2005: Stem Cells for the Repair of Knee Cartilage

by National University Hospital

Background

The articular cartilage is made up of cells, as well as an extensive extracellular matrix synthesized by chondrocytes. It provides a smooth surface at the ends of bones and this allows virtually frictionless movement within a joint. Cartilage is the most easily damaged component of the knee and this damage can be caused by injury or various types of arthritis. Once destroyed, the articular cartilage will not regenerate, but will only fill with reparative tissue.

Patients with cartilage defects usually complain of acute pain in the knees even while walking. The pain is especially prominent when they climb up and down stairs and during squatting. Patients also complain of swelling and locking of the knees. As such, many patients find that their quality of life is greatly reduced.

Currently, there are a few common methods to treat cartilage defects in knee joints. The conservative treatment involves prescribing medicine to stop the pain while the surgical approach involves an arthroscopy which can be performed by the keyhole technique to wash out the joint.

A more recent surgical procedure is the Autologous Chondrocytes Implantation (ACI). This method includes the removal of cartilage cells from non-weight-bearing areas of an affected knee. Then, the cartilage cells are used in a planned second operation that requires an open-knee surgery. However, chondrocytes may be unavailable due to the limited donor source in some patients. In addition, chondrocytes are terminally differentiated and have a limited lifespan.

Procedure

Due to the disadvantages, a team of doctors in the Department of Orthopaedic Surgery from the National University Hospital of Singapore has investigated the use of bone-marrow derived stem cells for cartilage repair.

The treatment is performed in two stages. The first involves bone marrow aspiration, where bone marrow stem cells are extracted under local anesthesia. The cells are then cultured in the laboratory for two to three weeks to allow the cells to grow to a substantially large population.

The second stage of the treatment involves the implantation of the stem cells. This can be achieved either through an open-knee surgery or through direct injection of the stem cells to the damaged area. The choice of the method of delivery will be dependent on factors such as the location and extent of damage to the cartilage.

The recovery period for patients who undergo the open-knee surgery will be approximately six weeks, whereas those who undergo the localized injection will require a shorter time to recover.

Patient Characteristics

A 42-year-old female patient presented with pain in both knees, with the pain more prominent in the left. She has been having the pain for the past 10 years due to a sporting injury. It is especially painful when she walks up and down stairs. On examination, it was confirmed that she was suffering from cartilage damage in her knees, with the left knee more severely affected than her right.

The patient was advised to perform repair on the left knee first. She went through the bone marrow aspiration and underwent an open-knee surgery for the implantation of the bone marrow derived stem cells.

Results

During the operation, a significant defect was found in the cartilage of the knee *(Figure 1)*. The defect was repaired with stem cells injected underneath a periosteal pouch *(Figure 2)*. After the operation, the patient was referred for physiotherapy sessions and she was able to walk with minimal pain in the knees.

A second look arthroscopy 9 months after surgery demonstrated a smooth regenerated surface of the cartilage defect *(Figure 3).* Success of this surgery had prompted patient to proceed with the operation on her righ knee using the same method.

Figure 1

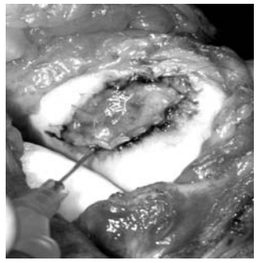

Figure 2

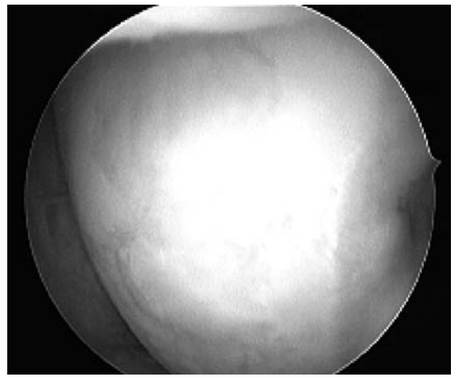

Figure 3