Preservation of the meniscus has become the standard in sports medicine after evidence emerged that there was progressive chondrosis following total meniscectomy as performed over 40 years ago. In this chapter, we will address pertinent aspects of meniscal preservation, specifically addressing how meniscus repairs and partial resection are relevant to the cartilage surgeon. This will include the concept of the meniscus being a load distributor more than a shock absorber; the subset of meniscus pathology in the anterior cruciate ligament (ACL)-deficient knee joint will also be discussed. To allow a practical framework from which to direct patient care, general guidelines will be presented that will include the outcomes of meniscus repair in cartilage patients regarding tear configuration, age, and degeneration of the knee joint.

Keywords
Meniscus
Repair
Inside-out
Meniscectomy
ACL deficiency
Extrusion

Introduction
Meniscus injuries represent the most common intra-articular injury in the United States (mean incidence 66 per 100,000). At present, a large number of these undergo surgical intervention with the majority resulting in meniscectomies. This indicates that there is a tremendous need for improvement in our current techniques to achieve the goal of meniscal preservation [1]. In 1948, Fairbanks described that the practice of total medial meniscectomy led to a fairly rapid development of medial-sided knee osteoarthritis (OA) [2]. Thirty-four years later, Gillquist described arthroscopic partial meniscectomy as an alternative approach in an effort to preserve the medial side of the knee joint and decrease the incidence of medial OA [3]. The next landmark development in meniscal preservation occurred over 20 years ago when Henning et al. developed and popularized the technique of meniscus repair [456].

Preservation
of the menisci seems intuitively obvious in the twenty-first century as we now appreciate that they are critical components for the normal knee function. While the medial and lateral meniscus each have a slightly different biomechanical role, their common purpose is optimizing load distribution in their respective knee compartments. They also participate in joint lubrication and joint stability. The shape and size of the meniscus provide a broad force distribution from the femur to the tibial plateau as long as integrity of the meniscus is maintained from horn to horn attachment. When the longitudinal network of collagen bundles is functioning, these allow the meniscus to translate compression forces (femoral condyle to tibial plateau) into hoop stresses. A subset of the full width of longitudinal collagen bundles is the peripheral rim. Its integrity is essential to meniscal function and explains the clinical and biomechanical difference between a total and partial meniscectomy with regard to joint contact force and development of early OA. Due to the distinct shape difference between the lateral and tibial plateau and the respective menisci, the lateral meniscus covers approximately 75–93% of the lateral tibial plateau, while the medial meniscus covers slightly less (51–74%) [7]. There is also significant variance in the size of the menisci among individuals. This could be conjectured to be one of the variables responsible for some patients that seem to be more “meniscus-dependent.” That is, those patients progress to develop earlier than typical postmeniscectomy symptoms of recurrent swelling and pain in the meniscectomized compartment even if they underwent a rather limited partial meniscectomy. While it is not possible to predict which patients are “at risk” after partial loss of the meniscus, it is possible to identify external factors (obesity, tibiofemoral malalignment, preoperative bone edema, anterior cruciate ligament (ACL) deficiency, etc.) that can be discussed preoperatively. Repair of meniscal tears remains limited. While “red–red or red–white” acute traumatic vertical tears have high potential for healing and are frequently repaired, healing potential is lower for complex or degenerative meniscus tears, and repair options are currently still unclear. For those irreparable tears that result in segmental meniscal loss, there are segmental replacement options that are discussed in Chap. 19. Finally, when there are symptoms related to complete loss of meniscal function, meniscus transplantation is an option and will be extensively discussed in Chap. 18.

Assessment of Partial Loss of the Meniscus

The ability to perform a partial meniscectomy rather than a total meniscectomy was not fully realized until the advent of modern arthroscopy. In fact, even when it was technically possible to perform an open partial meniscectomy, it was not done. The belief at that time was that a torn meniscus will only allow a pain-free knee if completely resected. In fact, total meniscectomy was suggested by some to be a prerequisite for the ingrowth of new meniscal tissue. While it was true that by removing the meniscus to a bleeding margin some tissue would regenerate, it was later appreciated that the blunted regrowth of fibrous tissue was
nonfunctional. In 1982, Gillquist first described his series of patients, who underwent arthroscopic partial meniscectomies [3]. Since then, the partial meniscectomy has become the most often performed arthroscopic procedure worldwide. While any resection of meniscal tissue may be called a partial meniscectomy, it is important for the cartilage surgeon to realize that there is a wide range of what may be considered “partial.” In addition, it is critical to know about the characteristics of the part of the meniscus that was resected and what tear configuration led to the partial resection. To illustrate this, Fig. 7.1 shows two “partial meniscectomies,” which result in distinctly different biomechanical consequences for the knee. As surgeons are quite variable in their descriptions of “partial meniscectomy,” it is often necessary to document the extent of a previously meniscectomized knee joint when considering articular cartilage restoration. This is part of the initial “staging arthroscopy” and should use the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) meniscus tear classification (Table 7.1) [8].

