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# KNEE ARTICULAR CARTILAGE REPAIR AND RESTORATION TECHNIQUES IN ATHLETES: A REVIEW

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Articular cartilage injuries are common among athletes, with a prevalence of 36-38% in high-level competitors. These lesions present unique challenges due to cartilage's limited healing capacity and the high demands placed on repair tissue by athletic activities. From an orthopaedic perspective, successful treatment must not only address pain and function but also facilitate return to sport (RTS) at pre-injury levels. This review examines current cartilage repair techniques and their outcomes in athletic populations. Bone marrow stimulation Bone marrow stimulation techniques such as microfractures involve creating small holes in the subchondral bone to stimulate mesenchymal stem cell migration and fibrocartilage formation.

This technique is commonly used for smaller defects (<2 $cm^2$) in athletes due to its minimal invasiveness and relatively quick recovery time. Athletic outcomes after microfracture show: RTS rates of 75-83% among professional athletes; Return to pre-injury level in 25-75% of cases; Average time to RTS of 7-9 months While microfracture allows quicker return, long-term outcomes often deteriorate after 5 years, with basketball players showing significant reduction in games played in the first season post-surgery. Autologous Chondrocyte Implantation (ACI) and Matrix-induced ACI (MACI) ACI is a two-stage procedure involving chondrocyte harvest, laboratory expansion, and reimplantation beneath a periosteal or collagen cover. MACI utilizes a collagen membrane seeded with chondrocytes. Engineered Nasal Chondrocyte Transplantation (Nose2Knee) is the novel tissue engineering approach utilizes autologous nasal septum chondrocytes. The technique addresses limitations of traditional autologous chondrocyte implantation (ACI) by using cells with superior regenerative capacity and minimal donor site morbidity.

Athletic outcomes include: 67-84% RTS rates; 64% return to pre-injury level; Average RTS time of 11-18 months; More durable long-term outcomes than microfracture27 Osteochondral Autograft Transplantation (OAT) OAT involves harvesting osteochondral plugs from non-weight-bearing areas and transplanting them to the defect site. This technique preserves hyaline cartilage structure. Athletic outcomes following OAT: Highest RTS rate among all techniques (89%); Fastest average return time (6.6 months); Significantly more "excellent or good" results compared to microfracture3; Limited by defect size due to donor site morbidity Osteochondral Allograft Transplantation (OCA) OCA uses cadaveric donor tissue to replace large osteochondral defects, offering the advantage of addressing sizeable lesions without donor site morbidity. Athletic outcomes after OCA: 75-88% RTS rates; 67-79% return to pre-injury competitive level; Average return time of 16 months; 77% adjusted RTS rate when considering athletes who believed they could return if they hadn't graduated from sports programs Treatment Selection Considerations Several factors influence treatment selection and

outcomes: 1. Defect size: Microfracture for small lesions (<2 cm²), ACI/MACI for medium lesions, OCA for large defects 2. Athletic level: Professional and elite athletes demonstrate higher RTS rates than recreational athletes 3. Sport type: Basketball players show lower RTS rates than soccer or football players 4. Age: Younger athletes have better outcomes across all techniques 5. Timing: Early intervention (<12 months from injury) correlates with improved RTS rates Conclusion Cartilage restoration techniques in athletes must balance durability with return-to-play timelines. Treatment selection should be individualized based on defect characteristics, athlete's competitive timeline, and long-term career considerations.

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