

REHABILITATION OF THE ANTERIOR CRUCIATE LIGAMENT



by Mladen Maksic

Dr. Mladen Maksic is a specialist in orthopaedic surgery and traumatology at the Institute for Orthopaedic Surgery and Traumatology of the Clinical Center of Serbia. He is also the team doctor of the Partizan basketball club in Belgrade, a division I team in Serbia and Montenegro. Dr. Maksic is a member of both the medical staff of the men's national team and the Olympic Committee of Serbia and Montenegro.

Arthroscopic reconstruction of a torn anterior cruciate ligament (ACL) of the knee is a widely accepted treatment for a patient with symptomatic knee instability. The rates of good or excellent long-term results (restoration of stability, pain relief, elimination of "give away" symptoms, and return to pre-injury level of function) have been reported to be between 75% and 90%. A scientifically-based and well-designed rehabilitation program following successful ACL surgery plays a vital role in the functional outcome of the reconstructed knee of an athlete.

Rehabilitation following ACL injury and surgery has undergone an evolution in the past decade. In the past, the recommended treatment to protect the healing knee included six to eight weeks of immobilization, eight to 12 weeks on crutches, and the avoidance of early isolated quadriceps contractions. Furthermore, a return to sporting



activities was not permitted until nine to 12 months following surgery. In 1990, an accelerated rehabilitation approach to ACL repair was first reported. The patients who followed this treatment exhibited better strength and range-of-motion (ROM), had less patellofemoral complaints, and an earlier return to sports. This is the approach we now use in ACL rehabilitation.

Whenever possible, we begin our rehabilitation program long before surgery. The basic pre-operative goals are to reduce pain, inflammation, and swelling; restore normal range-of-motion, normalize gait, and prevent muscle atrophy. Patient education is another critical aspect of the pre-operative

rative rehabilitation and we use it to prepare and educate the patient on both the upcoming surgical procedure and the all-important rehabilitation.

Postoperative rehabilitation begins immediately following surgery with immediate motion. Full passive knee extension is emphasized, along with a gradual restoration of flexion range-of-motion. Partial weight bearing without a knee brace is allowed, as tolerated, immediately following surgery, with a progression to full weight bearing without crutches by four to six weeks. Closed kinetic chain proprioceptive and strengthening exercises are initiated during the first two weeks following surgery. Neuromuscular control drills are gradually advanced to include dynamic stabilization and special training (week two to three), and light plyometric jump training (week eight). Functional activities, such as running, begin on week 12 to 14, jumping on week 14 to 16, and cutting on week 16 to 18. Finally, a gradual return to athletic competition for running and cutting sports, such as baseball, football, tennis, and soccer can occur at approximately five to six months, and, to jumping sports, such as basketball and volleyball, at six to eight months.

One of the most common complications following ACL reconstruction is motion loss, particularly loss of full knee extension. Thus, one of the primary goals of rehabilitation involves achieving full passive knee extension immediately following surgery. Specific exercises utilized include manual passive range-of-motion exercises performed by a rehabilitation specialist, supine hamstring stretches with a wedge under the heel, and gastrocnemius stretching with a towel.

The loss of patellar mobility following ACL reconstruction may be caused by various factors and may result in range-of-motion complications and difficulty recruiting quadriceps contraction. Patellar mobilizations are performed by the rehabilitation specialist in the medial-lateral and superior-inferior direction in order to prevent this from happening.

Although full passive knee extension and patellar mobility are two of the primary goals during the first week of rehabilitation, controlling postoperative pain, inflammation, and swelling are also critical immediately following surgery. This will help prevent long-term complications involving range-of-motion, voluntary quadriceps control, and a delay of the rehabilitation process.

