Radial Meniscal Tears: Updates on Repair Techniques and Outcomes

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Contents

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8.1 Introduction

Radial tears of the meniscus are oriented perpendicular to the circumferential fibers and appear in a vertical orientation, which extend from the inner edge of the meniscus toward the periphery. This chapter will discuss the diagnosis, biomechanics, treatment, and clinical outcomes of radial meniscal tears.

Radial tears are classified as partial or complete (Fig. 8.1) based on the depth of the tear. Complete tears disrupt the circumferential fibers located at the periphery of the meniscus, impairing the meniscal ability to transmit circumferential hoop stresses during load bearing and shock absorption. Variability exists in the depth of radial tears, where depth refers to the perpendicular meniscal length extending from the central white-white zone through to the periphery. A small radial tear involving less than 60 % of the depth of the meniscus does not significantly influence tibiofemoral biomechanics, whereas a large radial tear that extends greater than 90 % of the depth of the meniscus to the periphery results in a significant alteration in peak compartment pressures [1]. Additionally, larger partial radial tears increase the risk of progression to complete tears [2]. Radial tears that have greater involvement of the periphery can result in increased joint contact stress, meniscal extrusion, meniscal root pathology, osteoarthritis, and long-term cartilage damage [3–5]. Consequently, radial tears left

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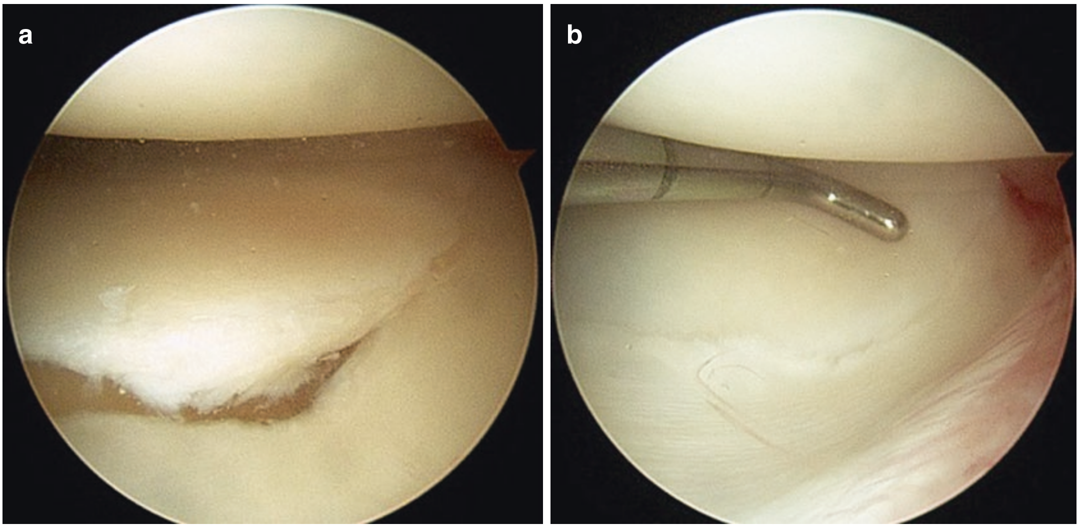

Fig. 8.1 Arthroscopic images of the left knee lateral meniscus demonstrating (**a**) partial and (**b**) complete radial tears at the junction of the anterior horn and body

untreated can have a profound biomechanical detrimental effect on knee health, greater than longitudinal (vertical) tears.

The incidence of radial tears has been reported to be 14–15 % of all meniscus tears, with the majority involving the junction of the middle and posterior third of the medial and lateral menisci [6, 7]. Radial meniscus tears are also commonly identified in the lateral meniscus after an acute rupture of the anterior cruciate ligament (ACL).

8.2 Diagnosis

Radial tears of the meniscus do not have specific history or physical examination findings; therefore, MRI has become useful for qualifying the type of meniscus tear. Radial tears present unique challenges and entail special consideration; correct preoperative characterization of radial tears can allow better operative planning and preoperative patient counseling. MRI has demonstrated high sensitivity in the detection of meniscus tears; however, identification of the tear as "radial" in orientation has been less reliable [6]. Classically, four signs have been described to detect and characterize radial tears [6].

1. *Truncated triangle sign* describes the amputated edge on sagittal and coronal images if the tear parallels the image orientation (Fig. 8.2).
2. *Cleft sign* simply describes a gap of the meniscus on sagittal and coronal images (Fig. 8.3).
3. *Marching cleft sign* is observed with obliquely oriented tears, typically occurring at the junction of the anterior horn and body. It is demonstrated with a migrating cleft on consecutive images.
4. *Ghost meniscus sign* refers to the complete absence of meniscal tissue that results with diastasis of the radial tear (Fig. 8.4).

