KNEE SURGERY

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Chapter 1

Recent Research in Knee Surgery

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Abstract

There is a significant amount of discussion about the best treatment for knee lesions. When dealing with anterior cruciate ligament (ACL) tears, there are many options for treatment. There is no global consensus on when it is best to perform the augmentation technique, single bundle technique, double bundle technique or when an extra articular procedure should be added to the ACL reconstruction. In partial ACL tears, it is very important to individualize the treatment to the patient's lifestyle. In patients with a partial ACL tear, it is important to analyze knee stability to determine the best treatment option.

When dealing with meniscus tears, it is mandatory to try to save the meniscus whenever possible. It is consensus that a meniscectomy is an important predisposing factor for early knee osteoarthritis development. Meniscal root tears deserve special attention because they behavior as a total meniscectomy. It should be repaired to avoid osteoarthritis.

Chondral lesions also merit attention because they are a relevant cause of pain and malfunction of the joint. They can be initially addressed with intra-articular injections of three main substances to be injected: corticosteroids, PRP and hyaluronic acid. In the case of persistent pain, a surgical approach, such as a marrow-stimulation procedure (microfracture), autologous chondrocyte implantation or osteochondral autograft transplantation (mosaicoplasty)

should be performed according to the lesion degree and patient profile.

Anterior Cruciate Ligament

Anatomy

Within the last two decades, surgeons have debated about the best surgical technique with which to treat ACL injuries. Some controversies have arisen; for example, there are questions about the positioning of the femoral and tibial tunnels or the optimal graft and single-bundle versus double-bundle technique. However, it is a well-established consensus that the objective of surgical outcomes is related to reestablishing the knee's rotational stability [1]. For a better understanding and application of all of these concepts, a deep comprehension of the morphology of the ACL is essential. Thus, anatomical reconstruction, restoration of native ACL dimensions and the correct placement of tunnel drilling are always idealized.

Some authors reported that the ACL formed a flat ribbon-like structure and a clear separation into bundles is not possible [2]. However, Ferretti at al. [3] confirmed two separation bundles, anteromedial (AM) and posterolateral (PL), when dissecting the ACLs of fetuses. In fact, the double-bundle concept is the most accepted among surgeons throughout the world.[2]

Siebold et al. described the division of the tibial ACL insertion into direct and indirect fibers. The direct fibers have a ´´C-shaped´´ insertion. The indirect fibers are anterior and broadly spread under the transverse ligament toward the anterior rim of the tibial pleteau [4]. Both fibers, direct and indirect, together have ´´duck-foot-like´´ footprint. The authors also believe that the ACL has a direct and indirect femoral insertion. It is described that the ACL midsubstance has a flat ribbon-like structure [5].

Biomechanics

The ACL is the prime static stabilizer against the anterior translation of the tibia on the femur. The secondary role of the ACL is to resist internal tibial rotation. The isometry configures as an equal length and tension of the ACL throughout a full arc of movement [6]. The AM bundle is tight in flexion and is the primarily limits anterior translation. The PL bundle is taut in full extension and is restrained against tibial internal rotation [5]. However, the ACL action as a secondary varus-valgus restraint is unclear [6].

Reconstruction Techniques

Augmentation

One of the indications of augmentation is a partial ACL lesion. However, the diagnosis of partial ACL injury remains a challenge because the physical examination is often non-specific. In addition, magnetic resonance imaging (MRI) may be inconclusive. When a history, physical examination and MRI suggest the presence of a partial lesion in the ACL, the definitive diagnosis is often made through arthroscopy.

Both conservative and surgical treatments may be indicated for patients with partial ACL lesions. During the interview with the patient, it is fundamental to ask about perspectives and to determine the sports in which the patient participates. A detailed physical examination and evaluation of the MRI is necessary. As a result, the surgeon may decide to pursue conservative or surgical treatment.

If an injury to the ACL is suspected, an appropriate physical examination should be performed. Two crucial tests must be done: the Lachman test and the pivot-shift test. Both tests are subjectively evaluated. For objective data, the KT-1000 or Rolimeter device are used [7]. Therefore, the diagnosis of a total or partial ACL lesion is made according to the patient's history, clinical examination and MRI findings.