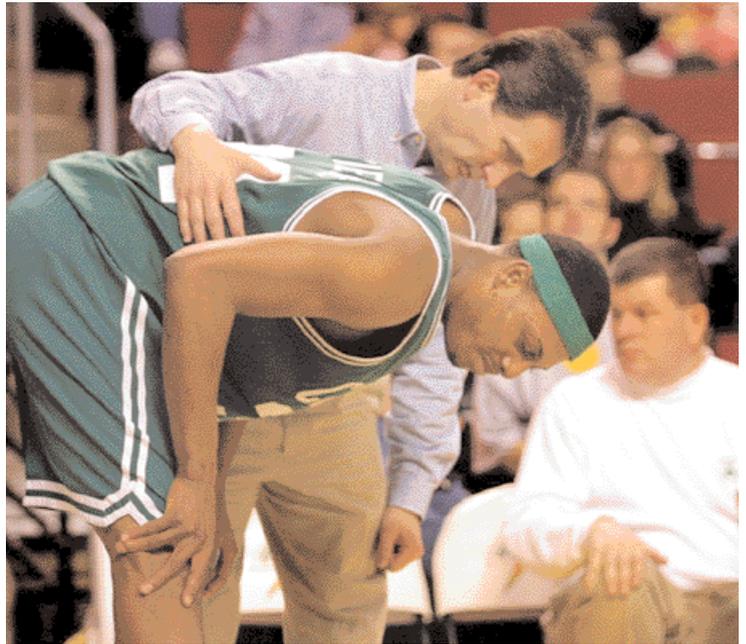
Pain can be reduced through the use of cryotherapy and analgesic medication, along with therapeutic modalities, such as electrical stimulation. Treatment options for swelling reduction include cryotherapy, high-voltage stimulation, and joint compression through the use of a knee sleeve or compression bandage.

Inhibition of the quadriceps muscle is a common clinical enigma in postoperative ACL reconstruction patients, especially in the presence of pain and swelling during the acute phases of rehabilitation. Electrical muscle stimulation and biofeedback are often incorporated with therapeutic exercises to facilitate the active contraction of the quadriceps muscles.

We begin using proprioceptive training during the third postoperative week, pending adequate normalization of pain, swelling, and quadriceps control. Proprioceptive training begins with basic exercises, including joint repositioning and closed kinetic-chain weight-shifting. Weight shifts may be performed in the medial-lateral direction and in diagonal patterns.

To facilitate dynamic stabilization and neuromuscular control of the knee joint, plyometric jumping drills may also be performed. Plyometrics are physically demanding and are only to be performed by the highly competitive athlete. Plyometric exercises utilize the muscle's stretch-shortening properties to produce maximum concentric contraction following a rapid eccentric loading of the muscle tissues.

Plyometric activities are typically initiated during week eight with plyometric jumping on the leg-press machine. The leg-press machine is used to control the amount of weight and ground reaction forces as the athlete learns how to perform jumping drills correctly. The patient is instructed to land softly on balls of the feet with the knees slightly flexed. This maximizes force



dissipation of the surrounding stabilizing muscles and avoids knee hyperextension. The drills then progress to include ankle hops; jumping in place; lateral, diagonal, and rotational jumping; bounding; and skip lunging. With increased knee strength, this is followed with the addition of single and multiple box jumps. We usually begin plyometric activities with two-leg jumps, progressing to single-leg jumps.

The final aspect of rehabilitation involves enhancing muscular endurance. Proprioceptive and neuromuscular control has been shown to diminish once muscular fatigue occurs. Exercises such as stationary bicycling, stair climbing, elliptical machines, and slide boards may be used for long durations to increase muscular endurance. High repetition, low-weight resistance training exercises can also help build muscular endurance.

An overly-aggressive approach early in the rehabilitation program may result in increased pain, inflammation, and swelling. Therefore, rehabilitation should involve a progressive application of therapeutic exercises designed to gradually increase function in the post-operative knee. This progression of weight-bearing and range-of-motion restoration helps insure that complications such as excessive motion restrictions or scar tissue formation are avoided while progressing steadily without overstressing the healing tissue. This simple concept may also be applied to the progression of strengthening exercises, proprioception training, neuromuscular control drills, functional drills, and sport-specific training.