

TREATMENT OF MENISCAL LESIONS IN PROFESSIONAL FOOTBALLERS

FEATURE / K.BORQUE, M.JONES, M.LAUGHLIN, M.COHEN, D.JOHNSON & A.WILLIAMS

Introduction

Meniscal injuries in footballers are a common cause of missed game time and even have the potential to be career shortening. While the treatment approach must take into account the footballer's position, time in season, and contract status, goals remain the same: achieving the quickest safe return to play while protecting the long-term health of the joint [1]. Historically, meniscectomy has been the treatment of choice for isolated meniscal tears in elite footballers, with repairs reserved for tears with concomitant ligament injuries [2,3]. With growing evidence of the potential short and long term negative effects of meniscectomy [4-6], especially of the lateral meniscus, treatment is currently evolving to include more meniscal repairs [7-9].

Medial Versus Lateral Meniscus Tears

Across elite sport, lateral meniscectomies, compared to medial, have been shown to have increased post-operative effusions and missed game time [6], lower return to play rates [4], and are more career shortening even than ACL injuries [5]. Fortunately, Logan et al showed that lateral meniscus repairs heal at a higher rate than medial repairs in their elite athlete cohort [10]. Consequently, the authors strongly recommend repair of most lateral meniscus tears in footballers. In contrast, most medial meniscectomies are tolerated well, at least in the short and medium term, by elite footballers [2]. This positive short-term outcome must be balanced against the development of medial osteoarthritis [11], although this usually develops after sports career end.

Tears of the Lateral Meniscus

Longitudinal tears of the lateral meniscus

For the reasons stated above, longitudinal tears of the lateral meniscus are always repaired, even if involving degenerative tissue. The vast majority will heal well in athletes [10]. In contrast, there are frequent short and long term problems with lateral meniscectomy [6].

Radial tears of the lateral meniscus

Radial tears of the lateral meniscus are most commonly associated with an ACL rupture, but isolated radial tears do occur. These tears decrease the contact area and increase contact pressures in the posterolateral

tibia [12]. Although shorter than many longitudinal tears, the longitudinal fibres of the meniscus are torn and the lateral meniscus loses function akin to total/sub-total lateral meniscectomy [13].

It has previously been thought futile to repair these tears since only the peripheral portion of a radial tear has a good blood supply. However, repair usually leads to healing and

decreased articular contact pressures, likely protecting the chondral surfaces in the short and long term [6,14,15]. For this reason, the authors strongly encourage repair of these tears in footballers. The authors prefer inside-out repair with a combination of vertical 'rip-stop' sutures either side of the tear spanned by an average of 3 horizontal mattress sutures as seen in Figure 2.

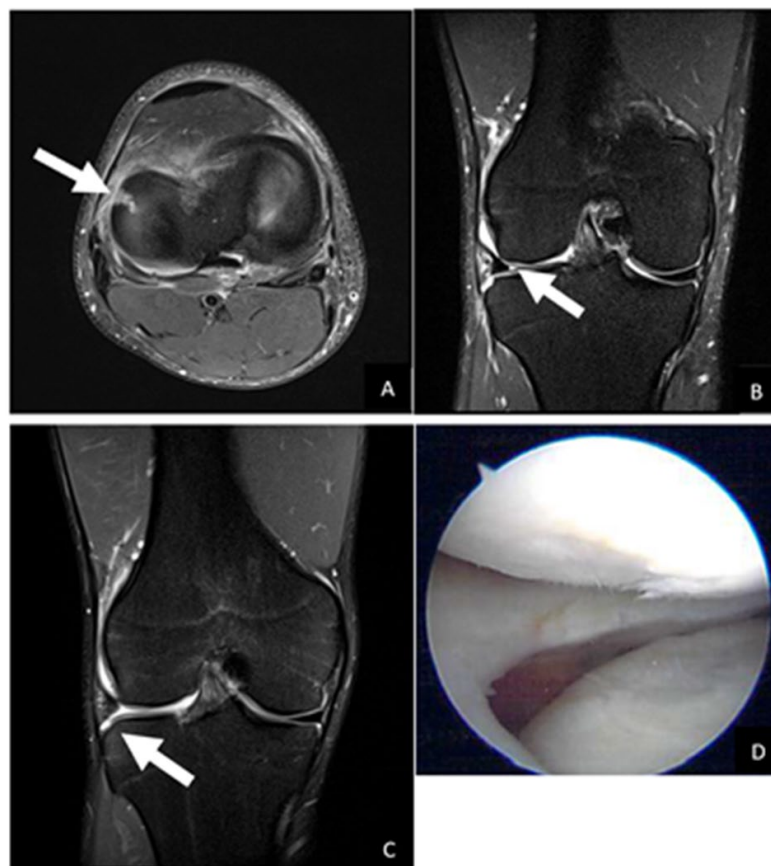


Figure 1. Degenerative changes in the lateral compartment of the knee, the consequence of a partial lateral meniscectomy in a 23 year old professional footballer.