**Fig. 7.1**
Subtotal (partial) meniscectomy with almost complete loss of the posterior horn of the medial meniscus (see *small image*) (a), is not equal to a small partial meniscectomy with over 75% of the posterior horn intact (b)
The International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) meniscus tear classification

<table>
<thead>
<tr>
<th><strong>Elements to be reported</strong></th>
<th><strong>Scale</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tear depth</td>
<td>Partial/complete</td>
</tr>
<tr>
<td>Location of tear</td>
<td>Zone 1–3</td>
</tr>
<tr>
<td>Radial tear location</td>
<td>Post/mid/ant; zone 1–3</td>
</tr>
<tr>
<td>Location relative to popliteal hiatus</td>
<td>Central to hiatus or not</td>
</tr>
<tr>
<td>Tear pattern</td>
<td>Bucket handle; horizontal; radial; vertical flap; horizontal flap; complex</td>
</tr>
<tr>
<td>Quality of tissue</td>
<td>Nondegenerative; degenerative; undetermined</td>
</tr>
<tr>
<td>Length of tear</td>
<td>Millimeter</td>
</tr>
<tr>
<td>Indication of amount resected</td>
<td>Indicate on map</td>
</tr>
<tr>
<td>% of medial meniscus resected</td>
<td>Indicate percentage</td>
</tr>
</tbody>
</table>

Based on data from Ref. [8]

**Biomechanical Effects of Meniscal Loss**

While a clear correlation between the amount of a partially resected medial or lateral meniscus and subsequent onset of OA has not been proven clinically, partial meniscectomy patients have been shown to have an increased risk of OA [9]. Clinically, the loss of the lateral meniscus leads to earlier development of clinically symptomatic OA than the medial meniscus. This observation is likely related to the more prominent role of the lateral meniscus in force distribution compared to the medial meniscus [1011]. Once a partial meniscectomy has been performed, the biomechanical environment in that compartment is substantially altered resulting in higher impact forces on the corresponding articular cartilage surfaces.
Utilizing finite element modeling (FEM), Zielinska et al. calculated 10 different meniscectomy situations in the medial compartment and found a linear relationship between meniscal loss and increase in contact force in the medial compartment. If 60% of the medial meniscus is resected in a longitudinal fashion, the remaining meniscus will be under an equivalently higher contact stress (65%). The medial tibial plateau will see an increase in contact stress by about 55% [12]. This study is corroborated in a biomechanical cadaver model in which a resection of 50% of the meniscal width resulted in a 24% increase in contact stress and a resection of 75% resulted in a 58% contact stress increase. If the resection was performed in the posterior medial meniscus horn, these changes were more dramatic showing a 43% and 95% increase in contact pressure, respectively [10]. These studies indicate that a resection of 50% or more of the meniscus may lead up to twice the contact stress exerted on the tibiofemoral joint with the loss of the posterior meniscus being more significant than mid- or anterior horn resections. A complete radial meniscus tear extending into the periphery, or a segmental meniscal loss, leads to a complete functional loss of the meniscus and is biomechanically indistinguishable from a subtotal or total meniscectomy [10].

