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ACL Reconstruction Rehabilitation Protocol

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The intent of this protocol is to provide the therapist and patient with guidelines for the preoperative and postoperative course after ACL reconstruction. The protocol is based on a review of the most recent scientific literature and our recent experience, however it is not intended to substitute for one's clinical judgement regarding the progression of a patients's postoperative course. If the therapist or patient requires assistance or has questions regarding progression, they should contact our office. A dot-matrix of suggested exercises to follow will also be provided.

One of the most common complications following ACL reconstruction is loss of motion, especially loss of extension. Loss of knee extension has been shown to result in a limp, quadriceps muscle weakness, and anterior knee pain. Studies have demonstrated that the timing of ACL surgery has a significant influence on the development of postoperative knee stiffness.

THE HIGHEST INCIDENCE OF KNEE STIFFNESS OCCURS IF ACL SURGERY IS PERFORMED WHEN THE KNEE IS SWOLLEN, PAINFUL, AND HAS A LIMITED RANGE OF MOTION.

The risk of developing a stiff knee after surgery can be significantly reduced if the surgery is delayed until the acute inflammatory phase has passed, the swelling has subsided, a range of motion from 0 – 120 degrees has been obtained, and a normal gait pattern has been reestablished.

Preoperative Rehabilitation Phase

Prepare for surgery using the information within this section.

Goals:
* **Control pain and swelling**
* **Restore normal range of motion**
* **Develop muscle strength sufficient for normal gait and ADL**
* **Mentally prepare the patient for surgery**

Before proceeding with surgery the acutely injured knee should be in a quiescent state with *little or no swelling*, range of motion at least 0 – 120 degrees, and the patient should have a normal or near normal gait pattern.

Use the following guidelines to prepare the knee for surgery:

Immobilize the knee

Following the acute injury you should use a knee immobilizer and crutches until you regain good muscular control of the leg. Extended use of the knee immobilizer should be limited to avoid quadriceps atrophy. You are encouraged to bear as much weight on the leg as is comfortable.

Control Pain and Swelling

Crushed ice or another cold compression device along with nonsteroidal anti-inflammatory medications such as Advil, Nuprin, Motrin, Ibuprofen, Aleve (2 tablets twice a day) are used to help control pain and swelling. The nonsteroidal anti-inflammatory medications are continued for 7 - 10 days following the acute injury.

Restore normal range of motion

You should attempt to achieve full range of motion as quickly as possible. Quadriceps isometrics exercises, straight leg raises, and range of motion exercises should be started immediately.

Full extension is obtained by doing the following exercises:

1) Passive knee extension.
    - Sit in a chair and place your heel on the edge of a stool or chair.
    - Relax the thigh muscles.
    - Let the knee sag under it's own weight until maximum extension is achieved.
2) Heel Props:
    - Place the heel on a rolled towel making sure the heel is propped high enough to lift the thigh off the table.
    - Allow the leg to relax into extension.
    - 3 - 4 times a day for 10 - 15 minutes at a time. See Figure 1

Figure 1. Heel prop using a rolled towel.

3) Prone hang exercise.
    - Lie face down on a table with the legs hanging off the edge of the table.
    - Allow the legs to sag into full extension.

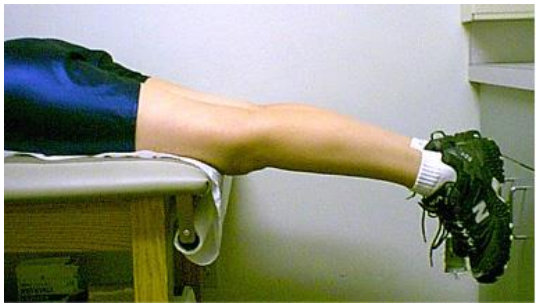

Figure 2. Prone Hang. Note the knee is off the edge of the table.

Bending (Flexion) is obtained by doing the following exercises:

1) Passive knee bend
    - Sit on the edge of a table and let the knee bend under the influence of gravity.
2) Wall slides are used to further increase bending.
    - Lie on the back with the involved foot on the wall and allow the foot to slide down the wall by bending the knee. Use other leg to apply pressure downward.

