Medial Meniscal Ramp Lesion Repair Through Anterior Portals Using a Medial Collateral Ligament Pie-Crusting Technique

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Abstract: Ramp injury, that is, injury to the peripheral attachment of the posterior horn of the medial meniscus, often requires additional surgery during anterior cruciate ligament (ACL) reconstruction. Diagnosis and treatment of ramp lesions are important because unrepaird ramp lesions could cause risk to the reconstructed ACL because of anteroposterior and external rotation laxity, whereas acute rupture or chronic deficiency of the ACL could also cause ramp lesions because of instability. Ramp lesions are difficult to diagnose and treat from the anterior compartment during arthroscopy. Typically, this repair requires technically demanding skills and is performed from the posterior portal using a suture hook under visualization with the arthroscope through the intercondylar notch. Inexperienced surgeons often struggle with using the posterior portal and the suture hook. Our all-inside repair technique using the FasT-Fix system (Smith & Nephew, Andover, MA) under direct visualization from the anterior compartment accompanied by a medial collateral ligament pie-crusting technique facilitates repair of ramp lesions without causing medial instability.

Ramp lesions, which were first reported in 1988 by Strobel, are characterized by injury to the peripheral attachment of the posterior horn of the medial meniscus. These lesions are found in approximately 9.3% to 17% of anterior cruciate ligament (ACL) injury cases. Diagnosis and treatment of ramp lesions are important because, if neglected, they can cause anteroposterior instability or injury to the body of the medial meniscus, resulting in early failure of the reconstructed ACL or early osteoarthritis of the knee joint. Ramp lesions are difficult to diagnose and treat arthroscopically from the anterior compartment. A technique using a suture hook through the high posteromedial portal is commonly used for ramp lesion repair. However, it is challenging and requires more surgical skill because there is some risk of damage to the posterior neurovascular structures and articular cartilage. Under these circumstances, Mostafa Zaky Abdelrazek et al. introduced a technique to repair ramp lesions using standard anterior portals. This technique provides convenient and reliable repair of ramp lesions through standard anterior portals using the FasT-Fix Meniscal Repair system (Smith & Nephew, Andover, MA). However, this technique requires visualization of the ramp lesion with a light source through the intercondylar notch, which can be challenging for inexperienced surgeons, especially in tight knees. We thus introduce a technique for repairing ramp lesions under anterior visualization using a medial collateral ligament pie-crusting technique (Video 1).

Surgical Technique

The patient is placed in the supine position on the operating table with an appropriate tourniquet applied over the cast padding. Routine arthroscopic examination is planned using the anteromedial, anterolateral, and superomedial portals. First, the superomedial portal.
for the drainage system is created 2 fingerbreadth lateral to the lateral patellar margin and 1 finger breadth superior to the superior patellar margin. Thereafter, the anterolateral portal is made using a No. 10 blade for arthrotomy; the arthroscope is advanced through this portal. Observing through the anterolateral portal and using a transillumination technique, the surgeon explores the preferred position for the anteromedial portal with an 18-gauge needle. Arthroscopic examination of both compartments is performed, and the status of the menisci is determined using a probe. Suspected medial meniscal ramp lesions are examined with posteromedial visualization of the posterior meniscocapsular attachment of the medial meniscus by pushing the arthroscope through the anterolateral portal deep into the intercondylar notch between the posterior cruciate ligament and the medial femoral condyle (Fig 1).

Typically, with the use of standard anterior portals, the ramp lesion is not fully exposed and space can be insufficient for repair. Under these circumstances, MCL release to widen the medial compartment with a pie-crusting technique (needling of the superficial MCL in the valgus position at 15° of flexion with manual assistance) and repair under anterior visualization is considered an alternative to repair using the posteromedial portal (Fig 2). Using this technique, we can secure sufficient space in the medial compartment. As a result, both the arthroscope from the anterolateral portal and a probe or FasT-Fix needle from the anteromedial portal can approach the posteromedial meniscocapsular junction without the need to place the arthroscope deep into the intercondylar notch (Video 1, Fig 3).

All repair procedures are performed using the FasT-Fix 360 Meniscal Repair system. The FasT-Fix 360 needle is first adjusted to the desired depth of 12 mm. It is introduced through the anteromedial portal over a slotted cannula to avoid catching soft tissues. The first needle is fired at the posterior capsule, and the second, into the meniscal body. The suture is then tightened to approximate the tear site, and an additional suture is placed as needed according the tear size (Video 1). Finally, an arthroscope is advanced through the posteromedial portal, and a well-reduced ramp lesion is confirmed (Fig 4). After completing repair of the ramp lesion and other meniscal tears, the surgeon performs ACL reconstruction of the ruptured ACL using autologous semitendinosus and gracilis tendons. All repair and reconstruction procedures are performed from anterior portals.

