Technical Note

# Horizontal Cleavage Meniscus Tear: "The Quad Tendon Augmentation Technique"

Maximiliano Ibañez, M.D., Felix Hoffmann, M.D., Caroline Mouton, Ph.D., and Romain Seil, M.D., Ph.D.

**Abstract:** The management of medial meniscus horizontal cleavage tears can be challenging. Currently, several treatment options, including nonoperative and surgical options, have been proposed in the literature. Different repair techniques aiming to promote the healing process have been reported and have shown good outcomes. However, recurrent parameniscal cysts and decreased meniscal volume have also been reported. In this Technical Note, a novel surgical technique to repair a horizontal cleavage tear of the posterior horn of the medial meniscus is reported in young patients. The technique uses a strip of autologous quadriceps tendon to fill the void between the upper and lower meniscal leaflets followed by an all-inside compression suture. Both of these technical features aim to overcome the limitations of current repair techniques.

Horizontal cleavage tears (HCTs) divide the meniscus into superior and inferior laminae or leaflets.[1] They are often extensive and affect both the vascular periphery and avascular central zones.[2-4] Based on magnetic resonance imaging, they can be classified on a scale of 1 to 3, grade 3 being lesions extending through the superficial fibril layers and opening into the joint.[5] The etiology of HCTs has not yet been clearly defined. They can be traumatic or degenerative in nature, the former being more frequently observed early in life.[6] In sports activities, HCTs may be attributable to excessive shear stress forces associated with a degree of myxoid degeneration.[1] Their development may, however, also be explained by necrosis of the horizontal collagen bundles caused by poor vascularization in that area.[7]

Several treatment options for HCTs have been proposed in the literature, including nonoperative management, arthroscopic suture repair,[8-10] partial meniscectomy including both leaflets,[11] partial meniscectomy of the inferior flap,[6] and open suture repair.[12] These different treatment options are, however, not free of negative aspects. Partial meniscectomy leads to early osteoarthritis as well as post-meniscectomy syndrome.[13] Parameniscal cysts have been reported not only with nonoperative management[14,15] but also in cases of repair failure or healing absence between both leaflets.[16-18] Although repair techniques initially aim to promote the healing process and show good outcomes,[8,9,19] they are also associated with a decrease in meniscal volume[20-23] if associated with debridement of the intermediate layer of collagen fiber bundles and isolated repair of the 2 leaflets.

Different techniques to repair an HCT should thus ideally aim to preserve meniscal anatomy and volume as well as to seal the meniscus to prevent the occurrence or recurrence of a parameniscal cyst. In this technical note, the authors report a surgical technique to repair an HCT of the posterior horn of the medial meniscus in young patients (Fig 1). The technique uses an autologous strip of quadriceps tendon (QT) to fill the void between the upper and lower meniscal leaflets followed by an all-inside compression suture. These technical features aim to overcome the limitations of currently existing repair techniques.

*From the Department of Orthopaedic Surgery, Centre Hospitalier Luxembourg—Clinique d'Eich, Luxembourg, Luxembourg (M.I., F.H., C.M., R.S.); Institut Català de Traumatologia i Medicina de l'Esport, Hospital Universitari Dexeus, Universitat Autònoma de Barcelona, Barcelona, Spain (M.I.); Luxembourg Institute of Research in Orthopaedics, Sports Medicine and Science, Luxembourg, Luxembourg (C.M., R.S.); and Human Motion, Orthopaedics, Sports Medicine and Digital Methods, Luxembourg Institute of Health, Luxembourg, Luxembourg (R.S.).*

*Received November 22, 2023; accepted February 3, 2024.*

*Address correspondence to Romain Seil, M.D., Ph.D., Department of Orthopaedic Surgery, Centre Hospitalier Luxembourg—Clinique d'Eich, 78 Rue d'Eich, L-1460 Luxembourg, Luxembourg. E-mail: rseil@yahoo.com*



*2212-6287/231717*
*https://doi.org/10.1016/j.eats.2024.102977*

## Surgical Technique

### Patient Positioning, Portal Establishment, HCT Identification, and Graft Preparation

The patient is placed supine on the operating table with the operated limb positioned in a leg holder at 90° of knee flexion. A tourniquet is placed on the proximal thigh. During the meniscal procedure, the tourniquet is generally not inflated except at the time of graft harvesting. The operative extremity is prepared and draped in a standard sterile fashion.

