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Rehabilitation After Microfracture of the Femoral Condyle

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 flaps at the margin of the lesion (Figure 2[2]). After this, the calcified chondral layer is debrided to expose the underlying subchondral bone (Figure 3[2]). Removing this layer allows the surgeon to pick holes into the subchondral bone with an awl. (Figure 4[2]) By picking holes in the

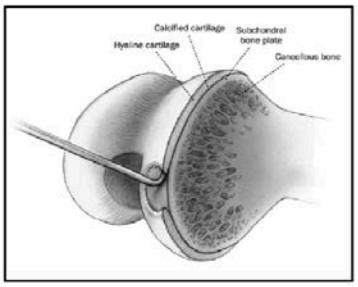

Figure 1 *Schematic drawing demonstrating the typical presentation of an articular cartilage lesion upon primary arthroscopic inspection.*

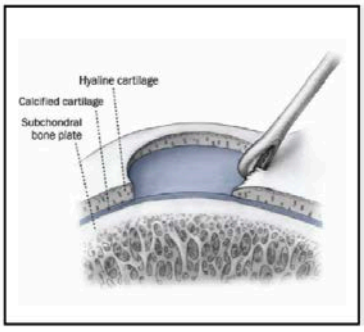

Figure 2 *Schematic drawing demonstrating débridement, with use of an arthroscopic shaver, of any loose cartilage flaps to create a stable peripheral cartilage margin.*

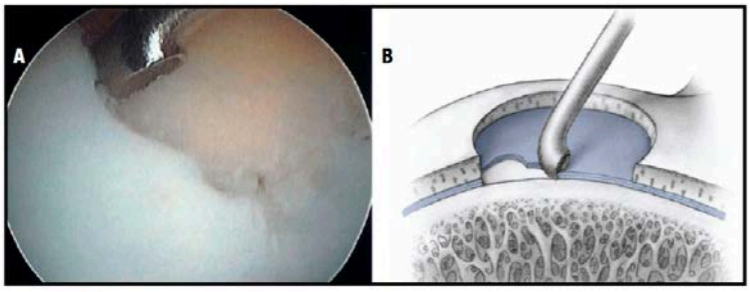

Figure 3 *Arthroscopic image (Figure 3-A) and drawing (Figure 3-B) showing the intraoperative débridement of the calcified cartilage layer with use of a curet to provide manual feedback control.*

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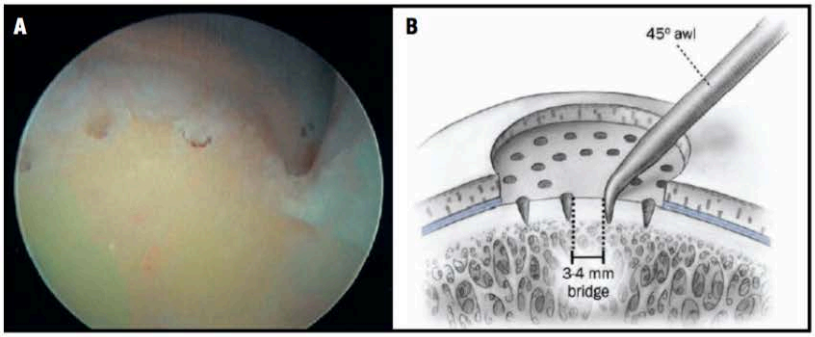

Figure 4 *Arthroscopic image (Figure 4-A) and drawing (Figure 4-B) demonstrating the adequate depth of subchondral bone penetration and width of osseous bridges between the individual microfracture holes.*

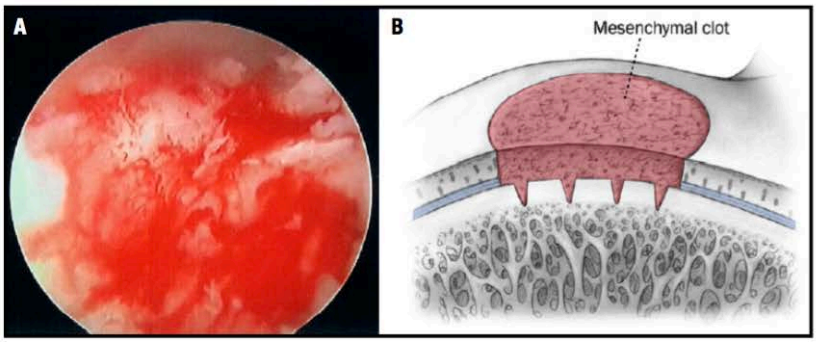

Figure 5-A *Arthroscpoic image of the treated defect after release of pump pressure, confirming the adequacy of the microfractures by noting the release of fat droplets and blood from the individual holes.* ***Figure 5-B*** *Schematic drawing showing the pooling of the mesenchymal clot in the treated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

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]).

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.

Rehabilitation After Microfracture of the Femoral Condyle

Phase I (Surgery to 6 weeks after surgery)

Weightbearing	o Using crutches: o Weeks 0-2 = non weightbearing o Weeks 3-4 = touchdown weightbearing o Weeks 5-6 = weightbearing as tolerated
Range of Motion Exercises	o 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. 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 Straight leg raises o Heel slides o Four way leg lifts in standing with brace on for balance and hip strength o Patellar mobilizations o Begin pool activity at the start of week 5. Exercises may include gait drills (forward walk, march walk, skate step, step and balance) with depth of water at the level of the axilla. Deep water running, vertical kicking or biking can also be included.
Cardiovascular exercise	o Upper body circuit training or upper body ergometer
Progression Criteria to advance to Phase II	o 6 weeks post-op o No effusion o Full knee extension

Phase II (Once criteria in Phase 1 are met)

Range of Motion Exercises	o Advance to full/painless ROM
Therapeutic Exercises	o Non impact balance and proprioceptive drills o Stationary bike o Gait Drills o Hip and core strengthening o Stretching for patient specific muscle imbalances o Quad strengthening – closed chain exercise short of 60 degrees knee flexion o Continue pool program – alternating days with land program
Cardiovascular Exercise	o Non-impact endurance training; stationary bike, Nordic track, swimming, deep water run, cross trainer

Progression Criteria to Advance to Phase III	o Normal gait on all surfaces o Full ROM o No effusion o Ability to carry out functional movement without unloading affected leg or pain, while demonstrating good control o Single leg balance greater than 15 seconds

Phase III (begin after meeting Phase II criteria, about 3 months)

Suggested Therapeutic Exercises	o Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to the same foot o Movement control exercises beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities o Sport/work specific balance and proprioceptive drills o Hip and core strengthening o Stretching for patient specific muscle imbalances
Cardiovascular	o Replicate sport or work specific energy demands
Return to Sport/Work Criteria	o Dynamic neuromuscular control with multi-plane activites, without pain or swelling

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