After repair and reconstruction, full range of motion (ROM) of the knee is confirmed. A hinged brace is applied for the first 6 weeks postoperatively during recovery of the reconstructed ACL and punctured MCL. Weight bearing is prohibited for 6 weeks to protect the repaired meniscus. ROM exercises are started and gradually increased to 90° until 2 weeks postoperatively and are maintained until 6 weeks postoperatively. After 6 weeks, patients are allowed to walk with crutches and

![Fig 1. Arthroscopic view of posteromedial compartment of left knee. The patient is positioned in the semi-lithotomy position with 80° of flexion of the left knee. The suspected ramp lesion is confirmed by advancing the arthroscope from the posteromedial portal and by probing it with a probe coming from the standard anterolateral portal through the intercondylar notch. This technique is performed to confirm that a ramp lesion is present.](image1)

![Fig 2. Left knee shown from lateral side of patient lying in semi-lithotomy position. On the basis of an examination of the surface anatomy, the medial collateral ligament (MCL) and joint line are marked. With a spinal needle, pie crusting of the superficial MCL is performed in the valgus position at 15° of flexion with manual assistance. By use of this position, the surgeon can more clearly feel the margin of the superficial MCL.](image2)
They should not return to sports activities until 6 months after surgery.

Discussion

A ramp lesion is a meniscal injury that frequently occurs concomitantly with ACL injury. Unrepaired ramp lesions can cause failure of ACL reconstruction, and acute rupture or chronic deficiency of the ACL can also cause ramp lesions owing to anteroposterior and rotational laxity. Thus, unstable ramp lesions need to be repaired to ensure successful ACL repair. However, unlike other meniscal injuries, ramp lesions can easily be misdiagnosed or overlooked. Even if diagnosed properly, more surgical experience is required for the repair, making it difficult for inexperienced surgeons.

Diverse surgical approaches have been used to repair ramp lesions, from arthroscopic-only techniques to techniques performed in combination with open surgery, including all-inside, inside-out, and outside-in repairs. Different suture techniques have been reported, such as repair with a suture hook using nonabsorbable suture material and with a suture device such as the FasT-Fix system. However, to our knowledge, no techniques have been reported that enable full visualization of the ramp lesion directly from the anterior compartment using an arthroscope placed through the anterolateral portal (without posteromedial visualization through the intercondylar notch) and repair of the lesion from the anteromedial portal using an MCL pie-crusting technique. Although Mostafa Zaky Abdelrazek et al. introduced a technique to repair ramp lesions using standard anterior portals, they visualized the posteromedial compartment by positioning the arthroscope through the intercondylar notch, which requires a high level of surgical skill.

The technique introduced in this article does not require a posterior portal or placement of the arthroscope through the intercondylar notch to visualize the posteromedial compartment. Instead, we visualize the posteromedial part of the meniscus, which is usually covered by the medial femoral condyle, directly from the anterolateral portal via an MCL pie-crusting technique. Simultaneous probing and repair of meniscal lesions including ramp lesions are possible through the anteromedial working portal. By means of this simple MCL pie-crusting technique, surgeons can overcome the limitations of the suture hook technique, such as the risk of neurovascular injury, as well as cartilage injury, and the relatively steep learning curve for novice surgeons. Moreover, there is no need for surgeons to alternate between 30° and 70° scopes and to shift portals during the repair, resulting in a reduced operating time. Considering that ramp lesion repair is usually accompanied by ACL reconstruction, shortening the operating time is an advantage.

Unlike previous reports that introduced MCL release as a technique only for patients with a tight medial compartment, we use this technique in all cases; it allows direct anterior visualization of the posteromedial part of the medial meniscus from the anterolateral portal. Many previous studies have established that MCL release is a safe and minimally harmful technique. MCL pie crusting has typically generated grade I MCL laxity without saphenous nerve or vein...
Table 1. Benefits and Limitations

| Benefits                                                                 | Limitations                                                                 |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Visualization is improved with MCL pie crusting, and surgeons could regulate the degree of widening under the arthroscope. Repair using a suture hook through the posteromedial portal or visualization through the intercondylar notch is not required. There is no risk of cartilage injury. | There is a risk of iatrogenic complete MCL rupture.                           |

MCL, medial collateral ligament.