Figure 3. Wall Slide: Allow the knee to gently slide down

3) Heel slides are used to gain final degrees of flexion.
    - Pull the heel toward the buttocks, flexing the knee. Hold for 5 seconds.
    - Straighten the leg by sliding the heel downward and hold for 5 seconds.

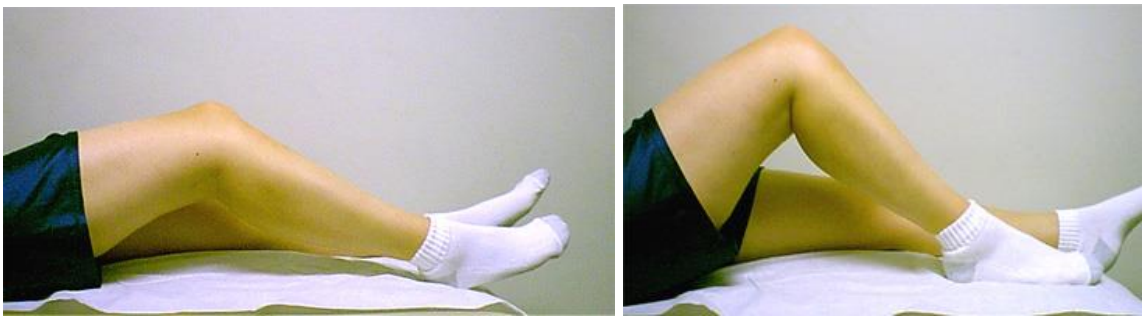

Figure 4. Heel slide – leg is pulled toward the buttocks

- In later stages of rehabilitation, do heel slides by grasping the leg with both hands and pulling the heel toward the buttocks.

Figure 5. Heel slides in later stages of rehabilitation

Develop muscle strength

Once 100 degrees of flexion (bending) has been achieved you may begin to work on muscular strength:

1) Stationary Bicycle. Use a stationary bicycle two times a day for 10 - 20 minutes to help increase muscular strength, endurance, and maintain range of motion.
2) Swimming is also another exercise that can be done during this phase to develop muscle strength and maintain your range of motion.
3) Low impact exercise machines such as an elliptical cross-trainer, leg press machine, leg curl machine, and treadmill can also be used.

This program should continue until you have achieved a full range of motion and good muscular control of the leg (you should be able to walk without a limp).

Mentally prepare

- Understand what to realistically expect of the surgery
- Make arrangements with a physical therapist for post-operative rehabilitation
- Make arrangements with your place of employment.
- Make arrangements with family and/or friends to help during the post-operative rehabilitation
- Read and understand the rehabilitation phases after surgery

Cold therapy devices

- You may elect to have a cold therapy device such as a Kodiak or Game Ready Unit. These devices provide cold therapy to the operative site and substitute for the use of an ice bag. These are rarely covered by insurance. Please contact our office if you would like to arrange for one of these devices.
- You may also simply use a bag of ice or ice gel device on your knee. It is important that you place a thin towel or shirt between your skin and ice to prevent frost bite.

When can I drive after surgery?

- Roughly 1 week for automatic cars, left leg surgery
- Roughly 2-4 weeks for manual cars or right leg surgery
- **You may not drive if you are taking narcotic medication**

Returning to Work or School

1) If you have a desk type job or go to school you can return to work/school when your pain medication requirements decrease, and you can safely walk with your crutches. Typically this is between 5 - 10 days after surgery.
2) Patients who have jobs where light duty is not permitted; policemen, firemen, construction workers, laborers, will be out of work for a minimum of 6 - 12 weeks.

Understanding Surgery

This section provides an understanding of the pre and post-operative phases of surgery.

Before Surgery

You may receive a femoral nerve block at the beginning of the operation. This will be determined by you and the anesthesiologist. If you did not receive a nerve block, at the conclusion of the operation, a solution containing a long acting local anesthetic will be injected into your knee. This solution will block the pain nerve fibers and local pain receptors in your knee. In many cases the injection or block will last 12 or more hours after surgery and significantly reduce the amount of pain medication that you will have to take.