1A & 1B: Initial post-injury axial (1A) and coronal (1B) images of a radial tear of the lateral meniscus (white arrows) in a professional footballer who then underwent partial lateral meniscectomy by a surgeon elsewhere before being referred for a second opinion.

1C: Coronal image taken 2 months post-meniscectomy showing lack of meniscal engagement in tibio-femoral articulation and therefore lack of meniscal function

1D: Arthroscopic image of the lateral compartment 4 months post-meniscectomy, at arthroscopy undertaken for persistent knee swelling and inability to return to sport, showing significant chondral damage

Images reprinted with permission from Springer. Borque KA, Jones M, Cohen M, Johnson D, Williams A. Evidence-based rationale for treatment of meniscal lesions in athletes. *Knee Surg Sport Traumatol Arthrosc* 2021. <https://doi.org/10.1007/s00167-021-06694-6>.

Complex tears of the lateral meniscus

Based on the short and long-term negative effects of lateral meniscectomies, meniscal repair is considered even in complex lateral meniscal tears. The literature shows lateral meniscal repairs have higher rates of healing than medial meniscal repairs in both the isolated setting in elite athletes and when combined with ACL reconstruction in the general population [10,16]. In footballers, regardless of age, it is the authors' view that repair should almost always be attempted even with tears traditionally thought to be unfavourable for suturing.

Anterior horn lateral meniscus tear

The average human makes 1-2 million cycles of lower limb joint motion a year with running athletes undertaking many more. As a result, attritional damage to the menisci occurs. During knee flexion the lateral femur moves significantly posteriorly dragging the lateral meniscus with it, in contrast the medial femoral condyle moves much less [17]. The anterior horns of the menisci move more than their posterior horns, and thus the lateral meniscus anterior horn moves the most of all [18]. Therefore, it is not surprising that attritional longitudinal fissuring of the anterior horn of the lateral meniscus occurs so frequently that it should be viewed as 'normal' in the running athlete and only rarely needs surgical intervention.

On occasion these splits detach at one end and the fibres of the affected portion of the meniscus curl up forming a lump of meniscal tissue close to the anterior root which can irritate the fat pad in extension. The footballer will complain of anterolateral pain on knee extension which is especially problematic for striking a ball. Even in this situation surgery can frequently be avoided with an ultrasound guided injection of steroid to the affected portion of fat pad. If the footballer is unable to return to play following an injection and surgery is indicated, great care is taken to remove as little tissue as possible; only unstable prominent tissue is resected and the remaining fissures are then repaired if needed, but usually left alone.

Horizontal (cleavage tears) / lateral meniscal cysts

These tears are the most common degenerative tears seen with elite footballers, whereas the normal population typically degenerative lesions are medial. Such tears are often asymptomatic and should not be operated upon without good reason. If symptoms are present, they frequently relate to an associated

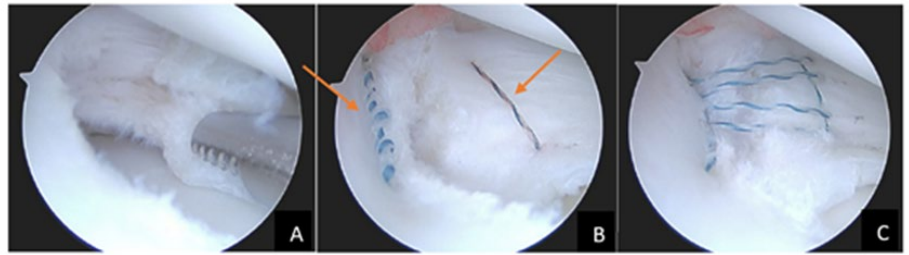


Figure 2. A complex, predominantly radial tear of the lateral meniscus in a 17 year old footballer

2A A radial tear between the anterior one third and posterior two-thirds of the lateral meniscus following gentle debridement of the tear to 'freshen' the tear and encourage bleeding

2B Two vertical sutures (red arrows) were placed first to prevent pull out of the horizontal sutures

2C Four horizontal sutures were placed to reduce and compress the tear

Images reprinted with permission from Springer. Borque KA, Jones M, Cohen M, Johnson D, Williams A. Evidence-based rationale for treatment of meniscal lesions in athletes. *Knee Surg Sport Traumatol Arthrosc* 2021. <https://doi.org/10.1007/s00167-021-06694-6>.

