

Lateral Meniscus Zip Lesion of Knee: Classification and Repair Methods



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Abstract: Lateral meniscus tears at the junction of the Wrisberg ligament and posterior horn are meniscocapsular injuries often seen with injury to the anterior cruciate ligament. Such lateral meniscus posterior horn lesions have been termed zip lesions. The lateral meniscus posterior horn is the major restraint for the pivot shift maneuver. Considering the morphology of condyles, lateral meniscus preservation and repair of unstable meniscocapsular posterior tear are needed to prevent future osteoarthritis. In this Technical Note, we aim to classify zip lesions of the posterior horn of the lateral meniscus. Zip lesions are located posteriorly and often are missed on magnetic resonance imaging and routine diagnostic arthroscopy. We recommend looking from the anteromedial portal and exploring the posterolateral compartment to identify hidden zip lesions, equivalent to medial-sided ramp lesions. We describe various all-inside techniques to repair these inaccessible tears.

Lateral meniscus tears are mostly traumatic and commonly associated with anterior cruciate ligament (ACL) injury.¹ Lateral meniscal injuries associated with ACL tears are sometimes missed due to their typical clinical, morphologic, and topographic characteristics. Small-size tears, posterior location, peripheral longitudinal lesions, and assessment shortly after injury contribute to erroneous diagnosis by magnetic resonance imaging. One such lesion is the meniscocapsular separation of the posterior horn of the lateral meniscus (PHLM).

The lateral meniscus is smaller, circular, and more mobile than the medial meniscus.² The increased mobility is due to weak or no connections with the lateral collateral ligament (LCL) and very loose connections with the capsule. The popliteus hiatus bisects the posterolateral (PL) meniscocapsular junction, weakening the meniscocapsular connection.³ Meniscocapsular separation (MCS) is the detachment of the

capsule from the meniscus, which is more common on the medial side than the lateral side.⁴

The mode of injury is still debatable, but the literature supports similarities with the mechanism of ACL tears. During an ACL tear, anterior tibial translation occurs, and the anterior part of PHLM moves anteriorly. The posterior part of PHLM remains in its place due to traction on the ligament of Wrisberg, which abuts against the posterior cruciate ligament and tears the longitudinal fragment of the lateral meniscus like the opening of a zip, therefore termed as “zip sign” or zip lesion. Zip lesions (Wrisberg rip, zipper tear) are longitudinal vertical/oblique meniscal tears at the junction of the Wrisberg ligament and the lateral meniscus posterior horn. The tear must extend more than 1.4 cm in the mediolateral direction from the lateral edge of posterior cruciate ligament.⁵ Zip lesion is equivalent to the medial-sided ramp lesion. Although various techniques, classification, and biomechanical studies have been described for the ramp, similar literature is lacking for the zip lesions.

Clinical examination of the knee remains inconclusive for PL MCS and zip lesion. The positive predictive values of identifying MCS with magnetic resonance imaging are low, with 9% for the medial meniscus and 13% for the lateral meniscus. The diagnosis is challenging, and the literature available is so naive questions arise over its classification and management. Therefore, the routine diagnostic exploration of the PL compartment during ACL reconstruction will help to

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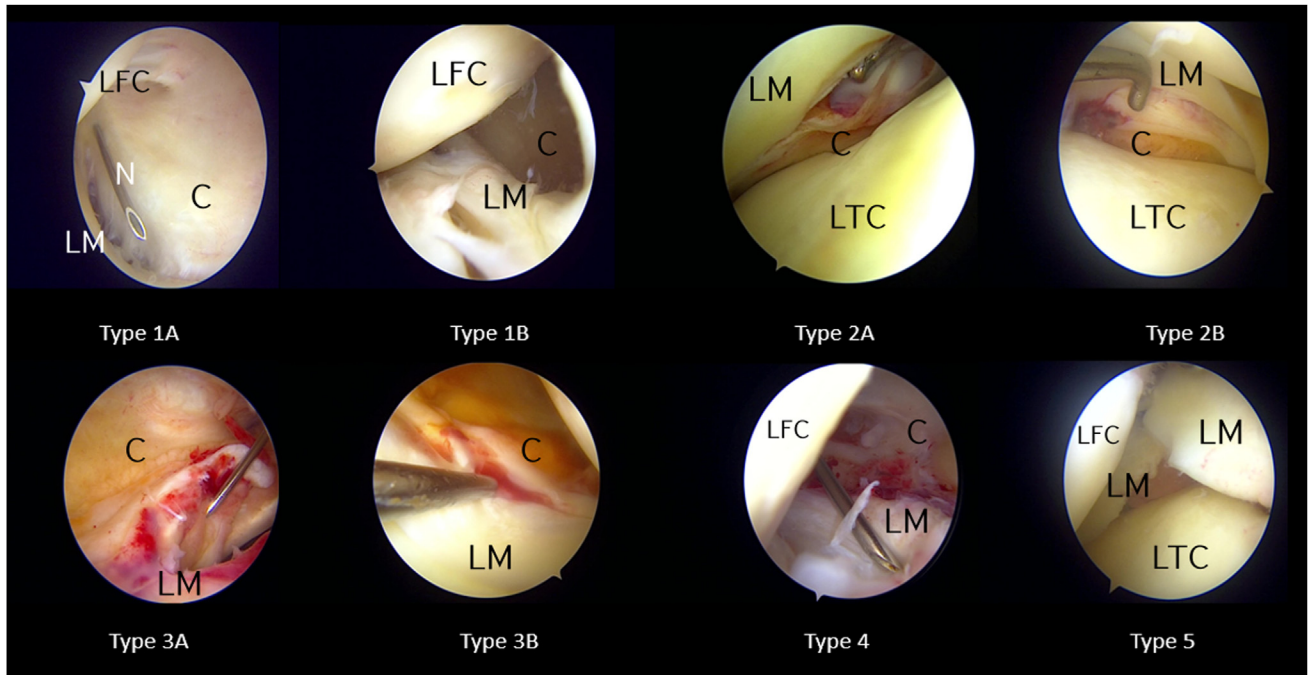


