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Rehabilitation Protocol Following Osteochondral Allograft or Autograft Transplantation (OATS)

There are two types of cartilage in the knee—meniscus and articular cartilage. There are two menisci in the knee—a medial meniscus and a lateral meniscus. These menisci are semi-lunar wedges that sit between the femur (thigh bone) and tibia (shin bone). The menisci are primarily composed of fibrocartilage, with about 75% of the dry weight being Type I collagen. The function of the menisci is to protect the other type of cartilage in the knee—the articular cartilage. The articular cartilage is a layer of hyaline cartilage that covers the end of bones that articulate with other bones. In the knee you have articular cartilage on the end of the femur (femoral condyles), the top of the tibia (tibial plateau) and the back of the knee cap (patella). The articular cartilage has a frictional coefficient approximately one fifth of ice on ice (i.e. rubbing articular cartilage on articular cartilage would be five times smoother than rubbing ice on ice.) This allows for a very smooth gliding surface. A large portion of articular cartilage is fluid, which provides significant resistance to compressive forces.¹

During athletic trauma or injury, focal areas of the articular cartilage can be damaged or torn, exposing the subchondral bone. This is referred to as an articular cartilage lesion (Figure 1). When this happens you lose the normal smooth gliding articulation and the ability to resist compressive forces at the joint. These changes can cause pain, swelling, loss of motion, weakness and reduced function or performance.

The osteochondral autograft transplantation (OATS) procedure involves transplantation of plugs of bone with overlying articular cartilage (Figure 3) from areas of relatively no weight bearing (Figure 2) to weight bearing areas of the knee which have articular cartilage loss.² An allograft (cadaver) plug is also an option that can be used to fill the lesion. The size of the harvested plug is sized to match that of the injury/lesion. These plugs are then pressed into holes created at the lesion. This can be done with a single large plug (Figure 4) or several smaller plugs (Figure 5). Initially these plugs can be susceptible to getting pushed in further, thus weight bearing is restricted for the next six weeks to ensure that the cartilage plug heals “flush” with the rest of the cartilage surface.²

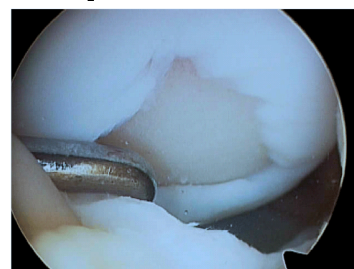


Figure 1 Full thickness articular cartilage lesion on the femoral condyle of the knee, exposing the subchondral bone plate

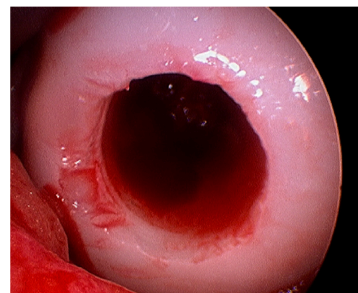


Figure 2 Donor site from area of relatively no weight bearing

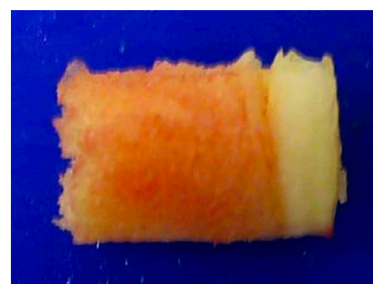


Figure 3 A harvest bone plug with overlying articular cartilage (removed from donor site, Figure 2)

Rehabilitation Protocol After OATS

The OATS procedure is currently the only procedure that restores the normal hyaline articular cartilage to the injured knee. Microfracture and chondroplasty procedures attempt to fill in the chondral defects with fibrocartilage. Research has shown that fibrocartilage is more likely to deteriorate over time, and that the chance of returning to sports is greater with the OATS procedure. A study by Gudas et al³ found that 93% of patients who had an OATS procedure were able to return to their pre-injury level of sports versus 52% who underwent microfracture. The ability to return to sport is also dependent on the size of the lesion (or degree of injury), patient age, patient size (BMI), associated injuries and length of time that the injury has been present. For some patients the goal will be to return to daily activities without pain, for others it may be returning to sports.

Initially post-operative rehabilitation will focus on regaining range of motion and protecting the healing plugs. As the rehabilitation progresses the focus shifts to regaining strength and movement control. Developing the muscular ability to reduce force will help decrease stress to the articular surfaces. In the final phase of rehabilitation the athlete will work on regaining movement control with change of direction activities, such as cutting and pivoting. This is imperative to prevent increase shear stresses on the articular cartilage.

The rehabilitation guidelines are presented below in a criterion based progression. Specific time frames, restrictions and precautions are given to protect healing tissues and the surgical repair/reconstruction. General time frames are also given for reference to the average, but individual patients will progress at different rates depending on the size and location of the chondral lesion, their age, associated injuries, pre-injury health status, and rehabilitation compliance. Specific attention must be given to impairments that caused the initial problem. For example if the patient is status post medial compartment OATS procedure and they have a varus alignment, post-operative rehabilitation should include correcting muscle imbalances or postures that create medial compartment stress.