Typically, a truncated triangle sign represents a shearing of the free edge, with preservation of its peripheral portion, often as a result of a partial radial tear. In contrast, a ghost meniscus has no in-plane residual normal meniscus signal, often as a result of a full-thickness tear. The two most reliable signs have been the cleft and truncated

Fig. 8.2 Truncated triangle sign revealing a radial tear of the left knee lateral meniscus

Fig. 8.3 Cleft sign of the left knee lateral meniscus indicating a radial tear

triangle signs, with the use of these two signs increasing MR detection identification rates of radial tears to 76 % [6]. The use of all four signs

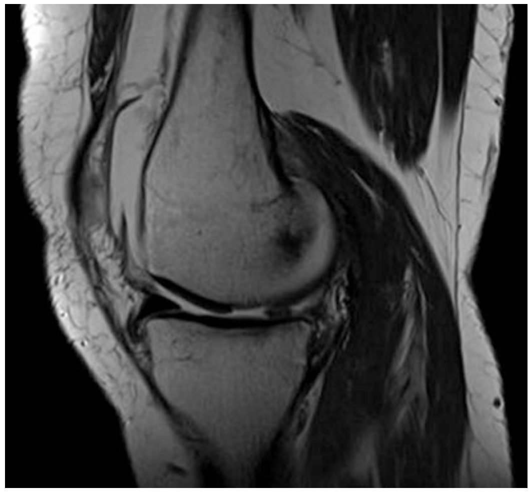

Fig. 8.4 Sagittal MRI with the absence of the posterior horn of the medial meniscus, demonstrating a ghost sign indicative of a radial tear

increases the rate of detection for radial tears to 89 % [6].

8.3 Treatment

8.3.1 Nonoperative Treatment of Radial Tears

Nonoperative treatment may be considered for asymptomatic partial radial tears, often found incidentally when other structures of the knee have been injured.

Radial tears, including those extending into the vascular zone (outer one third of the meniscus), have shown low rates of spontaneous healing and often progress to complete tears [8, 9]. This is in contrast to vertical longitudinal tears, which have an increased potential for spontaneous healing, thought to be due to the creation of a vascular channel to the inner avascular portion of the meniscus. Nonoperative management can be considered for symptom management of radial tears, which can include rest, activity modification, and use of anti-inflammatory modalities or corticosteroid injections. This may have a positive effect on symptom reduction, with no evidence of healing of the meniscus tear.

8.3.2 Partial Meniscectomy of Radial Tears

Previously, radial tears were regarded as unrepairable and were managed with partial meniscectomy, with the goal of reducing mechanical symptoms in a straightforward manner [10]. In most circumstances, partial radial tears located in the central, avascular zone can be debrided to a stable edge, working to preserve as much native tissue as possible and attempting to decrease the chance of tear extension into a deeper zone (Fig. 8.5). The extent of meniscal debridement, however, should never extend beyond the original depth of the tear.

Meniscectomy to reach a stable edge has been shown to reduce joint surface contact area by 75 % and increase compartment peak load contact stresses by more than 350 %. As little as 20 % of meniscal debridement has been shown to increase tibiofemoral contact forces [11]. Despite the benefits of short-term pain relief, partial meniscectomy has been associated with a

