ACL RECONSTRUCTION
REHABILITATION PROTOCOL
(PATELLAR TENDON AUTOGRAFT)

Rehabilitation following ACL reconstruction has changed dramatically over the past two decades. This protocol is an accelerated rehabilitation which emphasizes early extension, unrestricted weight bearing and a more expedient return to athletic activity. The accelerated rehabilitation program is based on the following three factors: (1) early terminal knee extension equal to the contralateral side; (2) early weight bearing; and (3) closed and open kinetic chain strengthening exercises.

Early knee extension is critical when using an accelerated protocol. The incidence of flexion contracture with associated quadriceps weakness and extensor mechanism dysfunction following ACL reconstruction has significantly decreased with accelerated knee extension immediately after surgery. Quadriceps strength is enhanced with early extension and early weight bearing. Closed kinetic lower extremity strengthening facilitates improved patellar tracking and has been determined to be a functional mode of exercise. The combination of early knee extension, early weight bearing, and closed kinetic quadriceps strengthening allows the patient to progress through the post-operative rehabilitation period at a rather rapid pace without compromising ligamentous stability.

The following ACL rehabilitation program is based on limited but purposeful clinic visits. Making the patient responsible for their rehabilitation through a structured program of patient education and clinical treatment is key to obtaining effective and efficient therapy. Clinical goals and expectations are established before surgery so that the patient is aware of what needs to be accomplished during each phase of the rehabilitation program. Instead of having the patient perform the
entire exercise program at the clinic, they are educated on how to perform each exercise effectively and how to progress each exercise independently based on clinical expectations. Goals are established for the patient at each visit with a detailed timetable as to when these goals should be attained. If the patient experiences difficulty in achieving the goals set forth, they will be scheduled for more routine physical therapy visits. Through appropriate pre- and post-operative visits we are able to avoid complications rather than treat them once they occur.

Throughout the 4 phases described below, it is possible to overlap phases depending on the individual progress of the patient.

**Phase I**  
*(Post-Injury / Pre-operative)*  
*(Physical, Mental and Emotional Preparation and Planning)*

The objectives with the pre-operative visits include physically preparing the knee for surgery as well as mental and emotional preparation of the patient and their support group to deal with surgery and the post-operative rehabilitation course. Patients with acute ACL tears will be placed on appropriate rehabilitation to decrease swelling and restore range of motion and strength to near normal levels. Both acute and chronic ACL patients will undergo pre-operative testing: KT 1000 and CYBEX isokinetic strength evaluation.

**Clinical Goals**
- Restore full ROM and appropriate strength prior to ACL reconstruction with emphasis on full motion before beginning strengthening
- Control swelling prior to ACL reconstruction
- Ensure complete understanding of the basic principles of accelerated rehabilitation including
  - Full hyperextension and full flexion
  - Early weight bearing
  - Closed and open chain strengthening

**Testing**
- Bilateral ROM including full terminal knee extension
- KT-1000
- Cybex isokinetic evaluation at 180/sec & 60º/sec
- Single leg hop on non-involved leg

**Exercises**
1. **ROM exercises for both extension and flexion**
   A. **Extension Exercises**
   - Heel props, towel stretches for passive heel lifts, prone hangs
   - Extension board or other extension device as indicated
B. Flexion Exercise
   - Heel slides, wall slides, supine/seated flexion hangs

II. Quadriceps control exercises (Extension “Habits”)
   - Active heel lifts
   - Standing knee “lock-outs”

III. Closed kinetic chain strengthening (only after obtaining full ROM with minimal swelling)
   - Leg press
   - Progressive squatting techniques
   - Step downs
   - Non-impact cardio (bike, stairmaster, elliptical, etc.)

Phase II
(Recover and Restore to normal ADLs)
(Week 1)

Clinical Goals
♦ Full passive knee extension and 90° flexion
♦ Independent straight leg raise
♦ Weight bearing as tolerated

Testing
♦ Bilateral ROM measurements

Exercises
♦ The patient begins using CPM the day of surgery, set from 0° to 40° flexion. The CPM machine is to be used as much as possible in the first 2 weeks, with a minimum of 6 hours per day.
♦ A CryoCuff or GameReady is placed on the patient’s knee immediately after surgery. This provides compression and cold to minimize pain and swelling. The CryoCuff also remains on the knee at all times, except when performing motion exercises.

I. Extension range of motion exercises six times a day:
   - The knee is allowed to fully extend to terminal extension for ten minutes during each exercise bout.
   - “Thunks” are performed to demonstrate full, comfortable extension.
   - Elevate the heel on the CryoCuff canister. A 2.5-lb. ankle weight is placed across the proximal tibia to facilitate terminal extension. Full extension allows the newly reconstructed ligament to fit perfectly into the intercondylar notch. Restricting full extension will allow the notch to fill with scar and become a block to extension.
   - Towel stretches to pull into a full passive heel lift

II. Knee flexion Exercises
   - Progressive CPM machine, from 60° to 110° (increasing 5°/day).
   - Continue to increase bend beyond 110° by pulling leg further to buttocks with hands and hold stretch for 3 minutes.

III. Leg control
   - Active quadriceps contraction with quad sets
   - Straight leg raises
Active heel height

During the first week the patient is to remain lying down with the knee elevated in
the CPM/using cold therapy as much as possible. However, when getting up to go
to the bathroom, the patient is encouraged to be full weight bearing as tolerated
with the crutches as needed.

