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Endoscope Inserted into the Joint through a Small Incision

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Abstract

Further high level studies are necessary to prove their usefulness. Newer methods which may hold promise are arthroscopic collagen sheath wrapping of complex tears with bone marrow aspirate injected under it, and a chitosan PRP composite implant. In some instances meniscus repair may not be feasible, and patients may have segmental, subtotal, or total loss of menisci. In such situations, meniscal substitution in the form of allograft transplant for subtotal or total meniscal loss, and artificial meniscal scaffolds for segmental defects are a viable option.

Keywords: Joint degradation; Peripheral rim; Native cells; Tissue engineering; Cartilage defects; Treatment methods

Introduction

In all these cases, the patient should be between 16 and 50 years of age, with a BMI <35, the knee should be stable with a normal alignment, and the cartilage should be well preserved with a ICRS grade of 2 or less. These have consistently given good results in appropriately selected patients in the long term. However, there are concerns which include graft size mismatch, questionable long-term chondro-protection, low rate of return to sports, progressive joint degeneration, graft sterility and incompatibility, limited availability in many countries, and low rates of remodeling and stability [1]. Meniscal scaffolds It may be useful when there is segmental loss of meniscus <5 cm with an intact peripheral rim. A scaffold theoretically allows for native cells and tissue to grow in, while it biodegrades over a period of time. There are two different types of scaffolds: Collagen meniscus implant (CMI) made from bovine collagen matrix, and polycaprolactone- polyurethane scaffold. Both have shown mixed results in patients with up to 10 year follow-up for CMI device,and up to 6 years follow-up in case of Actifit device. In a systematic review, both the devices have been found to be similar in terms of patient outcomes [2].

Discussion

A 12.6% rate of complications has been reported which includes pain, effusion, infections, debridement for non-integrated scaffolds, re-tears, and scar tissue removal. A failure rate of 9.9% at 40 months for Actifit, and 6.7% at 44 months, for CMI device has been reported. A scaffold which can produce high quality in vivo results in everyone has not yet been found. Tissue engineering and regenerative medicine for scaffolds Research is progressing in this field whereby these scaffolds will be 3D printed and impregnated with either autologous cells from the meniscus, or stem cells, and growth factors, which can then be cultivated in a bioreactor to get a patient-specific tissue engineered meniscal implant which is fully biocompatible [3]. Gene therapy for meniscus regeneration Encouraging results have been reported by gene therapy, whereby favorable genes can be introduced into target meniscal cells to encourage regeneration. Cartilage defects and injuries are a formidable challenge in regenerative medicine. Cartilage treatment strategies can be characterized as palliation (chondroplasty and debridement), repair (drilling and microfracture), or restoration (autologous chondrocyte implantation [ACI], osteochondral autograft transfer [OAT], and osteochondral allograft [OCA]). OATS and ACI While OAT does result in hyaline cartilage regeneration; it has its own disadvantages, most important being its inability to be used in lesions larger than 3 cm. ACI has shown excellent results with all three generations. The present generation of matrix ACI and fibrin ACI has the advantage of three-dimensional culture of chondrocytes which decreases the chondrocyte dedifferentiation noticed with earlier generations of the technique [4]. The key disadvantage of ACI remains that it requires a two stage procedure, and newer generations of this technique will aim toward a one-tage allograft ACI. Scaffold based cartilage regeneration can be applied for chondral or osteochondral defects. For chondral defects the defect may be repaired in one or two stages. The two stage technique utilizes the cartilage cells obtained from a normal area of the knee in the first stage, cultured in vitro, and impregnated into a variety of scaffolds. The scaffolds could be porcine collagen matrix, or a variety of synthetic substrates such as polylactic acid and polyglycolic acid, or natural substrates such as hyaluronic acid, collagen derivatives, agarose, alginate, or fibrin glue. Single stage procedures utilize scaffolds impregnated with either fragmented cartilage tissue obtained from a healthy area of the knee or bone marrow. Another approach called as autologous matrix induced chondrogenesis utilizes a porcine collagen matrix to stabilize a blood clot obtained from microfracture. AMIC plus adds PRP for further biologic stimulation [5]. For osteochondral defects, scaffolds have been developed with a two or three layered structure, and are currently under investigation. Similarly, 3D printed personalized scaffolds, nanofiber technology, and hydrogels are being investigated, and would be incorporated in cartilage repair in the future. 4D scaffolds are also an interesting development. These grafts are made from biomaterials which will respond to external stimuli and modify accordingly. Orthobiologics in focal cartilage defects: The orthobiologics used in cartilage defects are amniotic membrane derived mesenchymal stem cells (MSC), adipose-derived MSC, BMAC, PRP, and growth factors (BMP4 and BMP7). MSCs either used alone or with scaffolds have shown promise in animal models but have not shown significant benefits in humans. Intra-articular injections of MSC have not been shown to improve outcomes in osteoarthritis. BMAC contains a large number of growth factors and cytokines which help in cartilage

