Long-term solutions for cartilage injuries

AUTOLOGOUS CHONDROCYTE IMPLANTATION

By Prof. Mehmet Binnet / Dr Kerem Basarir

Sadly, there is no shortage of football players who are forced to hang up their boots due to some kind of cartilage damage in their joints – especially in their knees, where bones have a large contact area and strong forces applied to them. The knee articular cartilage is a few millimetres thick yet distributes the load in the joint, providing a low-friction surface for the gliding and rolling of joint surfaces against one another; in fact, its friction coefficient is calculated to be lower than that of ice on ice.

A torn cartilage, quite frequent in football, is usually associated with pain and swelling in the short term, making it difficult or impossible for the player to continue an active sporting life. One is tempted to assume that chronic problems are limited to the amateur game and, possibly, lack of adequate diagnosis and treatment. This is often nothing to do with medical skills but rather the player's reluctance to seek advice. But young players at the beginning of professional careers also run the risk of a premature end to their career due to damaged joint cartilage that can lead to osteoarthritis, a condition that can have a dramatic impact on the quality of the player's daily life. It is distressing to see footballers not only obliged to leave the game but to also face restrictions in physical activity due to painful and limited joint motion.

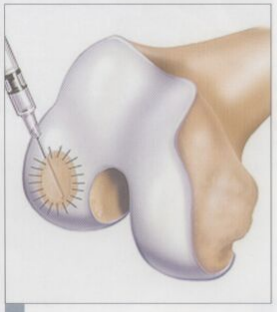
Articular cartilage responds differently to injury than other tissues. It has limited regeneration capacity due to the absence of blood vessels, lymphatics and nerves. Cartilage cells cannot migrate to the site of injury as cells in other tissues can. Articular cartilage injuries that do not penetrate the bone and thereby provide a flow of blood do not heal. The reparative scar tissue consists of suboptimal fibrocartilage, which does not have the same biomechanical properties as original hyaline cartilage, usually leading to fast breakdown of newly formed tissue.

Many techniques have been indicated for facilitating articular cartilage healing. The conventional method of treating a full-thickness chondral lesion was to produce a suboptimal fibrocartilage scar repair by penetrating the subchondral bone to elicit a bleeding response. Fibrocartilage is much less resistant to mechanical wear than normal hyaline cartilage, especially in the weight-bearing areas of the knee. Most of these procedures which provide scar tissue for healing, including debridement, chondroplasty, abrasion arthroplasty, and microfracture, improve pain and function in the short term. However these results deteriorate in the long term.

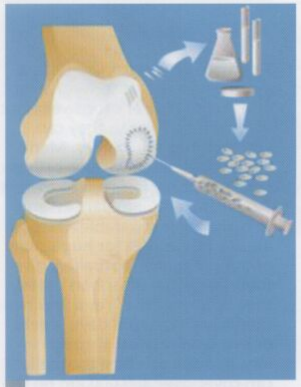
Different treatment modalities providing articular cartilage with similar mechanical properties were introduced in time, such as mosaicplasty. Small defects in the knee can be repaired with cartilage/bone plugs from other non-weight-bearing areas of the knee. However this modality is not suitable for larger lesions located in the weighted portion of the joint, because the source is limited and because they may cause donor-site problems.

The challenge facing orthopedic surgeons today is how to effectively treat larger chondral injuries in young, active football players and avoid significant morbidity with repeat operations and life-quality problems. A new technique for treating full-thickness articular cartilage defects in the knee was introduced in late 1990s, based on taking healthy cartilage cells, sending them to a laboratory for culture, and then returning them for implantation in the damaged area with a view to encouraging the growth of healthy cartilage. This entails two surgical procedures – one to harvest the tiny fragment of normal material, and a second, some weeks later, to perform the implantation. The damaged area is surgically cleaned and then a fragment of fibrous material (periosteum) is taken from a superficial bone like the hip to be sewn over the defect, the cells from the laboratory are injected behind the fibrous restraint, where they start to grow into a sheet of normal cartilage cells. It is called autologous chondrocyte implantation (ACI). It entails a period of four to six weeks of post-surgical physiotherapy but the majority of patients report good or excellent early results.

Success of this treatment is measured by the patient's ability to return to an active, productive sports life without experiencing limiting symptoms. These results have been extended in Europe and replicated in the United States in several centres in intermediate range follow-ups (up to ten years).



Chondrocyte implantation.



Cell transplantation.

Autologous chondrocyte implantation has been performed on football players in Turkey since 2000 and cell culture facilities have been constructed in the Biotechnology Institute of the Faculty of Medicine at Ankara University. This followed years of laboratory and animal research performed by Prof. Mehmet Binnet, Dr Kerem Basarir (orthopedics department) and Prof. M. Elcin (tissue engineering). Although physical preparation and training methods improve with time and cartilage injuries should, hopefully, become less frequent, these injuries do occur and there is a good chance of achieving long-lasting successful responses via autologous chondrocyte implantation.