

## Welcome to the: Orthopaedic Opinion Online Website

The website for the answer to all your Orthopaedic Questions

- **Orthopaedic Opinion Online** is a website designed to provide information to patients who have orthopaedic and musculoskeletal problems and are undergoing treatment.
- **Patient information** is provided in the form of downloadable information sheets.
- **Orthopaedic advice** and second opinions can be provided by our expert internationally renowned Consultant Orthopaedic Surgeons.
- **Online review** of patients' X rays or MRI scans can also be provided and any proposed treatment plans reviewed.
- **Book a clinical consultation** with one of our internationally renowned consultant orthopaedic surgeons in Bristol or London.
- **Orthopaedic reports** can be provided for Injury or Accident Claims and Medical Negligence claims.

**This Patient Information Sheet is provided by Orthopaedic Opinion Online**

### Articular Cartilage Lesions of the Knee and Their Management

**Author:**

**DAVID P JOHNSON**

MB ChB FRCS FRCS(Orth). MD  
Consultant Orthopaedic Surgeon

[www.Orthopaedics.co.uk](http://www.Orthopaedics.co.uk)

© D P Johnson 2008

Key words: Arthritis, articular cartilage, chondral injury, chondral defect, anatomy, physiotherapy, glucosamine, joint replacement, anti-inflammatory medication

#### **Introduction**

Knee injuries occur frequently among athletes and can vary widely in severity. Chondral injuries present a unique exceptional challenge to the treating physician in view of the poor natural healing capacity of the articular cartilage cells: chondrocytes. Therefore chondral injuries can result in considerable functional impairment, diminish an athlete's level of performance and potentially threaten their career. It is important therefore to diagnose and treat athletes with articular cartilage injuries.

The treatment of articular cartilage lesions is complicated and can be overwhelming as the treating surgeon has to decide how athletes can resume their sporting activities without compromising their recovery. Guidance and the treatment options available is provided as at present there is limited information regarding articular cartilage knee injuries and return to play.

Sports which involve pivoting movements such as basketball, football and soccer have a higher incidence of injuries to the knee and knee cartilage, with an increased risk of injury to athletes participating in high impact sports, particularly professionals. A significant number of ACL reconstruction patients also have articular cartilage lesions. Degenerative changes and arthritis can be the result of un-repaired or untreated articular cartilage lesions. The treating orthopaedic surgeon must therefore have a high level of suspicion of such lesions, be able to diagnose these injuries and employ a wide range of difficult surgical techniques to reconstruct the damage.

#### **Biology of Articular Cartilage**

Articular cartilage is avascular and therefore has a limited repair capacity. The function of the articular cartilage is to allow lubricated low friction gliding movements of joints and to cushion the loading across the joint. Articular cartilage is made up of dense Type II collagen, a proteoglycan matrix and chondrocytes fixed within the matrix. The fluid contained as hydrostatic pressure within the homeostasis within the extracellular matrix of articular cartilage. This maintains the mechanical integrity of the articular cartilage to withstand the compressive loads across a joint and allow gliding and sliding movement.

Consequently, chondral lesions that do not penetrate the subchondral bone heal poorly and a persistent defect is caused. In the base of full thickness injuries of articular cartilage usually heals to a limited degree with fibrocartilage. Fibrocartilage is a healing type of tissue composed of mainly Type I collagen. This fibrocartilage is less able to cushion the loads across the joint and to facilitate low friction movement of the joint. The joint is thus more liable to early wear and degeneration.

**Clinical Presentation of Articular Cartilage Lesions**

Articular cartilage lesions are often symptom free at the outset. Nevertheless, patients may subsequently present with persistent pain, swelling, locking and giving way. Symptoms complained of may include soreness radiating near the medial or lateral joint line that worsens on activity. In this case, the surgeon should consider an injury to the articular cartilage as it can imitate meniscal pathology. A high suspicion of such lesions should be considered in association with Anterior Cruciate Ligament injuries where 83% of injuries also involve injury to the articular surface as well as the ligament. (See Table 1.)

<b>Table 1. Differential Diagnosis of Chondral Injury in the Knee</b>	
<b>Medial meniscus tear</b>	<b>Tibial or femoral bone bruise injury</b>
<b>Lateral meniscus tear</b>	<b>Synovitis</b>
<b>Medial collateral ligament injury</b>	<b>Lateral collateral ligament injury</b>
<b>Popliteus tendon injury</b>	<b>Referred patellofemoral pain</b>

**Classification**

In the first instance a plain X-ray is required to assess chondral injuries. Although the articular surface is not shown on plain X-rays the joint alignment and any degeneration or arthritis may be detected.