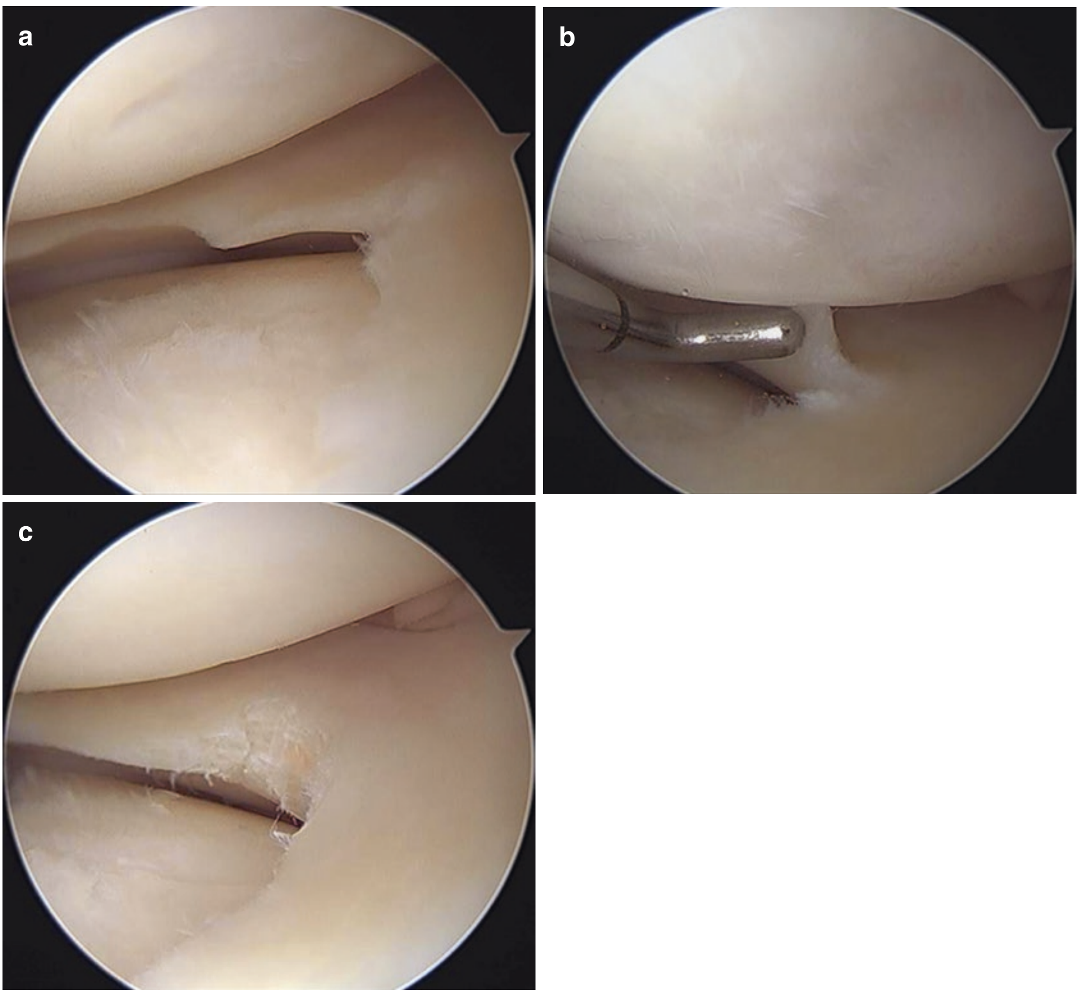

Fig. 8.5 Arthroscopic images of the left knee lateral meniscus demonstrating (**a**, **b**) partial radial tear (**c**) following debridement to a stable edge

substantially increased incidence of progressive degenerative changes [12].

Currently, there is limited evidence to detail the length of a partial tear that may progress to a deeper tear. Moreover, evidence-based criteria in guiding surgical treatment based on the depth of the tear are lacking. With the increasing concern of long-term osteoarthritis after meniscectomy and the risk of progression to complete tears, meniscal preservation with repair of radial tears should be considered.

8.3.3 Repair of Meniscal Radial Tears

The goal of repairing radial tears, regardless of technique, is restoring the circumferential meniscal fibers that work to resist hoop stresses, vital to its role in load transmission and energy absorption. Recently, a variety of radial tear repair techniques have emerged as viable alternatives to meniscectomy [13–17]. These modern repair techniques aim to improve patient outcomes and diminish long-term degenerative damage from loss of this chondroprotective structure.

Generally, two techniques have been described for arthroscopic repair: all-inside horizontal mattress repair or inside-out repair with single, double, or crossed horizontal mattress sutures. Both inside-out horizontal mattress repairs and in situ pull-out suture repairs have been reported to decrease tibiofemoral contact pressures and increase contact area [1, 18].

8.3.3.1 Inside-Out Meniscal Radial Repair Technique

The inside-out technique remains the standard for repair of radial meniscus tears. The current technique involves a double horizontal suture technique with parallel sutures 5 mm and 10 mm from the meniscal rim [15, 19–21]. The sutures are shuttled across the radial tear via a cannula, using a suture-passing device and tying horizontal mattress sutures above and below the radial tear (Fig. 8.6). This technique requires an additional incision for retrieval of the sutures. The inside-out technique allows the surgeon more control in tensioning the sutures; however, it is technically more challenging and may require additional personnel to retrieve sutures while protecting the surrounding neurovascular structures [15, 19, 20].

Furthermore, Bedi et al. [22] reported that inside-out double horizontal suture repair of a radial tear involving 90 % of the depth does not restore the location of the pressure peak to that of the intact knee. It was hypothesized that this was due to the horizontal sutures being orientated parallel with the circumferential meniscal fibers which are important for transmitting hoop stresses. In response, Matsubara et al. developed a cross-suture technique in which two stitches cross over each other at the site of the meniscal tear [21]. Theoretically, this allows for capturing a greater portion of the circumferential fibers because the direction of the sutures is oblique to, rather than parallel to, the fibers. The authors found this provided superior stiffness and a greater ultimate load to failure when biomechanically tested [21]. Although some authors have reported favorable healing rates of the peripheral meniscus with these techniques [15], other authors have reported an unacceptably low rate of meniscal healing, particularly when the tear location is in the central, white-white zone of the meniscus [23].

