MINI-SYMPOSIUM: SOFT TISSUE KNEE PROBLEMS

(ii) Meniscal tears

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Summary
Meniscal tears are the most common injuries to the knee. The menisci have important functions within the knee, and loss of a meniscus from surgical meniscectomy significantly increases the risk of subsequent development of degenerative changes within the knee. In younger patients, some meniscal tears may be repairable, and there is now a wide variety of different techniques available for meniscal repair, with highly encouraging published clinical results. In patients with a painful knee where there has already been a previous meniscectomy, meniscal replacement by meniscal allograft transplantation may be a viable option. However, in the future, solutions may well lie within the field of tissue engineering.

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Introduction

The menisci of the knee are two crescentic wedges of fibrocartilage, positioned between the tibia and the femur in the medial and lateral compartments (Fig. 1). They used to be considered to be nothing more than the vestigial remnants of a muscle within the knee. However, it is now well recognised that they have various important functions within the knee. They act as load sharers\textsuperscript{1} and shock absorbers\textsuperscript{2} within the joint, and are also secondary stabilisers,\textsuperscript{3} particularly in the ACL-deficient knee.\textsuperscript{4} Further roles of the menisci have been postulated with respect to joint lubrication,\textsuperscript{5} nutrition of the articular cartilage\textsuperscript{6} and proprioception.\textsuperscript{7}

Incidence and aetiology of meniscal tears

Meniscal tears are the most common injury of the knee, with a reported annual incidence of meniscal injury resulting in meniscectomy of 61 per 100,000 population.\textsuperscript{8} Medial meniscal tears are generally seen more frequently than tears of the lateral meniscus, to a ratio of approximately 2:1.\textsuperscript{9} Meniscal tears may occur in acute knee injuries in younger patients or as part of a degenerative process in older individuals. The acute tears frequently result from sports injuries where there is a twisting motion on the partially flexed, weight-bearing knee. Acute meniscal tears may also occur as part of a more major, combined injury to the knee. In particular, the triad of a rupture of the medial collateral ligament, rupture of the anterior cruciate ligament and a tear of the medial meniscus as a result of forced valgus angulation plus external rotation on the weight-bearing knee from, for example, a rugby tackle or a high-speed skiing injury, is a well-recognised entity.

In a study looking at 1236 patients aged between 18 and 60 years with arthroscopically proven meniscal injuries, 32%
arose as sports injuries, 38% were from non-sporting injuries and the remaining 28% reported no specific history of injury. In the group with non-sporting injuries, approximately 50% of the patients reported that their injury occurred on rising from a squatting position. The mean age of the patients in the sports injury group was 33 years, in the non-sporting injury group was 41 years, and in the no injury group was 43 years.

A report by Smillie in 1968 stated that out of 3000 cases of meniscectomy, 36% were due to acute tears (described as longitudinal tears), and 50% were due to degeneration. The degenerative tears were described as 'horizontal' tears, and occurred in an older age group (mean age 43, compared to a mean age of 31 in those with longitudinal tears). The degenerative tears were described as lesions of middle age, occurring in abnormal fibrocartilage. It was observed that this pattern of tear was most frequently seen in the posterior horn of the medial meniscus.

Meniscal tears are frequently observed in conjunction with anterior cruciate ligament injuries at the time of anterior cruciate ligament reconstruction. In an arthroscopic study, Nikolic found that as many as 72% of knees with a recent ACL tear had a concomitant tear of the lateral meniscus, with a preponderance of circumferential tears of the posterior horn.

In the chronically anterior cruciate ligament deficient knee, the incidence of meniscal tears has been reported to be as high as 98%. The medial meniscus, in particular, has been shown to significantly contribute to anterior stability of the tibia in the anterior cruciate ligament deficient knee. Furthermore, as noted by Vedi, the posterior horn of the medial meniscus is the least mobile portion out of both of the menisci. These factors seem to explain the frequency with which posterior medial meniscal tears, in particular, are found within the chronically anterior cruciate deficient knee.

The relationship between the delay in reconstructive surgery for an ACL rupture, and the subsequent development of meniscal tears as a direct result was demonstrated very elegantly in a study by de Roeck and Lang-Stevenson, where 10% of patients with ACL ruptures were found to have developed new meniscal tears between the time of their surgery.
first arthroscopy (where the ACL rupture was confirmed) and the time of their subsequent ACL reconstruction.  