Fig 1. Knee in 90 degree of flexion, viewing from anteromedial portal, classification of lateral meniscus zip tear into type 1A: partial superior meniscocapsular tear of the right knee; type 1B: partial superior peripheral posterior horn meniscus tear of the right knee within 1 to 3 mm; type 2A: partial inferior meniscocapsular tear of the left knee; type 2B: partial inferior peripheral posterior horn meniscus tear of the left knee within 1 to 3 mm; type 3A: complete meniscocapsular tear of the left knee; type 3B: complete peripheral posterior horn meniscus tear of the left knee within 1 to 3 mm; type 4: double tear of the right knee, tear of peripheral meniscus along with meniscocapsular tear; and type 5: radial tear of the right knee: radial tear and meniscocapsular separation give a T shape. (C, capsule; LFC, lateral femoral condyle; LM, lateral meniscus; LTC, lateral tibial condyle; N, needle.)

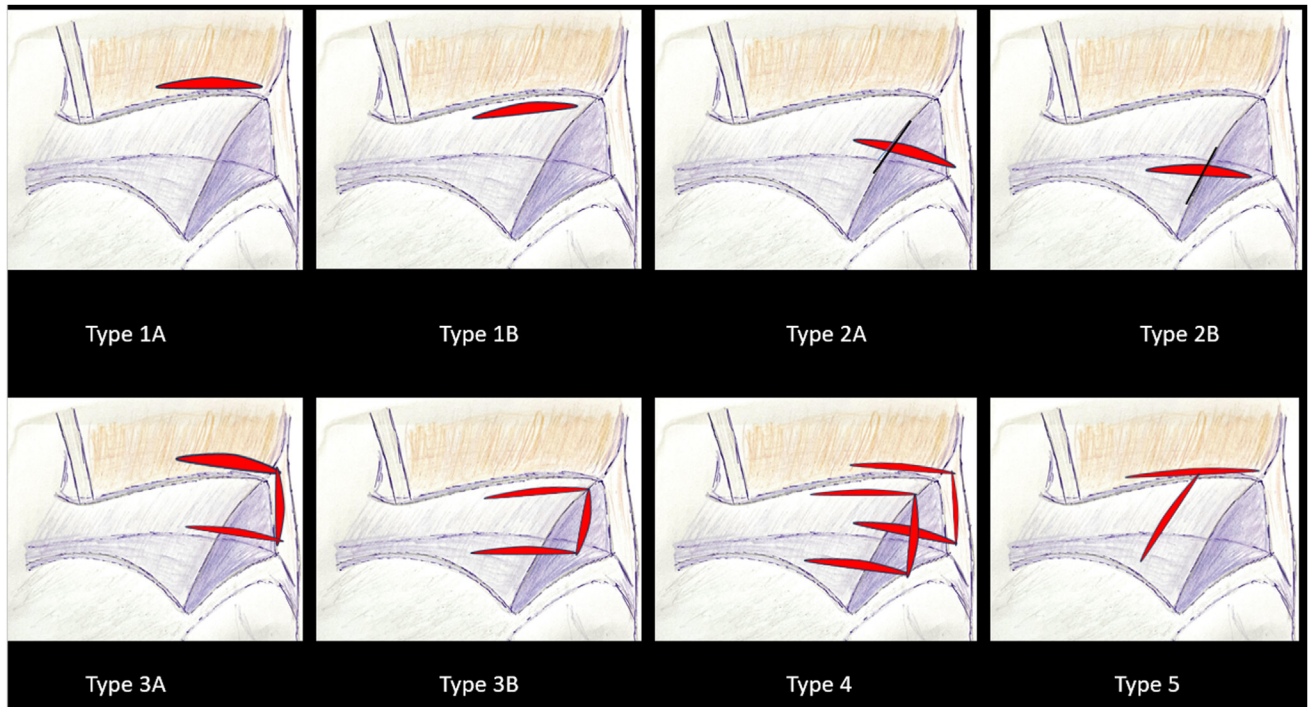


Fig 2. Schematic representation of zip classifications type 1 to type 5.

Table 1. Classification of Zip Lesions

Type	Subtype	Morphology	Identification
Type 1 Partial superior	Type 1A	Partial superior meniscocapsular tear	View: AM portal Probe: PL portal
	Type 1B	Partial superior peripheral posterior horn meniscus tear; within 1-3 mm	View: AL portal Probe: AM portal Press the meniscus down to identify
Type 2 Partial inferior	Type 2A	Partial inferior meniscocapsular tear	View: AL portal Probe: AM portal Lift the meniscus to identify.
	Type 2B	Partial inferior peripheral posterior horn meniscus tear; within 1-3 mm	View: AL portal Probe: AM portal Lift the meniscus to identify.
Type 3 Complete	Type 3A	Complete meniscocapsular tear	View: AM portal Probe: PL portal
	Type 3B	Complete peripheral posterior horn meniscus tear within 1-3 mm	View: AL portal Probe: AM portal
Type 4 Double tear		Double tear: tear of peripheral meniscus along with meniscocapsular tear	View: AL portal Probe: AM portal
Type 5 Radial		T-shape tear; radial tear along with meniscocapsular separation giving T shape appearance	View: AL portal Probe: AM portal

AL, anterolateral; AM, anteromedial; PL, posterolateral.

identify the zip lesions. During arthroscopy, we routinely probe the superior and inferior surfaces of the meniscus. Also, we regularly place our scope in the anteromedial (AM) portal to visualize the PL compartment and needle probing to identify zip lesions.