In addition, it has been shown that longitudinal partial meniscectomies significantly impact rheological conditions inside the knee joint. Fluid pressurization of the knee joint plays an essential role for the function of the load distribution inside the knee, and this is a factor that both cadaveric studies and traditional FEM approaches have not been taking into account. Kazemi et al. filled this knowledge gap utilizing an elegant FEM model, which showed a progressive increase in contact stress for simple creep, contact stress, and a combination of creep and torque. For all measured conditions, there was a significant increase due to the loss of fluid pressure distribution. Interestingly, even small partial meniscectomies lead to an increase in pressure in the corresponding femoral condyle. For example, for a lateral anterior meniscectomy, the anterior lateral femoral condyle will see a larger contact area and see a larger stress due to loss of fluid pressure distribution. This effect is substantial and increases the pressure up to twofold [11]. The Osteoarthritis Initiative (OAI) has facilitated a study by Chang et al. who assessed the risk of cartilage damage after meniscal loss in patients with OA. Even though these are patients beyond cartilage repair, the authors found that progressive loss of the medial meniscus, particularly the posterior horn, will lead to increased cartilage loss in the peripheral and posterior (normally meniscus covered) aspects of the tibia. This effect is present in medial and lateral compartments but stronger medially. In addition, they showed that the lateral meniscus is more in danger for extrusion, which is a higher risk factor for progressive cartilage loss than meniscus loss in the lateral compartment [13].
Furthermore, there are biochemical changes that occur after meniscus injury. Brophy et al. and others eloquently described these changes, which include the increase in degradatory enzymes and proinflammatory cytokines (MMP-1, ADAMTS-4, IL-1, TNF-α) [14]. The effect of these biochemical changes is currently unclear, but it may contribute to the overall chondrocatabolic environment that may be responsible for differing amounts of “chondropenia” that can be encountered in patients with cartilage defects.

Meniscal loss in conjunction with ACL injuries constitutes the strongest risk factor for subsequent development of OA [15]. Even if the ACL is reconstructed successfully, the loss of the medial meniscus will increase the odds for the development of OA by 4 to 7. One of the most potent risk factors may be knee joint stability after partial medial menisectomy. Allen et al. could show in a robot-controlled cadaveric experiment that the medial meniscus contributes significantly to anterior stability. In her experiments, she showed that if the medial meniscus is lost, the in situ forces in the ACL reconstruction significantly increase and may lead to long-term anterior increased translation [16]. Seon et al. recently corroborated these in vitro data showing an almost 100% increase in anterior tibial translation at 30° and 60° of knee flexion after subtotal medial meniscectomy. In addition, they reported a significant increase in lateral tibial translation after subtotal medial meniscectomy in the ACL-deficient knee joint. This lateral translation, however, could be fully corrected after ACL reconstruction [17]. While these data clearly indicate the importance of the medial meniscus as a secondary stabilizer in the ACL-deficient knee, less is known about the role of the lateral meniscus. The lateral meniscus provides less secondary AP stability to the tibiofemoral joint, as partial or total lateral meniscectomy does not increase anterior tibial translation significantly; yet recent data suggest a role for the lateral meniscus in rotational stability. Musahl et al. pointed out that while the medial meniscus provides significant secondary stability against anterior translation, the lateral meniscus contributes significant stability to the ACL-injured knee in rotation and valgus stability. Given that valgus and axial rotation is a significant element of the clinical phenomenon of giving way (clinically tested as the “pivot shift”), the integrity of the lateral meniscus may be more important for functional and rotational stability of the knee rather than static stability as tested in the Lachman test [18].

In addition, lateral meniscectomy in conjunction with a lateral femoral chondral defect increases anterior translation significantly. If additional tibial chondral debridement is performed, this translation can be increased up to 100% [13]. This effect of chondral loss can also be observed with medial meniscus deficiency, indicating again the importance of all structural components (meniscus, cartilage ACL/PCL) on the biomechanical stability of the intact knee joint [19].

In summary, partial meniscectomies increase load and stress and decrease load distribution in the affected compartment significantly.

Meniscectomy affects the newly uncovered aspects of the tibia due to an increase of the direct contact area. It affects the articulating surface of the femur in the area that newly
articulates with the tibial cartilage after meniscal loss, and the overall tibiofemoral contact forces will increase after any amount of meniscus loss. These effects range from 50% to over 200% increase in contact stress and joint force across the respective compartment and may even affect the opposite compartment with respect to fluid pressurization. While we are unable to give a clear guideline as to how much meniscus resection is too much, it is clear that meniscal preservation is preferred: resect the least amount of tissue possible to achieve a stable remnant as this will lead to a lesser degree of posttraumatic OA over time [20].