Clinical Follow-up

Patient will report to physical therapy one week after surgery and should have:
- Full terminal extension and flexion to 90°
- Minimal swelling and soft tissue healing
- FWB gait and ability to lift leg

Phase II
(Week 2)

Clinical Goals
- Full terminal extension and flexion to 110°
- Minimal swelling and soft tissue healing
- Normal gait (including ascending and descending stairs)
- Demonstrate ability to lock knee with weight shifted to ACL leg

Testing
- Bilateral ROM

Exercises
- Regaining full extension range of motion is the most critical factor in this phase.
  Early terminal extension has been demonstrated through many clinical research
  studies to be the key to a successful result. The patient is encouraged to push ex-
  tension by performing the following exercises:
  - Towel stretch
  - Heel props
  - Prone hangs
- Patient is encouraged to lock out their knee by standing with weight shifted to ACL leg so that
  extension is full and knee is fully locked (standing knee lock-out)
- It is very important to emphasize leg control early in the rehabilitation program.
  Through early extension and normal gait the patient is able to regain good quadriceps tone and leg control. This combination of clinical variables will set the pace for
  the entire rehabilitation program and a successful outcome.
- Once the patient has regained full knee extension and is ambulating normally, it
  will be possible to implement further leg control exercises:
  - Quarter squats
  - Knee extensions off side of bed with no additional weight
  - It is felt that this type of exercise facilitates return of lower extremity strength
    with minimal stress to the joint.
- Patient continues to increase flexion (DC use of CPM after week #1)
  - Heel slides
  - Wall slides
  - Supine flexion hangs
Clinical Follow-up
♦ The patient will return 2 weeks following surgery
♦ The patient should have full terminal extension, full flexion to 110°, and good quadriceps control to demonstrate an independent straight leg raise and near-normal gait mechanics.

Phase II
(3-4 Weeks)

Clinical Goals
♦ Full terminal extension and 135° flexion
♦ Continue leg control increases while full ROM is obtained

Testing
♦ Bilateral ROM

Exercises
♦ If the patient does not have full passive terminal extension or full flexion:
  - An extension board or other extension device will be given to the patient for home use in addition to routine clinic visits to restore full extension.
  - Supine flexion hangs are the most common means of regaining terminal flexion, however kneeling down and sitting back on one’s heels should be practiced as it is the goal for full, functional flexion. It is also used as the guideline for the patient, so the patients knows if he/she is overdoing it – losing the ability to sit on ones heels is an indicator that rest is needed until full, easy flexion returns.
  - Step downs may be added to leg control exercises with emphasis on stimulating the patellar tendon graft harvest site through high frequency and high repetitions as tolerated (to be determined by ROM and swelling).
    - Unilateral step downs
    - Quarter squats
    - Knee extensions with light weight to facilitate terminal knee control

Clinical Follow-up
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♦ At the 4-week follow-up visit the patient will work on:
  - Maintaining full terminal extension and finalizing full flexion
  - Increasing quadriceps strength
Phase III
(1-3 Months)
(Strength and Conditioning)

Clinical Goals
♦ Full ROM including terminal extension
♦ Quadriceps tone continues to improve with noticeable quadriceps definition returning by this time
♦ Demonstrate 70% quadriceps strength
♦ Proprioceptive/agility specific program as appropriate
♦ Begin a sport specific functional progression

Testing
♦ Subjective questionnaire
♦ Bilateral ROM
♦ KT 1000 ligamentous stability testing
♦ The first isokinetic evaluation is performed 2 months following surgery (180°/sec and 60°/sec)
♦ A single leg hop for distance may also be performed

Exercises- Continue with emphasis on patellar tendon graft site and quadriceps muscle
♦ Unilateral leg press
♦ Unilateral knee extensions
♦ Unilateral step-downs
♦ Progressive squatting/lunging movement patterns
♦ Non-impact cardio including: stairmaster, bicycle, elliptical, etc.

Agility
♦ Factors influencing the patient’s return to controlled agility training and sport specific activity includes patient subjective rating, as well as isokinetic and isometric test scores.
♦ Agility training and limited sports participation not only help the patient to regain fast speed strength but also help to restore confidence in getting back to aggressive athletic activities as tolerated in the program.
  - Form running (short distance)
  - Backward running
  - Lateral slides and crossovers
  - Practicing single leg hopping
  - Shooting baskets, dribbling soccer ball and/or other sport specific drills

Clinical Follow-up
♦ Pt will return to physical therapy at 6 – 8 weeks for strength testing, agility progression, and sport participation guidelines.
Phase IV
(3-6 Months)
(Return to Activity)

Clinical Goals
♦ Maintain full ROM
♦ Advance total leg strengthening
♦ Increase sporting activities as appropriate

Testing
♦ Subjective questionnaire
♦ Bilateral ROM
♦ KT-1000 ligamentous stability testing
♦ Isokinetic testing (Cybex) at 180/sec and 60/sec
♦ Single Leg Hop
♦ Beginning with the 2-month follow-up visit: Single leg hop- patient is instructed to perform a single leg hop for distance with take-off and landing the same leg. A side-to-side percentage is calculated for comparison.

Exercises
♦ Maintain full ROM
♦ Continue strength and conditioning program and adjust per needs of sport

Return to Sport
♦ Return to full, non-restricted practice and competitive activities
♦ Patient, parents, coach, and ATC must be educated to know when and how to modify situation according to subjective and objective findings of the knee.

Clinical Follow-up
♦ Patient returns for reassessment/strength testing at 3, 4 and 6 months postop with progression of sport activities based on strength testing results and physician exam.