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The surgical management of symptomatic articular cartilage defects of the knee: Consensus statements from United Kingdom knee surgeons

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ABSTRACT

Background: Symptomatic articular cartilage and osteochondral lesions in the knee are an important source of pain and disability, and may lead to osteoarthritis. There are several surgical treatments for the condition, with emerging data evaluating their clinical effectiveness and longer-term clinical outcome. Health care providers have challenged the indications for the use of expensive techniques and have been reluctant to authorize funding or reimbursement.
Methods: The UK Cartilage Consensus Meeting was convened, involving clinicians in the UK with experience in the treatment options, decision-making and evaluation of the literature on the subject.
Results: This paper reports the consensus of attendees regarding appropriate surgical options for managing articular cartilage defects in the knee, validated by a large cohort of surgeons in the UK who are active in the field of articular cartilage surgery.
Conclusions: An evidence-based United Kingdom Consensus of 104 clinicians on the surgical management of symptomatic articular cartilage lesions of the knee. Several techniques may be suitable for small defects. Cell therapy has the best evidence-based outcomes for larger defects. Responsible innovation, pooled data collection and improvement in physical therapies are important. Surgeons should have access to the most appropriate evidence-based therapies for first-line treatment.

1. Introduction

Articular cartilage injuries in the knee are common. Approximately 60% of patients undergoing arthroscopy for any indication have an articular cartilage lesion [1,2] with a preponderance for location on the femoral condyles. Cartilage lesions can be the result of trauma, or other conditions such as osteochondritis dissecans, previous sepsis or inflammation. Articular cartilage lesions are not symptomatic in all patients, but those that are can give rise to symptoms that are equivalent in magnitude and disability to end stage osteoarthritis of the knee [3]. Symptoms can include pain, swelling, catching, locking and instability symptoms. History and physical examination alone are not diagnostic, and patients usually undergo plain radiography of the knee to evaluate alignment of the joint, to detect the presence of any radio-opaque loose bodies and determine radiographic signs of arthritis. Magnetic resonance imaging (MRI) scanning (with or without gadolinium enhancement) can identify and partly quantify articular cartilage defects. Arthroscopy is the gold standard for assessment of the size of the lesion and functional integrity of the surrounding cartilage. Articular cartilage has very limited capacity of self-repair in adults and the natural history of articular cartilage lesions is that those over nine millimeters in diameter are biomechanically unstable and will progress to degeneration of the joint surfaces [4,5].

2. Context of the UK Cartilage Consensus Meeting

There is accruing evidence of the most effective treatments for symptomatic articular cartilage lesions. Some treatments are more expensive than others, and there is a wide disparity and geographical variation between health boards, hospitals, health insurance companies and other healthcare providers as to which treatments can be offered. Clinicians are restricted on economic grounds in treating their patient with what they would deem to be the best evidence-based surgical management for that individual patient.

Licensing by the European Medicines Agency of cell therapy products is rigorous, and companies providing this treatment commercially are obligated to invest in multicentre randomized controlled trials (RCTs) to establish product effectiveness [6,7]. Industry therefore attempts to recoup these investments by raising the price of the treatment they

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have proven to be effective. Government Human Tissue Authority licensing of individual hospitals is necessary to undertake cell therapy for articular cartilage repair, at a significant additional cost to the treatment. Reluctant health care providers have termed some cartilage repair techniques "experimental" and therefore not suitable for funding. Knee surgeons do not accept this, as they recognize that some of these so called "experimental" techniques have been in safe clinical practice for over 25 years, with published long-term patient reported outcomes [8–10]. Cartilage repair treatments are on the front line of innovation and tissue engineering, with new techniques and products constantly emerging that need rigorous trial evaluation. Surgeons who treat patients with symptomatic articular cartilage lesions in the UK are cognisant of the financial constraints of the system within which they work. However, they have recognized the need for a UK Consensus Paper to summarize the evidence-based best treatment for their patients and make this paper available to health care providers.

This paper reports the conclusions of the UK Cartilage Consensus Meeting regarding appropriate surgical options for managing articular cartilage defects in the knee, when conservative measures have failed.

3. Methods

The UK Cartilage Consensus Meeting was held on 23rd March 2014 at The Royal College of Surgeons of Edinburgh. It was an open meeting, free to attend for any interested clinician. The meeting was held in the absence of Industry sponsorship and was funded by an unrestricted grant from the Scottish Orthopaedic Research Trust into Trauma (SORTiT) whose remit is to promote research and education for improved care of the injured. An experienced non-medical facilitator chairman ensured all participants had an equal opportunity to participate, amend and veto suggestions. During the meeting, participants had access to all the peer-reviewed literature (paper or electronic) on the subject of articular cartilage injury and repair to consult as necessary.