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regeneration and healing [6]. It has been used as an adjunct to microfracture alone, microfracture with BMAC and HA, and microfracture supplemented with a scaffold impregnated with BMAC. Human studies with scaffolds have shown complete defect filling in 80–100% of patients. Clinical improvement has been reported in up to 100% patients at 5 years, and on second look arthroscopy was found to have regenerated near normal hyaline cartilage. BMAC also been reported to give better results in OCA transplants in terms of graft incorporation and healing when used as an adjunct. PRP has shown good results in the treatment of osteoarthritis, but the results are mixed in focal chondral defects. This may be due the non-standardized ways of its preparation and heterogeneous reporting standards [7]. It has been used in conjunction with micronized allograft articular cartilage, fibrin glue, scaffolds, and demineralized bone matrix for osteochondral defects; all with mixed results. BMP-4 and BMP-7 are the two main growth factors whichare tested in animal models and have shown good cartilage growth and hyaline cartilage differentiation. The role of limb realignment including high tibial osteotomy as an adjunct to cartilage repair is important. The rationale is changing the mechanical axis of the lower limb so as to transfer the body weight across to healthy articular cartilage. Several studies have shown that accurate correction is the leading predictor for success. Management of patella-femoral joint pathology is challenging as a result of the unique and complex organization of static forces and dynamic factors contributing to its functional capacity. The evaluation and treatment of patella-femoral instability (PFI) is basedon static evaluation of the joint. Dynamic evaluation of this pathology may help us give better results. Various developments in this field in the form of cine MRI, dynamic ultrafast MRI, diffuse tension MRI, and its combination with fluoroscopy and ultrasound have given deeper insights into this pathology. Based on these, PFI measurements such as a quadriceps active ratio and modified lateral patellar edge measurement have been proposed [8]. Recently, wearable devices have also been developed for dynamic evaluation of PFI. In future, Level 1 studies need to be developed to test these new diagnostic methods for better development of treatment methods. The role of the medial patella-femoral ligament (MPFL) and its anatomy have been investigated for many years. Recent studies have defined a broader medial attachment of the MPFL fanning across the upper half of the patella and the distal medial quadriceps tendon. Hence, this structure has now been called the medial patello-femoral complex. There is considerable variability in this attachment with 57.3% of this complex attached to the patella and the rest attached to the quadriceps tendon. In the skeletally immature patients the femoral origin of the MPFL has a wide variability, with the average origin 4.7–10 mm distal to the femoral physics with the superior most fibres overlying the physics. Fulkerson defined a new entity called medial quadriceps tendon femoral ligament, its attachments, role in lateral patellar stability, and its reconstruction technique. The medial attachment is to the distal quadriceps tendon, and femoral attachment is distal and anterior to the adductor tubercle immediately above the MPFL attachment [9]. Although the position of the knee during MPFL tensioning is varied; biomechanical studies confirm that a 2N tension with the knee placed in 30–60° of flexion is the best. Practically, tensioning such that a lateral patellar translation of one quadrant is achieved, at 30° knee flexion, is the best way to ensure avoiding over constraining the patella. A double-bundle graft has been shown to decrease the graft failure rates from between 10.6%-26.9% in single bundle grafts to 4.5%-5.5% in double bundle grafts. Several new techniques have been described to avoid the complications associated with patella tunnels and suture anchors. One such technique utilizes the central quadriceps tendon 10–12 mm in width and 3 mm depth left attached to the patella and rerouted in layer two of the knee to be fixed in the emoral isometric tunnel with an interference screw. MPFL repair may be indicated in young patients having first time dislocation with a patellar osteochondral fragment which needs fixation, where a distinct rupture from the patella, or less commonly from the femur, can be recognized. Similarly, imbrication of the MPFL may be sufficient in knees where bony realignment procedures have resulted in stable patella in the trochlea with a lax medial retinacular structure.

Conclusion

Patello-femoral cartilage defects These present unique challenges as patella-femoral joint loads may reach 6.5 times body weight, patella has the thickest cartilage in the body, femoral cartilage may not a good substitute, and an arthrotomy is needed to manage patellar cartilage defects.

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Conflict of Interest

None

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