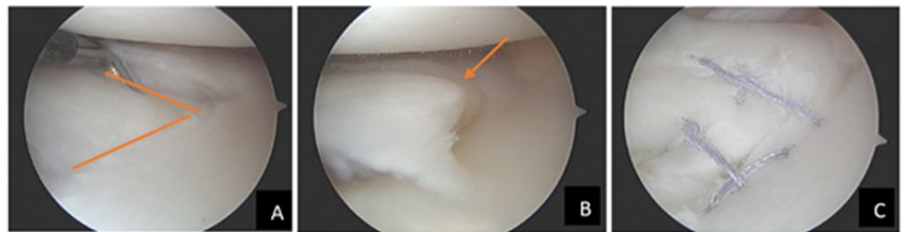


Figure 3. A chronic complex tear in the lateral meniscal body of a 17 year old volleyball player

3A The tear pattern is delineated by the orange lines.

3B The chronicity of the tear is evident by the rounded edges of the torn fragment.

3C The longitudinal component was repaired first followed by repair of the radial component. Healing was confirmed by MRI 4 months post-operatively

Images reprinted with permission from Springer. Borque KA, Jones M, Cohen M, Johnson D, Williams A. Evidence-based rationale for treatment of meniscal lesions in athletes. *Knee Surg Sport Traumatol Arthrosc* 2021. <https://doi.org/10.1007/s00167-021-06694-6>.

cyst irritating the iliotibial band rather than the tear itself. In this scenario, the first step should be non-operative. With ultrasound scan guidance an experienced radiologist can not only inject the meniscal cyst with steroid or platelet-rich plasma, but also disrupt it with multiple passes of a large bore needle to break it down. It is rarely possible to actually aspirate the gelatinous material out of the cyst, but this is frequently not necessary for resolution of pain. Only when this treatment fails should surgery be considered. Excision of the degenerative tissue in the central meniscus body is performed with gentle application of a shaver inserted through the horizontal cleavage, followed by repair of the remaining meniscus if at all possible. If resection is necessary, then that should be undertaken as sparingly as possible.

Posterior root lateral meniscus tear

Posterior root tears of the lateral meniscus almost always occur with ACL ruptures and are more common in injuries sustained playing contact sports [19-21]. Due to

their importance in load sharing, and their role in resisting anterior tibial translation and internal rotation, they should be repaired at the same time as undertaking ACL reconstruction [22-26].

Tears of the Medial Meniscus
Isolated Longitudinal tears of medial meniscus

Isolated longitudinal tears, including bucket handle tears, of the medial meniscus present the most difficult treatment decisions for clinicians involved in managing footballers. On the one hand, partial medial meniscectomy leads to predictable and reliable high return to play (RTP) rates. On the other hand, loss of meniscal tissue potentially leads to osteoarthritis in the long term [11]. The authors' experience is that, in great contrast to footballers who have undergone lateral meniscectomy, it is very rare for a player to retire prematurely due to the arthritic consequences of medial meniscectomy.

When making a treatment decision, factors such as tear distance from the periphery and athlete age impact healing and should be considered. Repairs of tears more than 4 mm from the periphery have shown higher rates of failure while repairs less than 2 mm from the periphery have shown increased healing potential [27,28]. Age is another factor with repair typically reserved for footballers younger than 18-20 years. The decision to perform a meniscectomy versus repair must be made in combination with the footballer, discussing the short- and long-term effects of each option. In contrast to isolated tears, due to much higher healing rates and the importance of the medial meniscus as secondary stabiliser aiding the ACL, longitudinal medial meniscal tears in the context of ACL reconstruction should be repaired.

