Platelet-Rich Fibrin Clot—Augmented Repair of Horizontal Cleavage Meniscal Tear

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Abstract: Although horizontal tears of the meniscus have historically been treated with partial meniscectomy due to poor vascularity within the tear, evidence suggests that repair of horizontal meniscal tears may be advantageous to partial meniscectomy. Furthermore, the addition of platelet-rich plasma has shown promise in improving meniscal healing. We present our technique of platelet-rich fibrin clot—augmented repair of horizontal cleavage meniscal tear.

Meniscal tears account for an estimated 400,000 ambulatory surgical visits each year in the United States.1 Mounting evidence shows that partial meniscectomy is associated with radiographic and clinical osteoarthritis within 2 years after the index procedure.2 As technology and instrumentation improve, meniscal repair has become increasingly popular in the treatment of meniscal tears.

Horizontal cleavage tears, which extend from the inner free margin of the meniscus into the outer meniscal substance, divide the meniscus into superior and inferior laminae. Because of technical difficulty, suture failure, and diminished blood supply thought to impair healing, these tears have been historically treated with partial meniscectomy and not repair. Recent evidence shows that repairs may lead to improved outcome compared with meniscectomy and equivalent healing rates compared with the more common vertical and bucket-handle tears.3 Furthermore, platelet-rich plasma (PRP), growth factor, and fibrin clot supplementation have shown promise in promoting meniscal healing.4,5 Therefore, our purpose is to show a technique for platelet-rich fibrin clot augmentation in repair of horizontal medial meniscus tear (Table 1).

Surgical Technique

Preoperative assessment is critical to identify those who may benefit from a biologically augmented meniscal repair. Those with horizontal cleavage meniscal tears should be considered for repair if the tear

Table 1. Pearls and Pitfalls

| Pearls | Pitfalls |
|--------|----------|
| When creating an anteromedial portal, ensure that the localizing spinal needle can touch the tear. This step shows accessibility of the tear. Identify the need for platelet-rich fibrin clot augmentation as early as possible during the procedure because the clot requires up to 30 min to prepare. | Inadequate centrifugation time during clot solidification may result in a fibrin clot lacking adequate structure for passage and implantation. Failure to use a cannula through the anteromedial portal may lead to the fibrin clot getting caught within the fat pad during passage. |
| Knee-specific Arthrex Scorpion suture passing device (Arthrex) self-captures the suture passed through the meniscus and has a lower profile and allows easier passage through the knee joint than larger suture passage devices. | |

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has adequate tissue quality and extends into the red-red or red-white zones, the medial compartment has minimal to no chondrosis, a perimeniscal cyst is present, and/or the patient is less than 50 years old and/or is willing to undergo the necessary weight-bearing restrictions postoperatively. Because most facilities do not stock PRP kits nor store centrifuges, coordinated planning must occur before the day of surgery to ensure that the equipment needed to create a platelet-rich fibrin clot is available.

Patient positioning for the procedure is flexible but must accommodate 2 important conditions: (1) ability to generate adequate valgus stress and (2) assess to the posteromedial aspect of the knee. To obtain these requirements, the patient is placed supine on the operative table and a stress post (Mizuho OSI, Union City, CA) is placed at the level of the tourniquet. Although some circumferential leg holders may satisfy these criteria, others may limit the passage of needles through the posteromedial aspect of the knee.

Portal Creation
Portal sites are selected to ensure that the posterior horn of the medial meniscus can be easily accessed through the anteromedial portal (Video 1). The anteromedial portal is established by passing a spinal needle at a trajectory such that the needle can easily touch the posterior horn of the medial meniscus. The anteromedial portal is created by directly visualizing an 11-blade scalpel passing through the capsule at the same trajectory as the spinal needle. Because the blade is often millimeters from the superior surface of the anterior horn of the medial meniscus, the scalpel is inserted with the blade directed away from the surface of the meniscus.

The platelet-rich fibrin matrix clot (Cascade Autologous Platelet System, Musculoskeletal Transplant Foundation, Edison, NJ) requires at least 20 minutes of preparation. Therefore, the decision to perform a meniscal repair augmented with a platelet-rich clot should be made as early in the case as possible to optimize timing and avoid delays. The horizontal cleavage tear should be thoroughly inspected to ensure that the leaflets of the tear are adequate for repair.

Fibrin Clot Preparation
Once the tear is deemed reparable, the patient’s blood is collected and placed through a series of centrifugations using the Cascade Autologous Platelet System. The first centrifugation, which lasts 6 minutes, separates the PRP from the blood cells. The PRP is transferred into another tube and is spun in the

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**Fig 1.** Two polyfilament sutures of different colors are passed through the platelet-rich fibrin clot to facilitate passage into the joint.