In this Technical Note, we propose the classification and repair methods for zip lesions (Figs 1 and 2, Table 1). This classification includes lateral meniscus posterior horn, meniscocapsular separation, and tears behaving similarly within 1 to 3 mm anterior from the meniscocapsular junction.

Surgical Technique (With Video Illustration)

Positioning

The patient is placed supine, and the knee is in 90° of flexion at the table's edge (Fig 3). A thigh support and tourniquet are placed high on the thigh. Using an aseptic sterile technique, the operative site is prepared, draping is done, and a tourniquet is inflated.

Operative Steps

Arthroscopy and Portal Placement

The anterolateral (AL) portal is made next to the patellar tendon at the level of the inferior pole of the patella. A second AM portal is made 1 cm above the joint line and 1 cm medial to the patellar tendon. A figure of 4 position is made to identify lateral meniscus zip lesion. Diagnostic arthroscopy is done, the probe is inserted from the AM portal, and the lateral meniscus is palpated superiorly and inferiorly to identify the zip lesion. While probing on the superior surface, pressing the meniscus down can help to identify complete type 3B tears (Fig 3). Undersurface type 2 tears are identified

by lifting the lateral meniscus by the probe (Fig 4). Then, the scope is shifted in the AM portal, and entry is made between the ACL and lateral femoral condyle to enter the PL compartment. In cases in which the ACL is already torn, this exploration is relatively easy, and the zip lesion, if present, can be seen very clearly. Once in the PL compartment, an 18-gauge spinal needle is placed anterior to the biceps and proximal and posterior to the LCL. Transillumination can help to put the spinal needle, which is used as a probe to palpate the meniscocapsular junction. This method best identifies type 1A and B, type 3A, and type 4 tears (Fig 5 and 6).

Usually, superior surface type 1A and B tears are stable and can be left alone, whereas type 2 tears and complete type 3 tears, which are unstable on probing,

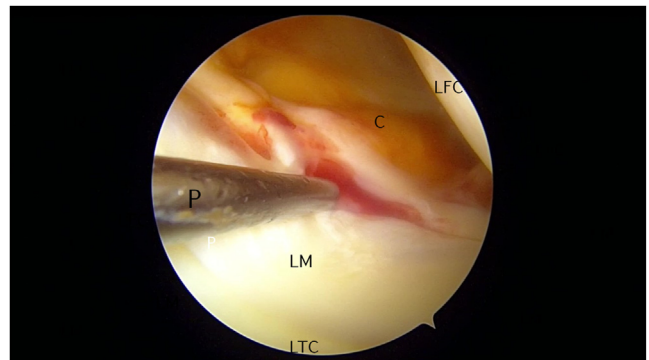


Fig 3. Left knee, a figure of 4 position, visualization from the anterolateral portal, probe from the anteromedial portal, showing complete posterior horn lateral meniscus tear within 3 mm from meniscocapsular junction indicating type 3B. (C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; P, probe.)

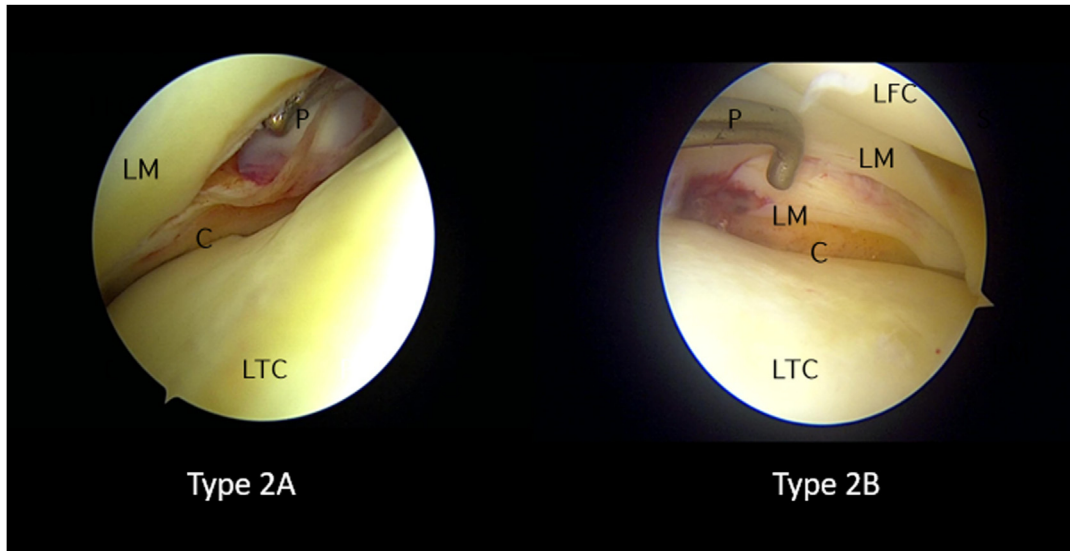


Fig 4. Type 2A: right knee, a figure of 4 position, visualization from the anterolateral portal, probe from the anteromedial portal, showing inferior surface posterior horn lateral meniscus tear at meniscocapsular junction indicating type 2A. Type 2B: left knee, a figure of 4 position, visualization from the anterolateral portal, probe from the anteromedial portal, showing inferior surface posterior horn lateral meniscus tear within 3 mm of meniscocapsular junction indicating type 2B. (C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; P, probe.)

will require repair. Type 4 and 5 (Fig 7 and 8) are inherently unstable and need repair. Various surgical techniques can be used to repair zip lesions. Depending on the accessibility of the tear, location, and size, one of the methods described in the sections to follow can be chosen.