Degenerative tears of medial meniscus

Degenerative tears are generally found in the posterior third to half of the medial meniscus and have poor healing potential [27,29]. These are frequently noticed as incidental findings on an MRI undertaken for another complaint and as such should be left alone. Nevertheless, a minority are genuinely symptomatic—especially those with an unstable fragment lodged between the MCL and tibia. Initial treatment includes a short term of rest plus physiotherapy. If there is an effusion, drainage and injection of hyaluronic acid (HLA) and/or platelet rich plasma (PRP) is considered [30]. Surgery is only considered after failure of non-operative measures and involves resection of as little tissue as possible.

Posterior root medial meniscus tear

Isolated posterior root medial meniscus tears are uncommon, but untreated they can be devastating. The footballer often describes a twisting injury with the knee in a flexed position and may describe a 'popping' sensation. They tend to present with posterior pain in deep flexion, but little or no swelling, lack of joint line tenderness, and a negative McMurray's sign [31]. Due to this, diagnosis can be difficult and high clinical suspicion is required. Medial meniscus posterior root repair restores the competence of the medial meniscus by addressing meniscal extrusion and should be attempted in all cases, even in the presence of established chondral damage [32].

Concomitant meniscal tears with ACL Injury

Meniscal injuries have been reported to occur in between 41% and 82% of ACL injuries with increased incidence noted with participation in contact sports [20]. While classical teaching states that acute ACL injuries result in lateral meniscus tears and

chronic ACL injuries lead to medial meniscal tears [33], the authors have found that both medial and lateral meniscal pathology is frequently found in elite footballers with ACL tears, likely a reflection of the greater forces that occur at high levels of sport.

Repair of a meniscus tear in the setting of an ACL injury should be the first choice knowing the importance of the menisci as secondary stabilisers for the ACL [22,26,34–37]. Meniscal integrity has been shown to be predictive of laxity and survivorship of the ACL graft following ACL reconstruction [38,39]. Fortunately multiple studies have suggested that meniscal repair is more likely to be successful when combined with an ACL reconstruction than when performed in isolation [28,29,40–42].

Biologic augmentation

Healing of meniscal repair depends on vascularity in the menisci, which is best peripherally and least centrally. Tear preparation prior to attempting repair is very important and every effort is made to improve the biological environment to increase chances of healing. Based on current research, the authors routinely use a rasp and gentle application of a power shaver to the torn meniscus edges and adjacent synovium [43,44], inject PRP into the suture line using spinal needles [45], and undertake bone marrow stimulation through microfracture [46] of the lateral wall of the intercondylar notch in isolated meniscal repairs.

Post-operative Rehab

Post-operatively full active and passive extension is encouraged immediately for all patients. Meniscectomies are allowed to weight bear as tolerated. The exception is when bone marrow oedema is present on MRI, in which case the footballer is limited to 3 weeks partial weight-bearing, after which full weight bearing is allowed once knee extensor

strength has been restored [47]. In these cases, use of an 'off-loader' brace is considered.

For meniscal repairs, weight bearing status and range of motion is determined by the type of meniscus tear [48]. Repairs of radial tears and root tears are kept non-weight bearing for four weeks, followed by two weeks of partial weight bearing [48]. If coronal plane alignment is unfavourable then an off-loader brace is worn for weight-bearing activity until the end of 12 weeks from surgery. Longitudinal tears are allowed to weight bear as tolerated, as weight bearing compresses the tear.

Flexion causes posterior meniscal motion especially over 60 degrees, [17] therefore flexion is limited to ninety degrees for the first four weeks following most meniscal repairs. For radial tears and root repairs, as they are more vulnerable, flexion is limited to 60 degrees for four weeks followed by two weeks limited to 90 degrees.

As flexion causes posterior femoral translation, especially laterally, and on the medial side a posterior shift in joint contact area [17], loaded flexion exercises are limited to a maximum 60 degrees for 6 weeks and 90 degrees until the end of the twelfth week. Running typically starts at the end of the twelfth week with the goal of return to play at 16 weeks. For radial tears this is usually a month later.

Conclusion

Meniscal injuries in elite footballers are a common and successful treatment requires the clinician to understand the player's goals and needs, communicate effectively between all stakeholders, and have knowledge of the challenges posed by the different types of meniscal tears seen in this population. It is important to recognise the differences in 'personality' of medial and lateral tears evidenced in the literature and understand the differing approaches to treatment.