High resolution high magnetic field MRI (Magnetic Resonance Imaging) scanning provides a better evaluation of these lesions. Using special proton density enhanced sequences a detailed picture of the articular cartilage can be demonstrated. The most accurate method of diagnosing the problem continues to be an arthroscopy enabling the surgeon to assess the size, depth, and characteristics of chondral defects and may also allow the surgeon to advise any further intervention is necessary and identify the possible prognosis.

The modified Outerbridge Classification is the most commonly accepted grading system for articular cartilage injuries. The quality of the articular cartilage lesions are graded I-IV, recording the total size (mm or cm). (See Table 2.)

<b>Table 2. Modified Outerbridge Classification of Articular Cartilage Lesions?</b>	
<b>Grade</b>	<b>Characteristics</b>
<b>I</b>	<b>Simple softening of cartilage</b>
<b>II</b>	<b>Superficial fissuring and cracking of cartilage</b>
<b>III</b>	<b>Deeper fissures than Grade II and "crabmeat" appearance</b>
<b>IV</b>	<b>Exposed subchondral bone</b>

**Articular Cartilage Treatment Options**

**Non-Operative**

If an obvious lesion is not present on X-ray, an MRI is necessary. If a small superficial lesion is identified then in the first instance non-operative treatment is indicated. This can consist of rest, partial weight bearing on the affected leg, a corticosteroid injection (if there is acute swelling and inflammation), and physical therapy to reduce swelling and increase muscle strength. If the lesion is large, full thickness or remains symptomatic then arthroscopic assessment and possibly reconstruction is necessary.

**Operative**

**Arthroscopic Debridement (Chondroplasty):** Arthroscopic debridement is performed to remove loose flaps that mechanically impinge on the joint and can improve symptoms in the short term. The procedure is usually limited to small, partial thickness cartilage lesions in which subchondral bone is not exposed. Interim follow-up in athletes has shown good to excellent results in most patients.

**Marrow Stimulation (Microfracture):** This procedure consists of piercing the subchondral plate with a small pick or awl, resulting in channels 3-4mm apart that fill the cartilage defect with blood. The clot contains pluripotent marrow-derived mesenchymal cells that result in reparative Type I fibrocartilage. Microfracture is appropriate for lesions up to 4cm<sup>2</sup> in size. Rehabilitation will involve continuous passive motion and protected weight bearing for 6-8 weeks. Return to full competition in high-impact pivoting sports was seen in only 44% of athletes and a rehabilitation period of up to six months after surgery was necessary.

**Osteochondral Transfer (Mosaicplasty) and Osteochondral Allografts:** The mosaicplasty technique offers an alternative treatment for all articular surfaces lesions up to 4cm. Autograft plugs are harvested from a non-weight bearing area and transplanted into the defect.

This technique provides a hyaline cartilage replacement. The restrictions of the procedure are possible donor site morbidity, availability of graft material and surgical skill to reproduce the radius of curvature of the defect. Seventeen authors have described up to 93% of athletes returning to full activity at 6-9 months following surgery.

Refrigerated or fresh osteochondral allografts can also be used to resurface articular cartilage defects. These allografts are usually reserved for lesions bigger than 2.5-3.0cm. Grafts are implanted within 28 days of donor harvest and can maintain up to 67% chondrocyte viability. At present, there have been no studies on the use of osteochondral allografts in athletes.

## Cell-Based Cartilage Repair Techniques

### **Autologous Chondrocyte Implantation (ACT)/Matrix Autologous Chondrocyte Implantation (MACI):**

ACI/MACI is suitable for athletes 20-50 years old with an isolated femoral condyle defect greater than 2-4 cm, less than 3-6mm deep. Chondrocytes are harvested from a non-weight bearing area of the joint and then expanded in vitro and re-implanted into the articular cartilage defect during a subsequent operation. Athletes should be able to return to full activity at approximately 12 months following surgery. Several differences to this technique are possible including selectively expanding harvested chondrocytes and use of a biodegradable scaffold for chondrocyte support.

A two year study of 50 patients from the United States and Europe showed 86% reported good to excellent results. There was a 13% complication rate with an estimated cumulative rate of failure at two years of 6%.