All-Inside Repair Using Implant Devices

Looking from the AL portal and figure of 4 position, probing is done from the AM portal to see the extent of the tear. The scope is shifted to the AM portal, and instruments are passed from the AL portal. The diamond rasp is now passed from the AL portal to enhance

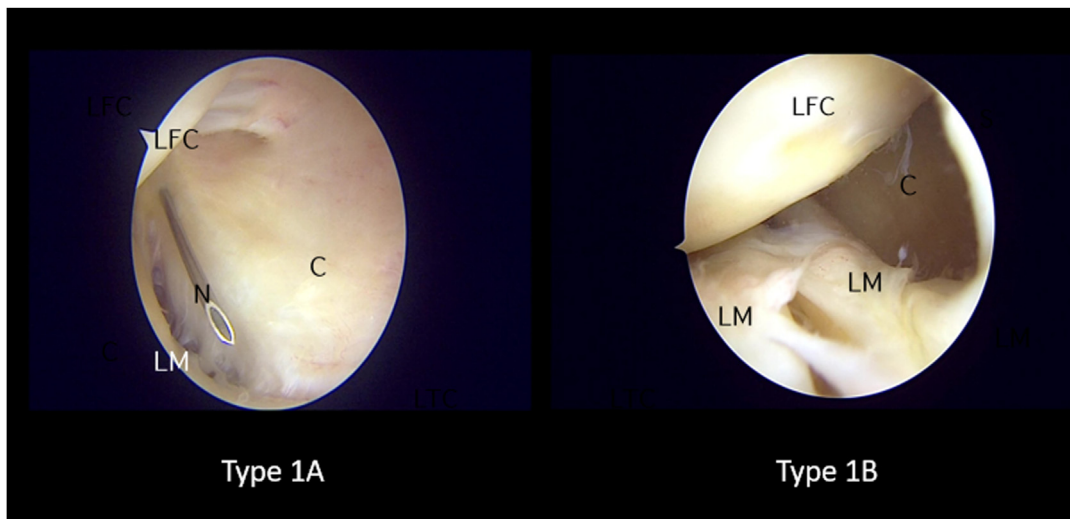


Fig 5. Type 1A: Right knee, knee in 90° of flexion, visualization from the anteromedial portal, needle from the posterolateral portal, showing superior surface posterior horn lateral meniscus tear at meniscocapsular junction indicating type 1A. Type 1B: Right knee, knee in 90° of flexion, visualization from the anteromedial portal, needle from the posterolateral portal, showing superior surface posterior horn lateral meniscus tear within 3 mm from meniscocapsular junction indicating type 1B. (C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; N, needle.)

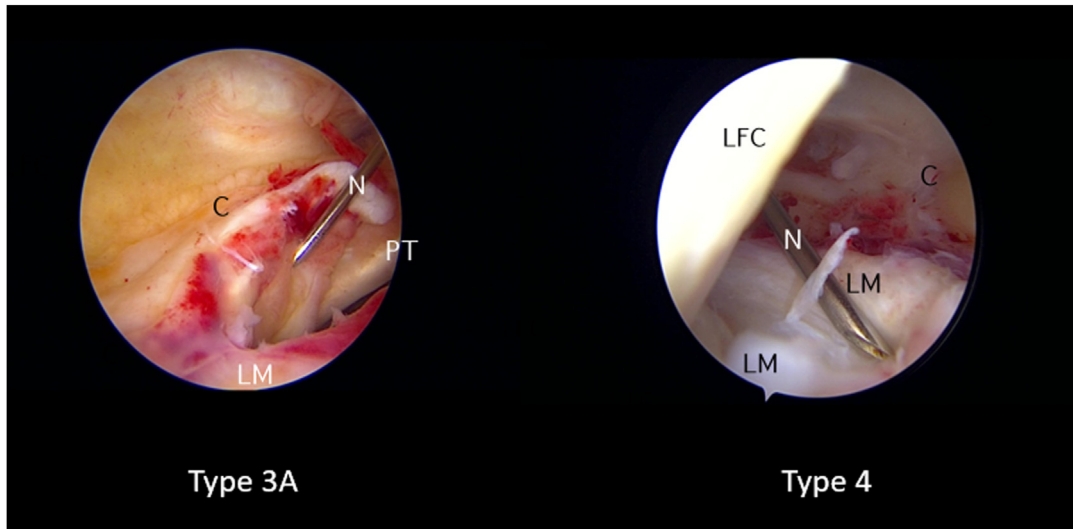


Fig 6. Type 3A: left knee, knee in 90° of flexion, visualization from the anteromedial portal, needle from the posterolateral portal, showing complete posterior horn lateral meniscus tear at meniscocapsular junction indicating type 3A with exposed popliteal tendon and sulcus. Type 4: right knee, knee in 90° of flexion, visualization from the anteromedial portal, needle from the posterolateral portal, showing complete meniscocapsular posterior horn lateral meniscus tear and complete tear within 3 mm from meniscocapsular junction; double tear indicating type 4. (C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; N, needle; PT, popliteus tendon.)