To decrease the need for further surgery, Haklar et al. [20] recommended performing a partial meniscectomy of the white-white portion of the meniscus while simultaneously performing a double inside-out horizontal mattress repair of radial midbody meniscal tears. Although they reported a high healing rate, which is favorable, the potential for a partial meniscectomy to lead to a detrimental effect over time on the articular cartilage persists.

Recent focus has moved toward improved stability of meniscal repairs and anatomically restoring the meniscus to its proper position. New techniques have been developed to augment horizontal suture repair constructs with transosseous tunnels [13, 24]. Biomechanical analysis by Bhatia et al. [24] demonstrated significantly less meniscal gapping and stronger ultimate failure loads, when compared to the classic double

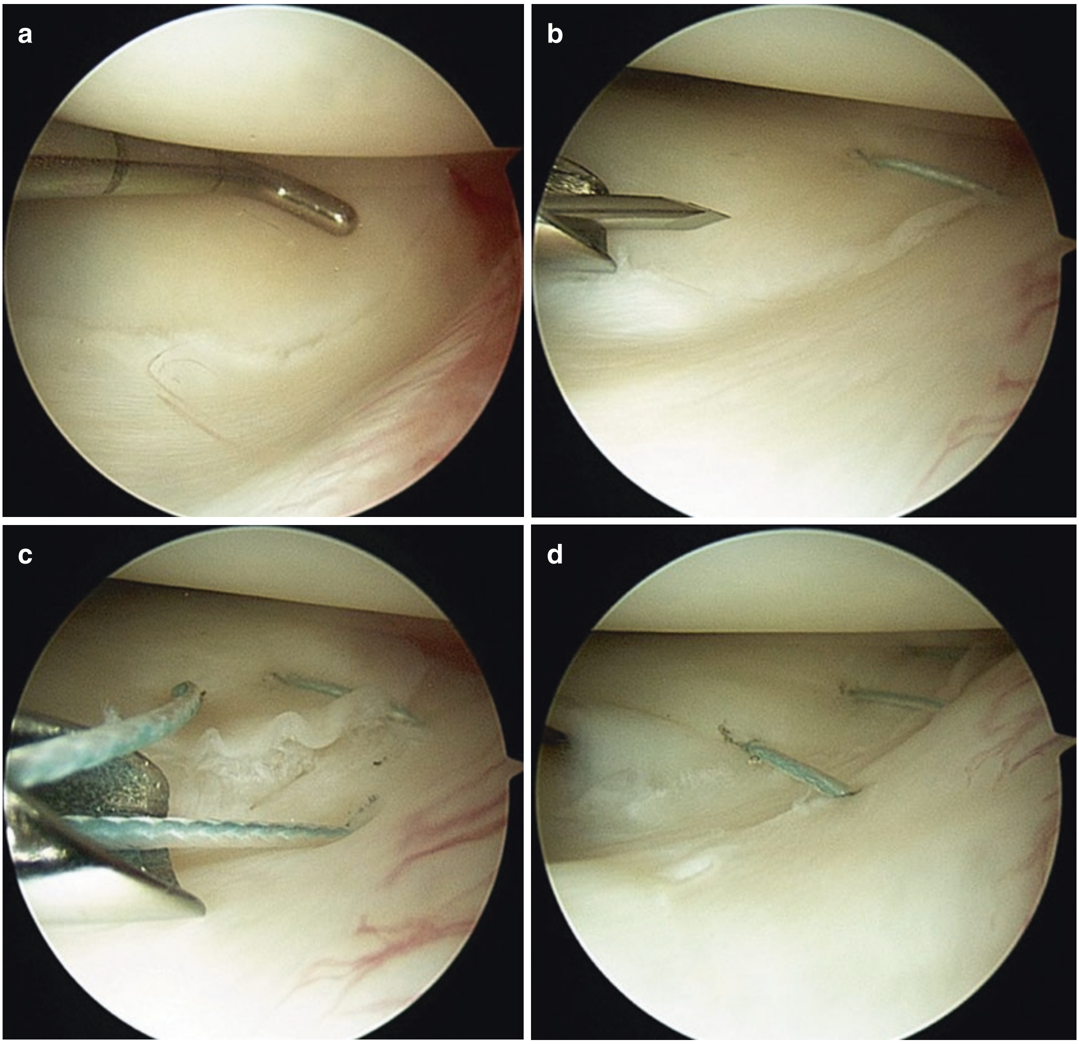

Fig. 8.6 Arthroscopic images of the left knee demonstrating an inside-out lateral meniscus repair. (**a**) Complete radial tear at the junction of the anterior horn and body. (**b**) Sutures are shuttled across the radial tear via a cannula, (**c**) using a suture-passing device and (**d**) tying horizontal mattress sutures above and below the radial tear