When a partial injury is suspected, it is important to talk with the patient about his / her sporting activity (i.e., whether the activity in question involves pivoting), his / her profession, patient's expectations and desired return to sports activity. After the interview and when considering the physical examination and MRI, the evaluator is able to decide upon the best treatment for the patient [7].

If conservative treatment is indicated, a protocol with physical therapy, lifestyle modification and a break from participation in pivotal sports should be initiated. Evaluation of the patient after 3, 6 and 12 months for new behavioral decisions is suggested. Conservative treatment may be maintained or surgical treatment indicated, primarily due to patient satisfaction [7]. One of the options for surgical treatment in partial ACL lesions is augmentation. The benefits of maintaining the remnant during ACL augmentation or selective reconstruction are due to the biomechanical advantage, maintenance of the blood supply with consequent support in the healing process and maintenance of proprioception [8]. Finally, the remnant helps to identify the correct location for wire guide.

For this type of patient, selective reconstruction (AM or PM bundle reconstruction) or augmentation can be performed [9]. The Biological Augmentation reconstruction described by Sonnery-Cottet et al. [10] can also be performed. In this case, the remnant is fully preserved. ACL is observed and tested during arthroscopy. It should be protected during the procedure, especially in the positioning of the guides and drill. The guide wire is placed. If the position is satisfactory, the tunnels are made. In selective reconstruction, the footprint of the injured band is usually used as a guide [9]. Several authors suggest the choice of hamstrings because of the technical ease with which the graft is passed. The graft diameter can be molded as needed. In selective reconstruction, one can use the double- or triple-hamstring graft.

Single Bundle

For patients with an ACL tear and unstable knee, ACL reconstruction is the treatment of choice. The surgeon should perform one of several options for surgical techniques, graft selection, graft position, tunnel position, and fixation techniques. The most commonly used grafts in ACL single-bundle (SB) reconstruction are hamstrings, bone-patellar tendon-bone (BTB) and quadriceps tendon. Autologous grafts can be used as well. The choice of graft depends on the surgeon's preference and experience, graft properties, fixation methods and patient criteria.

We prefer to use the hamstring autograft for ACL reconstruction. In a high-performance athlete who participates in pivoting sports or patients with severe ligament laxity, we used BTB. However, the positioning of the anatomical tunnels is the same. In patients with explosive pivot, bilateral ACL injury and revision, we associate reconstruction with extra articular stabilization [11].

After graft harvesting (hamstring or BTB), arthroscopy is performed as usual. The treatment of meniscal and chondral lesions is addressed according to need. Next, the intercondylar notch is prepared, the center of the ACL femoral attachment site is identified and the tibial footprint is noted.

The accessory anteromedial (AAM) portal is made with the help of a needle for the femoral attachment. The camera is placed in the medial portal and the guidewire is introduced through the portal AAM with the knee with 120° of flexion. The ACL femoral tunnel is made with an appropriate drill and in the anatomical position. In general, the ACL femoral attachment site can be localized using the native ACL footprint or the lateral intercondylar and bifurcate ridges.

The next step is the placement of the tibial bone tunnel. The tibial footprint is identified and used for orientation. The 55° tibial drill guide is introduced through the AM portal with the knee in 90° of flexion. The landmarks are the posterior border of the anterior horn of the lateral meniscus and the interspinous area. The pin guide is placed and the tunnel is drilled. The graft is positioned. For femoral graft fixation, a femoral extracortical fixation (femoral button system) is used. For tibial graft fixation, a bioabsorbable screw is placed.

Reconstruction with Extra-Articular Stabilization

The main indications for using the extra-articular plasty (EAP) are the presence of the Segond fracture, severe positive pivot-shift test, joint hyperlaxity, chronic ACL laxity and revision setting. The essential objective of the EAP is to avoid rotational instability [12].

EAP techniques have been described since the 1960s. Lemaire and Macintosh procedures are classic examples. Both used the strip ITB as a graft. Currently, EAP approaches can be performed in combination with ACL reconstruction. They can be used with any type of graft for ACL reconstruction. The graft options for EAP are the iliotibial band or the hamstrings.