In order to focus the scope of the Consensus Meeting and paper, it was assumed that surgery would be considered when the articular cartilage lesion of the knee was no longer responsive to effective pro-active conservative treatment, including specialized lower limb physiotherapy and rehabilitation, activity modification and weight management [11].

This consensus was established based upon an isolated defect of the knee joint which was stable or surgically stabilized by ligament reconstruction, where alignment was normal or surgically corrected by osteotomy, and free of inflammatory joint disease and with some functional meniscal tissue remaining.

Following the meeting, the paper was circulated in draft form to all meeting participants, other interested clinicians who were unable to attend the meeting and to all members of The British Association for Surgery of the Knee (BASK) to engage more widely. Participating clinicians were asked to declare any conflict of interest and the signatories to this consensus paper agreed with the majority of its content.

The consensus meeting and consensus statements cover isolated articular cartilage defects in the adult knee. There are many patients who are outside this description who benefit from chondral surgery as part of their management. They should not be excluded from appropriate treatment methods on the basis that their specific indications are not discussed in this document.

4. Overview of surgical treatment strategies

Surgical strategies used to repair articular cartilage lesions of the adult knee fall into four broad categories detailed below. Many patients may have had prior arthroscopic surgery to diagnose chondral or osteochondral lesions combined with mechanical or radio-frequency debridement procedures designed to remove unstable tissue and reshape defect edges.

1. Bone marrow stimulation techniques (microfracture, augmented microfracture, drilling). The bone in the base of a defect is multiply pierced and allowed to bleed [12–14]. Cells within the resultant blood clot form a fibrous scar tissue composed predominantly of type I collagen. The fibrocartilaginous scar tissue has poorer biomechanical properties compared to the surrounding hyaline articular cartilage and is thought to degenerate by around 24 months [15]. However, there may be a short-term improvement in symptoms [16]. Clinical outcome is poor in the medium-term for young active patients or patients with larger defects [17,18]. Techniques are described for performing a microfracture with the addition of a membrane or matrix overlying the clot to retain the clot in the defect [19]. The longer-term outcome data of this technique is awaited.
2. Osteochondral grafting. Usually autologous, a core of intact articular cartilage and its underlying bone is harvested from an area of the knee less involved in weight-bearing and implanted into the symptomatic articular cartilage defect of the same knee [20,21]. In this technique, autologous donor tissue is limited [22]. The bony element of the graft usually heals well, and patients can have a good short-term outcome. There is concern regarding the poor integration of the transferred cartilage tissue with the host hyaline cartilage, and there is evidence to confirm that significant portions of the chondrocytes in the periphery of the graft are rendered non-viable by the harvesting process itself [23]. Longer-term cohort studies and a randomized trial have shown poorer outcomes at medium- and long-term [24–26]. Patients with larger defects requiring multiple plugs and patients with lesions of the patella fare particularly badly with this technique. Allograft osteochondral grafting has been used successfully in some centres [27–29]. Suitable allograft is often difficult to obtain in the UK. The optimum balance between microbiological safety and graft cell viability, and the effect of storage is not yet established.
3. Osteochondral scaffolds. These are a group of treatments where matrices are implanted into defects [30]. The principle is that cells migrate into the scaffold, which provides a structural framework upon which they can proliferate. Long-term cohort results and randomized studies of these techniques are awaited. There is some overlap with the bone marrow stimulating group, as this can be the source of cells used to populate the scaffolds
4. Cell therapy (autologous chondrocyte implantation, ACI). In this technique [31], a small biopsy of autologous articular cartilage is harvested from an area of minimal weight-bearing of the knee or from the damaged tissue of cartilage defect itself. The cartilage is enzymatically digested in the laboratory to release the chondrocytes. These are cultured, and returned to the surgeon for implantation into the defect at a second surgery. First generation surgery at introduction of the technique in 1987 included using autologous periosteum as a patch under which cells were injected [31]. The periosteum was prone to hypertrophy [32], and the techniques currently licensed by the European Medicines Agency use a collagen patch, either as a cover for injected cells, or as a structure to be preloaded with cells. Key papers have emerged on the results of ACI. Long-term cohort studies of ACI [10], and two series independent of the surgeon-inventors of the technique have recently been published from the UK and USA [8,9]. These demonstrate good long-term outcomes for ACI of the femoral condyles and patella, with over 70% still successful at minimum of 10 years. Two high quality multi-centre (RCTs) of ACI vs microfracture have been published [6,7] demonstrating the clinical and histological superiority of cell therapy at two and at five years. A long-term RCT of ACI vs Mosaicplasty at minimum 10 years follow-up [26] demonstrated superiority of ACI in large lesions. Results of ACI have been shown to be worse if performed following bone marrow stimulation techniques with a six fold increase in the failure rate of ACI after previous microfracture [34,35]. One RCT of ACI vs microfracture [36] has results that differ with all other reported RCTs. This study reports no clinical difference between ACI and microfracture at five years, although better histology for ACI. At five years, 40% of this cohort