**Meniscal Tears and Focal Chondral Defects**

Partial meniscus tears often appear in conjunction with small, partial, or full thickness chondral lesions. Small focal chondral lesions that are otherwise well-shouldered may not require treatment. However, this may be different in knee joints with partial meniscectomies. Initial in vitro studies reported that shoulders of lesions less than 1 cm (0.79 cm²) diameter did not have increased stress, while larger lesions demonstrated progressive increase in shoulder loading [21]. Recently, Flanigan et al. calculated the minimal size of a femoral condylar defect that leads to increased contact loading on the opposing surface to be 1.6 cm² on the lateral condyle and 1.9 cm² on the medial condyle [22]. This “critical size” defect was calculated based upon bovine knees that have a similar overall condylar size as human knee joints. This principle has been used in an animal model of OA development as described by Schinhan et al. who created a critical size defect in a goat knee model. The defect alone does not lead to the development of OA, but in combination with a partial meniscectomy, these animals will reliably develop progressive OA in a few months [23]. It is therefore likely that the combination of a chondral defect just at or below the clinically significant size with a partial meniscectomy presents a higher risk for progressive cartilage loss. More research is needed in order to better define the clinically significant threshold for the combination of meniscal loss and chondral defect size. Evaluating the current data, it is clear that the cartilage surgeon needs to appreciate the combination of a focal chondral defect in a partially meniscectomized knee: defects that ordinarily are not deemed to be clinically sufficient may be symptomatic or may become symptomatic in these patients.

**Meniscal Repair**

The detrimental effects of loss of meniscal tissue emphasize the importance of meniscal preservation. While the topic of meniscal restoration after complete functional loss of the meniscus will be addressed in Chap. 27, this section will address important aspects of meniscal repair. There is a paucity of high-level evidence-based studies to guide the clinician in deciding when to repair and when not to repair a meniscus tear. To date, there has been only one level 1 study comparing different meniscus repair strategies versus partial meniscectomy in
ligamentously stable knees [24]. A recent systematic review of the literature indicated that there are only three level 3 studies, and the vast majority of all literature regarding meniscus repair alone or in comparison with partial meniscectomy are level 4 and 5 evidence [25]. Given this rather limited pool of evidence, one has to make clinical decisions from this literature and extrapolate from the in vitro data discussed above. A general overview of indications and contraindications for meniscus repair (largely empirical) is outlined in Table 7.2. Several points on that list are highlighted in the following paragraphs as they pertain specifically to the cartilage surgeon.

**Table 7.2**

Indications/contraindications for meniscus repair based upon clinical recommendations

<table>
<thead>
<tr>
<th>Indications</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt; 50</td>
<td>Age &gt; 60</td>
</tr>
<tr>
<td>Clinically symptomatic tear</td>
<td>Asymptomatic tears</td>
</tr>
<tr>
<td>Reducible, good tissue integrity</td>
<td>Degenerative tissue, complex tears with macerated meniscal tissue</td>
</tr>
<tr>
<td>Red–red or red–white zone tears</td>
<td>White–white zone tears</td>
</tr>
<tr>
<td>Concomitant ACL reconstruction</td>
<td>Incidental stable tears in conjunction with ACL injuries less than 1 cm in vertical length</td>
</tr>
<tr>
<td>Patient able and willing to follow rehab protocol</td>
<td>Incomplete radial tears</td>
</tr>
</tbody>
</table>

**ACL** anterior cruciate ligament

**Nature of the Tear**

No high-level evidence exists regarding which tear configuration can and cannot be repaired. It has been suggested that degenerative meniscus tissue should not be repaired as it leads to a high failure rate [4626] leading to a small percentage (6%) of repairable tears in the “older” patient population over 40 years of age [27]. Patients presenting with ACL tears and lateral meniscus tears
may represent a different subgroup of patients. In those patients, nondisplaced even somewhat degenerative tears heal or remain asymptomatic without intervention and thus may be of more benefit to the knee joint than resection [28]. Regarding the geometrical configuration of repairable meniscal tears, it appears to ultimately depend upon the healing capacity and the technical ability to fix the tear appropriately. Therefore, the ultimate decision whether it is repairable or not is both surgeon-dependent and tear configuration-dependent.

In the case of macerated tissue, in general, a repair is technically not feasible; however, radial beak tears, bucket handle tears, and even radially disrupted bucket handle tears may be amenable to a repair depending on the status of the tissue. Particularly, in young patients, these tear configurations should be carefully scrutinized regarding their potential for repair. A reasonable approach may be to have the tear “convince the surgeon that it cannot be repaired.”