The preparation of the EAP graft precedes the harvesting graft for ACL reconstruction. A sufficient graft should be collected (7 to 8 centimeters). The lateral collateral ligament must be identified and the graft is passed beneath it. The procedure is facilitated when the knee is flexed more than 90˚. The insertion point of the ITB graft is just posterior to the femoral attachment of the LCL. While fixing the EAP, the tibia must be in a neutral rotation to avoid knee stiffness [12].

Another extra-articular procedure is the anterior lateral ligament (ALL) reconstruction. This technique may be associated with ACL reconstruction. Some authors have reported that ALL and ACL reconstruction that is performed together reduce graft rupture rates [13]. Sonnery-Cottet et al. creates an ACL graft that is 3 parts semitendinosus and 1 part gracilis [14]. The ALL graft is then the continuation of the gracilis distal to the ACL graft. A 4.5-mm drill bit is used to create a bony tunnel on the tibia, between the Gerdy tubercle and the fibular head. The rate of graft failure with hamstring grafts associated with ALL reconstruction is less than half the isolated ACL reconstruction rate (respectively, with BTB and hamstring ACL reconstruction) [13].

Double Bundle

The surgical indication of double-band (DB) ACL reconstruction is controversial. After some studies on the subject, Jarvela and Siebold[15] showed that some authors did not find any significant differences in the clinical results between DB and SB reconstruction. However, most studies have reported that the DB technique had better results when compared to SB, especially when rotational stability is evaluated. In addition, no study showed better results with the SB technique [15].

Some factors may influence the choice of DB reconstruction. The size of the knee is the most important factor in arriving at this decision. The footprint should be measured intraoperatively with a ruler [16]. Other relevant factors are the associated ligament injuries and level of sports activity (i.e., which mainly relates to pivoting sports). The factors favoring SB reconstruction are a narrow trochlea, non-athletic individuals or recreational athletes, and isolated ACL lesions [15].

When indicated, DB reconstruction can be performed with standard grafts (hamstrings, quadriceps-bearing and BTB), alone or in combination. Autologous grafts may also be used.

After graft haverst, the arthroscopy procedure is started. Both femoral and tibial insertion sites of the AM and PM bundles are identified [14]. The guide wire for the AMB and PMB is drilled. Once the acceptable placement of both of the tunnels has been determined, the AM tibial tunnel is drilled first. Typically, the diameter of the AM tibial tunnel is 6-7 mm and that of the PL tunnel is 5-6 mm [15].

The femoral footprint of the AMB and PLB are identified for the placement of the guide wires. A guide pin is placed with aimers or by freehand. After the guide pins have been placed, the tunnels are made outside-in or inside-out, depending on the surgeon´s preference. The grafts are inserted from distal to proximal. The PL graft is passed first. The grafts are subsequently fixed with bioabsorbable screws. The size of the screw varies according to the size and length of the tunnels. Further, the graft fixation method also varies according to the surgeon preference. Some authors recommend extracortical femoral fixation [15].

Meniscus

The meniscus is a crescent-shaped fibrocartilaginous structure that covers approximately 70% of the articular surface of the tibial plateau. It is widely known that they are essential for shock absorption, load transmission, joint stability, proprioception, joint nutrition and lubrication [17,18]. Injuries to the menisci are recognized as a cause of knee pain, joint instability and an important predisposing factor of early knee osteoarthritis [19].

Meniscus injury is an extensive topic; in this section, a few updates in meniscus surgery will be discussed.

Meniscal Root Tears

Pagnani et al. first described meniscal root tears about 25 years ago [20]. However, with the current knowledge about meniscus relevance in knee biomechanics, it has reemerged as a research topic of increasing interest.

Injury to the meniscal attachment can lead to meniscal extrusion, which will increase stress to the cartilage by decreasing the contact surface. It causes impairment of hoop stress dissipation with accelerated articular degeneration [21]. It will usually have the same biomechanical effect of total meniscectomy [22,23]. Nowadays, orthopedic surgeons recognize that it is necessary to repair the meniscus as often as possible. Several recent studies have been published in order to describe updates about meniscus root tear biomechanics and the appropriate surgical techniques that are involved in such instances.

