Clinical Guidelines for Phase I Rehabilitation following Knee Articular Cartilage Procedures

The primary goal of post-surgical rehabilitation following cartilage repair (microfracture, grafting, autologous chondrocyte transplantation) is to control pain, reduce inflammation, protect the repaired tissue during the healing process, restore function, improve range-of-motion, and accelerate soft tissue healing. During the initial healing phase following surgery, six to eight weeks or more of passive range of motion is performed to protect the integrity of the repair. For a growing number of surgeons continuous passive motion (CPM) has become the Gold Standard for passive motion therapy during phase one of the rehabilitation program.

Anti-Inflammatory
O’Driscoll and Giori have demonstrated that CPM immediately following a surgical procedure acts to pump blood and edema fluid out of the joint and periartricular tissues. The reduction of these fluids from a synovial joint reduces the risk of post-surgical joint stiffness. Salter, Kim, Kroeder and Moran have all shown that CPM has reparative effects on inflamed joints. However, until recently the mechanism by which CPM acts as an anti-inflammatory agent was unknown. Recent studies by Gassner, Lee, Xu and Ferretti have helped explain the molecular basis for the beneficial effects of CPM on the inflamed joint. A CPM device by safely applying cyclic tensile stress on the involved joint for an extended time counteracts the effects of the inflammatory agents even better than immobilization.

Microfracture

“Since 1985, 298 patients have been studied after treatment of full-thickness articular surface defects of the knee. Most of these defects were found at the time of arthroscopy for other soft tissue injuries, and all were treated with a debridement and of the exposed subchondral bone. The lesions were graded from 1-5 at the initial and also at second look (77 patients), with Grade 5 being a chronic bare-bone lesion, and Grade 1 being normal appearing cartilage (all but 1 patient scored 5 initially). Although CPM was recommended for 8 weeks post-operatively for all patients, only forty-six of the sample of seventy-seven were able to comply, primarily because of insurance restrictions. We compared the two resulting subgroups: Group 1, with CPM (N=46) and Group 2, without CPM (N=31). The mean improvement in grade for patients in Group 1 was 2.67 as compared to 1.67 for Group 2 (p=.003). Only 15% of Group 1 had no improvement in Grade, whereas 45% of Group 2 had no improvement (p=.0065). The improvement in Group 1 over Group 2 was the same whether or not the lesion was patella-femoral or tibial-femoral, large or small, or in a young individual or older individual. We conclude that CPM for six hours daily for eight weeks post debridement and microfracture for full-thickness cartilage defects in the knee results in better gross healing of the lesion when evaluated by arthroscopic visualization as compared to the same treatment without CPM.”

Autologous Periosteal Transplantation

Fifty-seven consecutive patients, with a mean age of 32 years (range 16-53 years), who suffered from an isolated full-thickness cartilage defect of the patella and disabling knee pain of long duration, were treated by autologous periosteal transplantation to the cartilage defect. The first 38 consecutive patients (group A) were postoperatively treated with continuous passive motion (CPM), and the next 19 consecutive patients (group B) were treated with active motion for the first 5 days postoperatively. In both groups the initial regimens were followed by active motion, slowly progressive strength training, and slowly progressive weight bearing. In group A, after a mean follow-up of 51 months (range 33-92 months), 29 patients (76%) were graded as excellent or good, 7 patients (19%) were graded as fair, and 2 patients (5%) were graded as poor. In group B,
after a mean follow-up of 21 months (range 14-28 months), 10 patients (53%) were graded as excellent or good, 6 patients (32%) were graded as fair, and 3 patients (15%) were graded as poor. Altogether, nine of the fair or poor cases (50%) were diagnosed with chondromalacia of the patella. Our results, after performing autologous periosteal transplantation in patients with full-thickness cartilage defects of the patella and disabling knee pain, are good if CPM is used postoperatively. The clinical results using active motion postoperatively are not acceptable, especially not in patients with chondromalacia of the patella.

**Autologous Chondrocyte Transplantation**


Autologous chondrocyte transplantation (ACT) provides a durable hyaline repair tissue in correctly selected indications. Autologous chondrocyte transplantation is indicated for full-thickness, weight-bearing condyle injuries and injuries to the trochlea of the femur. ACT results in reproducibly satisfactory results with return to high-level activities including sports in over 90% of the patients. Second-look arthroscopies demonstrate tissue fills with biopsies showing hyaline-like cartilage repair. Hyaline cartilage repair is critical because this has been shown clinically to give long standing results with follow-up at to 9 years. As technical refinements improve and rehabilitation protocols, results for injuries to the patellar and the tibia will improve at this time the response to treating bipolar focal chondral injuries is unknown and not recommended. Continuous Passive Motion (CPM) is instituted as soon as cell attachment has occurred after 6 hours or the next day. CPM is increased to regain full range of motion to the patient’s tolerance with a very slow cycle setting of approximately 2 minutes. CPM is used for approximately 6 to 8 hours daily for up to 6 weeks postoperatively. This is based on experimental work showing an enhanced quality of repair tissue caused by this modality as well as clinical work showing an increase in repair tissue fill with use of CPM 6 to 8 hours per day for 6 to 8 weeks postoperatively.

