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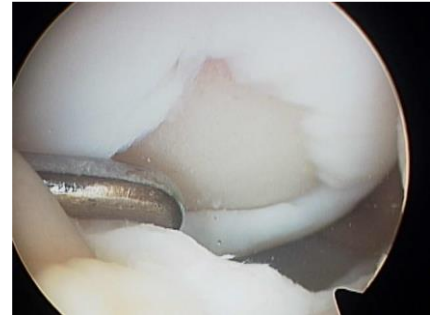
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## REHABILITATION GUIDELINES FOLLOWING OSTEOCHONDRAL AUTOGRAFT TRANSFER (OATS) FOR THE KNEE

Aaron M. Bott, M.D.

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 1/5 of ice on ice – i.e. rubbing articular cartilage on articular cartilage would be 5x smoother than rubbing ice on ice. This allows for a very smooth gliding surface. A large component of articular cartilage is water, which provides significant resistance to compressive forces.

During athletic trauma or injury, focal areas of the articular cartilage can be damaged, 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 OATS procedure involves transplantation of plugs of bone with overlying articular cartilage from areas of relatively no weight bearing to weight bearing areas of the knee which have articular cartilage loss. The size of the harvested plug is sized to match that of the injury/lesion. These plugs are then press fit into holes created at the lesion. Weight bearing is restricted for the first six weeks to ensure that the cartilage plug heals “flush” with the rest of the cartilage surface.

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 which is more likely to deteriorate over time. The ability to return to sport is 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.

The rehabilitation guidelines are presented 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 rehab compliance.

# OSTEOCHONDRAL AUTOGRAFT TRANSFER (OATS)

## Phase I Surgery to 6 Weeks

Aaron M. Bott, M.D.

<b>Appointments</b>	Physician: 7-10 days and 6 weeks postoperatively Physical Therapy: 3-5 days postoperatively 1-2x/week
<b>Guidelines</b>	<ul style="list-style-type: none"> <li>• Maintaining full extension is critical</li> <li>• Weightbearing:             <ul style="list-style-type: none"> <li>-Week 1-3: TTWB with the brace locked in extension</li> <li>-Week 4-6: Progress from 25%-100% WB with the brace locked in extension</li> </ul> </li> <li>• <b>Crutches:</b> <ul style="list-style-type: none"> <li>-Crutches must be utilized for the entirety of Phase I</li> </ul> </li> <li>• <b>Brace:</b> <ul style="list-style-type: none"> <li>-May be removed for ROM exercises</li> <li>-Must remain locked for all ambulation</li> <li>-Must be worn at night locked in extension for the first 2 weeks</li> <li>-May be removed at night from weeks 3-6</li> </ul> </li> <li>• Other exercises may be utilized at the therapist's discretion within the restrictions of the protocol</li> </ul>
<b>Range of Motion Exercises</b>	<ul style="list-style-type: none"> <li>• Extension             <ul style="list-style-type: none"> <li>-Knee extension on a bolster/Prone hangs</li> </ul> </li> <li>• Flexion             <ul style="list-style-type: none"> <li>-CPM machine</li> <li>-Supine wall slides</li> <li>-Assisted heel slides</li> <li>-Week 1-2 = 0-90°</li> <li>-Week 3-4 = 0-110°</li> <li>-Week 5-6 = 0-125°</li> </ul> </li> <li>• Stationary bike for motion only starting at week 4</li> <li>• ROM exercises should be performed frequently throughout the day with high repetitions to help remodel and contour the healing cartilage. The optimal goal during the first 6 weeks is to do 4-6 hours of ROM exercises daily</li> </ul>
<b>Strengthening Exercises</b>	<ul style="list-style-type: none"> <li>• Quad sets/SLRs/Ankle pumps/Patellar mobilizations</li> <li>• 4 way standing leg lifts with brace on for balance and hip strength</li> </ul>
<b>Balance Training</b>	<ul style="list-style-type: none"> <li>• Weight shifting at 4 weeks</li> <li>• Balance exercises standing on both feet at 5-6 weeks</li> </ul>
<b>Aerobic Conditioning</b>	<ul style="list-style-type: none"> <li>• Upper body circuit training or UBE</li> </ul>
<b>Modalities</b>	<ul style="list-style-type: none"> <li>• Electrical stimulation</li> <li>• Cryotherapy</li> </ul>
<b>Progression Criteria</b>	<ul style="list-style-type: none"> <li>• 6 weeks postop</li> <li>• Trace to no effusion</li> <li>• Full knee extension</li> </ul>

# OSTEOCHONDRAL AUTOGRAFT TRANSFER (OATS)

## Phase II 6 Weeks to 12 Weeks Postop

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<b>Appointments</b>	Physician: 6 weeks and 3 months postoperatively Physical Therapy: 1-2x/week
<b>Guidelines</b>	<ul style="list-style-type: none"><li>• Weightbearing:<ul style="list-style-type: none"><li>-Weeks 6-8: Unlock brace for WB and wean to allow FWB out of brace</li></ul></li><li>• Crutches:<ul style="list-style-type: none"><li>-Crutches may be discontinued once the patient is FWB in brace with Normal to near normal gait</li></ul></li><li>• Avoid post-activity swelling</li><li>• Avoid loading knee at deep flexion angles</li><li>• No impact activities until Phase III</li><li>• Radiographs will be obtained at the 6 week and 3 month appointments to assess for incorporation of the allograft</li><li>• Other exercises may be utilized at the therapist's discretion within the restrictions of the protocol</li></ul>
<b>Range of Motion Exercises</b>	<ul style="list-style-type: none"><li>• Stretching for patient specific muscle imbalances</li><li>• Stationary bike for ROM</li></ul>
<b>Strengthening Exercises</b>	<ul style="list-style-type: none"><li>• Hip and core strengthening</li><li>• Quadriceps strengthening<ul style="list-style-type: none"><li>-Quadriceps isometrics at various flexion angles</li><li>-Closed chain exercises from 0-60° flexion</li></ul></li><li>• Hamstring curls 0-90°</li><li>• Toe/calf raises</li></ul>
<b>Balance Training</b>	<ul style="list-style-type: none"><li>• Pool program<ul style="list-style-type: none"><li>-Gait drills</li><li>-Protected WB strengthening exercises</li></ul></li><li>• Double leg balance and proprioceptive drills</li></ul>
<b>Aerobic Conditioning</b>	<ul style="list-style-type: none"><li>• Non-impact endurance training<ul style="list-style-type: none"><li>-Swimming (stiff knee flutter kick)</li><li>-Deep water run</li></ul></li><li>• Upper body circuit training</li><li>• Stationary bike</li></ul>
<b>Modalities</b>	<ul style="list-style-type: none"><li>• Cryotherapy</li></ul>
<b>Progression Criteria</b>	<ul style="list-style-type: none"><li>• Normal gait on level surfaces</li><li>• Full range of motion</li><li>• No effusion</li><li>• Ability to carry out functional movements without unloading affected leg or pain, while demonstrating good control.</li><li>• Single leg balance greater than 15 sec.</li></ul>

# OSTEOCHONDRAL AUTOGRAFT TRANSFER (OATS)

Phase III 12 Weeks to 6 Months Postop

Aaron M. Bott, M.D.

Appointments	Physician: 3 months and 6 months postoperatively Physical Therapy: 1x/1-2 weeks
Guidelines	<ul style="list-style-type: none"><li>• Post-activity soreness should resolve within 24 hours</li><li>• Avoid post-activity swelling.</li><li>• Avoid knee pain with strengthening</li><li>• Radiographs will be obtained at the 3 and 6 month appointments to assess for incorporation of the allograft</li><li>• Other exercises may be utilized at the therapist's discretion within the restrictions of the protocol</li></ul>
Range of Motion Exercises	<ul style="list-style-type: none"><li>• Stretching for patient specific muscle imbalances</li></ul>
Strengthening Exercises	<ul style="list-style-type: none"><li>• Functional leg strengthening<ul style="list-style-type: none"><li>-Squats</li><li>-Lunges – all 3 planes</li><li>-Step backs</li><li>-Retro step ups</li><li>-Single leg press</li></ul></li><li>• Hip and core strengthening</li></ul>
Balance Training	<ul style="list-style-type: none"><li>• Single leg balance and proprioception progression</li><li>• Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot.</li><li>• Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities.</li></ul>
Aerobic Conditioning	<ul style="list-style-type: none"><li>• Stationary bike</li><li>• Water walking/Swimming</li><li>• Walking</li><li>• Stairmaster/Ski machine/Elliptical</li></ul>
Running Program	<ul style="list-style-type: none"><li>• <b>Running program (straight)</b><ul style="list-style-type: none"><li>-4 to 5 months postop</li><li>-Jog (progression of speed: 1/2, 3/4, full)</li><li>-Walk</li><li>-Backward run</li></ul></li><li>• <b>Cutting program</b><ul style="list-style-type: none"><li>-5 to 6 months postop</li><li>-Lateral, carioca, figure 8s</li></ul></li></ul>
Modalities	<ul style="list-style-type: none"><li>• Cryotherapy</li></ul>
Progression Criteria	<ul style="list-style-type: none"><li>• Dynamic neuromuscular control with multi-plane activities, without pain or swelling.</li></ul>

# OSTEOCHONDRAL AUTOGRAFT TRANSFER (OATS)

## Phase IV 6 Months to 12 Months Postop

Aaron M. Bott, M.D.

<b>Appointments</b>	Physician: 6 months and 12 months postoperatively Physical Therapy: 1x/1-2 weeks
<b>Guidelines</b>	<ul style="list-style-type: none"><li>• Post-activity soreness should resolve within 24 hours</li><li>• Avoid post-activity swelling.</li><li>• Avoid knee pain with impact.</li><li>• Goals include good control and no pain with sport and work specific movements, including impact</li></ul>
<b>Range of Motion Exercises</b>	<ul style="list-style-type: none"><li>• Stretching for patient specific muscle imbalances</li></ul>
<b>Strengthening Exercises</b>	<ul style="list-style-type: none"><li>• Hip and core strengthening</li><li>• Continued lower extremity PRE's</li></ul>
<b>Balance Training</b>	<ul style="list-style-type: none"><li>• Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot.</li><li>• Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities.</li><li>• Sport/work specific balance and proprioceptive drills</li></ul>
<b>Aerobic Conditioning</b>	<ul style="list-style-type: none"><li>• <b>Functional training</b><ul style="list-style-type: none"><li>-7 to 8 months postop</li><li>-Plyometrics: box hops, level, double-leg</li><li>-Sport-specific drills</li></ul></li><li>• Replicate sport or work specific energy demands.</li></ul>
<b>Modalities</b>	<ul style="list-style-type: none"><li>• Cryotherapy</li></ul>
<b>Progression Criteria/Return to Sports</b>	<ul style="list-style-type: none"><li>• Good dynamic neuromuscular control with multi-plane activities, without pain or swelling</li><li>• Biodex scores at least 85-90% of opposite side</li><li>• Osteochondral autograft transfer is a procedure designed to restore integrity of the articular cartilage within the knee. High-impact athletic activities may jeopardize the long-term health of the graft. Low-impact activities are recommended indefinitely. If high-impact activities are going to be pursued, they should probably be delayed for 7-8 months following surgery.</li></ul>