Standard anterolateral and anteromedial (AM) portals as well as a standard superomedial outflow portal are established. The AM portal is placed to ensure that the posterior horn of the medial meniscus can be easily accessed. Through direct visualization, a spinal needle is placed in the direction of the posterior horn of the medial meniscus, and the skin incision is performed under direct visualization with a 15 blade scalpel.

During standard diagnostic arthroscopy, both menisci are assessed with a probe. As described in Video 1, the HCT is identified and carefully inspected to determine whether both leaflets of the tear are adequate to proceed with repair. If needed, a medial collateral ligament "pie crust" release is performed to prevent cartilage damage during the procedure.

To prepare the meniscus, the avascular, nonrepairable central rim and frayed inner portions of the superior and inferior leaflets are removed using an arthroscopic meniscal biter and a mechanical shaver. This inevitably leads to a minor reduction of meniscal volume. To proceed with the biological augmentation, the fibrinous tissue at the tear interface is rasped, and the peripheral capsule is stimulated with a shaver to create some bleeding.

To explore the posteromedial compartment, a transnotch view is used. A tissue "bubble" can, in most cases, be seen in the meniscal ramp area when placing the shaver between the upper and lower leaflets of the tear (Fig 2). This finding highlights that the tear has completely extended through the meniscus and that surrounding tissues present some laxity.

### Quadriceps Graft Harvest and Preparation

The tourniquet is inflated and a 2-cm longitudinal skin incision is made at the anterior aspect of the thigh from the proximal end of the patella in a cranial direction. The incision is then deepened into the subcutaneous plane and the peritendinous tissues are released. The QT, vastus medialis, and patella are identified to determine the exact site of graft harvesting. The authors recommend achieving whenever possible a graft length of 20 mm and a width of 10 mm. The width of the graft is marked at the proximal pole of the patella using a 15 blade scalpel. The distal end of the graft is detached sharply from the upper pole of the patella. Only the superficial tendon layer is elevated using a scalpel or Metzenbaum scissors. The free distal end is then secured with a whipstitch and a nonabsorbable suture. Once the 20-mm length is reached, the tendon is cut with a 15 blade scalpel. Tendon closure is then performed to facilitate healing and reduce donor site morbidity. The paratenon is closed with an absorbable suture, and the subcutaneous tissue and skin are closed.

The graft is then prepared in a dedicated station. Two high-strength nonabsorbable sutures are placed on each end of the graft, and circumferential compression stiches of absorbable 0 Vicryl suture (Ethicon, Somerville, NJ) are passed all over the graft, which is then soaked in a vancomycin solution. The sutures from

