Rehabilitation Guidelines for Posterior Cruciate Ligament Reconstruction

The knee has three joints--the patellofemoral joint (knee cap), the tibiofemoral joint and the tibiofibular joint. Joints are named for the two bones that articulate with each other. Most people think of the tibiofemoral joint when thinking of the knee. This is the joint that is primarily responsible for flexing (bending) and extending (straightening) of the knee. A small amount of rotation occurs at this joint as well. Ligaments are bundles of connective tissue that attach from bone to bone. There are four main ligaments that stabilize the knee. The collateral ligaments (medial and lateral) are on the inside and outside of the knee and provide side to side stability for the knee. The cruciate ligaments (anterior and posterior) are two large ligaments that cross in the middle of the knee and provide rotational stability and stability front to back. The posterior cruciate ligament is a large, broad ligament that attaches from the back of the tibia and travels forward as it moves up to attach to the femur (Figures 1 and 2). Its primary function is to resist posterior translation of the tibia on the femur, especially in flexion. It is also a secondary stabilizer for rotation and varus stability.

Injuries of the posterior cruciate ligament (PCL) occur less frequently than those of the anterior cruciate ligament (ACL). The PCL is tight when the knee is bent, so most PCL injuries occur at that time. The most common cause of PCL tears (Figure 3) are sports injuries (37%) and trauma (56%). In sports, the most common cause of a PCL tear is falling on a flexed knee. In auto accidents, hitting the upper shin against the dashboard with the knee flexed during an accident (dashboard injury) is the most common cause. Immediately after the injury it is common to have swelling in the knee, general knee pain and a loss of motion. It is often difficult to predict the long-term outcome of a PCL injury. Some patients show significant symptoms and subsequent articular deterioration after a PCL injury, while others are essentially asymptomatic and maintain normal function. Evidence from randomized controlled trials to determine a single treatment of PCL injuries is lacking. Observational studies suggest that isolated PCL injuries may be treated conservatively, with good prognosis. Shelbourne treated 22 isolated grade 1 and grade 2 PCL injuries with extension bracing for six weeks. In Shelbourne's study 19 of the 22 patients went on to show healing by MRI and demonstrated stability. Bracing is primarily effective when it can be started within one week of the injury.

Surgical reconstruction is needed for patients with PCL injuries that are combined with other ligament injuries in the knee (combination injuries or multi-ligamentous injuries), isolated grade 3 injuries or PCL injuries with chronic instability. Patients with chronic instability rarely

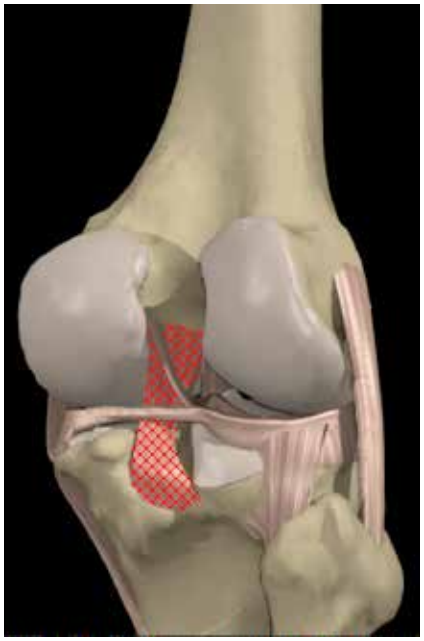

Figure 1 *Posterior (back) view of the knee with the PCL shaded in red*

suffer complete giving way episodes. More often it is a general sense of instability with pain in the front of their knee, especially with running or stair climbing. Posterior laxity can be assessed with a posterior drawer test, the dial test or a KT1000 test, although laxity is not directly correlated to instability. Surgical reconstruction is done by replacing the torn PCL with a graft. This graft can be a single strand/bundle of tissue or two strands (double bundle). Grafts can be taken from areas of your own body (autograft), such as the patellar tendon, or from cadavers (allograft). To date there have not been significant differences in outcome studies comparing the various graft choices. The grafts

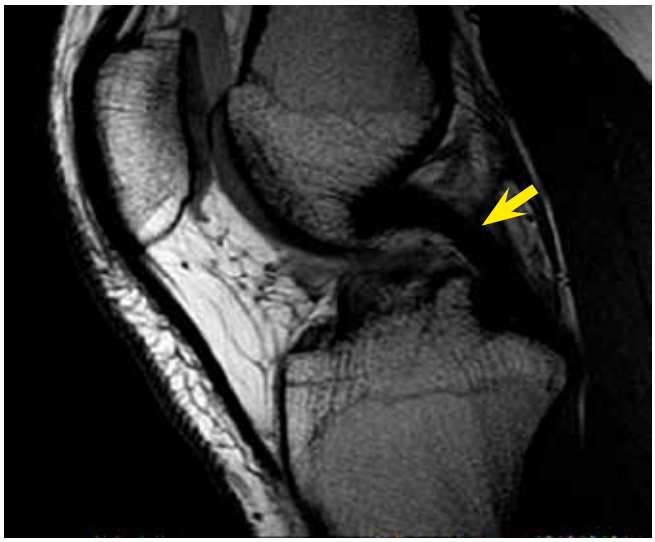

Figure 2 *Saggital PD MRI demonstrating a normal PCL*

Figure 3 *Saggital T1 MRI demonstrating a torn PCL*

are placed and anchored in tunnels drilled in the femur and tibia.