Table 2. Advantages and Disadvantages

| Advantages                                                                 | Disadvantages                                                                 |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Easy technique without steep learning curve                               | Inability to predict degree of medial-compartment widening                   |
| Requirement for fewer instruments and reduction of operating time          |                                                                              |
| Fewer morbidities than associated with posterior portal access             |                                                                              |
| (neurovascular injury, cartilage injury)                                   |                                                                              |

Injuries that can occur during the posterior portal technique. However, the unpredictability of the degree of medial-compartment widening as well as risk of iatrogenic complete MCL rupture is a limitation that surgeons should be aware of (Table 2). Our all-inside repair technique for ramp lesions of the medial meniscus under direct visualization through anterior portals via MCL pie crusting provides a good visual field and an easier learning curve with satisfactory clinical results.

References

1. Strobel M. Manual of Arthroscopic Surgery. New York, NY: Springer, 1988.
2. DePhillipo NN, Cinque ME, Kennedy NI, et al. Inside-out repair of meniscal ramp lesions. Arthrosc Tech 2017;6: e1315-e1320.
3. Malatray M, Raux S, Peltier A, Pfirrmann C, Seil R, Chotel F. Ramp lesions in ACL deficient knees in children and adolescent population: A high prevalence confirmed in intercondylar and posteromedial exploration. Knee Surg Sports Traumatol Arthrosc 2018;26:1074-1079.
4. Li WP, Chen Z, Song B, Yang R, Tan W. The FaSt-Fix repair technique for ramp lesion of the medial meniscus. Knee Surg Relat Res 2015;27:56-60.
5. Stephen JM, Halewood C, Kitil C, Bollen SR, Williams A, Amis AA. Posteromedial meniscocapsular lesions increase tibiofemoral joint laxity with anterior cruciate ligament deficiency, and their repair reduces laxity. Am J Sports Med 2016;44:400-408.
6. Thaunat M, Fayard JM, Guimaraes TM, Jan N, Murphy CG, Sonnery-Cottet B. Classification and surgical repair of ramp lesions of the medial meniscus. Arthrosc Tech 2016;5:e871-e875.
7. Acosta J, Ravaei S, Brown SM, Mulcahey MK. Examining techniques for treatment of medial meniscal ramp lesions during anterior cruciate ligament reconstruction: A systematic review. Arthroscopy 2020;36:2921-2933.
8. Mostafa Zaky Abdelrazeck BH, Waly MR, Abdel Aziz MA, Abdel Aziz A. Different techniques for the management of meniscal ramp lesions using standard anterior portals. Arthrosc Tech 2020;9:e39-e44.
9. Sonnery-Cottet B, Conteduca J, Thaunat M, Gunepin FX, Seil R. Hidden lesions of the posterior horn of the medial meniscus: A systematic arthroscopic exploration of the concealed portion of the knee. Am J Sports Med 2014;42: 921-926.
10. Markoff KL, Jackson SR, McAllister DR. Force measurements in the meniscus posterior horn attachment.
11. Hatayama K, Terauchi M, Saito K, Takase R, Higuchi H. Healing status of meniscal ramp lesion affects anterior knee stability after ACL reconstruction. *Orthop J Sports Med* 2020;8:2325967120917674.

12. Bumberger A, Koller U, Hofbauer M, et al. Ramp lesions are frequently missed in ACL-deficient knees and should be repaired in case of instability. *Knee Surg Sports Traumatol Arthrosc* 2020;28:840-854.

13. Liu X, Zhang H, Feng H, Hong L, Wang XS, Song GY. Is it necessary to repair stable ramp lesions of the medial meniscus during anterior cruciate ligament reconstruction? A prospective randomized controlled trial. *Am J Sports Med* 2017;45:1004-1011.

14. Greif DN, Baraga MG, Rizzo MG, et al. MRI appearance of the different meniscal ramp lesion types, with clinical and arthroscopic correlation. *Skeletal Radiol* 2020;49:677-689.

15. Negrín R, Reyes NO, Iñiguez M, Pellegrini JJ, Wainer M, Duboy J. Meniscal ramp lesion repair using an all-inside technique. *Arthrosc Tech* 2018;7:e265-e270.

16. Claret-Garcia G, Montañana-Burillo J, Tornero-Dacasa E, et al. Pie crust technique of the deep medial collateral ligament in knee arthroscopy: Ultrasound and anatomic study. *J Knee Surg* 2019;32:764-769.

17. Moran TE, Awowale JT, Werner BC, Fox MA, Miller MD. Associated morbidity after the percutaneous release of the medial collateral ligament for knee arthroscopy. *Arthroscopy* 2020;36:891-900.

18. Moran TE, Demers A, Awowale JT, Werner BC, Miller MD. The outside-in, percutaneous release of the medial collateral ligament for knee arthroscopy. *Arthrosc Tech* 2020;9:e393-e397.

19. Polat B, Aydin D, Polat AE, et al. Objective measurement of medial joint space widening with percutaneous ‘pie crust’ release of medial collateral ligament during knee arthroscopy. *J Knee Surg* 2020;33:94-98.