healing. A protection sleeve for passing all-inside repair devices is placed in the AL portal. This portal provides a better trajectory for repairing complete type 3B tears. A curved SureStich (Sironix Medtech, Bengaluru, Karnataka, India), set at a depth limit of 16 mm, is passed through the posterior portion of the meniscus tear, and the first implant is deployed. This is followed by passing the device needle through the anterior part of the meniscus to create a vertical mattress configuration. Then, the free end of the suture is pulled to reduce and repair the meniscus tear. The suture is cut flush with a

suture cutter. Depending on the tear length, further devices can be used to repair the meniscus (Fig 9).

All-Inside Repair Using Posterior SutureLasso

With the knee in 90° of flexion, the scope is in the AM portal, and entry is made between the ACL and lateral femoral condyle to enter the PL compartment. Once in the PL compartment, an 18-gauge spinal needle is placed anterior to the biceps and proximal and posterior to the LCL. A spinal needle is placed in such a way as to be parallel and just above the meniscocapsular area for

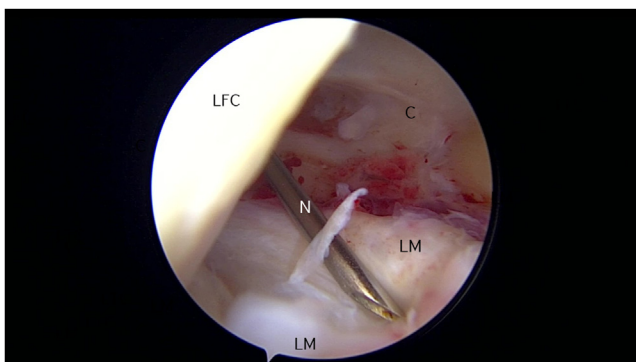


Fig 7. Right knee, knee in 90° of flexion, visualization from the anteromedial portal, needle from the posterolateral portal, showing complete meniscocapsular posterior horn lateral meniscus tear and complete tear within 3 mm from meniscocapsular junction; double tear indicating type 4. (C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; N, needle.)

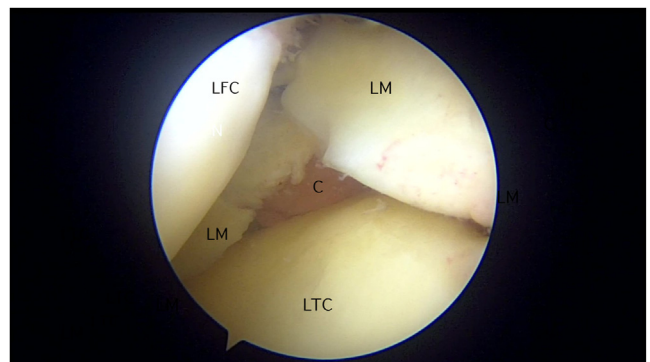


Fig 8. Right knee, a figure of 4 position, visualization from the anterolateral portal, probe from the anteromedial portal, showing posterior horn lateral meniscus tear at meniscocapsular junction and radial tear of meniscus giving T-shaped appearance indicating type 5. (C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle.)

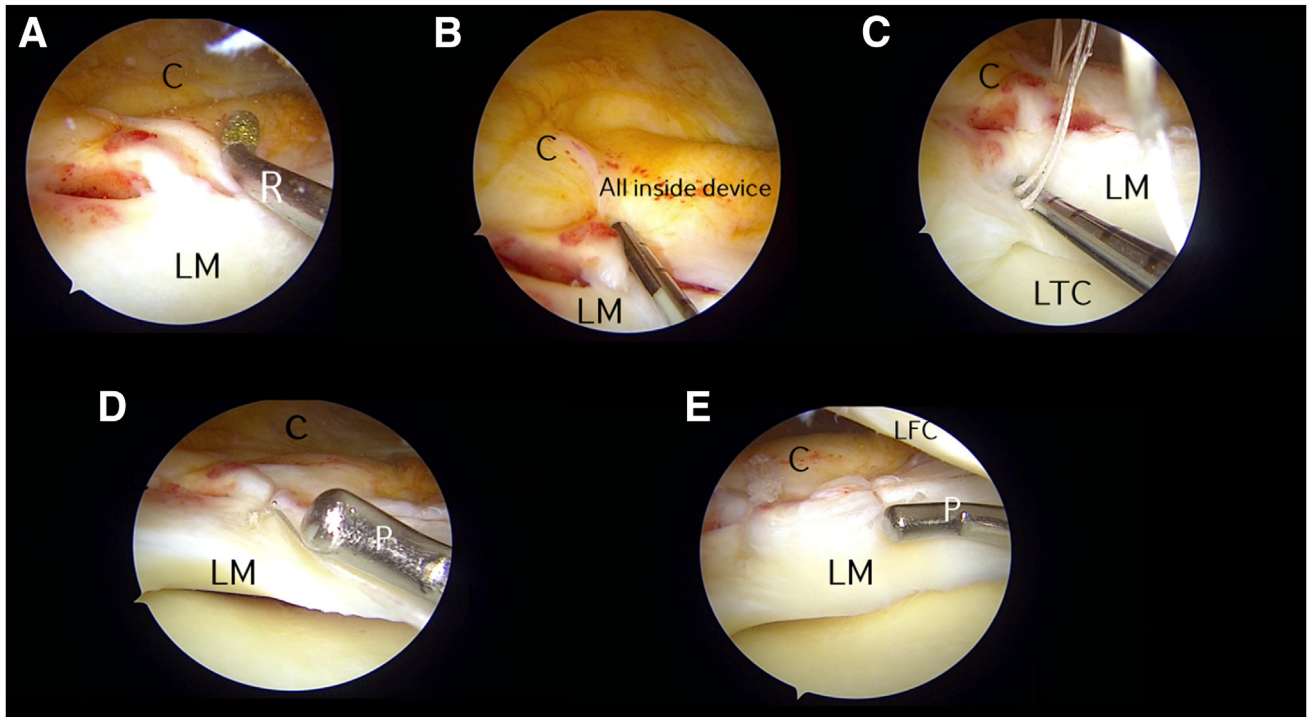


Fig 9. Left knee, a figure of 4 position, visualization from the anteromedial portal, instruments from the anteromedial portal, showing posterior horn lateral meniscus tear. (A) Looking from the AM portal, rasp is coming from the AL portal, and meniscus tear is rasped. (B) Looking from the AM portal, SureStich all inside devices coming from the AL portal, and the bite is taken on the capsular side. (C) Looking from the AM portal, SureStich all inside device coming from AL portal, and the bite is taken on the meniscus side. (D) Looking from the AM portal, the probe is coming from the AL portal, and the suture is pulled to repair the lateral meniscus. (E) Looking from the AM portal, the probe is coming from the AL portal, and the lateral meniscus is probed after repair with 3 all inside the SureStich device (AL, anterolateral; AM, anteromedial; C, capsule; LFC, lateral femoral condyle; LM, lateral meniscus; LTC, lateral tibial condyle; R, rasp.)

better instrument passage. After removing the needle, the PL is made, and the PassPort Cannula (Arthrex, Naples, FL) is passed. Rasping is done from the PL portal, and the curved SutureLasso (Arthrex) is passed first from the capsular side and then from the meniscal side. The preloaded suture is removed from the PL portal, and 2-0 FiberWire (Arthrex) is tied onto it to relay through the meniscus. Before tying, the first set of passed sutures is parked in the AL portal. This step ensures that further passage of the suture lasso device is easy. The same step is repeated to pass one more suture through the meniscus. This suture is tied from the PL portal using alternate half hitches, knot tying is completed, and sutures are cut. The first set of sutures is now retrieved from the AL portal to the PL portal. Again, alternate half hitches knot tying is done, and a probe is used from this portal to check the final stability of the repair (Fig 10).

All-Inside Repair Using Anterior Antegrade Suture Passage With the Knee Scorpion Device

Looking from the AL portal and figure of 4 position, probing is done from the AM portal to see the extent of the tear. A PassPort Cannula (Arthrex) is placed

through the AM portal to avoid soft tissue while tying knots. An additional central portal is made just below the lower pole of the patella for suture management. A Knee Scorpion (Arthrex) loaded with 2-0 FiberWire is passed from the AM portal to pass below the meniscus and to grasp the full thickness of the meniscus posterior to the tear. Then, the needle is triggered, passing FiberWire through the meniscus's full thickness. As the Scorpion is self-retrieving, the suture passage device suture will come out from the AM portal; now, it is unloaded from the scorpion. FiberWire, which has come out of the superior surface of the meniscus, is retrieved from the central portal and parked there. Another end of the FiberWire is mounted again on the scorpion device. It is passed from the AM portal to grasp total meniscus thickness anterior to tear, and the needle is triggered again. This will pass FiberWire through both meniscus surfaces anterior to the tear and get retrieved through the AM portal. Now, the suture parked in the central portal is taken in the AM portal. Knot-tying is done using alternate half hitches (Fig 11). This repair technique creates a vertical mattress circumferential pattern, avoiding the need for additional undersurface sutures. Further stitches can be placed depending on