**Proximal Tibial Valgus Osteotomy**


“In this prospective study high tibial osteotomy for medial gonarthrosis was performed in 95 patients (105 knee joints). A follow-up arthroscopic examination could be performed in 75 patients (85 knee joints) at the time of implant removal. In group 1 (20 knee joints), the osteotomy was performed after diagnostic arthroscopy without arthroscopic operation of the knee joint. The fixation of the osteotomy was accomplished by staples, postoperative plaster fixation and physiotherapy. In group 2 (20 knee joints), osteotomy was performed without additional operative arthroscopy after diagnostic arthroscopy, internal fixation by AOT-plate, no external fixation postoperatively and physiotherapy. In group 3 (22 knee joints), osteotomy was performed with additional operative arthroscopy (Pridie drilling), internal fixation by AOT-plate no external fixation postoperatively no external fixation, physiotherapy and continuous passive motion. In group 4 (23 knee joints), osteotomy was performed with additional operative arthroscopy (abrasio-arthroplasty), internal fixation by AOT-plate, no external fixation postoperatively, physiotherapy and continuous passive motion. All patients underwent arthroscopic examination of the knee with cartilage biopsies taken from three different regions of the femoral condyle during the same operative session as the osteotomy. At follow-up arthroscopy cartilage biopsies were taken from the same regions. There was no great difference in clinical outcome after 1 year between all groups. Arthroscopy as well as routine and electron microscopy showed better cartilage regeneration in groups 3 and 4. Groups 1 and 2 showed only regeneration isles, sometimes not well fixed to the underlying bone, while in groups 3 and 4 cartilage regeneration was thicker and more stable, sometimes covering all of the pre-existing erosions.” This series found the best results when osteotomy of the tibia for osteoarthritis together with operative arthroscopy in the same operative session and the use of CPM postoperatively.

**Home Exercise Compliance is Improved by the use of CPM**

Milroy10 in a review of home exercise compliance found one-third of patients can be expected to comply with their home program, another one-third will partially comply and the final one-third will not comply. In contrast, Rosen17 reported a compliance rate as high as 122% for CPM as participants utilized the device for 7 hours on average which was higher than the 6 hour daily requested rate. High home compliance for CPM programs may be explained by the reduction in pain associated with knee CPM use.9,20,34
ARTICULAR CARTILAGE TREATMENT

1. Set-Up Guidelines
   - If possible the patient should be instructed on knee CPM use preoperatively to improve compliance.  

⇒ Anatomical Knee Alignment: Kinex 4-Point leverage system helps ensure the CPM device is in alignment throughout the arc-of-motion. Helps avoid stress on the repair.

Wearing Schedule Guidelines:
   - The Kinex CPM is used for 6-8 weeks.
   - Kinex CPM is used 6-8 hours per day.

2. Wearing Schedule
   - Microfracture technique: The CPM is used for 8 weeks.  
   - Articular cartilage grafting: The CPM is used for 6 weeks.  
   - Autologous chondrocyte transplantation: The CPM is used for 6-8 weeks.  

⇒ The CPM device is worn 6-8 hours a day.  
⇒ The patient increases PROM 5-10° a day as tolerated in a pain free arc.

3. End-Range Goals:
   ⇒ Flexion 125°  
   ⇒ Extension/Hyperextension 0° to minus 5°  
   Note: Specific PROM parameters are determined by the physician.

⇒ Initial ROM Setting:
   ⇒ The Kinex Knee CPM is supported at the heel and thigh with no support at the calf.  
   ⇒ Extension: 0° or as tolerated in a pain free arc  
   ⇒ Flexion: 30° or as tolerated in a pain free arc

⇒ Kinex ISO™ Mode: Extension force reversal setting is separate from flexion force reversal setting. Knee extension is set between 10-20 (low resistance) and extension ROM is set at 0°. The CPM will work toward 0° extension without the patient changing the ROM parameters. If too much resistance is detected the Kinex device will automatically reverse direction.

Note: Calf is not a support point.

⇒ Repeatable Anatomical Position: Kinex 4-point leverage system ensures correct positioning each time the knee CPM is used. Helps avoid repair stress.

CONTAINMENT CONDITIONS
Acute inflammation of the joints, unless explicitly recommended by the doctor, spastic paralysis, unstable fractures. This device must be used under the advice and care of a physician.
References: