

Education and Rehabilitation of the High-Performance Knee Arthroplasty Patient

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Rehabilitation is essential to the success of any total knee arthroplasty (TKA). The following is an aggressive TKA protocol divided into four phases: Phase I, Early Mobilization Phase; Phase II, Work Phase (routine daily activities, walking, golf); Phase III, Power Phase (closed kinetic chain activities, low impact sports); Phase IV, Return to Functional Level (limited open-chain kinetic sports). The goals of this program are achieving early and maximal range of motion and strength, while minimizing stresses at fixation sites until sufficient bone ingrowth takes place. It consistently results in improved scores on all functional tests and fulfills patients' rehabilitation needs.

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Total knee arthroplasty (TKA) is indicated when functional impairment results from disabling knee pain, degenerative changes, or trauma.¹ Conservative measures to maintain knee function in patients with knee pain have failed, and total knee replacements are being performed in younger, more active, more demanding patients.¹⁻³ Rehabilitation is critical to the success of these active patients. Advances in component design, fixation method, and operative techniques all affect the rehabilitative program. We have applied the principles of sports medicine in anterior cruciate ligament (ACL) rehabilitation to total knee replacement (TKR) rehabilitation, creating rehab plans for patients to obtain higher overall function.⁴⁻⁷

These are rehabilitative plans that must be customized based on thorough patient history, evaluation, surgical technique, and surgeon's recommendations. The program allows patients to advance to higher activity as the goals of each phase are reached. Although the goals of one phase need to be accomplished before progressing to the next phase, many procedures, exercises, and activities carry over throughout. Each phase consists of a set of primary and secondary goals.

Preoperative Physical Therapy Program

- Instruction in lower extremity exercises (ie, quad setting, glut setting, SLR, ankle pumps)
- Instruction in gait training with assistive devices (depending on WB status)
- Review of transfers and appropriate assistance (ie, chair–bed, bed–chair, and bathroom)
- Review of precautions

Phase I, Days 1 to 14: Early Mobilization Phase

Primary Goals

- Control of soft-tissue edema and intra-articular effusion
- Wound protection
- Achievement of full passive knee extension to 0°

Secondary Goals

- Improvement of motor control in the affected limb
- Increase in passive knee flexion to 90° or better
- Increase of weight-bearing status as tolerated

Control of soft-tissue swelling and knee effusion is accomplished through several modalities: maintenance of a constant pressure dressing; cryotherapy utilization; soft-tissue massage; electrical stimulation; and exercises (as tolerated). The cryo-cuff is applied 15 to 20 minutes every 2 to 3 hours.

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Massage is also employed to aid the reduction of postoperative swelling and may be accompanied by passive range of motion performed by the physical therapist. Limiting soft-tissue swelling and joint effusion play an important role in minimizing quadriceps inhibition.⁸

The return and maintenance of full-knee extension and knee flexion to 90° or greater cannot be overemphasized during this phase. A continuous passive motion device (CPM) is utilized. The CPM is set for a 0- to 30-degree range of motion (ROM) on the first postoperative day and is advanced 5 to 10° per day until 90° or greater is achieved. The CPM is for 2 hours at a time, three times a day. The quantity and the quality the ROM can also be improved by continued use of a CPM.⁹ It has been widely suggested to place a towel roll or pillow under the heel (not the knee) to encourage passive knee extension when the patient is not participating in CPM or performing exercises.

The achievement of full knee extension diminishes the amount of scar tissue formation. Patella mobilization is employed early and often for the same reasons. Gentle stretching exercises for the hamstrings and gastroc-soleus muscle groups are utilized to achieve full knee extension.

The return of motor control to the limb is accomplished through an exercise program of ankle pumps, quad setting, straight leg raises (SLR), gluteal sets, and active assistive range of motion (AAROM) into extension and flexion. Quadriceps setting may be assisted with the use of a biofeedback unit placed over the vastus medialis obliquus (VMO) and/or the use of electrical muscle stimulation for 15 to 20 minutes, two to three times a day. Full knee extension is stressed while performing leg raises, thereby maintaining hip strength and mobility. A knee immobilizer may be used initially during these SLR exercises. An example of AAROM is heel slides, performed on a low-friction surface encouraging both active hip and knee ROM. The sets (2 to 3) and repetitions (12 to 20) for each exercise are patient dependent.

The patient's response to Phase I sets the tone for the remainder of the program. Once soft-tissue swelling and knee effusion is controlled, full knee extension and independent ambulation is achieved, and an uninhibited quadriceps mechanism is functioning, the patient is progressed to Phase II.

Phase II, Weeks 2 to 6: Work Phase

Primary Goals

- Continued improvement of range of motion (90° or better)
- Improvement in motor control and muscular endurance
- Enhancement of dynamic joint stability

Secondary Goals

- Continued control of soft-tissue swelling and joint effusion
- Normalization of gait pattern and functional activities
- Maintenance of full knee extension

During this phase, remodeling of the connective tissue occurs. At this time, emphasis is placed on protecting soft tissue around the joint from forces that will interfere with normal healing, and reconditioning the adjacent tissue to improve tensile and compressive tolerances.

Improved flexion of the knee is accomplished safely and gradually with assistance from a physical therapist. Standing leg curls provide an active return of flexion while strengthening the hamstring muscle group. Cycling is introduced as a functional exercise used to improve and achieve full knee ROM. The height of the seat can gradually be lowered to aid achieving maximal knee flexion. Caution must be taken to avoid patient hip hiking during this cycling progression. This can be minimized with the introduction of commercially available pedal adjustments. Maintenance of knee extension is achieved through such techniques as prone hanging or passive knee extension stretches. Stretching exercises for the hip flexors, quadriceps, hamstrings, gastrocnemius, and soleus continue to be implemented.

The exercise program of Phase II continues with quad sets, SLR in four planes, hamstring curls (previously mentioned), and the introduction of more advanced exercises. Coordination and motor control activities are introduced. Sport cord/theraband training with diagonals, proprioceptive neuromuscular facilitation (PNF) patterns with resistance from a therapist, and side steps with 2 to 5 inches to steps are increased as command of the exercise is achieved. Increased weight-bearing force about the knee is provided by the use of a leg press device. Gradual increases of weight increments are allowed depending on joint tolerance. Squats are introduced using an unloading device and commercially available cable weight stack. The higher the weight utilized, the more assist given the patient from partial/full squat position to standing.

This author (A.D.S.) prefers a closed kinetic chain philosophy. A standing terminal knee extension (TKE) is introduced utilizing a cable and strap (SABA®, Scandinavian Mobility, Norway). Knee extensions from 90 to 0° can be introduced if an open kinetic chain activities are tolerated.

Nearing the end stages of Phase II, front lunges and a pool program can be introduced. Pelvic stabilizers are also used and strengthened incrementally as needed.

Normalized gait pattern with a heel-to-toe pattern and hip extension during toe off is emphasized. One must continue to encourage symmetry of motion, evenness of weight bearing, equal stride length, and normal cadence. The patient can ambulate without assistive device once they no longer exhibit a limp. Improved muscular endurance in functional activities is achieved by increasing distance ambulation, over even and uneven surfaces, and up and down stairs. Reinforced here is the initiation of cycling, walking in water, and swimming.

Additional secondary goals including swelling and effusion control are accomplished, and the maintenance of full extension is continued. The introduction of "skin rolling" (a soft-tissue mobilization technique) should be used to minimize the development of dermal adhesions. This technique is performed by the therapist and reinforced in a patient home program. When the affected limb has shown tolerance to these activities, soft-tissue swelling is consistently dimin-

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