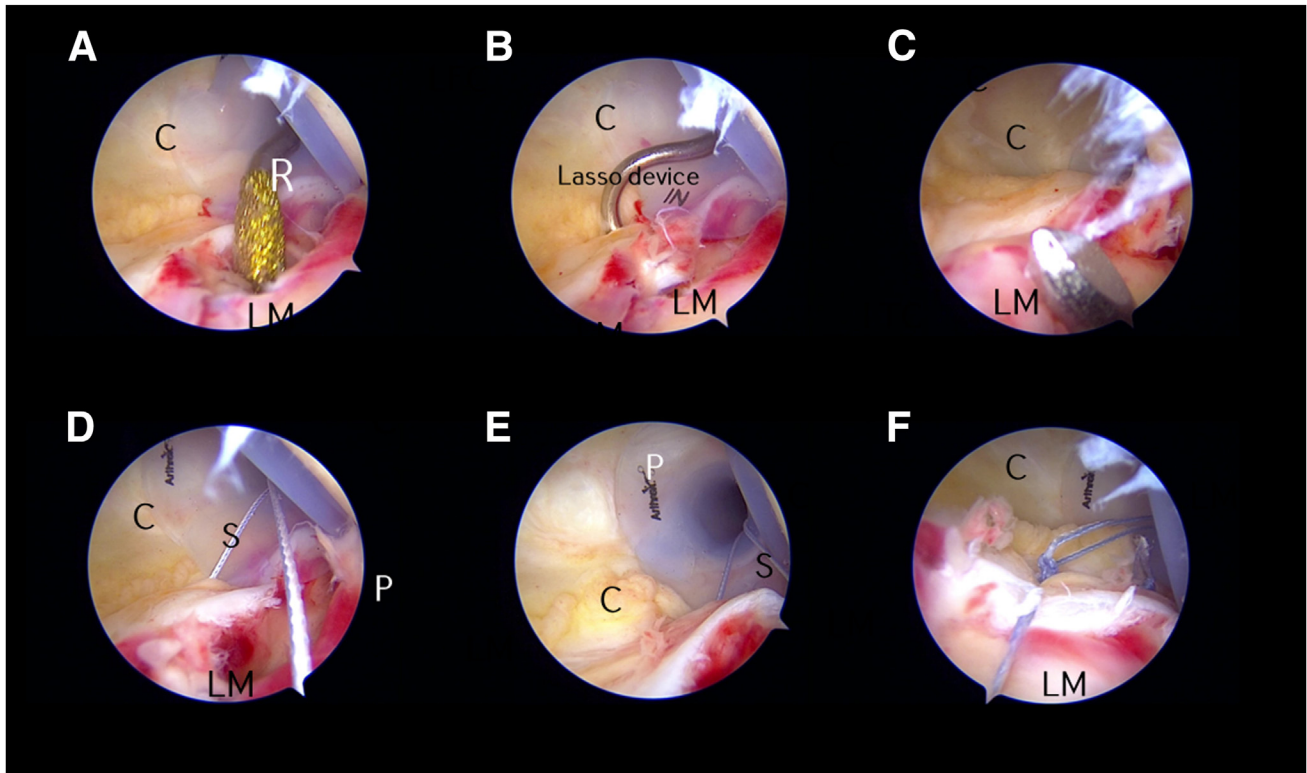


Fig 10. Left knee, knee in 90° of flexion, visualization from the anteromedial portal having passport cannula through it, showing complete posterior horn lateral meniscus tear (A) Looking from the AM portal, rasp is coming from the PL portal, and meniscus tear is rasped. (B) Looking from the AM portal, the SutureLasso device is coming from the PL portal, and the bite is taken on the capsular side. (C) Looking from the AM portal, the SutureLasso device is coming from the PL portal, and the bite is taken on the meniscus side. (D) Looking from the AM portal, a passport is from the PL portal, and the FiberWire suture is relayed to repair the lateral meniscus. (E) Looking from the AM portal, the second set of sutures are seen passed through the meniscus. (F) Looking from the AM portal, the second set of sutures is tied to repair the meniscus, and the first set is tied to repair the posterior horn type 3A tear. (AL, anterolateral; AM, anteromedial; C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; P, PassPort cannula; R, rasp.)

the length of the tear. A Shoulder Scorpion can be used if the Knee Scorpion cannot negotiate the entire width of the lateral meniscus, particularly if the tear is very posterior.

Postoperative Rehabilitation

From the next day, quadriceps tightening, ankle pumping, and active straight leg raise exercises are advised. Toe-touch weight-bearing and passive range of motion up to 45° are permitted in the first 2 weeks. From the second to fourth week, 0 to 90° of motion with partial weight-bearing is allowed. After 4 weeks, full weight-bearing is allowed. At 6 to 8 weeks, a full range of motion is started. Squatting is allowed after 6 months. Return to sports activities is permitted after nine months.

Discussion

Lateral meniscus tears alter the knee biomechanics and lead to progressive lateral compartment arthrosis.⁶ Failure to diagnose posterior lateral meniscus zip lesion

or inadequate repair may lead to loss of concomitant ACL reconstruction.⁷ Systemic arthroscopic exploration of the PL compartment is essential for identifying these hidden lesions.⁸ Stable repair for this lesion is necessary to prevent further tear progression.⁹ The PHLM is a crucial area for which is challenging due to limited posterior space and proximity of neurovascular structures.¹⁰

Various techniques available for meniscus repair are mainly inside-out, outside-in, and all-inside. Considering the zip is a PL meniscus lesion, the outside and inside-out technique is not convenient to repair at this location.^{11,12} Therefore, we prefer all-inside techniques, which can be done using all-inside devices,¹³ Knee Scorpion,¹⁴ and the PL suture hook method.¹⁵

Among the 3 techniques, the preferred technique is based on tear size, location, and type. Of the 3, our preferred method is the all-inside suture hook method from the PL portal, as its outcomes are similar and comparable with other techniques, with better vision and less risk of neurovascular structures.¹⁶ Advantages