**Fig 2.** Right knee, internal view of the medial compartment using the anterolateral portal. An 18-gauge spinal needle is passed through the skin from the posteromedial knee and entering the joint between the superior and inferior meniscal leaflets at the anterior aspect of the tear. A 0 monofilament suture is passed through the needle and grasped using an arthroscopic grasper. A second monofilament suture is shuttled through the posterior extent of the tear using a similar technique. These sutures will be used to eventually shuttle the clot into the tear.

**Fig 3.** Right knee, internal view of the medial compartment using the anterolateral portal. The degenerative tissue found between the meniscal leaflets is debrided using a meniscal rasp. Debridement continues until bleeding is encountered within the base of the tear.
centrifuge for 15 to 20 minutes to create the fibrin clot. A longer duration of centrifugation time produces a more reliable and rigid clot. The clot is aseptically removed from the vial and placed onto the surgical field. Adsorbable polyfilament sutures of different colors, for example, dyed and undyed 0 Vicryl sutures (Ethicon, Somerville, NJ), are carefully passed through each end of the clot in a locking pattern (Fig 1).

Shuttle Suture Passage
While the blood sample is being processed, the meniscus tear can be prepared. An 18-gauge spinal needle is inserted through skin overlying the posteromedial skin. The needle should be directed at the anterior extent of the tear and should enter the knee between the superior and inferior leaflet of the tear. Once the needle has been adequately positioned at the anterior extent of the tear, a 0 monofilament suture (Prolene, Ethicon) is passed through the needle and grasped using an arthroscopic grasper (Fig 2). Before retrieving the suture out the anteromedial portal, the needle is retracted from the joint to prevent the tip of the needle from lacerating the suture. A second monofilament suture is shuttled through the posterior extent of the tear using a similar technique.

Meniscus Preparation
The meniscus tissue is prepared to create an adequate bed for healing. A meniscal rasp is used to debride the degenerative tissue often found within the tear (Fig 3). Debridement of the degenerative meniscal tissue occurs between the 2 sutures and should proceed until bleeding is encountered within the base of the lesion.

Clot Passage
The joint is prepared for passage of the platelet-rich fibrin clot into the apex of the meniscal tear. A 5.0-mm-diameter cannula is inserted through the anteromedial portal, and the monofilament sutures previously passed through the meniscus are again each retrieved out of the joint through the cannula. Each of these monofilament suture tails is secured to one of the suture pairs passed through each end of the clot (Fig 4). The monofilament sutures will be used to position the platelet-rich fibrin clot into the center of the meniscus tear. Each monofilament suture is sequentially removed from the joint by pulling on the suture limb exiting the skin overlying the posteromedial knee, and, thus, the clot is slowly manipulated into the tear one end at a time. Once all polyfilament
Suture limbs are passed through the meniscus and out the posteromedial knee, tension is applied to both polyfilament sutures and the graft is further entrenched into position between the 2 leaflets of the tear (Fig 5).

**Meniscus Repair**

The meniscus can now be repaired. A self-capturing suture passage device (Knee Scorpion, Arthrex, Naples, FL) is used to pass a high-strength braided suture (2-0 Fiberwire, Arthrex) through both superior and inferior meniscal leaflets at the tear's midpoint and 2 to 3 mm from the central edge of the tear (Fig 6). The suture limbs are secured using a series of half-hitch knots on the meniscus' superior surface. Additional sutures are placed anteriorly and posteriorly to the initial suture until the edges of the tear are reapproximated (Fig 7). With the platelet-rich fibrin clot firmly entrapped within the repaired meniscus, the polyfilament sutures passed through the clot are resected as they exit the skin overlying the posteromedial knee.

Postoperatively, the patient is 50% partial weight-bearing in a knee extension brace for 4 weeks followed by full weightbearing with the brace unlocked for the next 2 weeks. Physical therapy including gentle range of motion begins at 2 weeks with motion limited to 45° of flexion until week 4 and 90° until week 6. At 6 weeks postoperatively, full weightbearing without a brace commences and flexion restrictions are removed. No pivoting, twisting, hopping, jumping, and running are permitted for 3 months postoperatively. Light jogging is expected to begin at 3 months and return to sports between 4 and 6 months.