horizontal mattress technique. After each radial tear edge is released, one or two tunnels are placed at the meniscocapsular region of the tibia. Each torn edge of the meniscus is sutured superoinferiorly at the posterior corner of the tear edge, and sutures are shuttled through transtibial tunnels. The sutures can then be tied together over a button while directly visualizing the radial tear to ensure an accurate reduction. Once the transosseous portion of the repair is complete, two inside-out horizontal mattress sutures are additionally placed on both the superior and inferior portion of the meniscus as described above. Importantly, this technique allows for anchoring the meniscal tissue to the proximal tibia (Fig. 8.7). Both one- and two-tunnel techniques have been described, but to date no significant difference has been observed with respect to displacement or ultimate failure load [25]. The results of current clinical outcome studies are outlined in Table 8.1.

8.3.3.2 All-Inside Radial Repairs

In an effort to eliminate the need for a separate incision, as well as decreasing personnel demands, all-inside devices have been developed. The all-inside technique uses standard

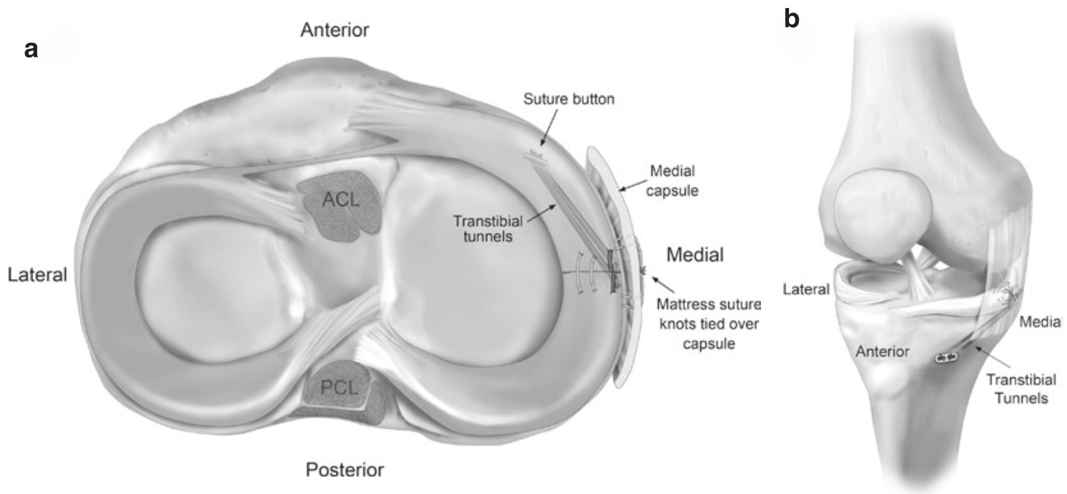

Fig. 8.7 (**a**) Superior and (**b**) anteromedial view of transtibial two-tunnel repair of a meniscal radial tear illustrating the crisscross transtibial tunnel technique in a left knee. Sutures were passed through an anterior and posterior tibial tunnel to the anteromedial cortex and tied together over a button. ACL, anterior cruciate ligament; PCL, posterior cruciate ligament [24]

Table 8.1 Studies with a minimum 2-year follow-up reporting radial tear inside-out meniscal repair techniques and outcomes

Study	Level of evidence	Number of patients	Mean follow-up, mo	Mean age, yr	Operative technique	Concurrent procedures	Outcomes reported
Anderson et al. [19]	IV	8	70.5	29	Inside-out sutures	ACL reconstruction (8/8)	Lysholm, IKDC, Tegner
Haklar et al. [20]	IV	5	31	28.6	Inside-out double horizontal sutures	None	Lysholm, MRI
Ra et al. [15]	IV	12	12	–	Inside-out with fibrin clots	ACL reconstruction (2/12)	Lysholm, Tegner, second-look arthroscopy

mo months, *yr* year

anteromedial and anterolateral portals for suture placement [15, 16, 23, 26]. This technique has been reported to be less technically challenging; however, proper tensioning and securing the sutures arthroscopically can be more challenging when compared with using an open posterior incision.

