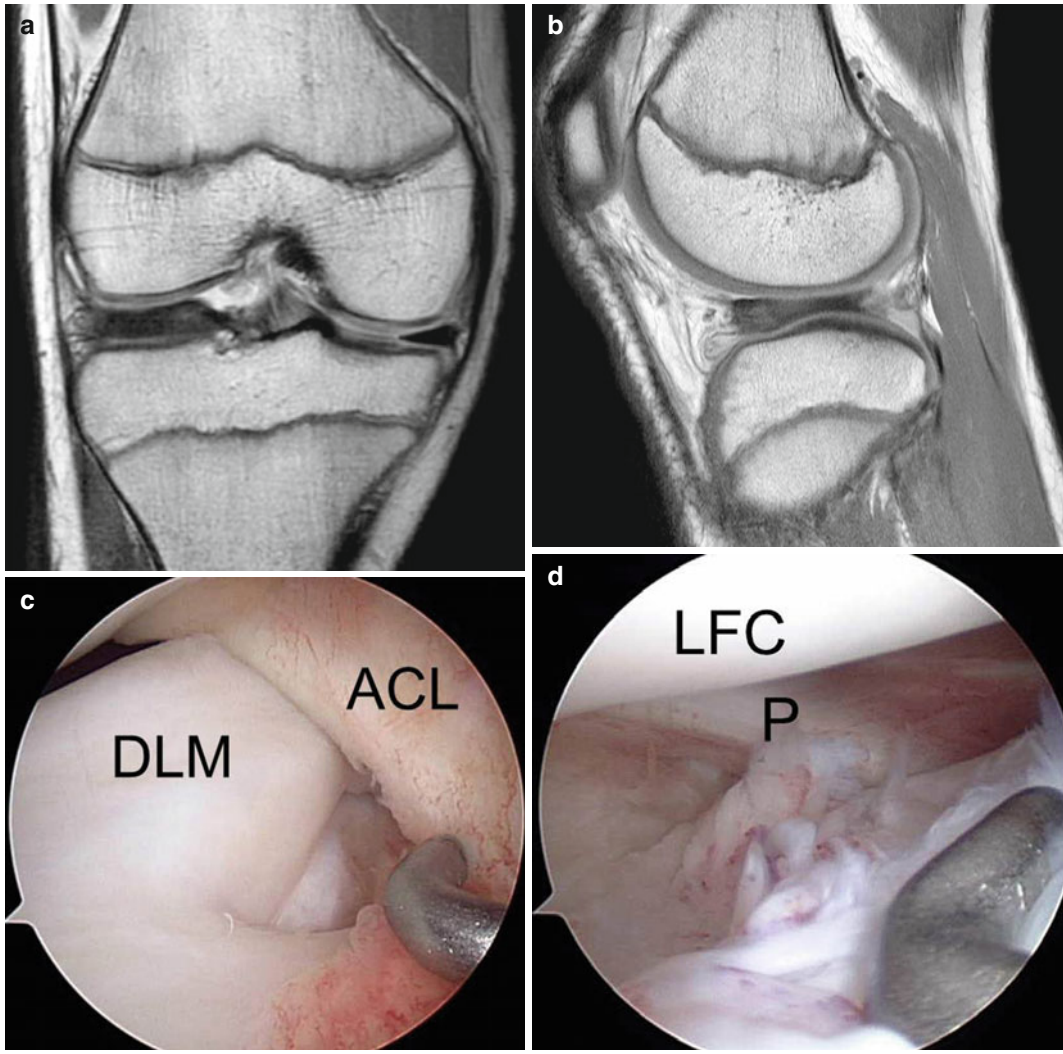


Fig. 25.14 (**a**) Coronal and (**b**) sagittal images of a 7-year-old boy show antero-central shift type of the discoid lateral meniscus in the right knee. (**c**, **d**) Arthroscopic photograph showing a complete type of discoid lateral meniscus with meniscocapsular junction tear at the lateral meniscus posterior horn around popliteal hiatus (*LFC* lateral femoral condyle, *ACL* anterior cruciate ligament, *DLM* discoid lateral meniscus, *P* popliteus tendon)

While keeping the knee flexed at 90° for maximal joint distension and to avoid neurovascular injury, a 16-gauge spinal needle is inserted at the posterolateral (PL) corner using a transillumination technique and a PL portal is established, without the use of a cannula. A probe is inserted to examine the extent, degree, and shape of the peripheral tear at the LMPH. The arthroscope is switched to the PL portal by use of a switching stick to examine the PL compartment and the torn LMPH from a different view.