- [1] Borque KA, Jones M, Cohen M, Johnson D, Williams A. Evidence-based rationale for treatment of meniscal lesions in athletes. *Knee Surg Sport Traumatol Arthrosc* 2011. <https://doi.org/10.1007/s00167-021-06694-6>.
- [2] Lysholm J, Gillquist J. Arthroscopic meniscectomy in athletes. *Am J Sports Med* 1983;11:436–8. <https://doi.org/10.1177/03635465830100610>.
- [3] Paxton E, Stock M V, Brophy R. Meniscal repair versus partial meniscectomy: a systematic review comparing reoperation rates and clinical outcomes. *Arthroscopy* 2011;27:1275–88.
- [4] Aune KT, Andrews JR, Dugas JR, Cain EL. Return to play after partial lateral meniscectomy in National Football League athletes. *Am J Sports Med* 2014;42:1865–72. <https://doi.org/10.1177/0363546514535069>.
- [5] Brophy RH, Lyman S, Chehab EL, Barnes RP, Rodeo SA, Warren RF. Predictive value of prior injury on career in professional American football is affected by player position. *Am J Sports Med* 2009;37:768–75. <https://doi.org/10.1177/0363546508329542>.
- [6] Nawabi DH, Cro S, Hamid IP, Williams A. Return to play after lateral meniscectomy compared with medial meniscectomy in elite professional soccer players. *Am J Sports Med* 2014;42:2193–8. <https://doi.org/10.1177/0363546514540271>.
- [7] Becker R, Kopf S, Seil R, Hirschmann MT, Beaufils P, Karlsson J. From meniscal resection to meniscal repair: A journey of the last decade. *Knee Surgery, Sport Traumatol Arthrosc* 2020;28:3401–4. <https://doi.org/10.1007/s00167-020-06316-7>.
- [8] Sochacki KR, Varshneya K, Calcei JG, Safran MR, Abrams GD, Donahue J, et al. Comparing meniscectomy and meniscal repair: A matched cohort analysis utilizing a national insurance database. *Am J Sports Med* 2020;48:2353–9. <https://doi.org/10.1177/0363546520935453>.
- [9] Abrams GD, Frank RM, Gupta AK, Harris JD, McCormick FM, Cole BJ. Trends in meniscus repair and meniscectomy in the United States, 2005–2011. *Am J Sports Med* 2013;41:2333–9. <https://doi.org/10.1177/0363546513495641>.
- [10] Logan M, Watts M, Owen J, Myers P. Meniscal repair in the elite athlete: Results of 45 repairs with a minimum 5-year follow-up. *Am J Sports Med* 2009;37:1131–4. <https://doi.org/10.1177/0363546508330138>.
- [11] Stein T, Mehling AP, Welsch F, Von Eisenhart-Rothe R, Jäger A. Long-term outcome after arthroscopic meniscal repair versus arthroscopic partial meniscectomy for traumatic meniscal tears. *Am J Sports Med* 2010;38:1542–8. <https://doi.org/10.1177/0363546510364052>.
- [12] Bedi A, Kelly N, Baad M, Fox AJS, Ma Y, Warren RF, et al. Dynamic contact mechanics of radial tears of the lateral meniscus: Implications for treatment. *Arthroscopy* 2012;28:372–81. <https://doi.org/10.1016/j.arthro.2011.08.287>.
- [13] Ode GE, Van Thiel GS, McArthur SA, Dishkin-Paset J, Leurgans SE, Shewman EF, et al. Effects of serial sectioning and repair of radial tears in the lateral meniscus. *Am J Sports Med* 2012;40:1863–70. <https://doi.org/10.1177/0363546512453291>.
- [14] Scheller G, Sobau C, Bülow JU. Arthroscopic partial lateral meniscectomy in an otherwise normal knee: Clinical, functional, and radiographic results of a long-term follow-up study. *Arthroscopy* 2001;17:946–52. <https://doi.org/10.1053/jars.2001.28952>.
- [15] Boyd K, Myers P, Watts M. Meniscus preservation: rationale, repair techniques and results. *Knee* 2003;10:1–11.
- [16] Wright RW, Huston LJ, Haas AK, Nwosu SK, Allen CR, Anderson AF, et al. Meniscal repair in the setting of revision anterior cruciate ligament reconstruction: Results from the MARS cohort. *Am J Sports Med* 2020;48:2978–85. <https://doi.org/10.1177/0363546520948850>.