Acute meniscal tears may be radial, vertical-circumferential or horizontal-cleavage in orientation (Figs. 2A–C). The central portion of a circumferential tear may be unstable and can displace inwards within the relevant compartment of the knee. Such a tear is referred to as a bucket handle tear, and frequently causes mechanical locking of the knee. Degenerative tears tend to be complex in morphology (Fig. 2D).

Symptoms, signs and investigations

The classic symptoms of a meniscal tear around the time of injury are pain around the affected side of the joint, possible locking of the joint, and swelling. The swelling tends to develop gradually over the first 24-h, as opposed to the knee with an acute ACL tear, where the swelling tends to develop rapidly, within the first hour.

Ongoing symptoms of a meniscal tear include pain around the joint line, clicking (which may or may not be painful), giving way and locking. It is also common for patients to complain that they are either unable or else find it painful to squat fully (a position that heavily stresses the posterior horns of both menisci).

The eponymous test that is commonly performed as part of the routine knee examination in order to test for the presence of a meniscal tear is McMurray’s test, which was described by McMurray in 1942 in the British Journal of Surgery. There are many differing written descriptions of how McMurray’s test is actually performed, and even more variations are witnessed in clinical practice. However, McMurray’s original description is as follows: “In carrying out the manipulation with the patient lying flat, the knee is first fully flexed until the heel approaches the buttock; the foot is then held by grasping the heel and using the forearm as a lever. The knee being now steadied by the surgeon’s other hand, the leg is rotated on the thigh with the knee still in full flexion. During this movement the posterior section of the cartilage is rotated with the head of the tibia, and if the whole cartilage, or any fragment of the posterior section, is loose, this movement produces an appreciable snap in the joint. By external rotation of the leg the internal cartilage is tested, and by internal rotation any abnormality of the posterior part of the external cartilage can be appreciated. By altering the position of flexion of the joint the whole of the posterior segment of the cartilages can be examined from the middle to their posterior attachments. Thus, if the leg is rotated with the knee at right angles the cartilages in their mid-section come under some pressure, but, anterior to this point, the pressure exerted on the cartilage is so diminished that accurate examination is impossible. When a loose segment of the cartilage is caught between the bones during rotation, the sliding of the femur over the loose fragment is accompanied by a thud or click, which can sometimes be heard but can always be felt, and the size of the detached portion can be judged by the rocking of the tibia, and usually by the severity of the sound produced. This method of examination is not easy to master; the rotation requires a considerable amount of practice, and the whole procedure must be carried out systematically if success is to be attained. Probably the simplest routine is to bring the leg from its position of acute flexion to a right angle, whilst the foot is retained first in full internal rotation, and then in full external rotation. Any abnormality in the cartilage structure in the area under examination will be discovered during the straightening of the joint.”

The role of MRI in the diagnosis of meniscal injuries can be the cause of some debate. In an ideal world, with no financial restrictions or limits on capacity, one might suggest that all patients with significant symptoms suggestive of soft tissue derangement within the knee should undergo MRI scanning. However, certainly within the NHS in the UK, the reality is such that waiting times for scans can be considerable in some centres. This may well influence decision making in some perhaps borderline cases. MRI is a fairly accurate investigation, with reported sensitivity of 80%, specificity of 71%, positive predictive value of 84% and negative predictive value of 71%. However, as can be seen from these values, MRI is far from infallible in the diagnosis of meniscal tears, and there is, therefore, good argument for proceeding directly to arthroscopy in those patients where there is a high index of clinical suspicion in situations where the requesting of an MRI scan is likely to cause undue delay.

Treatment

Meniscectomy

In the past open total meniscectomy was the appropriate treatment for tears of the menisci. Indeed, although the popular eponymous test for meniscal integrity carries his name, McMurray himself actually stated that “A far too common error is shown in the incomplete removal of the injured meniscus”, and actually went as far as to suggest that if the knee were opened up on the clinical suspicion that there was a meniscal tear, but the meniscus was found to be intact, it should be excised anyway. However, reviewing the literature, McNeil Love recognised as far back as 1923 that the prognosis after meniscectomy should be guarded, and he observed that “the occasional pain .... was usually associated with changes in the weather, suggesting its association with secondary osteo-arthritis”.