In more anatomically confined PL compartments, it is often difficult to manipulate the instruments sufficiently. The arthroscopic all-inside suture of LMPH tear through a single PL portal was developed to address such limitations. Our suturing technique allows greater freedom in suture hook manoeuvring by creating a single PL portal without using a cannula. This technique allows excellent visualization of the PL compartment, anatomic coaptation of the torn meniscus, and strong efficient knot tying while avoiding

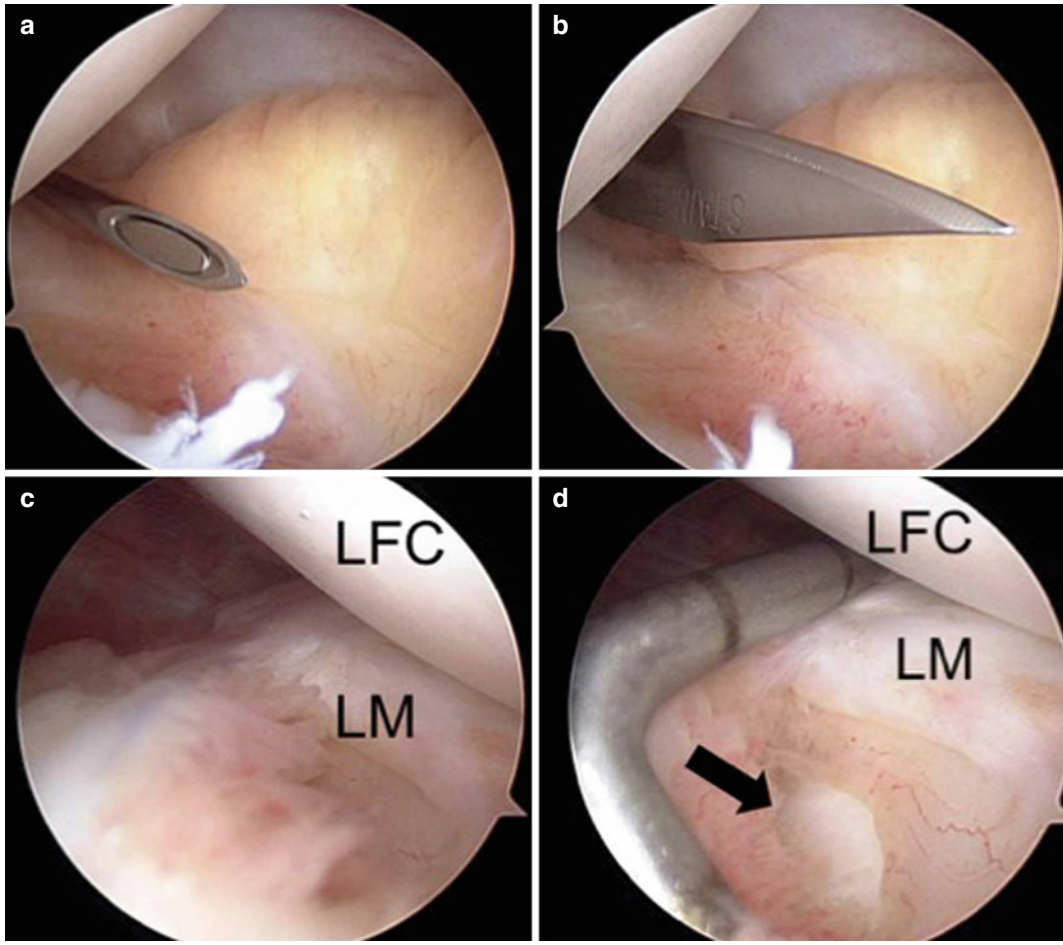


Fig. 25.15 (**a**, **b**) The posterolateral portal is created under direct arthroscopic visualization of 30° arthroscope inserted from antero-medial portal. (**c**, **d**) The 30° arthroscope inserted from posterolateral portal shows the longitudinal tear (*arrow*) of the posterior horn of the lateral meniscus around the meniscocapsular junction (*LFC* lateral femoral condyle, *LM* lateral meniscus)

inadvertent injury to the remnant meniscus and the articular cartilage. We recommend this technique for suture placement in peripheral longitudinal tear of the LMPH.

With a 70° arthroscope inserted from the antero-medial portal and passed through the intercondylar notch to view the PL compartment, a shaver or rasp is introduced through the PL portal for debridement of both tear portions. The 70° arthroscope allows better visualization. Inserting and manipulating instruments without a cannula allow easier instrumentation manoeuvring in the relatively restricted PL compartment. After preparation of the tear site, a 45° angled suture hook loaded with a No. 0 PDS is introduced through the PL portal, and a suture is performed starting from the tear site of the inner tear penetrating the most central portion in an inferior to superior direction (Figs. 25.17, 25.18, and 25.19). During this procedure, care must be taken not to damage the cartilage of the femoral condyle, as the hook is closest to the condyle during this procedure. Both ends of the No. 0 PDS are pulled out with a suture retriever through the PL portal. The superior end of the suture is marked with a straight haemostat, and the inferior suture end is left alone. A suture hook loaded with 2-0 MAXON is inserted through the

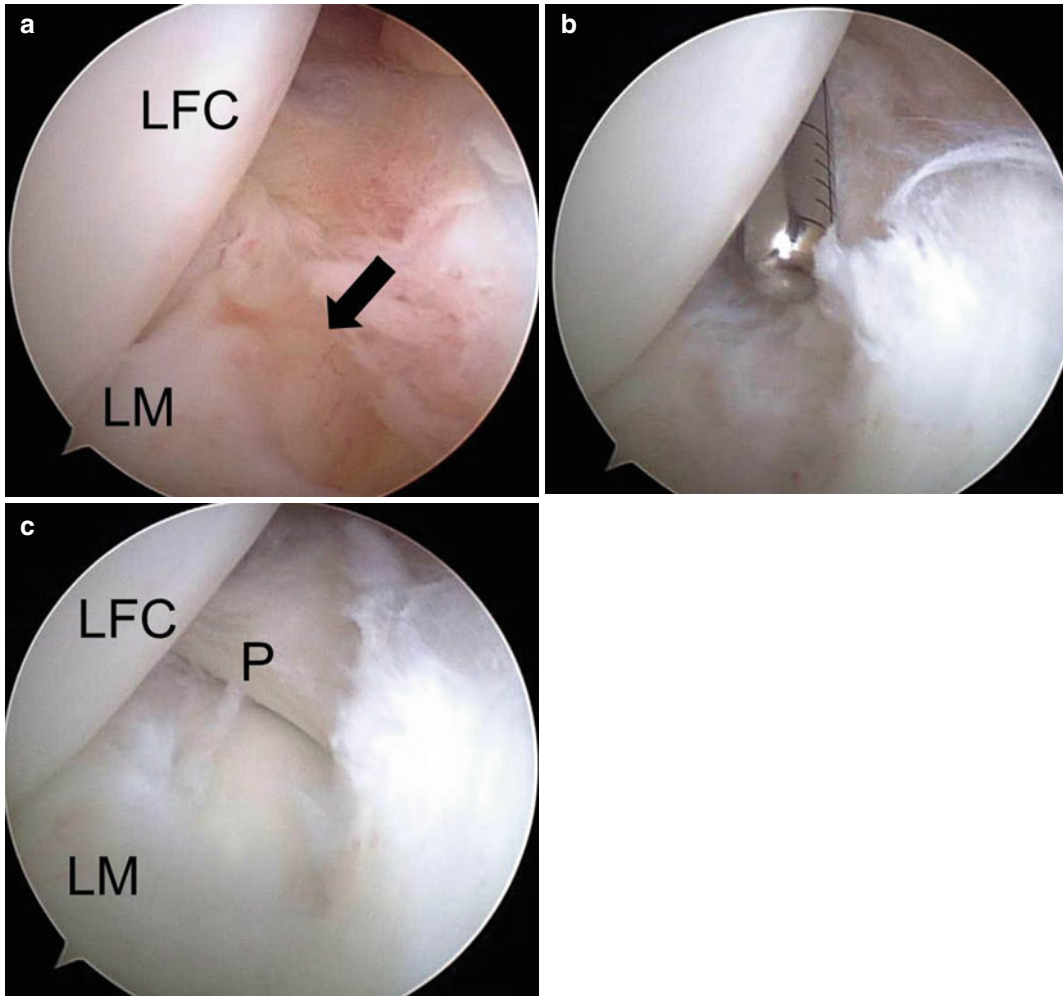


Fig. 25.16 (**a**) The 70° arthroscope inserted from the antero-medial portal to the posterolateral compartment shows the longitudinal tear of posterior horn of lateral meniscus (*arrow*). (**b**, **c**) A shaver or rasp is introduced through the posterolateral portal without a cannula for debridement of both sides of the tear (*LFC* lateral femoral condyle, *LM* lateral meniscus, *P* popliteus tendon)

PL portal and used to pierce the peripheral rim of the meniscus at the capsular side from the superior to the inferior surface in the same manner. After both ends of the 2-0 MAXON are pulled out with a suture retriever through the PL portal, the superior end of the suture is marked with a straight haemostat. The inferior ends of the PDS and MAXON are held together and pulled out simultaneously through the PL portal using a suture retriever without soft tissue interposition between both ends. In doing so, any soft tissue (such as joint capsule or fat) entrapped between the sutures can be extracted. Next, the inferior end of the 2-0 MAXON is tied to the inferior end of PDS and the haemostat holding the superior end of the MAXON wire is then pulled. The PDS is passed through both sides of the meniscal tear and the MAXON wire is changed to a No. 0 PDS from the tibial to the femoral surface. Both ends of the PDS are held together and simultaneously pulled through the PL portal using a suture retriever. The SMC (Samsung Medical Center) knot is made outside and slipped inside the joint using a knot pusher through a previously inserted cannula in the PL portal. Depending on the size of a tear, additional sutures can be performed.

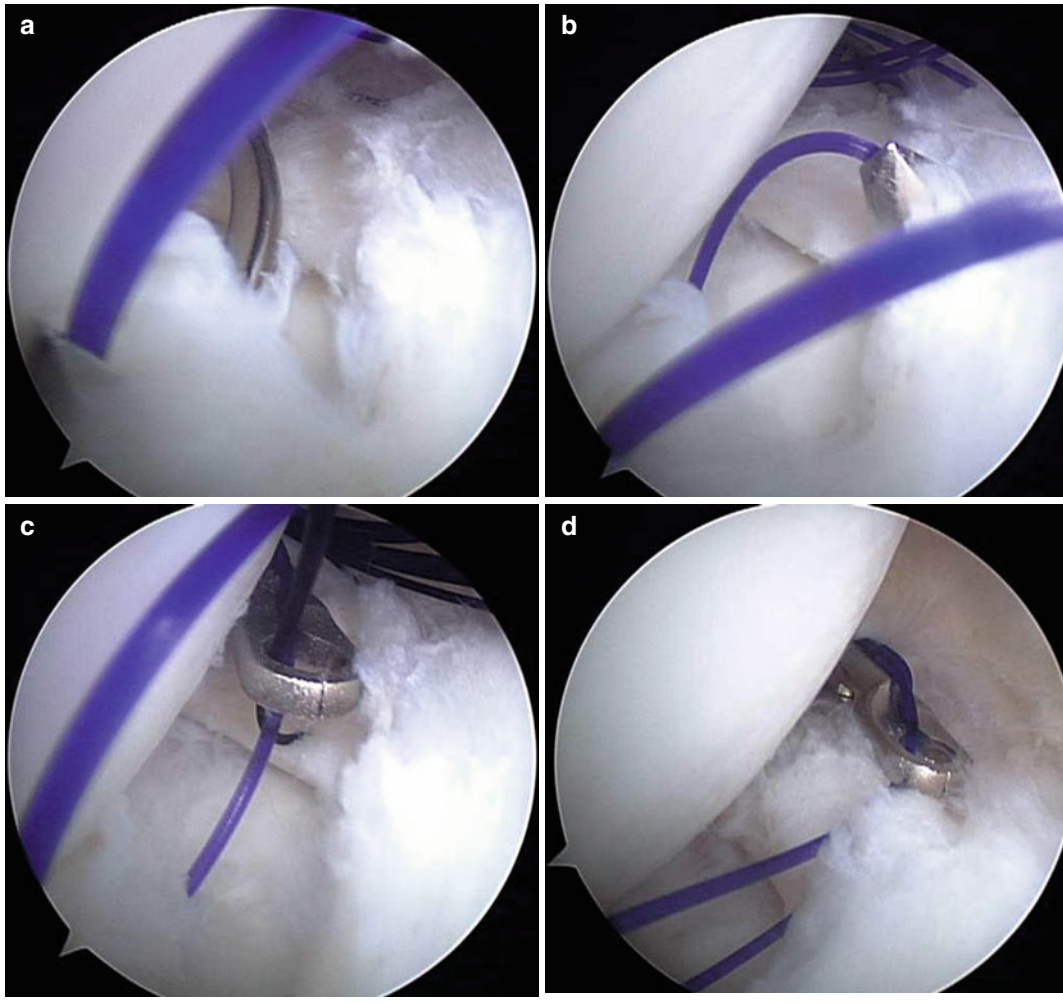


Fig. 25.17 (**a**) The 70° arthroscope shows a suture passage made starting from the inner tear penetrating the most central fragment from inferior to superior. (**b**) After passing the PDS suture, (**c**, **d**) both ends of PDS are held together and retrieved at the same time through the posterolateral portal using a suture retriever

Usually 2-3 sutures are adequate for repair of longitudinal tears in the LMPH.

25.3.6 Postoperative Care

The protocol for postoperative rehabilitation follows guidelines similar to those advocated for rehabilitation after ACL (ligamentous) reconstruction of the knee. The knee is immobilized in a full extension brace for 2 weeks. The affected knee joint is permitted gradual range of motion, which is initiated with a range of motion/limited-motion brace, in which at least 90° of flexion is expected to be achieved during a 4- and 6-week postoperative period. Squatting, or deep flexion, greater than 120°, which places the repair site at risk for re-tear, is restricted for at least 8 weeks following the repair. Patients are also restricted for 6 months from sport activities that include jumping, cutting, or twisting manoeuvres. Crutches are used full time for the first 4 weeks postoperatively to protect the repair site from loading. Patients are allowed to initiate full weight bearing by the 6th postoperative week.

