Comprehensive Therapeutic Approach For Cartilage Repair

Byoung-Hyun Min

Department of Orthopedic Surgery, School of Medicine, Department of Molecular Science and Technology, School of Engineering, Ajou University, Suwon, Korea

Cartilage wear arises from the destruction of homeostasis caused by breakdown exceeding the formation of extracellular matrices (ECM) by cells and also often accompanies the inflammatory reaction, thus cartilage recovery or repair should be tried with alleviation of inflammation. There may be losses in various forms ranging from loss of chemical substances of the extracellular matrix (chondromalacia) to partial or full thickness defects of the cartilage.

In the case of chondromalacia wherein ECM is lost with no change in cartilage surface, it is expected that the lost ECM can be supplemented by stimulating chondrocytes that secrete ECM. Intraarticular injection of cells has shown the possibility to replace the role of drug by antiinflammation and immunomodulation. Gene transfection technology is another promising field in the treatment of cartilage defects and osteoarthritis. Research has concentrated on transfecting gene vectors that will enhance extracellular matrix formation from the transfected cells, thereby increasing the chance of transplanted cells to be functional. There have been many reports of chondrocyte metabolism being enhanced by mechanical stimulation. The author reported that internal cartilage damage can be treated using mechanical stimulation from ultrasonic waves to prevent apoptosis of chondrocyte and promote the formation of extracellular matrices and showed that the penetration of hyaluronates into synovial membrane increases and reduces inflammations. There are currently no methods for treating partial thickness defects of cartilage, although a study suggesting the possibility of treatment involving surface modification with protease and cell injection has been conducted. The author reported the plausible treatment of partial thickness defects of cartilage with cartilage gel using fetal cartilage derived stem cell, and near future related clinical studies are planned. When full thickness of the cartilage has been lost, and the subchondral bone is exposed, a variety of surgical techniques can be attempted. Bone marrow stimulation techniques (drilling, microfracture, abrasion arthroplasty), osteochondral transplantation, and autologous chondrocyte transplantation may be attempted, with the appropriate surgical method used depending on the size and depth of each cartilage defect. The author developed a technique to cover the biological membrane to enhance the clinical effectiveness of bone marrow stimulation techniques. The tissue engineering method refers to a technique wherein biomaterials and cells are used to produce cartilage in vitro. The author produced artificial cartilage by inoculating chondrocytes into extracellular matrix biomaterials, and clinical tests are planned.

In conclusion, Cartilage repair has so far studied on filling of defect. However considering amelioration of inflammation contributes repair process, the research paradigm in restoration of cartilage tissue should shift to covering both recovery and repair of cartilage ECM by controlling both its synthesis and degradation. Various treatment modalities should focus current research on the clinical unmet needs and hurdles between bench and bedside. This shift of paradigm will expedite application of cartilage repair modalities.