After King’s pivotal paper in 1936, there was a sea change in the literature, and as awareness of the true functional importance of the menisci grew, the consequences of meniscectomy became more fully appreciated. Loss of the meniscus leads to a decrease in intra-articular contact areas of approximately 75% and an increase in the peak local contact pressures of approximately 235%. Fukuda used mini-pressure transducers in cadaver knees and demonstrated significant increases in the stresses in subchondral bone after meniscectomy.

A study by Roos reporting the long-term follow-up at 21 years of patients after meniscectomy compared to matched controls has shown a relative risk of 14 for the development of radiographic signs of osteoarthritis after meniscectomy. It has been shown that the chance of developing osteoarthritis after a lateral meniscectomy is greater than that after a medial meniscectomy. This finding is most
probably secondary to the fact that on the lateral side the meniscus carries 70% of the compartment load, compared with the medial meniscus, which only carries 50% of the medial compartment load.1 Furthermore, in the sagittal plane, on the medial side the convexity of the femoral condyle and the concavity of the medial tibial plateau give some degree of congruity, even in the absence of the medial meniscus. On the lateral side, however, the convexity of the femoral condyle is mirrored by convexity of the lateral tibial plateau. Thus, in the absence of the meniscus, on the lateral side there will be a greater tendency towards point loading and increased peak contact pressures (Fig. 3).

Studies have shown that after meniscectomy, results can be affected by the quality and frequency of athletic activities. Jorgensen reviewed 147 athletes after meniscectomy for isolated meniscal injuries and found that radiographic deterioration started after 4.5 years. At 14.5 years follow-up, 89% of athletes had radiographic evidence of degeneration, and 46% had given up or reduced their sporting activity. These values are far higher than would be expected for the general population. However, the full importance of exercise and activity levels after meniscectomy have not yet been thoroughly studied.27

Given the clearly demonstrated and now universally acknowledged adverse effects of total meniscectomy, much interest has focused on the potential benefits of partial rather than total meniscectomy. In a biomechanical study of partial versus total medial meniscectomy, Burke showed that there was a linear correlation between increase in peak stress on the tibial joint surfaces and the amount of meniscal tissue removed. Similar findings were confirmed by Ihn. The clinical relevance of these observations was confirmed in a review of patients undergoing either partial or total meniscectomy, where Hede found that the function of the knee was inversely related to the amount of meniscal tissue excised. However, there was still a significant number of complaints from patients after partial meniscectomy.

**Meniscal repair**

Given the above, over the past years there has been great interest in and effort towards avoidance of meniscectomy wherever possible, and meniscal repair has grown in popularity. The first case of meniscal repair was performed in 1885 by Thomas Annandale, and was reported in the British Medical Journal. Annandale described the case of a 30-year old miner who had felt something give within his knee whilst kneeling, followed by an effusion with subsequent pain and locking. An arthrotomy showed that the medial meniscus “was completely separated from its anterior attachment, and was displaced backwards”. The torn meniscus was repaired with three chromic catgut sutures, and the patient was “dismissed cured”.

Animal studies of the response of the menisci to injury have shown that at its periphery, meniscal tissue is capable of producing a reparative response. Cabaud performed transverse medial meniscal lacerations and repair with a single Dexon suture in 20 canine and 12 rhesus knee joints. By four months, only 6% of the menisci had failed to heal. The scar tissue that was present at the site of healing was shown to be composed of unorganised collagen without common ground substance components.

Arnoczky performed a complete midportion transaction of the medial meniscus in 15 canine knees. He showed that the response originated from the peripheral synovial tissues, and that the menisci had completely healed by fibrovascular scar by 10 weeks. Longitudinal incisions in the inner, avascular portion of the meniscus failed to heal.

Using rabbit knees, Heatley performed meniscal incisions of varying magnitude, with resection of the peripheral meniscal rim, and with or without suturing of the resultant gap. He showed that healing occurred circumferentially, with cells proliferating at the synovial margin and migrating along the cut meniscal edge. The newly formed scar tissue was largely avascular. Heatley noted that synovial cells proliferate readily whilst chondrocytes have only a limited capacity for mitosis. He concluded that healing most probably depended not on the presence of a vascular supply, but on the presence of synovial cells invading the tissue from the periphery. The synovial cells were noted to form tissue that was initially very cellular, but which later became more fibrous. This fibrous tissue was also occasionally seen to transform into fibrocartilage, possibly as a response to compression of the tissue. Suturing the menisci facilitated the healing process by providing stability, and possibly by supplying bridges for synovial cells to migrate onto the meniscus.