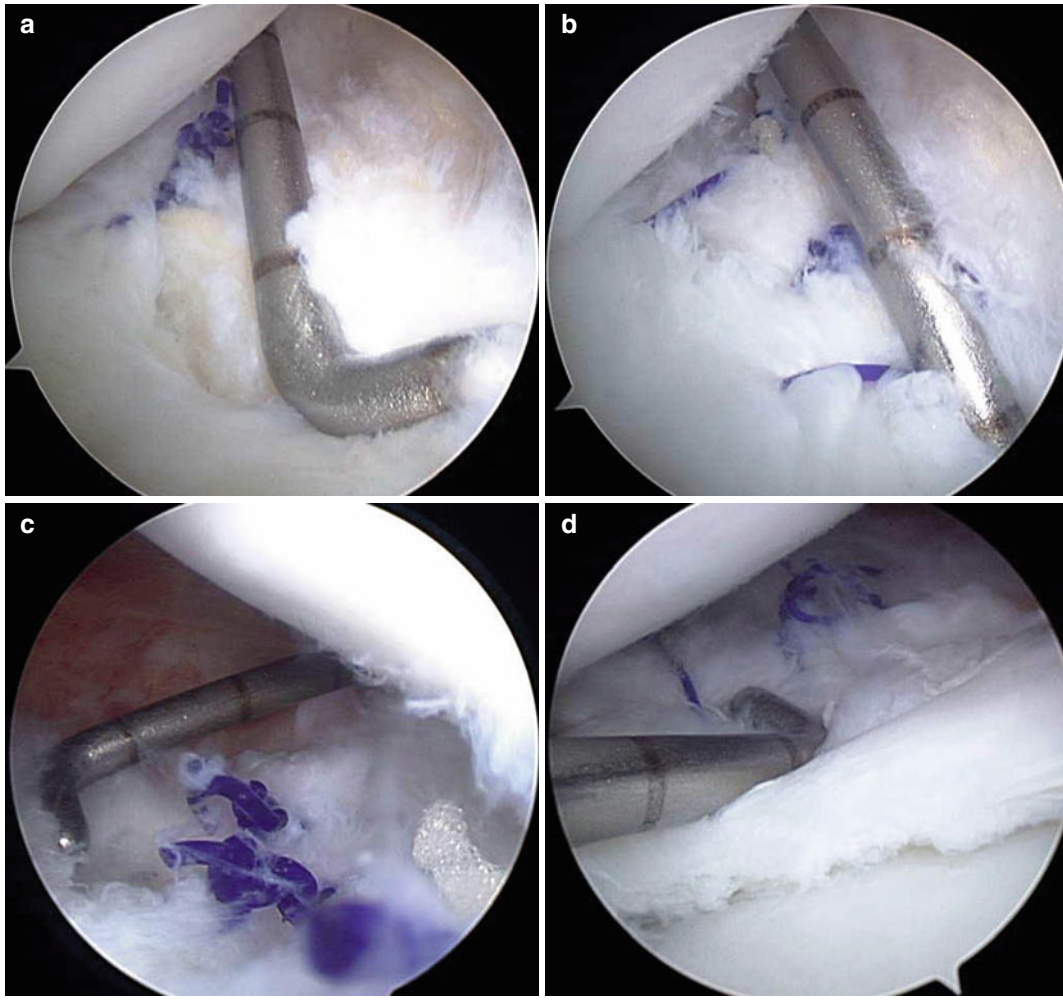


Fig. 25.18 (**a**) The 70° arthroscope shows vertical sutures at the longitudinal tear of the posterior horn of lateral meniscus. (**b**) And then, 2 more stitches are performed with the same technique. (**c**) The 30° arthroscope, inserted from posterolateral portal and (**d**) anterolateral portal, also shows anatomic coaptation of the lateral meniscus posterior horn tear with three vertical sutures