The symptoms are not specific and the exact diagnosis may be difficult. MRI is the best exam to analyze meniscus injuries; however, some authors state that is not possible to be sure about the lesion until performing arthroscopy and obtaining a direct view of the injury [24]. Meniscus root tear repair indications are an acute lesion within healthy cartilage or chronic tears without relevant knee osteoarthritis [25]. Contraindications are chondral lesions (outer bridge grade 3 and 4), joint-space narrowing, limb malalignment and a body mass index greater than 30 [26].

La Prade et al. classified meniscus root tears according to 5 distinct types [27] (Figure 1):

- **Type 1:** partial stable root tears (with no other concurrent adjacent meniscal body tears) within 9 mm of the center of the root attachment
- **Type 2:** complete radial tears within 9 mm of the center of the root attachment (most common)
- **2A:** 0 to 3 mm from the center of the root attachment
- **2B:** 3 to 6 mm from the center of the root attachment
- **2C:** 6 to 9 mm from the center of the root attachment
- **Type 3** bucket-handle tears with complete detachment of the meniscal root attachment within 9 mm of the center of the root attachment
- **Type 4:** complex oblique meniscal tears leading to complete root detachment within 9 mm of the center of the root attachment
- **Type 5** comminuted tibial eminence fractures

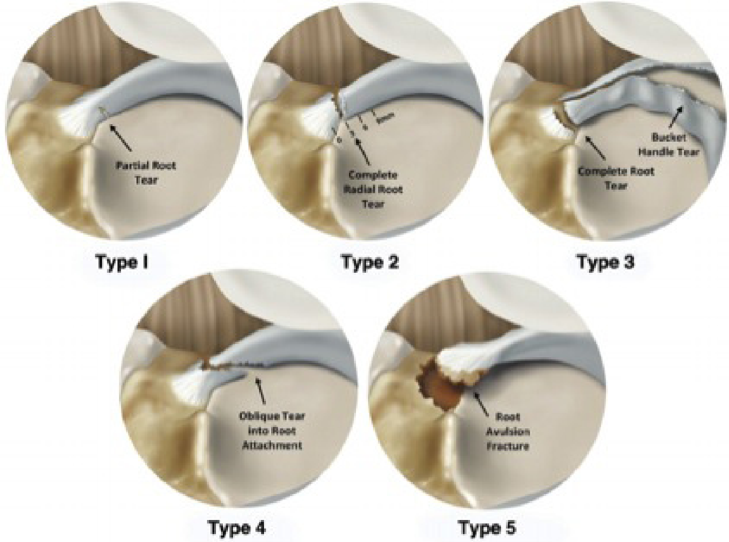

Figure 1: Illustrations of the meniscal root tear classification system in 5 different groups based on the tear morphology. In this illustration, all meniscal tears are shown as medial meniscal posterior root tears for consistency. The 5 tear patterns were classified according to morphology: partial stable root tear (type 1), complete radial tear within 9 mm from the bony root attachment (type 2), bucket-handle tear with complete root detachment (type 3), complex oblique or longitudinal tear with complete root detachment (type 4) and a bony avulsion fracture of the root attachment (type 5) (Reproduced with permission from La Prade et al. [27]).

The treatment options that are described in literature vary between debridement, transtibial pull-out repair, suture repairs, suture anchor repair and open reduction with internal fixation [21,27].

The pull-out technique will be described in this chapter. This technique is generally indicated when the root is avulsed from the tibial insertion and no multiligamentous reconstruction is planned [21,28]:

- 1 or 2 small tunnels (2 mm) are drilled with an ACL guide at the level of the avulsed meniscal root.
- A curved suture passer is used to arm the meniscal root with 2 n°0 non-absorbable sutures.
- The sutures are then retrieved through the tunnels from the anteromedial tibia.
- Next, the sutures are tightened distally with different fixation options, including pull-out buttons, screws or bone bridges (Figure 2)

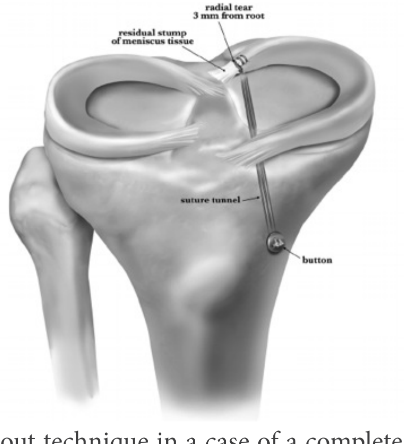

Figure 2: Pull-out technique in a case of a complete radial meniscal tear. Proper tensioning and anatomic placement of the attachment are critical for healing and the restoration of meniscal function (Reproduced with permission from Padalecki et al. [28]).

Biological Therapies for Meniscus Injuries: Scaffolds

In regenerative medicine, scaffolds are used as a temporal template to facilitate host tissue integration for the formation of new tissue and remodeling. Meniscal scaffolds must have biocompatibility; a shape that is similar to the normal meniscus; a porous structure that promotes cell growth; resistance to mechanical forces acting on the knee joint; slow biodegradability; permeability to macromolecules and cell-instructive structures that promote cellular differentiation and proliferation [29,30].

The indications for meniscal scaffolding are when the patient is between 16 and 50 years old, is skeletally mature, there is the presence of an irreparable meniscal tear or partial meniscal loss (>25%), the defect length is limited to 6 cm, the meniscal rim is intact and there is enough tissue in the anterior and posterior horns to allow for the scaffold to be fixed. Contraindications are uncorrected ligamentous instability, uncorrected axial malalignment (deformity greater than 5°), a body mass index > 35, full-thickness loss of articular cartilage with exposed bone (i.e., an International Cartilage Repair Society (ICRS) classification > 3), the presence of meniscal root lesions, the evidence of osteonecrosis of the involved knee, the incidence of systemic or local infection and the presence of inflammatory arthritis or autoimmune diseases.

Two kinds of scaffolds are currently in clinical use:

- Collagen matrix scaffolds: a type-I collagen (isolated and purified from bovine Achilles tendon) scaffold to which glycosaminoglycans are added
- Noncollagen matrix scaffold: consisting of a polymer with polycaprolactone and urethane segments

Collagen matrix scaffolds are biocompatible and biodegradable. They have a microscopic porous structure that allows for cellular ingrowth and induces the differentiation and proliferation of fibrocartilaginous cells; however, they are fragile during the implant procedure and have shown a decrease in size on follow-up MRIs and arthroscopic second-look follow-up [31]. The noncollagen matrix scaffold was developed to overcome these perceived limitations. Studies have shown significant improvement in clinical parameters that were evaluated in patients with a follow-up of 2 years [32].

Surgical Technique: Any existing axial misalignments and/or ligament insufficiencies must be corrected prior to or during the scaffold implantation. It is possible to perform the procedure arthroscopically by using the two standard portals. The native remaining meniscus is evaluated and any injured tissue is removed in order to leave a healthy and uniform meniscal rim. The defect site should extend into the vascularized red-on-red or red-on-white zone of the meniscus. The meniscal rim is punctured in order to create vascular access channels. Rasping of the synovial lining may stimulate meniscal integration and tissue ingrowth. The size of the defect is measured starting at the posterior end of the lesion. The scaffold is tailored to the correct size (10% larger than the in situ measurement to compensate for the shrinkage caused by suturing and to assure optimal fit into the prepared defect). In order to achieve a perfect fit between the scaffold and the native meniscus at the anterior junction, the anterior side should be cut at an oblique angle of 30°- 45°. The implant is inserted into the defect (Figure 3). Standard arthroscopic meniscal suturing techniques may be utilized for scaffold stabilization along the periphery. The anterior and posterior scaffold extremities are fixed to the native remnant with horizontal stitches [31].

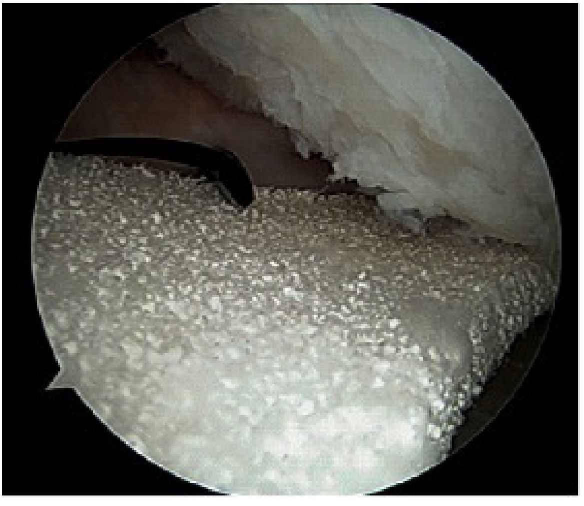

Figure 3: Arthroscopic features of a medial meniscal implant (Reproduced with permission from Bastos et al. [31]).

Currently, literature shows that collagen matrix scaffolds and the noncollagen matrix scaffold seem to be safe; positive results have been shown for both types. However, the quality of the studies is generally low, with a lack of randomized trials and little long-term follow-up to confirm clinical benefit and the most appropriate indications. Despite these good results, adverse events and treatment failure rates are high; thus, further studies are necessary to elucidate the efficacy of these techniques [31].

Chondral Lesions

Knee osteoarthritis is a highly prevalent disease among the world's population and is one of the main causes of pain and limitation for sports and daily activities. [33-36]. The initial treatment consists of the use of antiinflammatories, analgesics, physiotherapy and intra-articular injections. There are three main substances to be injected: corticosteroids, platelet-rich plasma (PRP) and hyaluronic acid (HA) [33].

Physioterapy initially focuses on pain and inflammatory control, followed by gaining increased range of motion, especially full extension and muscular strength. Muscle strengthening and aerobic exercise have been shown to improve joint pain and function. Weight loss not only improves joint pain and function, but has a myriad of other health benefits. It also reduces mechanical stress on the joints [37].

It is evident that HA and PRP have resulted in improving pain and function limitation in daily activities. The HA is endogenously produced; inflammation in the knee lowers this production process. After the injections, the HA levels are restored and raise the endogenous production.

In those cases that the ICRS categorizes as grade III and IV and in which conservative treatment fails, surgery becomes an option. The surgery should be individualized according to many factors. After collecting the history and conducting a physical exam, complementary exams help to evaluate the location and size of the lesions. A weight-bearing x-ray, panoramic x-ray from inferior limbs and MRI are often useful.

The main factors to be evaluated when determining a course of treatment are:

- age, sex, BMI
- limb alignment, range of motion, other lesions (e.g., anterior cruciate ligament tear or meniscus tears)
- identify the localization, size, depth and level of containment

The three most common forms of treatment are the marrow-stimulation procedure (microfracture), autologous chondrocyte implantation (ACI) and osteochondral autograft transplantation surgery (mosaicoplasty).[5,14] The aim of cartilage repair procedures is, therefore, to reduce the patient's symptoms, but also to prevent the development of osteoarthritis [38].

Microfracture

This procedure is the most popular way to treat cartilage defects because it has good results, low cost, low morbidity and is easily reproduced. It allows bone marrow mesenchymal stem cells and fibroblasts to invade the lesion along with the blood to form a clot. This tissue lacks the biomechanical and viscoelastic features of hyaline cartilage [39,40].

Indications: Better results are achieved with lesions under $2cm^2$ but microfracture is still recommended for bigger lesions. Younger patients have better results, yet the process can still be performed in patients up to 55 years of age, male or female, with full cartilage defects and with weight-bearing localization. It is usually done in the femoral condyle and patella, and the defects can be unique or in multiples.

Surgical technique:

- identify the lesions during arthroscopy
- inspect the cartilage surrounding the chondral defect; if it is unstable, it should be removed until stable cartilage is achieved
- remove the calcified layer that covers the subcentral bone (mostly seen in chronic lesions)

- microfracture is performed with 3 mm of distance between the holes and an approximate depth of 3-4mm (until fat droplets are visible coming from the bone).

Steadman et al. reported the outcomes of microfracture for traumatic chondral defects of the knee after a mean of 11 years [36]. The mean Lysholm score had improved from 59 to 89, and 80% of the patients rated themselves as improved at the 7-year postoperative point.[17]

Osteocondral Autologous Transplantation

This approach is also called mosaicoplasty. This procedure is the only one that covers the chondral defect with hyaline cartilage. The idea is to cover the lesion in the weight-bearing position for an osteochondral plug from a non-weight-bearing area. The donor sites are the area of the distal femur that experiences the lowest contact pressure, most commonly the supero-medial and supero-lateral trochlea. Up to two plugs of 1 cm^2 can be taken from each area with reasonable safety. There is also an allograft that has less mobility because it does not need to be harvested, but it is more expensive.

