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Opinion Article

Restoring Cartilage: Techniques and Outcomes

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ABOUT THE STUDY

Cartilage is a specialized connective tissue that covers the surface of bones in the joints. It provides a smooth surface for joint movement, reduces friction and absorbs shock. Unfortunately, cartilage has a limited capacity to repair itself once damaged. Cartilage injuries can lead to chronic pain, stiffness, and functional limitations. Cartilage restoration procedures aim to regenerate or replace the damaged tissue and restore joint function.

Cartilage injuries

Cartilage injuries can occur due to trauma, overuse, or degenerative changes. Commonly affected joints include the knee, hip, shoulder, and ankle. Cartilage damage can range from a small focal defect to a large full-thickness lesion that exposes the underlying bone. Cartilage injuries are often accompanied by other joint pathologies, such as meniscal tears, ligament injuries, and bone bruises. Cartilage injuries can be classified according to their size, location, and depth. Small focal defects are less than 2 cm in diameter and can be treated with less invasive procedures.

Large defects are greater than 2 cm and require more extensive treatment. The location of the defect can also influence the choice of treatment. Cartilage in weight-bearing areas, such as the medial femoral condyle in the knee, is subject to higher mechanical stress and may require more durable repair techniques. The depth of the lesion can also affect the treatment options. Superficial defects that involve only the top layer of cartilage have a better healing potential than deep defects that extend into the bone.

Techniques for cartilage restoration

The choice of treatment for cartilage injuries depends on the size, location, and depth of the defect, as well as the patient's age, activity level, and overall joint health. The following are some of the commonly used techniques for cartilage restoration.

Microfracture: Microfracture is a minimally invasive technique that stimulates the formation of new cartilage by creating small holes in the exposed bone. The technique is performed arthroscopically, and the holes are made using a specialized tool called an awl. The holes allow the bone marrow cells to migrate to the surface and form a blood clot that fills the defect. The clot eventually transforms into a fibrous tissue that resembles cartilage.

Microfracture is most effective for small, shallow defects in non-weight-bearing areas. The technique has a high success rate in young patients with good joint alignment and no signs of arthritis. However, the fibrous tissue formed by microfracture is not as durable as normal cartilage and may wear out over time.

Autologous Chondrocyte Implantation (ACI): ACI is a two-stage procedure that involves the removal of a small amount of healthy cartilage from the patient's joint, which is then sent to a laboratory to grow more chondrocytes. Chondrocytes are the cells that produce cartilage. The cultured chondrocytes are then implanted into the patient's joint through a small incision. The chondrocytes attach to the exposed bone and begin to produce new cartilage.

ACI is effective for large, deep defects in weight-bearing areas. The technique has a high success rate in young, active patients with good joint alignment and no signs of arthritis. However, ACI is a more invasive procedure than microfracture, and the laboratory processing can add significant cost and time to the procedure.

Osteochondral Autograft Transfer (OAT): OAT involves the transplantation of healthy cartilage and bone from a non-weight-bearing area of the patient's joint to the damaged area. The healthy tissue is harvested through a small incision and transferred to the defect using specialized instruments. The transplanted tissue is secured in place with sutures or screws.

OAT is effective for larger, deeper defects in weight-bearing areas. The technique has a high success rate in young, active patients with good joint alignment and no signs of arthritis. OAT has the advantage of using the patient's own tissue, which reduces the risk of rejection and infection. However, the procedure can be limited by the availability of suitable donor tissue.

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Autologous Matrix-Induced Chondrogenesis (AMIC): AMIC is a technique that combines microfracture with the use of a collagen-based matrix. The matrix is implanted into the defect and serves as a scaffold for the formation of new cartilage. The matrix is biodegradable and is gradually replaced by new tissue.

AMIC is effective for small to medium-sized defects in weight-bearing areas. The technique has a high success rate in young, active patients with good joint alignment and no signs of arthritis. The matrix provides a more durable structure than the fibrous tissue formed by microfracture alone.

Allograft transplantation: Allograft transplantation involves the use of donor tissue from a cadaver. The tissue is screened for disease and matched to the patient's joint. The donor tissue is then transplanted into the patient's joint to replace the damaged cartilage.

Allograft transplantation is effective for larger, more complex defects in weight-bearing areas. The technique has a high success rate in patients who are not suitable candidates for autologous procedures due to previous surgeries or insufficient donor tissue. However, allograft transplantation carries a higher risk of rejection and infection than autologous procedures

Outcomes

The success of cartilage restoration procedures depends on many factors, including the patient's age, activity level, joint alignment, and overall joint health. The size, location, and depth of the defect also play a significant role in determining the outcomes of the procedure. In general, younger patients with smaller defects and good joint alignment have better outcomes than older patients with larger defects and poor joint alignment. The outcomes of cartilage restoration procedures can be measured in terms of pain relief, functional improvement, and durability of the repair.

Patients can expect to experience a reduction in pain and an improvement in joint function following the procedure. The durability of the repair depends on the technique used and the patient's individual factors. Microfracture has the shortest durability, while autologous procedures have longer-lasting results.