### **Neocartilage Implantation**

Neocartilage implantation involves sophisticated tissue engineering technology. The chondrocytes are harvested in a similar way to ACI, the cells are then expanded in a 2-D culture and seeded in a bovine collagen gel/sponge construct. Following incubation a specific bioreactor is used to encourage the chondrocytes to produce cartilage matrix proteins. The result is the formation of a sponge-like neocartilage that contains chondrocytes and an extracellular matrix. No studies have been published indicating the optimal return to play following this procedure, although the procedure shows potential.

## Rehabilitation Following Articular Cartilage Repair

The integrity of the surrounding articular cartilage should be maintained during rehabilitation whilst also protecting the graft. If conservative treatment is preferred the aim is to reduce symptoms of pain and disability. Changes to lifestyle and activity may be necessary and along with weight loss, if appropriate. For the active athlete, an aggressive managed physical therapy program may be fitting. If this is recommended by the surgeon this would include full weight bearing and specific muscle strengthening. This may be in cases such as simple arthroscopic debridement.

Protected weight bearing for a minimum of six weeks is recommended for procedures to reconstitute the articular surface. Maintaining joint movement during this rehabilitative period is essential. This can be in the form of CPM maintaining joint motion and surface contour whilst preventing mechanical overload. At

present, no well controlled studies have been undertaken that depict the best postoperative rehabilitation procedure for athletes after surgical treatment of an osteochondral injury.

**Return to Play**

The appropriate time for an athlete to return to full activity should be based upon sufficient tissue healing, complete osteochondral integration, and adequate functional rehabilitation. The recommendation in Table 3 are a summary of various expert opinions. Currently, there are no well controlled published guidelines regarding return to full activity after surgical treatment of a chondral injury.

Patients undergoing microfracture can expect an unrestricted return to play after 3-6 months but this can be as long as 9-12 months. Following ACI/MACI surgery return to sports is advised after 14-18 months. Earlier return to unrestricted sports following osteochondral autograft or allograft transplantation surgery may be possible but is reliant upon subchondral bone incorporation. A full range of motion must be demonstrated along with 80 quadriceps function compared to the uninjured side, and a minimal effusion to allow return to play. This can often take six months. MRI scanning to ensure graft bone incorporation can be recommended prior to consent to return to play.

**Conclusion**

Articular cartilage sports injuries are common and can be difficult to diagnose and treat. At present, there are a few surgical options available based upon the size and depth of the lesion. An appreciation of the specific biological process and timetable regarding surgical intervention is essential. It is critical the surgeon weighs up urgency with patience in deciding an speedy yet safe timetable for the athlete to return to sport

**Table 3.  
Return to Play Guidelines after Specific Articular Cartilage Procedures**

<b>Procedure</b>	<b>Timetable to Return to Play</b>	<b>Special Considerations</b>
<b>Arthroscopic Debridement (Chondroplasty)</b>	<b>2 - 4 weeks</b>	<b>Normal knee range of motion -80% strength of unaffected limb Minimal swelling</b>
<b>Marrow Stimulation (Microfracture)</b>	<b>3+ -12 months</b>	<b>Normal knee range of motion -80% strength of unaffected limb Minimal swelling</b>
<b>Autologous Chondrocyte Implantation (ACI/MACI*) *see manuscript</b>	<b>14 -18 months</b>	<b>Normal knee range of motion -80% strength of unaffected limb Minimal swelling Graft healing</b>

Please visit [www.orthopaedics.co.uk](http://www.orthopaedics.co.uk) for more information.

**DAVID P JOHNSON**  
**MB ChB FRCS FRCS(Orth). MD**

**Spire Glen Hospital, Redland Hill, Bristol BS6 6HW. UK**  
**Appointments: 0117 970 6655**  
**E-Mail: boc@orthopaedics.co.uk**  
**Web site: www.orthopaedics.co.uk**

Disclaimer: The views expressed in this article are not necessarily those of Orthopaedic Opinion Online or the author. The information is provided for general background reading only and should not be relied upon for treatment. Advice should always be taken from a registered medical practitioner for individual circumstances and for treatment of any patient in any circumstances. No liability is accepted by Orthopaedic Opinion Online, or the author in respect to the information provided in respect of the content or omission or for any reason or as a result of treatment in individual circumstances. This information is not for use in the USA.