Indications: Lesions bigger than 1cm^2 and less than 3cm^2, full-thickness chondral defects in weight-bearing areas, patients between the ages of 16 to 55 and male or female.

Surgical procedure:

- identify the lesion during arthroscopy
- create a mini incision to remove the plug
- use an appropriated instrument to remove the osteochondral plug with 1 cm of depth
- preparation of the defect area that will receive the plug
- fix the plug by press-fitting it

Results: When compared to microfractures, there was no difference between them in relation to the necessity to perform any subsequent in the first two years. After five (mid-term) and ten (long-term) years, microfracture required a higher number of surgeries. Considering the clinical parameters, there was no difference in Lysholm or Tegner during the ten years of follow-up.

Autologous Chondrocytes Transplantation

Autologous chondrocyte implantation (ACI) and newer-generation cell-based techniques, including the use of stem cells instead of chondrocytes, are indicated for larger lesions according to many surgeons [36]. It has been confirmed that this technique produces mechanically and functionally stable cartilage [41]. Furthermore, ACI in particular has evolved through 3 generations: first-generation ACI involved a periosteal cover (ACI-P); second-generation ACI involved a type I/type III collagen-derived cover (ACI-C); and the third-generation approach involved matrix-induced ACI (MACI) [42].

This procedure is usually indicated for lesions bigger than 1cm^2, patients between the ages of 18 to 55 and male or female. There are two surgical times.

- Arthroscopy
- Measurement of the chondral lesion and removal of hyalite cartilage from a non-weight-bearing area
- Cartilage is sent to the lab, where it will be cultivated to be re-implanted during the second surgery
- After two weeks, the second surgical procedure is performed
- At this time, a small arthrotomy is necessary
- The lesion is curetted until the subchondral bone is reached
- The area is recovered with periosteum or synthetic membrane. The periosteum is usually taken from the patient's tibia
- A fibrin clot and absorbable dots are used to close the periosteum/membrane. The distance between the dots is 5 mm.
- Just before closing the entire area, the chondrocytes are introduced.
- The patient should usually avoid bearing weight with the limb for the following 6 weeks

Peterson et al. concluded that clinical and functional outcomes remain high, even 10 to 20 years after the implantation. Seventy-four percent of the patients (165/224) reported they were better or the same in the following years, while 26% reported that they were worse. Ninety-two percent were satisfied with the operation and would undergo the ACI process again (202/219) [40].

Mid-term follow-up (3 years) comparing microfracture and mosaicoplasty concluded that both were satisfactory; 86% of the patients would do the surgery again. No difference was found between the two groups with regard to clinical outcomes [41].

In a randomized prospective trial conducted in France that compared mosaicoplasty and third-generation ACI after two years of follow-up, no statically significant differences were observed between lesions lower than 3,5 cm^2 between the groups, but for lesions bigger than that, the group of mosaicoplastly had better clinical outcomes.

In a systematic review [35] comparing the three procedures, the authors noted that all of them had good funcional results and lowered the intensity of the pain in the mid-term follow-up period without any difference between them. Therefore, they conclude that there is no unequivocally superior outcome in improvising intermediate-term function and pain outcomes.

At the long-term follow-up (15-year) evaluation comparing microfracture and ACI, no differences were observed in the clinical scores and more patients from the ACI category underwent and another surgery (i.e., total knee artroplasty) [36,39].

The treatment of chondral lesions is challenging. The aim is to cover the defect with hyaline cartilage, improve the patient's symptoms and avoid the need to perform knee arthroplasty. However, after 20 years, these techniques have not been proven to reduce the risk of osteoarthritis. There only few long-term follow-ups that compared the techniques. Continued basic and clinical research is needed in this field.

Conclusion

When dealing with knee injuries, there will always be a large number of options for lesion treatment. With regard to ACL injury, meniscus tears and chondral lesions, there is not always a consensus about the best treatment option. The surgeon must be aware of all options and choose the best one for each patient. There are a lot of questions that the scientific community still discusses and many studies are being performed to answer them.

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