Despite Heatley’s observations, meniscal tears are still often classified according to the location of the tear relative to the blood supply of the meniscus (Fig. 4). With a ‘red–red’ tear, both the peripheral and inner margins of...
the tear have a functional blood supply, and these peripheral tears reportedly have the best prognosis for healing. The 'red–white' tear has vascularised tissue on the peripheral side and avascular tissue on the inner side. The 'white–white' tear is completely in the avascular zone and is least likely to heal.34,37

Various techniques have been described in an attempt to facilitate healing of tears in the inner, avascular portion of the meniscus, including the creation of vascular access channels,34 trephination,36 rasping of the parameniscal synovium,39,40 and use of exogenous fibrin clot41–43 or free synovial autografts.44–46 or even laser welding.47

Techniques of open,48,49 inside-out,50–52 outside-in53,54 and all-inside arthroscopic repair55,56 have been described, and each has its merits.57

A number of biomechanical studies have investigated the properties of meniscal repairs using various different techniques of sutureing,58–61 and all have confirmed that the vertical loop suture is the strongest, exhibiting the greatest load to failure when compared to horizontal or mulberry-knot sutures.

Furthermore, numerous meniscal repair devices, such as bioabsorbable arrows, fasteners, and ‘T’-bar ended sutures (Fig. 5), are now available that may offer potential benefits compared to the traditional method of meniscal repair by suturing.62–69

Having tried many of the meniscal suturing devices available, my own personal preference is towards the use of the FasT-Fix device, from Smith & Nephew (Fig. 6). This is an all-inside suture repair system comprising two 5 mm polymer suture bar anchors, with a pre-tied, self-sliding knot of #0 non-absorbable polyester suture. It allows easy and rapid insertion of strong, tight horizontal or vertical loop sutures, which, biomechanically, remain the gold-standard.61 However, at the same time the FasT-Fix avoids some of the potential complications that have been observed with some of the bioabsorbable arrow or dart-like devices available, such as foreign body reactions in the soft tissues due to migrating broken devices, or severe chondral damage from broken or protruding implants within the knee.70,71

The results reported with the use of the FasT-Fix for meniscal repair have been highly encouraging. Kotsovoulos reported on the outcome of 58 meniscal repairs at an average follow-up of 18 months, and observed that just over 90% of repairs were clinically successful, with absence of joint-line tenderness, locking, or swelling, and a negative McMurray test.72

The potential long-term benefits of meniscal repair must, however, be weighed on a patient-by-patient basis against the significant differences in post-operative rehabilitation that are required compared to recovery after a simple partial meniscectomy. Patients are often told that there are no specific functional restrictions necessary after simple partial meniscectomy, and are frequently advised to return to full activities and work within a couple of weeks after surgery. However, although advice does vary, my personal post-operative recommendations to patients after meniscal repair is that they wear a hinged knee brace, locked between 0° and 60° for 6 weeks, and remain partial weight bearing during this period. At the end of this period they are then referred for physiotherapy to help them regain their range of motion and strength, and are told to refrain from running until 3 months after the repair. Such restrictions can be extremely imposing on, for example, a self-employed builder, who may well prefer the option of partial meniscectomy. Detailed, informed patient consent is therefore vital prior to any arthroscopic procedure where meniscal repair could potentially be considered, and treatment should be tailored to the needs and wishes of each individual patient.

Meniscal replacement

Despite recent advances, a large proportion of meniscal tears remain irreparable, and partial, subtotal or even total meniscectomy may still unavoidably be indicated. In the
past, a number of different tissues or materials have been used in an attempt to replace excised meniscal tissue. These include the use of silastic,\textsuperscript{73} carbon fibre,\textsuperscript{74} Dacron,\textsuperscript{75–78} and Teflon\textsuperscript{75,79} prostheses, patellar, Achilles or semitendinosus tendon autograft,\textsuperscript{80–82} fat pad autograft,\textsuperscript{83} and autologous rib perichondrial grafts.\textsuperscript{84} However, all have met with poor results.