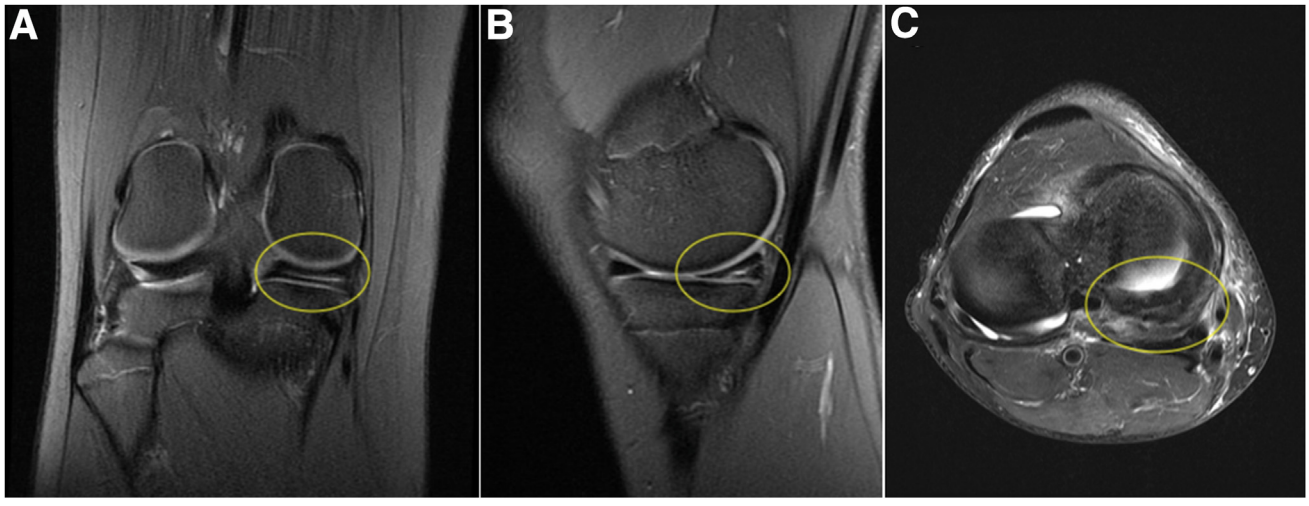


**Fig 1.** (A) Coronal, (B) sagittal, and (C) axial MRI views of a right knee showing a horizontal tear involving the posterior horn of the medial meniscus from its central avascular part to its wall. (MRI, magnetic resonance imaging.)

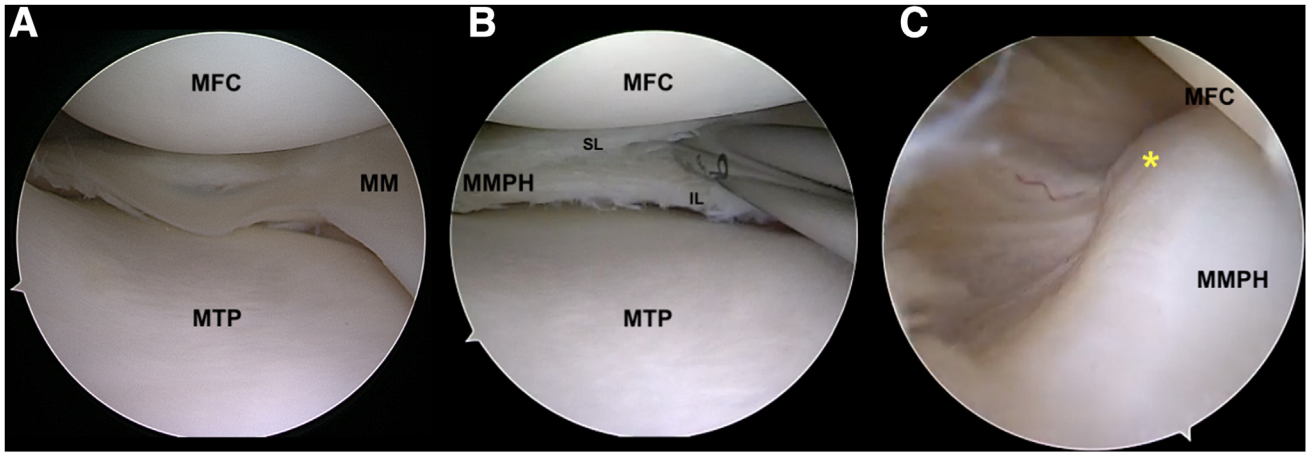


**Fig 2.** Arthroscopic view from the anterolateral portal of the medial compartment of a right knee. Acute HCT of the MMPH (A) before debridement and (B) after debridement. The avascular, nonrepairable central rim and frayed inner portions are removed using an arthroscopic meniscal biter and a mechanical shaver. (C) Through a transnotch view, a tissue "bubble" (indicated by asterisk) can, in most cases, be observed in the meniscal ramp area when placing the shaver between the superior and inferior leaflets of the tear. (HCT, horizontal cleavage tear; IL, inferior leaflet; MFC, medial femoral condyle; MM, medial meniscus; MMPH, medial meniscus posterior horn; MTP, medial tibial plateau; SL, superior leaflet.)

both ends can be further used as traction sutures to position the graft (Fig 3).

### Graft Passage and Meniscal Repair

The graft is inserted through the AM portal using a KingFisher grasper (Arthrex, Naples, FL) and placed inside the HCT. Vertical sutures are applied using FAST-FIX anchors (Smith & Nephew Endoscopy, Andover, MA) from the most lateral side of the posterior horn of the medial meniscus to bring together and compress the superior and inferior leaflets of the torn meniscus and stabilize the graft.