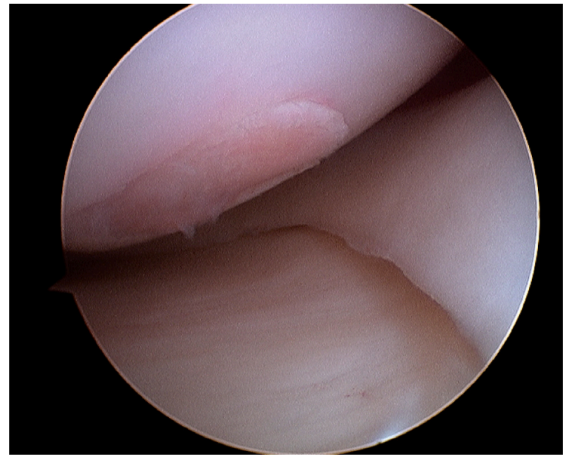


Figure 4 A large single plug press fit into a hole created at the site of the lesion

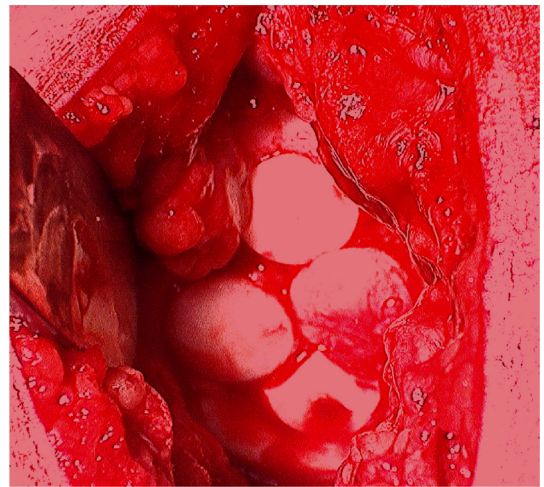


Figure 5 Several smaller plugs press fit into a hole created at the site of the lesion

Rehabilitation Protocol After OATS

Phase I (Surgery to 6 weeks after surgery)

Goals	<ul style="list-style-type: none"> ○ Protection of knee after surgery ○ Restore normal knee ROM (range of motion) and patellar mobility ○ Restore full control over leg
Bracing	<ul style="list-style-type: none"> ○ Week 1: Hinged knee brace locked in extension; removable for CPM & rehab ○ Weeks 2-6: Gradually open brace in 20° increments as quad strengthens ○ D/C brace when able to perform straight leg raise w/o extension lag
Range of Motion Exercises	<ul style="list-style-type: none"> ○ Continuous Passive Motion (CPM) Machine: 6-8 hours per da, 6-8 weeks ○ Set CPM to 1 cycle per minute, starting at 40° flexion ○ Advance 10° per day until flexion is achieved (goal: 100° by week 6) ○ PROM/AAROM and stretching under guidance of PT
Therapeutic Exercises	<ul style="list-style-type: none"> ○ Patellar mobilization ○ Quad/hamstring/adductor/gluteal sets: straight leg raise, ankle pumps ○ Stationary bike for ROM

Phase II (6 to 8 weeks following surgery)

Goals	<ul style="list-style-type: none"> ○ Advance to full weight-bearing as tolerated ○ D/C crutch use
Range of Motion Exercises	<ul style="list-style-type: none"> ○ Advance to full/painless ROM (should obtain 130° of flexion)
Therapeutic Exercises	<ul style="list-style-type: none"> ○ Closed chain exercises: wall sits, shuttle, mini-squats, toe raises ○ Gait training ○ Patellar mobilization ○ Begin unilateral stance activities

Rehabilitation Protocol After OATS

Phase III (8 to 12 weeks following surgery)

Goals	<ul style="list-style-type: none">○ Full weight-bearing
Range of Motion Exercises	<ul style="list-style-type: none">○ Full/painless ROM
Therapeutic Exercises	<ul style="list-style-type: none">○ Advanced closed chain strengthening exercises, proprioception activities○ Sport-specific rehabilitation○ Maintenance program for strength and endurance
Other Suggestions	<ul style="list-style-type: none">○ Gradual return to athletic activity as tolerated○ Jogging: 3 months○ Higher impact activities: 4-6 months

References

1. Pearle AD, Warren RF, Rodeo SA. Basic science of articular cartilage and osteoarthritis. *Clin Sports Med*. Jan 2005;24(1):1-12.
2. Reinold MM, Wilk KE, Macrina LC, Dugas JR, Cain EL. Current concepts in the rehabilitation following articular cartilage repair procedures in the knee. *J Orthop Sports Phys Ther*. Oct 2006;36(10):774-794.
3. Gudas R, Kalesinskas RJ, Kimtys V, et al. A prospective randomized clinical study of mosaic osteochondral autologous transplantation versus microfracture for the treatment of osteochondral defects in the knee joint in young athletes. *Arthroscopy*. Sep 2005;21(9):1066-1075.