As an alternative, the concept of meniscal allograft transplantation was developed, and the first reported animal study describing meniscal allograft transplantation in dogs was by Canham in 1986.\textsuperscript{85} Since this study, meniscal transplantation has been described in sheep,\textsuperscript{86} rabbits,\textsuperscript{87} mice,\textsuperscript{88} rats,\textsuperscript{89} goats,\textsuperscript{90} and monkeys.\textsuperscript{91}

The first report of human meniscal allograft transplantation was published by Milachowski in 1987,\textsuperscript{92} and again in 1989.\textsuperscript{86} It has been estimated that over 4000 meniscal transplantations have now been performed in the USA (personal communication, Kevin Stone, San Francisco, USA), and this technique is also gaining in popularity in various countries across Europe.

van Arkel\textsuperscript{93} reported more recently a larger and longer-term study of 63 consecutive meniscal transplantations with a mean follow-up of 60 months. He found a cumulative survival rate of 76% for lateral meniscal allografts, 50% for medial allografts, and 67% for medial and lateral allografts transplanted into the same knee.

Verdonk\textsuperscript{94} reported his findings after implantation of fresh meniscal allografts into 31 patients. The medial meniscus was transplanted in 46% of cases, the lateral meniscus in 40%, and in the remaining 14%, grafts were inserted bilaterally. Follow-up arthroscopy or magnetic resonance imaging confirmed that all but 5 of the grafts were intact. The clinical outcome was assessed using the Hospital for Special Surgery (HSS) knee rating system,\textsuperscript{95} and showed that initially the results were good, with 62% of patients achieving a score of 175 or above. However, after approximately the first 3 years, the clinical results were seen to deteriorate, and after 7 years, only 25% of patients reached an HSS score of 175.

The difficulty with interpreting the clinical results of these studies to-date lies in the heterogeneity of the patients reported. The meniscal grafts were frequently performed in conjunction with various other major procedures, such as reconstruction of the anterior cruciate ligament,\textsuperscript{86,92,94,96,97} valgus or varus high tibial osteotomy or varus distal femoral osteotomy,\textsuperscript{94,96} or articular osteochondral allografting.\textsuperscript{96,99} Furthermore, a variety of different graft types were implanted, including fresh,\textsuperscript{94,96} lyophilised,\textsuperscript{86,92} fresh-frozen non-irradiated\textsuperscript{97} fresh-frozen gamma-irradiated\textsuperscript{98} and cryopreserved allografts.\textsuperscript{100–102} In addition, the grafts themselves were implanted using various different surgical techniques, ranging from suturing alone,\textsuperscript{94,96,103} to peripheral suturing plus attachment of the anterior and posterior horns by bone plugs into tunnels in the proximal tibia.\textsuperscript{97,102,104} What is still needed is a long-term, prospective, controlled study to compare knees with an absent meniscus that receive a meniscal allograft, with those that do not. Until the results of such a trial are reported, human meniscal allograft transplantation should be considered an experimental, salvage procedure.\textsuperscript{105}

Tissue engineering and the future

The process of tissue engineering, as applied to meniscal regeneration, is the production of newly synthesizing meniscal tissue, in part or in whole, by the addition of exogenous cells, matrix scaffold, specific stimuli (growth

Figure 6  FaSt-Fix meniscal repair system (Smith & Nephew).
factors, mechanical stress), or any combination thereof, in an in vitro or in vivo environment. Given the poor results following prosthetic meniscal replacement and the highly variable results of autografting using alternative tissues such as tendons, much interest and study is currently being directed towards the field of tissue engineering.

In terms of cell sources, three basic cell types have been identified as potential sources for the regeneration of meniscal tissue: the meniscal fibrochondrocyte, the mesenchymal stem cell and the pluripotential fibroblast. The ideal matrix would allow cell proliferation, free diffusion of nutrients, access to cytokines, be mechanically durable and yet resorbable as the tissues own extracellular matrix develops. These are all characteristics shown by the body’s own regenerative scaffold, the fibrin clot.