Once the graft is secured, the traction sutures are cut and the graft remnant is trimmed. The FAST-FIX needle is inserted first into the superior leaflet of the tear, and the second anchor is placed across the HCT, inside the depth of the inferior leaflet. Stitches are repeated every 5 to 10 mm to reproduce the effect of a vertical mattress suture and promote sealing of the meniscus. An outside-in suture with 2 spinal needles and 0 PDS suture material is further applied at the most medial part of the tear where the posterior horn of the medial meniscus is in continuity with the medial meniscus body (Fig 4).

Throughout the procedure, care should be taken to avoid iatrogenic cartilage injuries of the tibial plateau and femoral condyle. At the end of the procedure, the stability and tightness of the repair are tested with a probe as well as with repetitive knee flexion-extension movements. Through the transnotch view, it is noted that the tissue "bubble" in the meniscal ramp area has disappeared, indicating a successful repair. The tissue is tighter and the height of the meniscus is restored (Fig 5).

A step-by-step summary of this technique is provided in Table 1. Pearls and pitfalls of the surgical procedure are listed in Table 2.

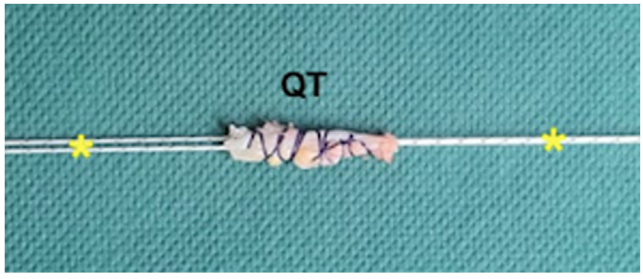


**Fig 3.** QT autograft preparation. Both ends are secured with 2 high-strength nonabsorbable sutures (indicated by asterisks), and circumferential compression stiches of absorbable 0 Vicryl suture are passed all over the graft. The sutures from both ends can be further used as traction sutures to position the graft. (QT, quadriceps tendon.)

## Discussion

This article presents a technique using a QT autograft and an all-inside vertical suture to augment and repair HCTs of the posterior horn of the medial meniscus in young patients. In comparison with previously published techniques, the current procedure may allow for a more anatomic restoration of the volume and height of the meniscus and may induce a sealing effect of the meniscus to prevent recurrent parameniscal cysts.

The use of tendon tissue for meniscal reconstruction has been extensively studied in the past. In a study conducted in 1992 on 20 skeletally mature female merino sheep, Kohn et al.[24] found that replacement of the meniscus with a tendon autograft may decrease the