The rehabilitation process begins the first week after surgery. During the first four weeks, weight bearing and range of motion are limited to protect the healing of the graft. Hamstring exercises are also avoided because the hamstring pulls the tibia posteriorly (backward), which would cause stress to the healing graft. In phase 2 patients will begin to work more aggressively on strength and range of motion, usually discontinuing all use of the brace by six weeks. Prior to returning to sports, patients must regain strength, movement control, proprioception and force control. This often involves several months of progressive rehabilitation exercises. The rehabilitation guidelines below 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 their age, associated injuries, pre-injury health status, rehab compliance and injury severity.

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PHASE I (surgery to 4 weeks after surgery)

Appointments	• Physician appointment: 1-2 weeks and 4-6 weeks after surgery • Rehabilitation appointments begin 1-3 days after surgery. 2 times per week
Rehabilitation Goals	• Protection of the post-surgical knee • Restore normal knee extension • Eliminate effusion (swelling) • Restore leg control
Precautions	• Weight bearing as tolerated (WBAT). Use pain and gait as guides • Must wear the brace for all weight bearing activities • Progress from locked to unlocked when patient has good quadriceps control • Use axillary crutches for normal gait • No open chain hamstring strengthening or isolated hamstring exercises • No hamstring stretching • No bike • Follow range of motion (ROM) guidelines
Range of Motion Exercises	• Weeks 0-4: full extension to 90° flexion • Extension: Knee extension on a bolster, avoid prone hangs secondary to hamstring guarding • Flexion: use gravity or assistance to minimize hamstring activity, such as supine wall slides or seated knee flexion
Suggested Therapeutic Exercise	• Quadriceps sets • Open chain knee extension against gravity • Straight leg raises • Leg lifts in standing with brace on for balance and hip strength – avoid hip extension 2° to hamstring restrictions
Cardiovascular Exercise	• Upper body circuit training or upper body ergometer (UBE)
Progression Criteria	• Pain-free gait using brace without crutches • No effusion (swelling) • Knee flexion to 90°

PHASE II (begin after meeting Phase I criteria, usually 5 weeks after surgery)

Appointments	• Physician appointment: 8-12 weeks after surgery • Rehabilitation appointments are 1-2 times per week
Rehabilitation Goals	• Single leg stand control • Normalize gait • Good control and no pain with functional movements

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Precautions	• Discontinue brace weeks 4-6 as the patient gains leg control and balance • No open chain hamstring strengthening or isolated hamstring exercises • No hamstring stretching • No bike • Follow ROM guidelines – no forced hyperflexion
Range of Motion Exercises	• Weeks 5-6: full extension to 120° flexion. Gradually attain full flexion, avoiding forced flexion • Extension: Knee extension on a bolster, avoid prone hangs secondary to hamstring guarding • Flexion: use gravity or assistance to minimize hamstring activity, such as supine wall slides or seated knee flexion
Suggested Therapeutic Exercise	• Quadriceps strengthening – closed chain exercises short of 70° of knee flexion • Non-impact balance and proprioceptive drills • Gait drills • Hip and core strengthening • Stretching for patient specific muscle imbalances
Cardiovascular Exercise	• Upper body circuit training or upper body ergometer (UBE)
Progression Criteria	• Normal gait on all surfaces • Ability to carry out functional movements without unloading affected leg and without pain, while demonstrating good control • Single-leg balance greater than 15 seconds • Full ROM

PHASE III (begin after meeting Phase II criteria, usually about 12-16 weeks)

Appointments	• Physician appointment: 3 months after surgery and 4 months after surgery • Rehabilitation appointments are 1-2 times per week
Rehabilitation Goals	• Good control and no pain with functional movements, including step up/down, squat and lunge • Good control and no pain with light agility and low-impact multi-plane drills
Precautions	• No open chain hamstring strengthening or isolated hamstring exercises
Suggested Therapeutic Exercise	• Quadriceps strengthening – closed chain (progressing to multi-plane) and open chain exercises • Non-impact balance and proprioceptive drills • Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot • Movement control exercise beginning with low velocity, single-plane activities and progressing to higher velocity, multi-plane activities • Hip and core strengthening • Stretching for patient specific muscle imbalances

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Cardiovascular Exercise	• Upper body circuit training or UBE
Progression Criteria	• Normal gait on all surfaces • Ability to carry out multi-plane functional movements without unloading affected leg or pain, while demonstrating good control • Ability to land from a sagittal, frontal and transverse plane leap with good control and balance

PHASE IV (begin after meeting Phase III criteria, usually about 24 weeks)

Appointments	• Physician appointment: 6, 9 and 12 months after surgery • Rehabilitation appointments are 1 time every 2-4 weeks
Rehabilitation Goals	• Good dynamic neuromuscular control and no pain with sport/work specific movements, including impact
Precautions	• Post-activity soreness should resolve within 24 hours • Avoid post-activity swelling
Suggested Therapeutic Exercise	• Sport/work specific balance and proprioceptive drills • Progress impact control exercises to reactive strengthening and plyometrics. Incorporate running program as appropriate • Continue quadriceps strengthening • Hip and core strengthening • Stretching for patient specific muscle imbalances
Cardiovascular Exercise	• Replicate sport/work specific energy demands
Return to Sport/Work Criteria	• Dynamic neuromuscular control with multi-plane activities, without instability, pain or swelling

These rehabilitation guidelines were developed collaboratively by UW Health Sports Rehabilitation and the UW Health Sports Medicine Physician group.

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