There are several all-inside meniscus repair devices. Most commonly, these devices deliver an anchor containing self-adjusting sutures across the tear. Two passes of an insertion needle on either side of the tear place an anchor in the extra-articular recess behind the meniscus on the capsular surface. Sutures spanning the tear are tensioned, and a self-locking knot is tightened to close the gap in the meniscus. Likewise, fixation is possible without the use of anchor devices. Systems have been designed to deliver a needle through the meniscus tear to capture a suture loop from the instrument's tip, which can then be tensioned and tied to compress the meniscus repair site.

Although less invasive than inside-out techniques, the all-inside repair techniques are not without potential complications. In addition to neurovascular injury, irritation from the anchors and implant failure have been reported [27]. Furthermore, follow-up studies with MRI and second-look arthroscopy have demonstrated high rates of no healing or partial healing following all-inside radial tear repair [23, 28].

Currently, most all-inside devices work to place the suture horizontally in a fashion similar to that of an inside-out repair. All-inside horizontal sutures, however, fail to fully encircle the tear at the periphery. Additionally, horizontal sutures are oriented parallel to the longitudinal fibers of the meniscus, leading to suture cleavage through the meniscal tissue. As such, new techniques and all-inside devices have been developed to incorporate both vertical and horizontally oriented sutures, effectively encircling the meniscal fibers. A recent biomechanical study demonstrated the combined vertical and horizontal suture configuration resulted in lower displacement, higher load to failure, and greater stiffness compared with the classic horizontal inside-out technique [29]. The vertical loop tended to fail by suture breakage, while the horizontal loop failed when it tore through the tissues [29]. Vertical suture techniques have been described, but further literature support is needed.

A summary of clinical outcomes of all-inside techniques is summarized in Table 8.2.

8.4 Postoperative Rehabilitation Protocol

Previously, strict non-weight-bearing rehabilitation was instituted after repair of complete radial tears to reduce the potential for tear diastasis. Weight bearing increases hoop stresses, thus placing distraction forces on the repair, separating the tear margins, and preventing healing. Recently, some authors have chosen to allow partial weight bearing postoperatively and have reportedly demonstrated equivalent healing rates [30]. Further investigation of postoperative rehabilitation protocols is warranted.

8.5 Outcomes of Radial Tear Repairs

Overall, the current level of evidence on clinical outcomes after meniscal radial tear repairs is scarce [31]. Outcomes are typically reported as failure due to subsequent reoperation and meniscectomy. Patient-reported outcome tools are varied and include Lysholm, IKDC, and Tegner scores. A recent systematic review of six level IV studies demonstrated that surgical repair of meniscal radial tears led to improved patient outcomes in most patients at an average follow-up of 38.4 months [31]. They reported two general categories of radial repair techniques: an inside-out suture technique and an all-inside suture technique. Similar to repair of other meniscus tear patterns, outcomes after inside-out suture

Table 8.2 Studies with a minimum 2-year follow-up reporting radial tear all-inside meniscal repair techniques and outcomes

Study	Level of evidence	Number of patients	Mean follow up, mo	Mean age, yr	Operative technique	Concurrent procedures	Outcomes reported
Choi et al. [23]	IV	14	36.3	29.9	All-inside with absorbable sutures	None	Lysholm, Tegner, MRI, second-look arthroscopy
Song et al. [16]	IV	15	24	34	All-inside FAST-FIX repair system	ACL reconstruction (15/15)	Lysholm, Tegner, MRI, second look arthroscopy

repair (Lysholm, 86.9–94.2; IKDC, 81.6–92) were comparable to all-inside repair (Lysholm, 94–95.6; IKDC, 90). Literature comparing the effectiveness and complications of the inside-out repair technique and the all-inside technique in isolated meniscal tears has consistently demonstrated no differences in clinical failure rate or subjective outcomes [27]. Clinical failure rate in isolated meniscal tears of all types has been cited between 17 and 19 % [27]. More nerve symptoms have been associated with the inside-out technique while more implant-related complications are associated with the all-inside technique. Unfortunately, much of the literature does not isolate radial tear repairs from other tear patterns. Additionally, most studies are confounded by concomitant ACL injury and/or reconstruction. Hence, the outcomes of radial tear treatment have a paucity of published results.

8.6 Conclusions/Future Directions

Meniscal preservation with repair of radial tears results in improved short-term clinical outcomes; however, long-term outcomes remain unknown. Significant differences between repair and partial meniscectomy may only occur in long-term (10+ years) follow-up, as prior studies have reported worse long-term outcomes for partial meniscectomy compared with short-term results [32, 33]. At this time, no supported conclusions can be made about the long-term effects of meniscal repair and preservation of its chondroprotective function; however, we do know that resected or ignored meniscal tears do poorly [3, 5, 8].