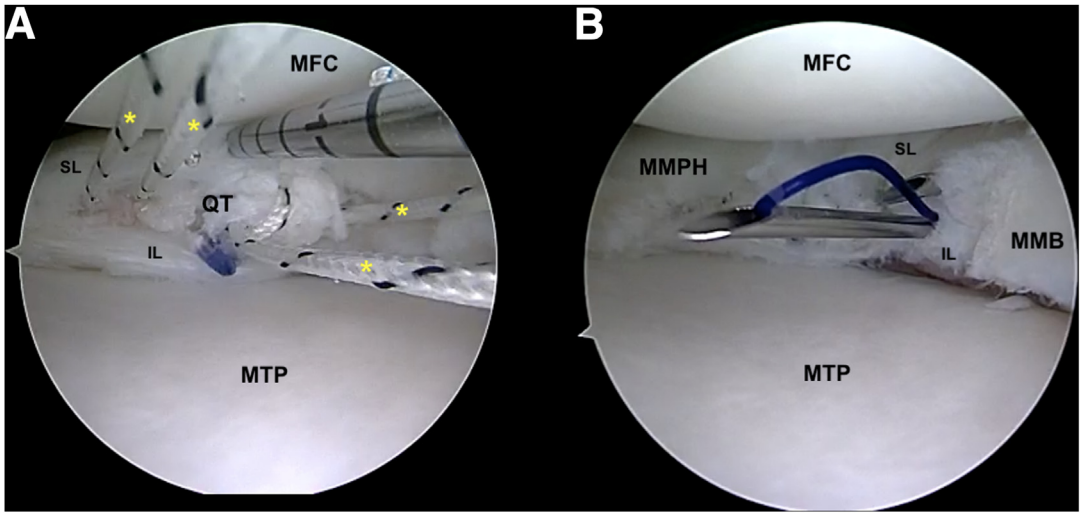


**Fig 4.** Quadriceps augmentation technique for HCT of the posterior horn of the medial meniscus. Right knee view from the anterolateral portal. (A) Graft passage and meniscal repair. The graft is inserted through the anteromedial portal using a KingFisher grasper and placed inside the HCT. Vertical sutures are applied using FAST-FIX anchors from the most lateral part of the posterior horn of the medial meniscus to bring together and compress the superior and inferior leaflets of the torn meniscus and stabilize the graft. Traction sutures are indicated by asterisks. (B) Stitches are repeated every 5 to 10 mm to reproduce the effect of a vertical mattress suture and promote sealing of the meniscus. An outside-in suture with 2 spinal needles and 0 PDS suture material is further applied where the posterior horn of the medial meniscus is in continuity with the medial meniscus body. (HCT, horizontal cleavage tear; IL, inferior leaflet; MFC, medial femoral condyle; MMB, medial meniscus body; MMPH, medial meniscus posterior horn; MTP, medial tibial plateau; QT, quadriceps tendon; SL, superior leaflet.)

severity of degenerative cartilage changes after meniscectomy. In a recent in vivo study, Rönnblad et al.[25] used autologous semitendinosus tendons as possible meniscus transplants. Their study indicated that the grafts survived and adapted in shape and capabilities to an original meniscus without adverse events and with improvements in patients' pain and quality of life.

Studies reporting the clinical results of HCT repair have confirmed that partial meniscectomy may not be the best treatment option for these types of lesions.[2,12,26] In 2014, a systematic review of 9 studies involving HCT repair in 98 patients noted a clinical success rate of 78% when using reoperation to perform a meniscectomy as the end point.[17] The authors of a

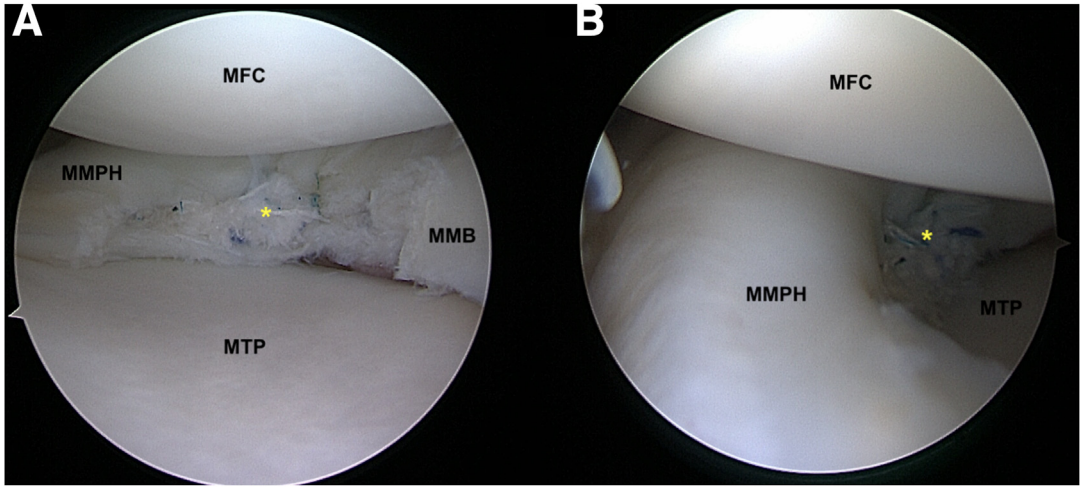


**Fig 5.** Final view of the quadriceps augmentation technique for HCT of the posterior horn of the medial meniscus. Right knee view from the anterolateral portal. (A) At the end of the procedure, the stability and tightness of the repair are tested with a probe as well as with repetitive knee flexion-extension movements. QT graft is indicated by asterisk. (B) The tissue "bubble" in the meniscal ramp area described in Figure 2C has disappeared, indicating a successful repair. The tissue is tighter and the height of the meniscus is restored. QT graft is indicated by asterisk. (HCT, horizontal cleavage tear; MFC, medial femoral condyle; MMB, medial meniscus body; MMPH, medial meniscus posterior horn; MTP, medial tibial plateau; QT, quadriceps tendon.)