Meniscus repairs, like rotator cuff repairs, can be performed in many different ways, for example, using inside-out, outside-in, all-inside techniques, or combinations thereof. A myriad of different meniscal repair devices and techniques are commercially available. As one third-generation technique has not been proven superior to another, the cartilage surgeons should have several different techniques at their disposal to approach any potentially repairable tear with the necessary tools. Noyes beautifully outlined different repair approaches for different tear configurations. He listed a variety of suture configurations that can be utilized with various different techniques [6]. The overall goal of any of these techniques is to allow for a period of fixation across the tear to allow the meniscus to heal. Equally important as the surgical technique is the rehabilitation program after repair. The goal is reduction of meniscal separation at the tear site. This may include protected weight-bearing as well as restrictions in range of motion.

**Location of the Tear**

In general, lateral meniscus repairs have a lower reoperation rate (13.9%) than medial meniscus repairs (20.7%). This may have to do with the fact that the lateral meniscus has a more mobile fixation that may be more forgiving during the rehabilitation process.

Meniscus repairs performed at the time of concomitant ACL reconstruction have a significantly lower reoperation rate (medial 17.5%; lateral 8%) [25]. Another contributing factor may be that the medial meniscus receives a significantly higher load, particularly after suboptimal ACL reconstruction. In general, the literature recommends fixation only in tears that are in the red–red zone or in the red–white zone as the success of repairs in the white–white zone is considered to be poor. This distinction is based upon Arnoczky’s sentinel work on the blood supply of the meniscus indicating that the white–white zone receives its nutrient supply exclusively through diffusion from the joint fluid rather than through a direct blood supply [29]. However, several recent studies have disputed this notion based upon the finding that intra-
Articular blood clots seem to allow for white–white tears to heal both in animal models and in small series in humans, whereby it appears that the cells at the repair site appear to be predominantly synovially derived [430]. There may also be a different ability to heal white–white tears in very young individuals who may still have a remnant blood supply to the meniscal white–white zone [31].

In general, meniscal repairs (using standard guidelines on which meniscal tears to repair) have a high success rate. The literature suggests that inside-out meniscal repairs have a failure rate of approximately 20% overall [28]. Noyes et al. performed several subgroup analyses on their patients and were able to show that this failure rate does not correlate with age [32]. They also found that medial meniscal repairs have a higher failure rate than lateral meniscal repairs. Only 2/29 patients showed joint space narrowing, and 3/29 were declared a failure based upon magnetic resonance imaging (MRI) evaluation. They also found that in a subgroup of patients under the age of 20 and a follow-up of 16.8 years, there is the same failure rate overall, indicating that once a meniscal tear is healed it remains functional for the long term [32]. These data are corroborated by the systematic review by Paxton et al. [25]. One caveat regarding meniscal tears is the switch from the traditional inside-out suture repair utilizing 4–6 inside-out sutures to the more popular utilization of all-inside devices. While the biomechanical repair strength of these devices is equivalent to a horizontal or in some cases even vertical suture fixation, on average, fewer devices are utilized per repair (cost related and size of entry hole into the meniscus), potentially leading to a less biomechanically stable repair during the healing process. It will be years until the long-term results of these devices are known. With this limitation, the cartilage surgeon should not compromise the repair even if it is “more convenient” to use all-inside devices. All inside-out or a combination of all-inside and inside-out sutures may be the optimal treatment in certain circumstances.

Biological Enhancement of Meniscal Repairs

While meniscus tears in the red–red zone have a good healing potential, tears in the white–white zone have poor healing potential. This vexing problem has led to many interesting approaches in an attempt to overcome the lack of an adequate intrinsic healing response. Obviously, the first techniques focused just on the technical aspect of suture repair [4633]. The next steps were trephination of the tear site and adjacent tissues as well as perimeniscal synovial abrasion: synovial cells have often been noted migrating on the surface of the peripheral portion to the level of the tear site [26]. To address the commonly cited cause for lack of a healing response and inadequate blood supply, many groups have designed novel approaches to overcome this obstacle. Henning first reported the “blood clot” technique in the 1990s, and he showed that he had an overall success rate of 64% [43435]. This technique provides a tissue scaffold that can be manipulated behind a repairable horizontal tear as well as into a small tissue defect as may be
encountered in a radial tear. The blood clot hosts a myriad of growth factors similar to the more expensive and soluble platelet rich plasma (PRP) products but has the advantage of being moldable and strong enough to actually hold a Vicryl suture. Using the zone-specific inside-out cannulas, the blood clot repair can be done under controlled conditions (Fig. 7.2).