While the biomechanics, natural history, and treatment techniques of radial tears have been increasingly investigated, a paucity of long-term clinical outcomes remains. Future studies will require particular attention to defining and isolating radial tears from other tear patterns, with stratification of concomitant injuries and consistency in outcome reporting.

References

1. Bedi A, Kelly NH, Baad M, et al. Dynamic contact mechanics of the medial meniscus as a function of radial tear, repair, and partial meniscectomy. J Bone Joint Surg Am. 2010;92(6):1398–408. doi:10.2106/JBJS.I.00539.
2. Mononen ME, Jurvelin JS, Korhonen RK. Effects of radial tears and partial meniscectomy of lateral meniscus on the knee joint mechanics during the stance phase of the gait cycle-A 3D finite element study. J Orthop Res. 2013;31(8):1208–17. doi:10.1002/jor.22358.
3. Badlani JT, Borrero C, Golla S, Harner CD, Irrgang JJ. The effects of meniscus injury on the development of knee osteoarthritis: data from the osteoarthritis initiative. Am J Sports Med. 2013;41(6):1238–44. doi:10.1177/0363546513490276.
4. Lerer DB, Umans HR, Hu MX, Jones MH. The role of meniscal root pathology and radial meniscal tear in medial meniscal extrusion. Skeletal Radiol. 2004;33(10):569–74. doi:10.1007/s00256-004-0761-2.
5. Peña E, Calvo B, Martínez MA, Palanca D, Doblaré M. Finite element analysis of the effect of meniscal tears and meniscectomies on human knee biomechanics. Clin Biochem. 2005;20(5):498–507. doi:10.1016/j.clinbiomech.2005.01.009.
6. Harper KW, Helms CA, Lambert HS, Higgins LD. Radial meniscal tears: significance, incidence, and MR appearance. Am J Roentgenol. 2005;185(6):1429–34. doi:10.2214/AJR.04.1024.
7. Magee T, Shapiro M, Williams D. MR accuracy and arthroscopic incidence of meniscal radial tears. Skeletal Radiol. 2002;31(12):686–9. doi:10.1007/s00256-002-0579-8.
8. CB W, Lundberg M, Hamberg P, DeHaven KE, Gillquist J. Non-operative treatment of meniscal tears. J Bone Joint Surg Am. 1989;71(2):811–22.
9. Foad A. Self-limited healing of a radial tear of the lateral meniscus. Knee Surg Sports Traumatol Arthrosc. 2012;20(5):933–6. doi:10.1007/s00167-011-1660-4.
10. McDermott I. Meniscal tears, repairs and replacement: their relevance to osteoarthritis of the knee. Br J Sports Med. 2011;45(4):292–7. doi:10.1136/bjsm.2010.081257.
11. Seitz AM, Lubomierski A, Friemert B, Ignatius A, Dürselen L. Effect of partial meniscectomy at the medial posterior horn on tibiofemoral contact mechanics and meniscal hoop strains in human knees. J Orthop Res. 2012;30(6):934–42. doi:10.1002/jor.22010.
12. Baratz ME, Fu FH, Mengato R. Meniscal tears: The effect of meniscectomy and of repair on intraarticular contact areas and stress in the human knee: a preliminary

