Knee Osteoarthritis / Defects of the Articular Cartilage

Articular cartilage defects are variable in their presentation, in terms of location as well as severity. Several surgical procedures have been developed to deal with the specifics of different defects. The least invasive, arthroscopic debridement often requires a very short rehabilitation. It is important to note that a different healing cascade occurs in the presence of superficial vs. deep defects, and some evidence suggests that meaningful healing responses only occur when the subchondral plate has been involved. In other words, full thickness tears may have a greater healing potential than partial thickness lesions. Effective management of articular cartilage defects including the aggressive management of co-existing conditions at the knee, such as alignment, ligamentous stability, and meniscal function. The repair of articular defects also has some interesting research taking place for the future. These include using genetic material to provoke cartilage repair and the use of synthetic matrixes, in which chondrocytes are matured within a bio-reactor and subsequently inserted into the host, as the next step in autologous chondrocyte implantation.

Surgical Considerations:

Arthroscopic Debridement:
Performed to reduce inflammation and eliminate mechanical irritants. This technique includes removal of osteophytes, smoothing of cartilage disruptions, removal of synovial tissue, and irrigation of the joint capsule.

Microfracture
Microfracture surgery is a much more invasive intervention designed to stimulate a healing response within the articular cartilage. The mechanism of effects can be briefly described by the three different phases of microfracture repair: necrosis, inflammation, and repair. Holes are drilled into the subchondral plate, causing tissue necrosis and a resultant inflammatory reaction, most notable of which is the formation of a fibrin clot, which serves as a matrix for the growth of a fibrous repair matrix, or collagenous scar. By engaging the underlying marrow, the expectation is that that mesenchymal cells released in the inflammatory process differentiate to produce a repaired tissue that is grossly hyaline cartilage, although the actual makeup of the resultant tissue is variable. The quality of this repaired cartilage has been shown to continue to improve up to one year after the procedure. Optimal results for microfracture have been reported when applied to lesions less than 4mm in diameter.

High Tibial Osteotomy (HTO)
In patients with uni-compartmental degenerative changes, an HTO may be performed in hopes of realigning the joint, thus reducing abnormal joint forces and preserving the joint and avoiding TKA. Patients likely to be considered for an HTO often are under age 60, have a varus or valgus deformity and no evidence of an inflammatory process such as RA or
inflammatory arthritis. This realignment technique is often performed in conjunction with other procedures to improve articular cartilage. This procedure is used in younger, active patients to delay the need for a TKA. A distal femoral osteotomy is often used with later compartment arthritis, while the HTO is most often used in patients with medial compartment arthritic changes.

**Rehabilitation Considerations:**
Reinold et al (2006) offer generalized considerations for rehabilitation for patients with articular cartilage defects:

**Lesion**
- Depth
- Size
- Location
- Containment
- Quality of Surrounding Tissue

**Patient**
- Age
- Body Mass
- General Health
- Nutrition
- Quality of articular cartilage
- Previous activity level
- Specific Goals
- Motivation

**Surgery**
- Repair procedure
- Tissue Involvement
- Concomitant Procedures

Further guidelines for rehabilitation deal with balancing the restoration of motion, strength and function against the need to create a positive healing environment for the articular lesion.

- **Motion**: Early active and passive motion, open chain early
- **Weight-bearing**: Limited weight bearing early. While arthroscopic debridement patients may be full weight bearing initially, those patients treated with microfracture, abrasion arthroplasty, or graft fixation may be limited to NWB status for up to 6 weeks.
- **Use isometric strengthening early in ranges of motion that do not cause the lesion to be engaged, usually in full extension or at 90° of knee flexion.**
- **Good communication with the surgeon with regards to location of lesion and guidelines for tissue healing is imperative.**
- **Footwear, exercise surface, and careful monitoring of weight bearing progression should all be considered for these patients.**
Articular Cartilage Evidence Summary

Arthroscopic Debridement:
Although the concept of smoothing and irrigating a joint in response to arthritic irritation seems to be based primarily on biologic plausibility, the actual evidence supporting the use of this procedure is lacking. In a 2007 systematic review, Siparsky et al. examined the use of arthroscopy in the treatment of knee osteoarthritis. Their conclusions indicated that no substantial evidence exists which supports the use of arthroscopic lavage or debridement as a routine treatment for knee osteoarthritis. One caveat is that existing research has not yet delineated the effectiveness of arthroscopy for different levels or arthritis. As such, the authors note that there may yet be some sub-group which stands to benefit from the procedure. This sub-group would likely be characterized by mild levels of arthritic progression, youthfulness, and perhaps the presence of loose bodies. A study by Moffat (1994) suggests early and intensive physical therapy interventions can improve the recovery of muscle strength after arthroscopic procedures.

Oxford Evidence Level: B

Microfracture:
Microfracture is primarily used in the treatment of small articular cartilage lesions in the knee. Overall reported outcomes are good for small and medium sized lesions, the outcomes seem to be worse when used to treat larger lesions. A randomized trial by Knutsen et al. compared microfracture to autologous chondrocyte implantation and found no differences between the groups, though noted that younger patients performed better post-operatively.

Traditionally, microfracture procedures have been managed with non-weight bearing and CPM, thought to both protect the articular cartilage and improve the quality of the resultant tissue. One recent report by Marder et al. demonstrated in a retrospective, case control cohort of patients that no difference existed between one group receiving CPM and non-weight-bearing and another receiving no CPM and weight-bearing as tolerate after microfracture surgery. In that study, both groups demonstrated significant improvements in Lysholm scores and Tegner activity scores post-operatively, regardless of grouping. Yen et al has provided a nice description of a more traditional rehabilitation model in which the science and rehabilitation principle of microfracture surgery are reviewed.

In a case series of 32 athletes undergoing microfracture for the treatment of relatively small articular cartilage defects, 44% of subjects were able to return to high-impact, pivoting activities at a 2 year follow-up. Only 57% of that group was able to perform at pre-operative level, with higher rates of return in athletes under the age of 40. Outcomes in the general population were reported recently by Steadman, where 80% of patients reported an “improved” status 7 years post-operatively. A 2006 review in JOSPT by Gill provides an excellent overview on the microfracture procedure and important principles of rehabilitation.

Oxford Evidence Level: B
High Tibial Osteotomy:
High Tibial Osteotomy (HTO) is primarily used as a treatment for unicompartmental osteoarthritis of the medial aspect of the knee. A Cochrane Systematic review on the subject reports “Silver” level evidence in support of the procedure’s ability to reduce pain and improve function. However, the authors note that no advantage for HTO versus other surgical or conservative treatment methods was observed. When compared against unicompartmental, hemi-arthroplasty of the knee, findings range from equivalent outcomes to an advantage long term for hemi-arthroplasty. Rehabilitation following either procedure was investigated by Ivarsson, with improved gait velocity and single limb stance duration noted with unicompartmental arthroplasty. Evidence supporting rehabilitation following HTO is limited. In a prospective case study, Noyes documented a physical therapy protocol consisting of 4 weeks of toe-touch weight-bearing and early range of motion to 110°. It should be noted at this point, that the Ivarsson study mentioned above, published in 1991, included six weeks of plaster cast immobilization after the HTO was performed. Early motion is further supported by Billings, in a 2001 retrospective review of 64 patients receiving HTO who were treated with immediate continuous passive motion as well as 50% weight-bearing for six weeks. The protocol used by Billings is reflective of a more modern approach to rehabilitation after HTO.

Oxford Evidence Level:  B for support of the procedure, C for rehabilitation

References:


