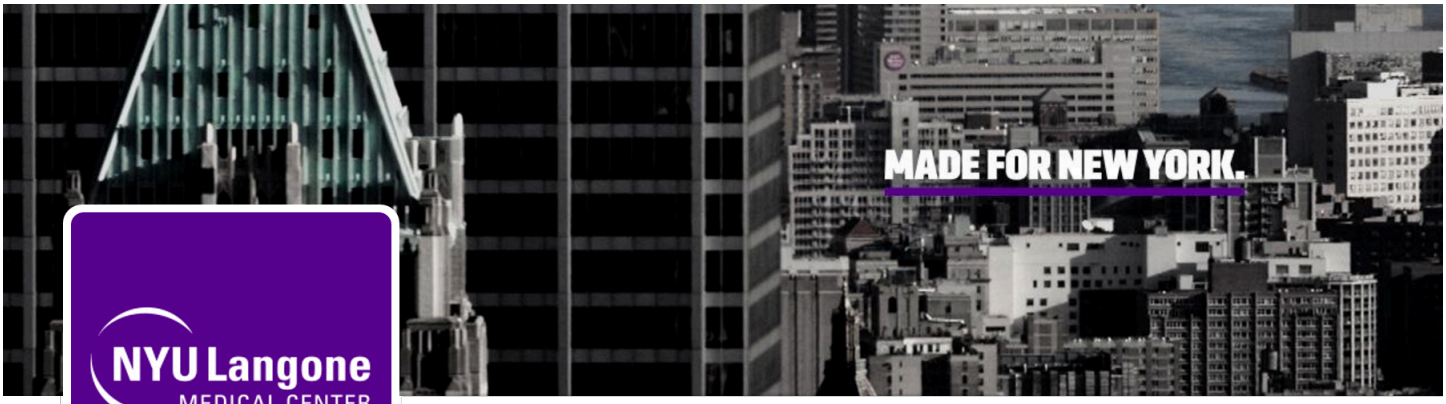

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Rehabilitation Protocol Following Microfracture Procedures to the Knee

There are two types of cartilage in the knee: meniscus and articular. One type of cartilage is the meniscus. The knee has a medial meniscus and a lateral meniscus which together are called menisci. 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 there is 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 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. This is referred to as an articular cartilage lesion (Figure 1[2]). When this happens the articular cartilage loses its 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.

One option for treating articular cartilage lesions is a microfracture procedure. When performing a microfracture procedure, the surgeon will start by debriding any frayed tissue or aps at the margin of the lesion (Figure 22). After this, the calcified chondral layer is debrided to expose the underlying subchondral bone (Figure 32). Removing this layer allows the surgeon to pick holes into the subchondral bone with an awl. (Figure 4[2]) By picking holes in the subchondral bone, blood and fat droplets are given a pathway to flow into the defect or lesion. This develops in to a mesenchymal clot, which will mature and form in to fibrocartilage (Figure 5[2]).

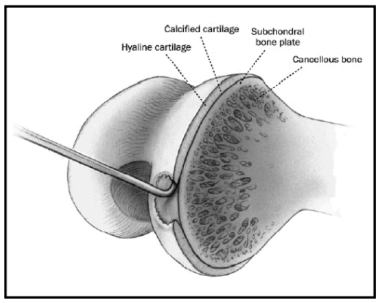

Figure 1 *Schematic drawing demonstrating the typical presentation of an articular cartilage lesion upon primary arthroscopic inspection.*

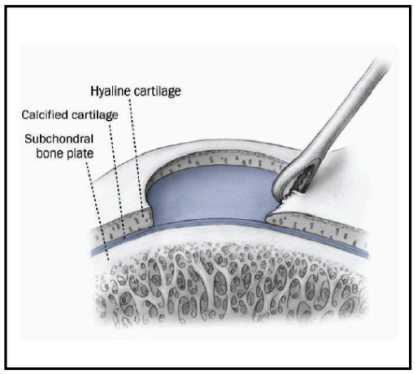

Figure 2 *Schematic drawing demonstrating débridement, with use of an arthroscopic shaver, of any loose cartilage flaps to create a stable peripheral cartilage margin.*

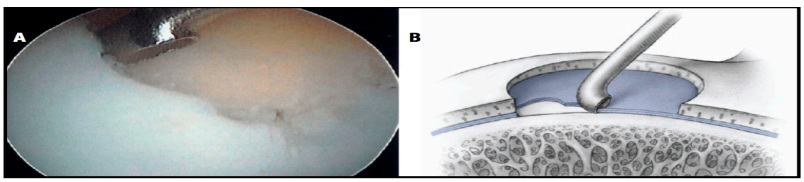

Figure 3 *Arthroscopic image (Figure 3-A) and drawing (Figure 3-B) showing the intraoperative débridement of the calcified cartilage layer with use of a curet to provide manual feedback control.*

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The rehabilitation process is crucial for the success of the microfracture procedure. Avoiding weight bearing exercises and engaging in frequent range of motion activities are the hallmarks of the early rehabilitation process. Articular cartilage lesions are more accurately identified thanks to improved imaging techniques and awareness.

Many professional athletes have suffered articular cartilage injuries to the knee. Greg Oden was the first selection in the 2007 NBA draft and was diagnosed with an articular cartilage injury 4 months later. He then went on to have a microfracture procedure. This procedure has become so common in the NBA that a website has been developed that tracks the outcome of these players. The NFL also has a similar list.

The return to high impact sports after a microfracture procedure is more difficult than the return to non-impact sports and activities of daily living.[3] A successful outcome and the time it takes to return to activity is dependent on the patient's age, patient's body mass, lesion size, duration of symptoms prior to surgery, presence of arthritis, previous surgery and post-operative rehabilitation program.[2-4] Because of this, there are some patients that may not be candidates for the microfracture procedure.

Post-operative rehabilitation is an important factor in achieving a successful outcome from a microfracture procedure.[5] The UW Health Sports Medicine 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 to reference the average rehabilitation time, but individual patients will progress at different rates depending on their age, associated injuries, pre-injury health status, rehabilitation compliance and injury severity. Injury severity refers to the size and location of the articular cartilage lesion. Individuals with lesions that are larger or are in predominantly weight bearing locations will progress more slowly than those with smaller or non- weight bearing lesions.[5] Specific attention must be given to impairments that caused the initial injury. For example if the patient is status post medial compartment microfracture procedure with a varus alignment, post-operative rehabilitation should include correcting muscle imbalances or postures that contribute to medial compartment stress.

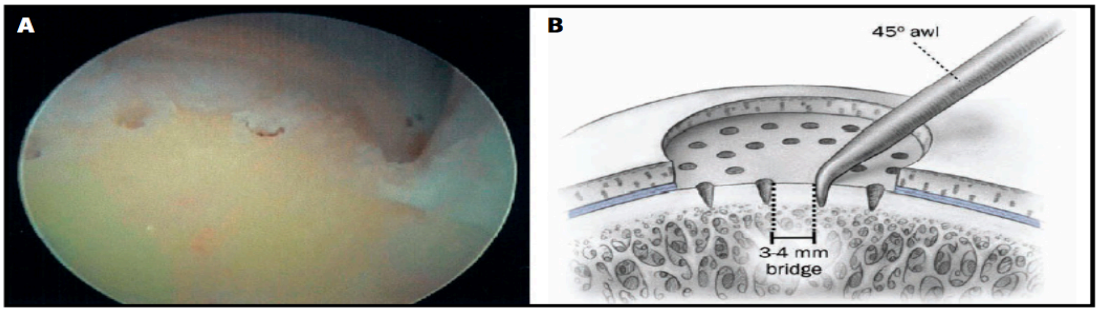

Figure 4 *Arthroscopic image (Figure 4-A) and drawing (Figure 4-B) demonstrating the adequate depth of subchondral bone penetration and width of osseous bridges between the individual microfracture holes.*