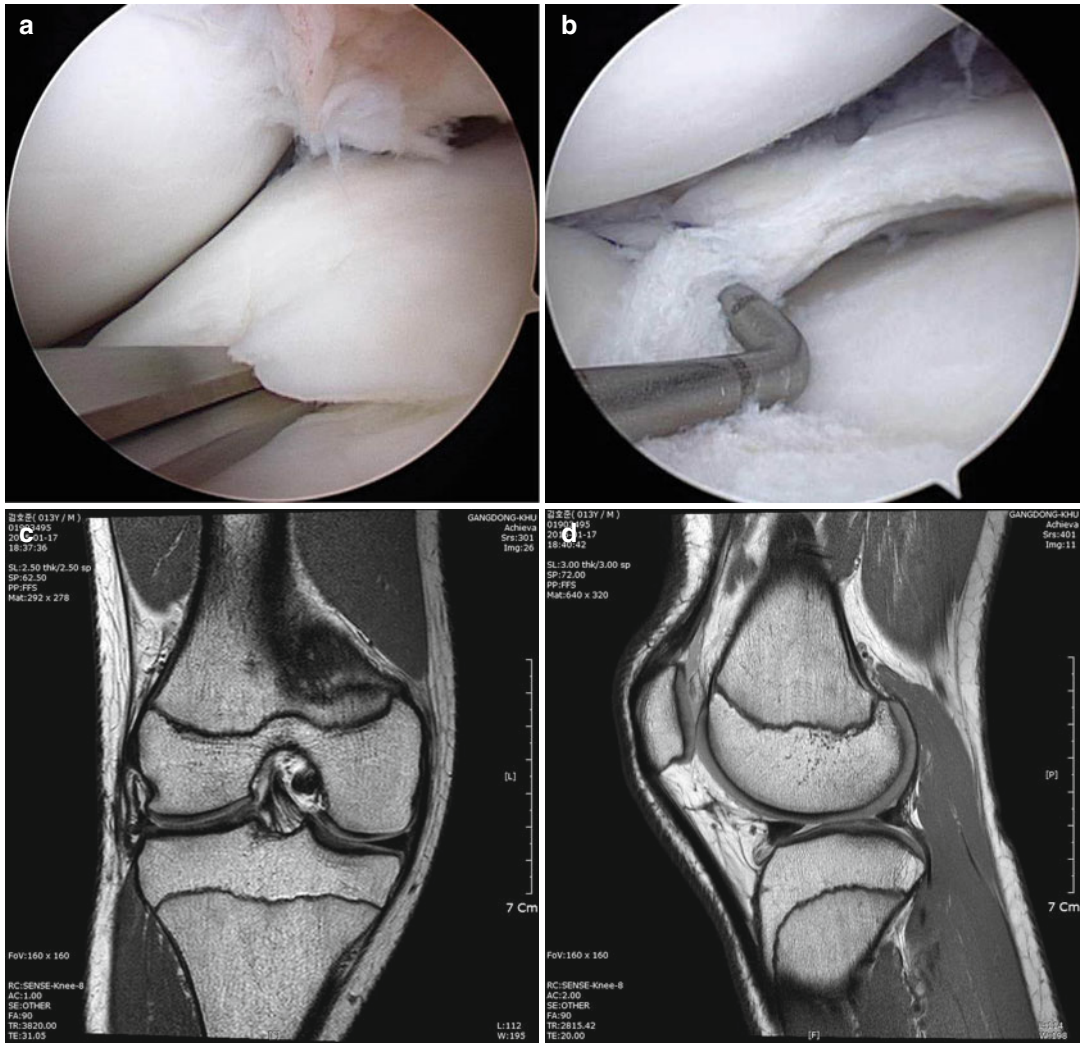


Fig. 25.19 (**a**, **b**) Discoid meniscus is managed with partial central meniscectomy using Iris scissor; a tear between the meniscus and the posterior capsule was closed after tying 3 all-inside sutures. The width of the medial meniscus can be measured with a probe. (**c**, **d**) Coronal and sagittal magnetic resonance imaging shows complete healing of the tear site with a lateral meniscus of normal shape at 6 months follow-up

References

1. Young R (1889) The external semilunar cartilage as a complete disc. In: Cleland J, Mackey J, Young R (eds) Memoirs and memoranda in anatomy. Williams and Norgate, London, p 179
2. Barthel T, Pesch R, Lippert M, Lutz G (1995) Artroskopischen Behandlung des lateralen Scheibemeniskus. Arthroskopie 8:12–18
3. Ikeuchi H (1982) Arthroscopic treatment of the discoid lateral meniscus. Technique and long-term results. Clin Orthop Relat Res 167:19–28
4. Rao PS, Rao SK, Paul R (2001) Clinical, radiologic, and arthroscopic assessment of discoid lateral meniscus. Arthroscopy 17:275–277
5. Kocher MS, Klingele K, Rassman SO (2003) Meniscal disorders: normal, discoid, and cysts. Orthop Clin North Am 34:329–340
6. Smillie IS (1948) The congenital discoid meniscus. J Bone Joint Surg Br 30:671–682
7. Dickhaut SC, DeLee JC (1982) The discoid lateral-meniscus syndrome. J Bone Joint Surg Am. 64:1068–1073 1982. PMID: 7118974
8. Kelly BT, Green DW (2002) Discoid lateral meniscus in children. Curr Opin Pediatr 14:54–61. PMID: 11880735