Fig. 7.2
Radial medial meniscus tear with “gapping” (a), the blood clot was pulled into the gap through a shortened 8.5 mm shoulder cannula via a resorbable suture using a nitinol wire with a loop (b), the inside-out stitches were placed in a horizontal fashion (c), after tensioning and tying of the sutures, the tear reduces over the blood clot (d)
His patient population, however, was somewhat heterogeneous and not all tears were white–white tears [4]. Van Trommel et al. reported the use of the blood clot
repair in young patients with lateral meniscus radial tears central to the popliteus tendon and reported healing in 3/3 studied subjects with full functional return [34]. The authors have anecdotally used the blood clot technique in unusual situations in children with difficult healing environments (Fig. 7.3).

Fig. 7.3
Blood clot repair of lateral bucket handle meniscus tear in an 8-year-old with a history of previous discoid meniscus saucerization: the bucket handle tear of the lateral meniscus sits in the typical locked location in front of the lateral femoral condyle (a), the view past the bucket handle component of the meniscus reveals a complete detachment from the periphery (b), a blood clot was inserted between the remnant capsule and the meniscus (c) due to the previous history of resection of a “discoid” meniscus in the lateral compartment.
A further technical pearl allowing for a better delivery and capture of the blood clot repair technique has been described by Piontek et al. [36]. They treated 53 patients with a meniscus wrapping using a biodegradable collagen type I/III membrane to contain comminuted meniscus tears augmented with a blood clot. The 2-year results suggest a successful retention of the meniscus in over 80% of patients with a clinically relevant and statistically significant increase in patient-reported outcomes. (Fig. 7.4).

**Fig. 7.4**

A schematic depiction of the meniscus wrapping or “taco” technique using a biodegradable collagen I/III membrane

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Okuda et al. have expanded the concomitantly recommended meniscal rasping into the population of patients who have ACL injury-associated meniscal tears less than 1 cm in length and reported excellent results [30]. Novel approaches continue development such as stenting using small tubular implants (Bioduct, Stryker, Kalamazoo, MI; on hold to market) [37], transfer of synovial tissue either as a free or pedunculated autograft, or allogenic tissue graft that has shown promising results in experimental settings. However, none of these techniques have been tested in the clinical situation to date except the Bioduct (that remains on hold). One stem cell study (Chondrogen, Osiris, USA) to evaluate the potential for regrowth after segmental meniscal loss was effective in the canine but not effective in an initial pilot clinical trial [38]). The use of growth factors has been limited by the lack of adequate delivery and dosing technology. A particularly interesting approach was published by Whitehouse et al. In their first-in-man study, they utilized autologous mesenchymal stem cells obtained from blood and cultured those on a collagen
scaffold. The scaffold was then implanted into the meniscus tear of five patients, three of which had bucket handle meniscus tears and two had radial type beak tears. All five patients had MRI scans showing a healed meniscus at 2 years, and none of the knees had undergone a reoperation [39]. With more experimental data emerging over the next few years, one can remain hopeful that these technologies will soon be ready for clinical application in form of adjunct implants, growth factor-coated suture material, or alternate delivery strategies.

Conclusions
The function of the meniscus is vital to the knee joint. For the cartilage surgeon, the preservation of meniscal function is of utmost importance. In practical terms, this requires the cartilage surgeon to be at the forefront of meniscal preservation regarding correct identification as well as treatment of meniscal pathology. Even though there is an approximately 20% risk of reoperation after meniscal repair, the high potential for development of OA after meniscal loss stresses the need to accept this “risk” of retear. The meniscus is an essential part of joint integrity and homeostasis that, if intact or repaired, will increase the success of articular cartilage repair/restoration and, when missing, will likely decrease the articular cartilage treatment’s long-term success.

References
8.


Flanigan DC, Harris JD, Brockmeier PM, Siston RA. The effects of lesion size and location on subchondral bone contact in experimental knee articular cartilage defects in a bovine model. Arthroscopy. 2010;26(12):1655–61.