- [17] Johal P, Williams A, Wrapp P, Hunt D, Gedroyc W. Tibio-femoral movement in the living knee: A study of weight bearing and non-weight bearing knee kinematics using ‘interventional’ MRI. *J Biomech* 2005;38:269–76.
- [18] Vedi V, Williams A, Tennant S, Hunt D, Gedroyc W. Meniscal motion- an in vivo study employing magnetic resonance imaging in near real-time in the weight-bearing and non-weight-bearing knee. *J Bone Jt Surg* 1999;81-B:37–41.
- [19] Krych AJ, LaPrade MD, Cook CS, Leland D, Keyt LK, Stuart MJ, et al. Lateral meniscal oblique radial tears are common with ACL injury: A classification system based on arthroscopic tear patterns in 600 consecutive patients. *Orthop J Sport Med* 2020;8:1–6. <https://doi.org/10.1177/2325967120921737>.
- [20] Praz C, Vieira TD, Saithna A, Rosentiel N, Kandhari V, Nogueira H, et al. Risk factors for lateral meniscus posterior root tears in the anterior cruciate ligament injured knee: An epidemiological analysis of 3956 patients from the SANTI Study Group. *Am J Sports Med* 2019;47:598–605. <https://doi.org/10.1177/0363546518818820>.
- [21] Feucht MJ, Salzmann GM, Bode G, Pestka JM, Kühle J, Südkamp NP, et al. Posterior root tears of the lateral meniscus. *Knee Surg Sport Traumatol Arthrosc* 2014;23:119–25. <https://doi.org/10.1007/s00167-014-2904-x>.
- [22] Shybut TB, Vega CE, Haddad J, Alexander JW, Gold JE, Noble PC, et al. Effect of lateral meniscal root tear on the stability of the anterior cruciate ligament-deficient knee. *Am J Sports Med* 2015;43:905–11. <https://doi.org/10.1177/0363546514563910>.
- [23] Pache S, Aman Z, Kennedy M. Meniscal root tears: Current concepts review. *Arch Bone Jt Surg* 2018;6:250–9.
- [24] Perez-Blanca A, Espejo-Baena A, Amat Trujillo D, Prado Nóvoa M, Espejo-Reina A, Quintero López C, et al. Comparative biomechanical study on contact alterations after lateral meniscus posterior root avulsion, transosseous reinsertion, and total meniscectomy. *Arthroscopy* 2016;32:624–33. <https://doi.org/10.1016/j.arthro.2015.08.040>.
- [25] LaPrade C, Jansson K, Dornan G, Smith S, Wijdicks C, LaPrade R. 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 Jt Surg Am* 2014;96:471–9.
- [26] Tang X, Marshall B, Wang JH, Zhu J, Li J, Smolinski P, et al. Lateral meniscal posterior root repair with anterior cruciate ligament reconstruction better restores knee stability. *Am J Sports Med* 2019;47:59–65. <https://doi.org/10.1177/0363546518808004>.
- [27] Scott G, Jolly B, Henning C. Combined posterior incision and arthroscopic intra-articular repair of the meniscus: An examination of factors affecting healing. *J Bone Jt Surg* 1986;68:847–61.
- [28] Cannon WD, Vittori JM. The incidence of healing in arthroscopic meniscal repairs in anterior cruciate ligament-reconstructed knees versus stable knees. *Am J Sports Med* 1992;20:176–81. <https://doi.org/10.1177/036354659202000214>.
- [29] Noyes FR, Barber-Westin SD. Arthroscopic repair of meniscal tears extending into the avascular zone in patients younger than twenty years of age. *Am J Sports Med* 2002;30:589–600. <https://doi.org/10.1177/03635465020300042001>.
- [30] Strauss E, Hart J, Miller M, Altman R, Rosen J. Hyaluronic acid viscosupplementation and osteoarthritis: Current uses and future directions. *Am J Sports Med* 2009;37:1636–44.
- [31] Evans PJ, Bell GD, Frank C. Prospective evaluation of the McMurray test. *Am J Sports Med* 1993;21:604–8. <https://doi.org/10.1177/036354659302100420>.
- [32] Witherow A, Young J, Myers P. Repair of posterior medial meniscal root tears in the setting of Outerbridge III and IV cartilage damage. *Orthop J Sport Med* 2017;5:2325967171750019. <https://doi.org/10.1177/2325967171750019>.