9. Klingele KE, Kocher MS, Hresko MT et al (2004) Discoid lateral meniscus: Prevalence of peripheral rim instability. J Pediatr Orthop 24:79–82. PMID: 14676539
10. Tachibana Y, Yamazaki Y, Ninomiya S (2003) Discoid medial meniscus. Arthroscopy 19:E12–E18
11. Ahn JH, Lee SH, Yoo JC, Lee HJ, Lee JS (2010) Bilateral discoid lateral meniscus in knees: evaluation of the contralateral knee in patients with symptomatic discoid lateral meniscus. Arthroscopy J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc 26(10):1348–1356, S0749-8063(10)00177-5 [pii]
12. Bae JH, Lim HC, Hwang DH, Song JK, Byun JS, Nha KW (2012) Incidence of bilateral discoid lateral meniscus in an Asian population: an arthroscopic assessment of contralateral knees. Arthroscopy J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc 28(7):936–941. doi:10.1016/j.arthro.2011.12.003
13. Watanabe M, Takada S, Ikeuchi H (1969) Atlas of arthroscopy. Igaku-Shoin, Tokyo
14. Ogut T, Kesmezacar H, Akgun I, Cansu E (2003) Arthroscopic meniscectomy for discoid lateral meniscus in children and adolescents: 4.5 year follow-up. J Pediatr Orthop B 12:390–397
15. Atay OA, Doral MN, Leblebicioglu G, Tetik O, Aydingoz U (2003) Management of discoid lateral meniscus tears: observations in 34 knees. Arthroscopy 19:346–352
16. Kim YG, Ihn JC, Park SK et al (2006) An arthroscopic analysis of lateral meniscal variants and a comparison with MRI findings. Knee Surg Sports Traumatol Arthrosc 14:20–26. PMID: 15905996
17. Mizuta H, Nakamura E, Otsuka Y et al (2001) Osteochondritis dissecans of the lateral femoral condyle following total resection of the discoid lateral meniscus. Arthroscopy 17:608–612. PMID: 11447548
18. Singh K, Helms CA, Jacobs MT et al (2006) MRI appearance of Wrisberg variant of discoid lateral meniscus. AJR Am J Roentgenol 187:384–387. PMID: 16861542
19. Gicquel P, Sorriaux G, Clavert JM, Bonnomet F (2005) Discoid menisci in children: clinical patterns and treatment in eighteen knees. Rev Chir Orthop 91:457–464
20. Raber DA, Friederich NF, Hefti F (1998) Discoid lateral meniscus in children. Long-term follow-up after total meniscectomy. J Bone Joint Surg Am 80:1579–1586
21. Washington ER 3rd, Root L, Liener UC (1995) Discoid lateral meniscus in children. Long-term follow-up after excision. J Bone Joint Surg Am 77:1357–1361
22. Aglietti P, Bertini FA, Buzzi R, Beraldi R (1999) Arthroscopic meniscectomy for discoid lateral meniscus in children and adolescents: 10-year follow-up. Am J Knee Surg 12:83–87
23. Vandermeer RD, Cunningham FK (1989) Arthroscopic treatment of the discoid lateral meniscus: Results of long-term follow-up. Arthroscopy 5:101–109. PMID: 2736005