**Table 1.** Step-by-Step Summary of "The Quad Tendon Augmentation Technique"

| Step | Description |
|---|---|
| 1 | The patient is placed supine on the operating table with the operated limb positioned in a leg holder at 90° of knee flexion. A tourniquet is placed on the proximal thigh. |
| 2 | A standard AL arthroscopic portal is created to explore the joint. Through direct visualization, the best position for the AM portal is determined. |
| 3 | The HCT is identified in the posterior horn of the medial meniscus and inspected to determine whether the leaflets of the tear are adequate for repair. |
| 4 | The avascular, nonrepairable central rim and frayed inner portions are removed using an arthroscopic meniscal biter and a mechanical shaver. |
| 5 | A QT graft measuring 20 mm in length and 10 mm in width is harvested. Two high-strength sutures are placed on each end, and circumferential compression stiches are passed all over the graft, which is then soaked in a vancomycin solution. |
| 6 | The graft is inserted through the AM portal using a KingFisher grasper and placed in position inside the HCT. |
| 7 | Vertical sutures are applied using FAST-FIX anchors from the most lateral side of the posterior horn of the medial meniscus to bring together and compress the superior and inferior leaflets of the torn meniscus and stabilize the graft. |
| 8 | Once the graft is secure, the traction sutures are cut and the graft remnant is trimmed. |
| 9 | The FAST-FIX needle is inserted first into the superior leaflet of the tear, and the second anchor is placed across the HCT, inside the depth of the inferior leaflet. |
| 10 | An outside-in suture with 2 spinal needles and 0 PDS suture material is applied at the most medial part of the tear where the posterior horn of the medial meniscus is in continuity with the medial meniscus body. |
| 11 | At the end of the procedure, the stability and tightness of the repair are tested with a probe as well as repetitive knee flexion-extension movements. |

AL, anterolateral; AM, anteromedial; HCT, horizontal cleavage tear; QT, quadriceps tendon.

more recent systematic review suggested that repair of HCTs may result in acceptable outcomes despite the low-quality evidence base in the literature.[27] However, they found a reoperation rate of 11.7%, with most cases involving meniscectomy at revision.

Despite good outcomes after repair of HCTs, meniscal narrowing and a decrease in meniscal volume have been reported as limitations of previously published surgical techniques. In a prospective case series of 53 arthroscopic meniscal repairs, Pujol et al.[20] found significant width reduction or shrinkage of the repaired middle and posterior segments ($9 \pm 1.2\%$, $P < .02$) when comparing preoperative magnetic resonance imaging and postoperative computed tomographic arthrography of the medial meniscus. These changes may have been caused by meniscal abrasion, suture tightening, or a shrinkage effect during the healing process. They may furthermore be associated with the development of post-meniscectomy knee osteoarthritis,[28,29] inducing abnormal contact areas and contact pressures.[22,23,30] With this technique, using a QT autograft augmentation, the authors intend to minimize these changes by restoring meniscal volume and height.

Although not very common, another limitation of existing repair techniques for HCTs that needs to be addressed is the possibility of a parameniscal cyst occurring or recurring after repair.[31] By filling the void between both leaflets of the torn meniscus with an autologous QT graft, we hypothesize that the current technique can induce a better sealing effect of the meniscus in comparison with an isolated repair, thus reducing this possible complication. A list of advantages and limitations of the procedure can be found in Table 3.

**Table 2.** Pearls and Pitfalls

Pearls
- Establish the AM portal under direct visualization using a spinal needle so that it touches the posterior horn of the medial meniscus.
- An MCL "pie crust" release can be performed to avoid damaging the cartilage when preparing the meniscus or applying the suture.
- Proper graft sizing is key to avoiding overstuffing the HCT site.
- Circumferential compression sutures in the graft allow for restoration of the anatomic shape and volume of the meniscus.
- The use of traction sutures is useful when manipulating and positioning the graft within the knee joint in case of problems when using the KingFisher.
- Sutures should be placed inside the superior and inferior leaflets in a vertical fashion to totally seal the HCT.

Pitfalls
- The superior edge of the anterior horn of the medial meniscus can be easily damaged during the creation of the AM portal.
- Too aggressive removal of the central rim may prevent proper sealing of the meniscus.
- Excessive debridement of the frayed inner portion may compromise the inferior leaflet of the meniscus.