- [33] Cipolla M, Scala A, Gianni E, Puddu G. Different patterns of meniscal tears in acute anterior cruciate ligament (ACL) ruptures and in chronic ACL-deficient knees: Classification, staging and timing of treatment. *Knee Surg Sport Traumatol Arthrosc* 1995;3:130–4.
- [34] Ahn JH, Bae TS, Kang KS, Kang SY, Lee SH. Longitudinal tear of the medial meniscus posterior horn in the anterior cruciate ligament-deficient knee significantly influences anterior stability. *Am J Sports Med* 2011;39:2187–93. <https://doi.org/10.1177/0363546511416597>.
- [35] Zhang Y, Huang W, Yao Z, Ma L, Lin Z, Wang S, et al. Anterior cruciate ligament injuries alter the kinematics of knees with or without meniscal deficiency. *Am J Sports Med* 2016;44:3132–9. <https://doi.org/10.1177/0363546516658026>.
- [36] Papageorgiou CD, Gil JE, Kanamori A, Fenwick JA, Woo SLY, Fu FH. The biomechanical interdependence between the anterior cruciate ligament replacement graft and the medial meniscus. *Am J Sports Med* 2001;29:226–31. <https://doi.org/10.1177/03635465010290021801>.
- [37] Musahl V, Citak M, O’Loughlin PF, Choi D, Bedi A, Pearle AD. The effect of medial versus lateral meniscectomy on the stability of the anterior cruciate ligament-deficient knee. *Am J Sports Med* 2010;38:1591–7. <https://doi.org/10.1177/0363546510364402>.
- [38] Vindfeld S, Strand T, Solheim E, Inderhaug E. Failed meniscal repairs after anterior cruciate ligament reconstruction increases risk of revision surgery. *Orthop J Sport Med* 2020;8:1–6. <https://doi.org/10.1177/2325967120960538>.
- [39] Parkinson B, Robb C, Thomas M, Thompson P, Spalding T. Factors that predict failure in anatomic single-bundle anterior cruciate ligament reconstruction. *Am J Sports Med* 2017;45:1529–36. <https://doi.org/10.1177/0363546517691961>.
- [40] Ahn JH, Lee YS, Yoo JC, Chang MJ, Koh KH, Kim MH. Clinical and second-look arthroscopic evaluation of repaired medial meniscus in anterior cruciate ligament-reconstructed knees. *Am J Sports Med* 2010;38:472–7. <https://doi.org/10.1177/0363546509348102>.
- [41] Melton J, Murray J, Karim A, Pandit H, Wandless F, Thomas N. Meniscal repair in anterior cruciate ligament reconstruction: a long-term outcome study. *Knee Surg Sport Traumatol Arthrosc* 2011;19:1729–34.
- [42] Tenuta JJ, Arciero RA. Arthroscopic evaluation of meniscal repairs: Factors that effect healing. *Am J Sports Med* 1994;22:797–802. <https://doi.org/10.1177/036354659402200611>.
- [43] Ochi M, Uchio Y, Okuda K, Shu N, Yamaguchi H, Sakai Y. Expression of cytokines after meniscal rasping to promote meniscal healing. *Arthroscopy* 2001;17:724–31.
- [44] Uchio Y, Ochi M, Adachi N, Kawasaki K, Iwasa J. Results of rasping of meniscal tears with and without anterior cruciate ligament injury as evaluated by second-look arthroscopy. *Arthroscopy* 2003;19:463–9.
- [45] Everhart JS, Cavendish PA, Eikenberry A, Magnussen RA, Kaeding CC, Flanigan DC. Platelet-rich plasma reduces failure risk for isolated meniscal repairs but provides no benefit for meniscal repairs with anterior cruciate ligament reconstruction. *Am J Sports Med* 2019;47:1789–96. <https://doi.org/10.1177/0363546519852616>.
- [46] Kaminski R, Kulinski K, Kozar-Kaminska K, Wasko M, Langner M, Pomianowski S. Repair augmentation of unstable, complete vertical meniscal tears with bone marrow venting procedure: a prospective, randomized, double-blind, parallel-group, placebo-controlled study. *Arthroscopy* 2019;35:1500–1508.
- [47] Moffet H, Richards C, Malouin F, Bravo G, Paradis G. Early and intensive physiotherapy accelerates recovery postarthroscopic meniscectomy: Results of a randomised controlled study. *Arch Phys Med Rehab* 1994;75:415–26.
- [48] Noyes F, Heckmann T, Barber-Westin S. Meniscus repair and transplantation: A comprehensive update. *J Orthop Sport Phys Ther* 2012;42:274–90.