24. F. Pellacci F, Montanari G, Prosperi P et al (1992) Lateral discoid meniscus: treatment and results. Arthroscopy 8:526–530. PMID: 1466716
25. Fujikawa K, Iseki F, Mikura Y (1981) Partial resection of the discoid meniscus in the child's knee. J Bone Joint Surg Br 63:391–395, PMID: 7263752
26. Fritschy D, Gonseth D (1991) Discoid lateral meniscus. Int Orthop 15:145–147. PMID: 1917190
27. Kim SJ, Lee YT, Kim DW (1998) Intraarticular anatomic variants associated with discoid meniscus in Koreans. Clin Orthop 356:202–207
28. Adachi N, Ochi M, Uchio Y et al (2004) Torn discoid lateral meniscus treated using partial central meniscectomy and suture of the peripheral tear. Arthroscopy 20:536–542. PMID: 15122147
29. Bin SI, Kim JC, Kim JM, Park SS, Han YK (2002) Correlation between type of discoid lateral menisci and tear pattern. Knee Surg Sports Traumatol Arthrosc 10(4):218–222. doi:10.1007/s00167-001-0273-8
30. Good CR, Green DW, Griffith MH, Valen AW, Widmann RF, Rodeo SA (2007) Arthroscopic treatment of symptomatic discoid meniscus in children: classification, technique, and results. Arthroscopy J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc 23(2):157–163, S0749-8063(06)01145-5 [pii]
31. Singh K, Helms CA, Jacobs MT, Higgins LD (2006) MRI appearance of Wrisberg variant of discoid lateral meniscus. AJR Am J Roentgenol 187(2):384–387
32. Ahn JH, Lee YS, Ha HC, Shim JS, Lim KS (2009) A novel magnetic resonance imaging classification of discoid lateral meniscus based on peripheral attachment. Am J Sports Med 37(8):1564–1569, 0363546509332502 [pii]
33. Ahn JH, Lee SH, Yoo JC, Lee YS, Ha HC (2008) Arthroscopic partial meniscectomy with repair of the peripheral tear for symptomatic discoid lateral meniscus in children: results of minimum 2 years of follow-up. Arthroscopy J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc 24(8):888–898, S0749-8063(08)00218-1 [pii]
34. Ahn JH, Kim KI, Wang JH, Jeon JW, Cho YC, Lee SH (2015) Long-term results of arthroscopic reshaping for symptomatic discoid lateral meniscus in children. Arthroscopy J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc. doi:10.1016/j.arthro.2014.12.012
35. Ahn JH, Choi SH, Lee YS, Yoo JC, Chang MJ, Bae S et al (2011) Symptomatic torn discoid lateral meniscus in adults. Knee Surg Sports Traumatol Arthrosc 19(2):158–164. doi:10.1007/s00167-010-1058-8
36. Ahn JH, Oh I (2006) Arthroscopic all-inside lateral meniscus suture using posterolateral portal. Arthroscopy J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc 22(5):572.e1–572.e4
37. Ahn JH, Wang JH, Yoo JC, Kim SK, Park JH, Park JW (2006) The modified outside-in suture: vertical repair of the anterior horn of the meniscus after decompression of a large meniscal cyst. Knee Surg Sports Traumatol Arthrosc 14(12):1288–1291