AM, anteromedial; HCT, horizontal cleavage tear; MCL, medial collateral ligament.

**Table 3.** Advantages and Limitations

Advantages
- Simple, safe, reliable technique.
- Restores the height, volume, and tightness of the meniscus.
- Using an autograft avoids foreign or synthetic material and enhances tissue healing.

Limitations
- Requires advanced skills in arthroscopic surgery and a non-negligible learning curve.
- Requires small incisions in addition to the arthroscopic portals to perform graft harvesting.
- Minor risk of donor site morbidity.

This QT augmentation technique aims at restoring the volume and inducing a sealing effect of the meniscus compared with isolated repair techniques. Future biomechanical and clinical studies will need to confirm this hypothesis.

## Disclosures

The authors report the following potential conflicts of interest or sources of funding: R.S. reports a consulting or advisory role with Smith & Nephew, Olympus Corporation, and Amplitude Ventures and grant funding from VirtaMed. R.S. is also president of the Luxembourg Institute of Research in Orthopedics, Sports Medicine and Science; past president of the Society for Orthopaedic Traumatologic Sports Medicine/European Society of Sports Traumatology, Knee Surgery and Arthroscopy; chairman of The Meniscus 2022; vice chairman of the European Society of Sports Traumatology, Knee Surgery and Arthroscopy meniscus certification module; and editorial board member of *Knee Surgery, Sports Traumatology, Arthroscopy* as well as *Arthroskopie* and *Sports Orthopaedics and Traumatology*. C.M. is the chairwoman of the European Society of Sports Traumatology, Knee Surgery and Arthroscopy and serves on the basic science committee and editorial board for *Knee Surgery, Sports Traumatology, Arthroscopy* and the *Journal of Experimental Orthopaedics*. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