**Discussion**

Symptomatic horizontal cleavage meniscal tears have been typically treated with partial meniscectomy owing to the proposed poor vascular supply and impaired healing. However, recent pooled data suggest that those who underwent repair for this meniscal tear configuration had improved outcomes versus those who had a segment of the meniscus resected.3

Fibrin clots have previously been used as a method to improve healing potential of repaired menisci. More recently, PRP, which can induce upregulation of biglycan, decorin, aggrecan, collagen type I (\(\alpha_1\)), and elastin, has been introduced as a biological augment to increase healing rates after meniscal repair.6,7 A commercially available system can facilitate formation of PRP clots that can be sutured and manipulated between the tear edges. Available in vitro data are mixed on efficacy of PRP to induce meniscal tears to heal.7-9

| Table 2. Advantages and Disadvantages |
|---------------------------------------|
| **Advantages** | **Disadvantages** |
| Repair of horizontal meniscus tears can lead to improved outcomes compared with partial meniscectomy | Commercially available platelet-rich plasma clot has increased cost compared with a traditional fibrin clot |
| Improved healing milieu and healing rate after meniscus repair using platelet-rich plasma | Repaired horizontal meniscus tear has potential to not heal and may require subsequent surgery to perform meniscectomy |
| Clot content and structure is predictable | Intra-articular suture and knots may be abrasive to chondral surfaces |
| Procedure can be performed using the all-arthroscopic technique | |

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**Fig 6.** Right knee, internal view of the medial compartment using the anterolateral portal. A self-capturing suture passage device is used to pass a high-strength suture through the superior and inferior leaflets of the meniscus. The suture is secured to entrap the fibrin clot between the meniscal leaflets.

**Fig 7.** Right knee, internal view of the medial compartment using the anterolateral portal. A series of sutures are passed through both meniscal leaflets and secured to appose the edges of the meniscus and complete the repair.
Limited data exist to substantiate the clinical benefit of PRP augmentation in meniscus repair (Table 2). One study of 35 isolated meniscal repairs suggested no clinical advantage when PRP is used; however, although not reaching statistical significance, both Lysholm and International Knee Documentation Committee values were increased in the PRP-treated group compared with the control group. Other studies including only those with horizontal meniscal tears show an improvement in functional outcome and magnetic resonance imaging–documented healing when PRP is added to the repair site. Given that PRP may improve rates of healing and outcomes after meniscal tears and the potential for limited healing with repair of horizontal meniscal tears, platelet-rich fibrin clots are a useful adjunct for the treatment of these tears.

References
1. Cullen KA, Hall MJ, Golosinskiy A. Ambulatory surgery in the United States, 2006. Natl Health Stat Report 2009;11:1-25.
2. Roemer FW, Kwoh CK, Hannon MJ, et al. Partial meniscectomy is associated with increased risk of incident radiographic osteoarthritis and worsening cartilage damage in the following year. Eur Radiol 2017;27:404-413.
3. Kurzweil PR, Lynch NM, Coleman S, Kearney B. Repair of horizontal meniscus tears: A systematic review. Arthroscopy 2014;30:1513-1519.
4. Ionescu LC, Lee GC, Huang KL, Mauck RL. Growth factor supplementation improves native and engineered meniscus repair in vitro. Acta Biomater 2012;8:3687-3694.
5. Kamimura T, Kimura M. Repair of horizontal meniscal cleavage tears with exogenous fibrin clots. Knee Surg Sports Traumatol Arthrosc 2011;19:1154-1157.
6. Howard D, Shepherd JH, Kew SJ, et al. Release of growth factors from a reinforced collagen GAG matrix supplemented with platelet-rich plasma: Influence on cultured human meniscal cells. J Orthop Res 2014;32:273-278.
7. Ishida K, Kuroda R, Miwa M, et al. The regenerative effects of platelet-rich plasma on meniscal cells in vitro and its in vivo application with biodegradable gelatin hydrogel. Tissue Eng 2007;13:1103-1112.
8. Kwak HS, Nam J, Lee JH, Kim HJ, Yoo JJ. Meniscal repair in vivo using human chondrocyte-seeded PLGA mesh scaffold pretreated with platelet-rich plasma. J Tissue Eng Regen Med 2017;11:471-480.
9. Zellner J, Taeger CD, Schaffer M, et al. Are applied growth factors able to mimic the positive effects of mesenchymal stem cells on the regeneration of meniscus in the avascular zone? Biomed Res Int 2014;2014:537686.
10. Griffin JW, Hadeed MM, Werner BC, Diduch DR, Carson EW, Miller MD. Platelet-rich plasma in meniscal repair: Does augmentation improve surgical outcomes? Clin Orthop Relat Res 2015;473:1665-1672.
11. Pujol N, Salle De Chou E, Boisrenoult P, Beaureilhs P. Platelet-rich plasma for open meniscal repair in young patients: Any benefit? Knee Surg Sports Traumatol Arthrosc 2015;23:51-58.