At present, much work is being undertaken in the development of collagen scaffolds. Collagen scaffolds obtained from enzymatically purified bovine Achilles tendon have been used. The collagen is highly crystalline and can be covalently cross-linked by dehydration, dramatically diminishing its susceptibility to collagenase degradation, without altering its natural triple-helix structure. The collagen can be further cross-linked by the use of aldehyde. Thus, the potential resorption rate of the scaffold can be controlled to suit the in vivo environment. The use of such collagen scaffolds has been described in canine studies where they were used to replace an 80% resection of the medial meniscus. The knees with the implanted scaffolds showed significantly less articular cartilage erosion and osteophyte formation compared to knees with meniscectomy alone, and there was also significant meniscal regeneration into the prosthetic scaffolds. Histologically, well-differentiated meniscal fibrochondrocytes were identified within the scaffolds, and by 12 months these cells were shown to be producing more proteoglycan than was seen in cells around the edges of resected menisci alone.

Trials of collagen meniscal scaffolds have progressed to human studies, and Stone published the results of ten patients receiving purified, treated, gamma radiation sterilised, moulded bovine Achilles tendon collagen implants after meniscectomy to varying degrees. The patients were followed up by questionnaires, physical examination, X-rays, bone scans, serum analysis and magnetic resonance imaging. At thirty-six months postoperatively, the patients’ activity scores were similar to those that would be expected after simple meniscectomy. There were no significant changes demonstrated on X-ray. MRI showed that the interface between the remaining host meniscal rim and the implant regenerated tissue complex became less distinct as time progressed. Histology of biopsies of the implant regenerating tissue complex demonstrated progressive invasion and replacement by new collagen and cells typical of meniscal fibrochondrocytes. Immunological evaluation revealed no apparent immune responses to the implants.

A further study by Rodkey reported the results of the use of collagen scaffolds for reconstruction of irreparably damaged meniscal. Eight patients received a collagen meniscus implant (Fig. 7), and they were followed up for a minimum of 24 months. All patients improved clinically, and radiographically there was no evidence of any progression of degenerative joint disease. Relook arthroscopy showed apparent meniscal tissue regeneration, and preservation of the articular surfaces of the joint. Histological analysis from biopsies at the site of implant insertion confirmed new fibrocartilage matrix formation.

These studies confirm that human meniscal cartilage-like tissue does grow into resorbable collagen scaffolds, and initial experience suggests that their use is safe. Further studies examining the efficacy of such implants, compared to meniscectomy, repair, the use of allografts, or no treatment are currently underway.

Other synthetic engineered bioabsorbable scaffolds have also been described for meniscal regeneration, including polyglycolic acid discs seeded with fibrochondrocytes, and 50/50 copolymers of lactide/caprolactone. Animal studies have shown that bovine fibrochondrocytes seeded onto polyglycolic acid scaffolds implanted subcutaneously into mice give rise to new meniscus-like tissue. Scaffolds of co-polymers of lactide and caprolactone have been used to replace sections of excised meniscus in canine knees, and it has been shown that there is ingrowth of fibrous tissue, formation of fibrocartilagenous tissue and gradual degradation of the polymer. Furthermore, only scaffolds manufactured with a high compressive modulus, close to that of normal meniscal tissue, showed formation of fibrocartilagenous tissue, whereas in implants with a lower compressive modulus, only fibrous tissue growth was seen. It was also observed that good adhesion of the periphery of the implant was not a prerequisite for fibrocartilage tissue formation. It was therefore suggested that the new fibrocartilage tissue was formed by metaplasia of fibrous tissue, and not by ingrowth from adjacent meniscal tissue, and that this only occurred in appropriate mechanical environments, as provided by scaffolds with compressive moduli comparable to normal meniscal tissue.

Work using cultured mesenchymal stem cells implanted into collagen sponge scaffolds to fill meniscal defects in rabbits has shown that the repair process is augmented. Although degenerative changes within the rabbit knees were not prevented, seeding with the mesenchymal stem cells was shown to lead to the formation of fibrocartilage histologically similar to normal meniscal tissue, whereas...
use of collagen sponge alone, without cells, to fill meniscal defects, led to healing by fibrous tissue only.

Further work has recently been directed towards the gene therapy for meniscal injury. In vivo work has shown that meniscal cells can be readily transduced by retroviral vectors carrying TGFβ3, growth factor genes. The cells in monolayer culture then show greatly increased matrix synthesis.

The discipline of tissue engineering is in its relative infancy, but technological advances are enabling the application of new techniques at a rapidly increasing rate, and instead of merely being in the realms of science fiction, the prospect of creating tailor-made replacement tissues by order now seems ever more likely to be a reality.

References

Meniscal tears