## References


1. Biedert RM. Intrasubstance meniscal tears. Clinical aspects and the role of MRI. *Arch Orthop Trauma Surg* 1993;112(3):142-147.
2. Sallé de Chou E, Pujol N, Rochcongar G, et al. Analysis of short and long-term results of horizontal meniscal tears in young adults. *Orthop Traumatol Surg Res* 2015;101:S317-S322 (suppl 8).
3. Mordecai SC, Al-Hadithy N, Ware HE, Gupte CM. Treatment of meniscal tears: An evidence based approach. *World J Orthop* 2014;5(3):233-241.
4. Nguyen JC, De Smet AA, Graf BK, Rosas HG. MR imaging-based diagnosis and classification of meniscal tears. *Radiographics* 2014;34(4):981-999.
5. Crues JV, Mink J, Levy TL, Lotysch M, Stoller DW. Meniscal tears of the knee: Accuracy of MR imaging. *Radiology* 1987;164(2):445-448.
6. Kim JR, Kim BG, Kim JW, Lee JH, Kim JH. Traumatic and non-traumatic isolated horizontal meniscal tears of the knee in patients less than 40 years of age. *Eur J Orthop Surg Traumatol* 2013;23(5):589-593.
7. Gershuni DH, Skyhar MJ, Danzig LA, Camp J, Hargens AR, Akeson WH. Experimental models to promote healing of tears in the avascular segment of canine knee menisci. *J Bone Joint Surg Am* 1989;71(9):1363-1370.
8. Ahn JH, Kwon OJ, Nam TS. Arthroscopic repair of horizontal meniscal cleavage tears with marrow-stimulating technique. *Arthroscopy* 2015;31(1):92-98.
9. Kamimura T, Kimura M. Repair of horizontal meniscal cleavage tears with exogenous fibrin clots. *Knee Surg Sports Traumatol Arthrosc* 2011;19(7):1154-1157.
10. Tiftikçi U, Serbest S. Repair of isolated horizontal meniscal tears with all-inside suture materials using the overlock method: Outcome study with a minimum 2-year follow-up. *J Orthop Surg* 2016;11(1):131.
11. Biedert RM. Treatment of intrasubstance meniscal lesions: A randomized prospective study of four different methods. *Knee Surg Sports Traumatol Arthrosc* 2000;8(2):104-108.
12. Pujol N, Bohu Y, Boisrenoult P, Macdes A, Beaufils P. Clinical outcomes of open meniscal repair of horizontal meniscal tears in young patients. *Knee Surg Sports Traumatol Arthrosc* 2013;21(7):1530-1533.
13. Beaufils P, Pujol N. Management of traumatic meniscal tear and degenerative meniscal lesions. Save the meniscus. *Orthop Traumatol Surg Res* 2017;103:S237-S244 (suppl 8).
14. Campbell SE, Sanders TG, Morrison WB. MR imaging of meniscal cysts: Incidence, location, and clinical significance. *AJR Am J Roentgenol* 2001;177(2):409-413.
15. Cowden CH, Barber FA. Meniscal cysts: Treatment options and algorithm. *J Knee Surg* 2014;27(2):105-111.
16. Kimura M, Hagiwara A, Hasegawa A. Cyst of the medial meniscus after arthroscopic meniscal repair. *Am J Sports Med* 1993;21(5):755-757.
17. Kurzweil PR, Lynch NM, Coleman S, Kearney B. Repair of horizontal meniscus tears: A systematic review. *Arthroscopy* 2014;30(11):1513-1519.
18. Lombardo S, Eberly V. Meniscal cyst formation after all-inside meniscal repair. *Am J Sports Med* 1999;27(5):666-667.
19. Pujol N, Salle De Chou E, Boisrenoult P, Beaufils P. Platelet-rich plasma for open meniscal repair in young patients: Any benefit? *Knee Surg Sports Traumatol Arthrosc* 2015;23(1):51-58.
20. Pujol N, Panarella L, Selmi TAS, Neyret P, Fithian D, Beaufils P. Meniscal healing after meniscal repair: A CT arthrography assessment. *Am J Sports Med* 2008;36(8):1489-1495.
21. Lee SW, Chun YM, Choi CH, et al. Single-leaf partial meniscectomy in extensive horizontal tears of the discoid lateral meniscus: Does decreased peripheral meniscal thickness affect outcomes? (Mean four-year follow-up). *Knee* 2016;23(3):472-477.
22. Haemer JM, Wang MJ, Carter DR, Giori NJ. Benefit of single-leaf resection for horizontal meniscus tear. *Clin Orthop Relat Res* 2007;457:194-202.
23. Brown MJ, Farrell JP, Kluczynski MA, Marzo JM. Biomechanical effects of a horizontal medial meniscal tear and subsequent leaflet resection. *Am J Sports Med* 2016;44(4):850-854.
24. Kohn D, Wirth CJ, Reiss G, et al. Medial meniscus replacement by a tendon autograft. Experiments in sheep. *J Bone Joint Surg Br* 1992;74(6):910-917.
25. Rönnblad E, Rotzius P, Eriksson K. Autologous semitendinosus tendon graft could function as a meniscal transplant. *Knee Surg Sports Traumatol Arthrosc* 2022;30(5):1520-1526.
26. Billières J, Pujol N. Meniscal repair associated with a partial meniscectomy for treating complex horizontal

cleavage tears in young patients may lead to excellent long-term outcomes. *Knee Surg Sports Traumatol Arthrosc* 2019;27(2):343-348.
27. Morris JH, Magnussen RA, DiBartola AC, et al. Patient outcomes after horizontal cleavage tear repair: A systematic review. *Arthroscopy* 2020;36(8):2316-2331.
28. Dube B, Bowes MA, Kingsbury SR, Hensor EMA, Muzumdar S, Conaghan PG. Where does meniscal damage progress most rapidly? An analysis using three-dimensional shape models on data from the Osteoarthritis Initiative. *Osteoarthritis Cartilage* 2018;26(1):62-71.
29. Tack A, Mukhopadhyay A, Zachow S. Knee menisci segmentation using convolutional neural networks: Data from the Osteoarthritis Initiative. *Osteoarthritis Cartilage* 2018;26(5):680-688.
30. Arno S, Bell CP, Uquillas C, Borukhov I, Walker PS. Tibiofemoral contact mechanics following a horizontal cleavage lesion in the posterior horn of the medial meniscus. *J Orthop Res* 2015;33(4):584-590.
31. Nagura I, Yagi M, Kokubu T, Yoshiya S, Kurosaka M. Generation of meniscal cyst after arthroscopic meniscal repair. *Arthroscopy* 2004;20(8):869-871.