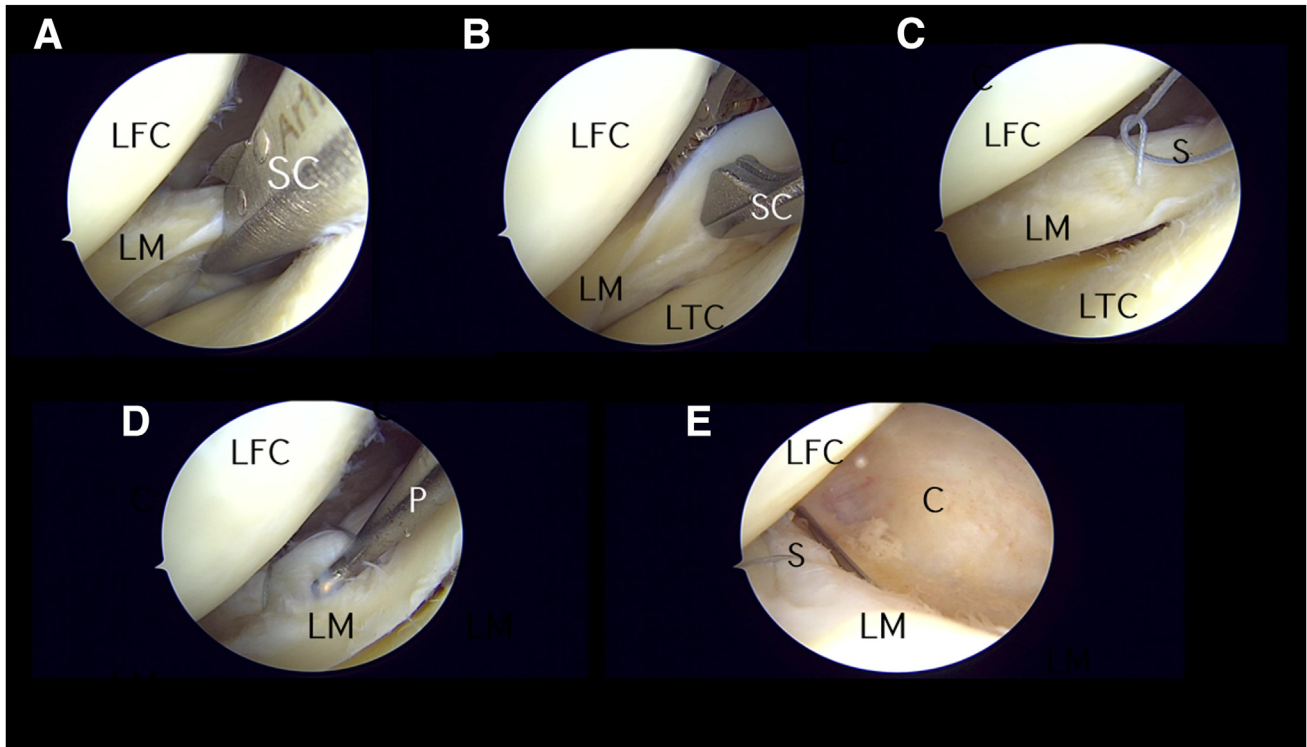


Fig 11. Right knee, a figure of 4 position, visualization from the anterolateral portal, instruments from the anteromedial portal (A) Looking from the AL portal, the Scorpion, loaded with FiberWire 2-0, comes from the AM portal, and the bite is taken on the capsular side. (B) Looking from the AL portal, the Scorpion comes from the AM portal, and the bite is taken on the meniscus side. (C) Looking from the AL portal, the knot pusher comes from the AM portal, and the suture is tied to repair the lateral meniscus. (D) Looking from the AL portal, the probe is coming from the AM portal, and the lateral meniscus is probed after repair with three fiber wires using the Scorpion device. (E) Looking from the AM portal, the needle is coming from the PL portal, and the lateral meniscus is probed after repair with 3 FiberWires using the Scorpion device. (AL, anterolateral; AM, anteromedial; C, capsule; LFC, lateral femoral condyle, LM, lateral meniscus; LTC, lateral tibial condyle; P, PassPort cannula; SC, Scorpion.)

and disadvantages and pearls and pitfalls of arthroscopic zip repair are described in [Table 2](#) and [Table 3](#), respectively.

Disclosures

The authors (S.G., A.D., S.K.C., P.G.) report that they have no conflicts of interest in the authorship and

Table 2. Advantages and Disadvantages of All-Inside Zip Repair

Advantages	Disadvantages
<ul style="list-style-type: none"> • Technically more straightforward and easily reproducible. • Scorpion and SutureLasso techniques are all-inside, low-cost, nonimplant surgeries. • Multiple sutures can be used in Scorpion and SutureLasso methods. • Less chances of injury to posterior structures in Scorpion and SutureLasso hook method. • Less associated morbidity as compared with inside-out. • Using posterolateral portals allows better visualization of the extent of the tear, hidden lesions, better maneuvering, and repair. • High healing rates. • Strong repair construct. • Complex tears also can be managed with the lasso hook and Scorpion method. 	<ul style="list-style-type: none"> • Risk of cartilage injury in the tight lateral compartment to the posterior aspect of femoral condyles. • Demands special instruments like Knee Scorpion and SutureLasso hook passer. • May need an additional incision. • Chances of neurovascular injury in all inside devices. • Regular posterolateral portal essential for zip identification and repair. • Chances of cut-through of sutures if poor tissue quality. • Failure to heal or inappropriate rehabilitation can lead to changes in knee biomechanics. • Need to put all-inside devices on the top and bottom of the surface, thereby increasing the cost.

Table 3. Pitfalls and Pearls for All-Inside Zip Repair

Pitfall	Pearls
Entering the posterolateral compartment is difficult in a tight knee.	Use the anteromedial portal and enter into the space between ACL and LFC.
Difficulty in making posterolateral portal.	The transillumination circle at the posterolateral aspect with the operating room's lights off makes entry easy.
Finding the right trajectory for instrumentation through a low posterolateral portal.	Use of spinal needle before making the portal in such a way that it is at the level of meniscus and not too anterior.
Passing of suture through meniscus with scorpion may be difficult.	The use of flexion–extension movements will allow easy entry beneath the meniscus.
Once the first suture is passed, subsequent suture's passage and management are complex.	Park sutures in the anterolateral portal.

ACL, anterior cruciate ligament; LFC, lateral femoral condyle.

publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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