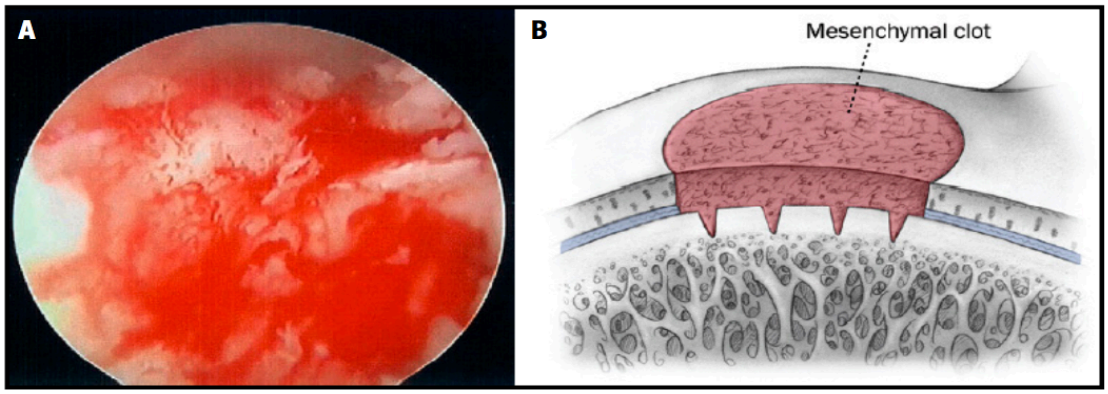

Figure 5-A *Arthroscpoic image of the treated defect after release of pump pressure, confirming the adequacy of the microfractures by noting the release of fat droplets and blood from the individual holes.* ***Figure 5-B*** *Schematic drawing showing the pooling of the mesenchymal clot in the treated cartilage defect and the anchoring effect of the microfracture penetrations.*

Rehabilitation Protocol Following Microfracture Procedures to the Knee

Phase I (Surgery to 8 weeks after surgery)

Microfracture of the Femoral Condyle	**Weightbearing:** Touchdown weightbearing (20-30% of body weight max) for 6-8 weeks – No Bracing Required **Range of Motion** – Continuous Passive Motion (CPM) Machine for 6-8 hours per day for 6-8 weeks o Set CPM to 1 cycle per minute – starting at level of flexion that is comfortable o Advance 10° per day until full flexion is achieved o Passive Range of Motion and stretching under guidance of PT **Therapeutic Exercises** o Quadriceps/Hamstring isometrics o Heel slides
Microfracture of the Femoral Trochlea/ Patellar Defect	**Weightbearing:** Weightbearing as tolerated in hinged knee brace locked in extension **Hinged Knee Brace:** Locked in extension for ambulation – opened up 0-40° for ROM exercises **Range of Motion** – Continuous Passive Motion (CPM) Machine for 6-8 hours per day for 6-8 weeks o Set CPM to 1 cycle per minute – range from 0-40° o Passive Range of Motion and stretching under guidance of PT **Therapeutic Exercises** o Quadriceps/Hamstring isometrics

Rehabilitation Protocol Following Microfracture Procedures to the Knee

Phase II (8 weeks to 12 weeks following surgery)

Microfracture of the Femoral Condyle	**Weightbearing:** Advance to full weightbearing as tolerated -- discontinue crutch use **Range of Motion** – Advance to full/painless ROM **Therapeutic Exercises** o Closed chain extension exercises o Hamstring curls o Toe raises o Balance exercises o Begin use of the stationary bicycle/elliptical
Microfracture of the Femoral Trochlea/Patellar Defect	**Weightbearing:** Advance to full weightbearing as tolerated -- discontinue crutch use **Discontinue Use of Hinged Knee Brace** **Range of Motion** – Advance to full/painless ROM (PROM/AAROM/AROM) **Therapeutic Exercises** o Emphasize Patellofemoral Program o Closed chain extension exercises o Hamstring curls o Toe raises o Balance exercises o Begin use of the stationary bicycle/elliptical

Phase III (3 months to 6 months following surgery)

Microfracture of the Femoral Condyle	**Weightbearing:** Full weightbearing **Range of Motion** – Full/Painless ROM **Therapeutic Exercises** o Advance closed chain strengthening exercises, proprioception activities o Sport-specific rehabilitation Gradual return to athletic activity as tolerated – including jumping/cutting/ pivoting sports Maintenance program for strength and endurance
Microfracture of the Femoral Trochlea/Patellar Defect	**Weightbearing:** Full weightbearing **Range of Motion** – Full/Painless ROM **Therapeutic Exercises** o Advance closed chain strengthening exercises, proprioception activities o Sport-specific rehabilitation Gradual return to athletic activity as tolerated – including jumping/cutting/ pivoting sports Maintenance program for strength and endurance

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