report. Am J Sports Med. 1986;14(4):270–5. doi:10.1177/036354658601400405.
13. James EW, LaPrade CM, Feagin JA, LaPrade RF. Repair of a complete radial tear in the midbody of the medial meniscus using a novel crisscross suture transtibial tunnel surgical technique: a case report. Knee Surg Sports Traumatol Arthrosc. 2014;23(9):2750–5. doi:10.1007/s00167-014-3089-z.
14. Nakata K, Shino K, Kanamoto T, et al. New technique of arthroscopic meniscus repair in radial tears. In: Sports injuries. Berlin/Heidelberg: Springer; 2012. p. 305–11. doi:10.1007/978-3-642-15630-4_41.
15. Ra HJ, Ha JK, Jang SH, Lee DW, Kim JG. Arthroscopic inside-out repair of complete radial tears of the meniscus with a fibrin clot. Knee Surg Sports Traumatol Arthrosc. 2013;21(9):2126–30. doi:10.1007/s00167-012-2191-3.
16. Song H-S, Bae T-Y, Park B-Y, Shim J, In Y. Repair of a radial tear in the posterior horn of the lateral meniscus. Knee. 2014;21(6):1185–90. doi:10.1016/j.knee.2014.07.018.
17. Saliman JD, Bolano LE, Grana WA, et al. The circumferential compression stitch for meniscus repair. Arthrosc Tech. 2013;2(3):e257-64. doi:10.1016/j.eats.2013.02.016.
18. LaPrade CM, Jansson KS, Dornan G, et al. Altered tibiofemoral contact mechanics due to lateral meniscus posterior horn root avulsions and radial tears can be restored with in situ pull-out suture repairs. J Bone Joint Surg Am. 2014;96(6):471–9. doi:10.2106/JBJS.L.01252.
19. Anderson L, Watts M, Shapter O, et al. Repair of radial tears and posterior horn detachments of the lateral meniscus: minimum 2-year follow-up. Arthrosc J Arthrosc Relat Surg. 2010;26(12):1625–32. doi:10.1016/j.arthro.2010.07.020.
20. Haklar U, Kocaoglu B, Nalbantoglu U, Tuzuner T, Guven O. Arthroscopic repair of radial lateral meniscus tear by double horizontal sutures with inside-outside technique. Knee. 2008;15(5):355–9. doi:10.1016/j.knee.2008.05.012.
21. Matsubara H, Okazaki K, Izawa T, et al. New suture method for radial tears of the meniscus: biomechanical analysis of cross-suture and double horizontal suture techniques using cyclic load testing. Am J Sports Med. 2012;40(2):414–8. doi:10.1177/0363546511424395.
22. Bedi A, Kelly N, Baad M, et al. Dynamic contact mechanics of radial tears of the lateral meniscus: implications for treatment. Arthrosc J Arthrosc Relat Surg. 2012;28(3):372–81. doi:10.1016/j.arthro.2011.08.287.
23. Choi N-H, Kim T-H, Son K-M, Victoroff BN. Meniscal repair for radial tears of the midbody of the lateral meniscus. Am J Sports Med. 2010;38(12):2472–6. doi:10.1177/0363546510376736.
24. Bhatia S, Civitarese DM, Turnbull TL, et al. A novel repair method for radial tears of the medial meniscus: biomechanical comparison of transtibial 2-tunnel and double horizontal mattress suture techniques under cyclic loading. Am J Sports Med. 2015. doi:10.1177/0363546515615565.
25. LaPrade CM, LaPrade MD, Turnbull TL, Wijdicks CA, LaPrade RF. Biomechanical evaluation of the transtibial pull-out technique for posterior medial meniscal root repairs using 1 and 2 transtibial bone tunnels. Am J Sports Med. 2015;43(4):899–904. doi:10.1177/0363546514563278.
26. Yoo JC, Ahn JH, Lee SH, Lee SH, Kim JH. Suturing complete radial tears of the lateral meniscus. 2007;23. doi:10.1016/j.arthro.2006.07.056.
27. Grant JA, Wilde J, Miller BS, Bedi A. Comparison of inside-out and all-inside techniques for the repair of isolated meniscal tears: a systematic review. Am J Sports Med. 2012;40(2):459–68. doi:10.1177/0363546511411701.
28. Rosso C, Kovtun K, Dow W, et al. Comparison of all-inside meniscal repair devices with matched inside-out suture repair. Am J Sports Med. 2011;39(12):2634–9. doi:10.1177/0363546511424723.
29. Beamer BS, Masoudi A, Walley KC, et al. Analysis of a new all-inside versus inside-out technique for repairing radial meniscal tears. Arthrosc J Arthrosc Relat Surg. 2015;31(2):293–8. doi:10.1016/j.arthro.2014.08.011.
30. Noyes FR, Barber-Westin SD. Arthroscopic repair of meniscus tears extending into the avascular zone with or without anterior cruciate ligament reconstruction in patients 40 years of age and older. Arthroscopy. 2000;16(8):822–9. doi:10.1053/jars.2000.19434.
31. Moulton SG, Bhatia S, Civitarese DM, Frank RM, Dean CS, LaPrade RF. Surgical techniques and outcomes of repairing meniscal radial tears: a systematic review. Arthrosc J Arthrosc Relat Surg. 2016;32:1–7. doi:10.1016/j.arthro.2016.03.029.
32. Stein T, Mehling AP, Welsch F, von Eisenhart-Rothe R, Jager A. Long-term outcome after arthroscopic meniscal repair versus arthroscopic partial meniscectomy for traumatic meniscal tears. Am J Sports Med. 2010;38(8):1542–8. doi:10.1177/0363546510364052.
33. Hoser C, Fink C, Brown C, Reichkendler M, Hackl W, Bartlett J. Long-term results of arthroscopic partial lateral meniscectomy in knees without associated damage. J Bone Joint Surg Br. 2001;83(4):513–6. doi:10.1302/0301-620x.83b4.11364.