After Surgery

While in the recovery room

- You will have ice or a cold therapy device placed on your knee.
- After surgery, your leg will be wrapped in soft cotton bandage. You may change the dressing on the second day after surgery using 4 x 4 gauze (available at your local drug store) and an ace wrap (see below).
- You will have a hinged knee brace placed on your knee locked in extension (see below for specific instructions)

After the anesthesia has worn off, your vital signs are stable and your pain is under control you will be discharged from the hospital or surgical center.

You will not be allowed to drive a car. Therefore prior to your discharge, you must arrange for transportation.

Weight bearing

You will be partial weight bearing (25% of total weight) with crutches for the first 2 weeks. Full weight bearing is then allowed gradually. If this was your second ACL surgery on the same leg or if you had microfracture or a meniscal repair, you will be partial weight bearing for 6 - 8 weeks.

Bracing

You will be placed in a hinged knee brace locked in extension. This brace is designed to protect your leg from unexpected stress. You may remove it during your exercises or if you are in a safe, protected environment

Weeks 1 – 2: Brace locked in extension for ambulation and sleeping

Weeks 3 – 4: Unlock brace and have flexion limited to 90 degrees as quad control allows. Continue to wear locked in extension while sleeping

Weeks 4 – 8: Wear brace in vulnerable situations (crowds, uneven terrain). After week 8 you may discontinue the brace

Caring for your knee

1) The first night and day after the surgery you can expect the dressing to have some drainage. This is normal! We want the blood to drain out of the knee on to the dressings rather than build-up in your knee and cause swelling and pain.

   If the dressings become extremely bloody or wet you should change them as needed. Use the following directions for changing the dressing:

   - The elastic wrap should be removed first followed by the cotton wrap and 4 inch x 4 inch gauze bandages.
   - A clean, dry, 4 inch x 4 inch gauze bandage should be applied over the incisions and held in place by a clean elastic dressing.
   - Do not use tape to keep the gauze in place as this may cause skin blisters. The stocking will keep the gauze in place.

2) You may shower, but you must keep your incisions dry until your follow up visit. This can be achieved by placing a waterproof plastic bag secured by a rubber band over your leg. You may also elect to just use a sponge bath.

3) Leave the steri-strips (white stickers) on your leg until your follow up visit.

4) After 4 weeks, you may apply vitamin E oil or another emollient to the incisions, as this will improve their appearance.

5) The appearance of your incision can be improved further if you keep direct sunlight off of it for one year. When exposed to the sun the incisions can be covered with a bandage, sunscreen with SPF of 30 to 50, or zinc oxide paste.

Medication Regimen

You may be given one of the following pain medication regimens:

1. **Vicodin – 5/500**: Take 1 – 2 tablets every 4 – 6 hours as needed for pain. Due to the Tylenol in the medication you may **not take more than 8 tablets per day as this may cause liver failure**. This medication can be called into your pharmacy prior to surgery.
2. **Oxycontin – 10mg**. Take 1 tablet every 12 hours after your surgery. Do not crush or chew the tablets and do not exceed the prescribed dosage. This is a time-release medication with a gradual onset of action. You will be given a prescription for this medication at the time of your surgery or at your preoperative visit. Please fill the prescription immediately and store the medication in a child-proof, safe, locked location.

   AND

   Oxycodone 5 mg. Take 1-2 tablets every 6 hours as needed for breakthrough pain only. This is for pain that is not controlled by the Oxycontin alone. Stop using the oxycodone as soon as you can. You will be given a prescription for this medication at your preoperative office visit or at the time of surgery. Please fill the prescription immediately and store the medication in a child-proof, safe, locked location.
3. Other medications:
   a. Aspirin (Ecotrin 325 mg). You may be instructed to take Aspirin after surgery. You should take 1 tablet daily for 7-10 days to prevent blood clots. This can be purchased over-the-counter.
   b. Colace (or other stool softener). Take 1 tablet daily with a lot of water to counteract the constipating effects of the pain medication. This can be purchased over-the-counter.

Phase 1 "Range of motion phase": Immediately post operatively until the end of week 6

IT IS EXTREMELY IMPORTANT THAT YOU WORK ON EXTENSION IMMEDIATELY.

Goals:
* **Control pain and swelling**
* **Protect graft and graft fixation**
* **Restore range of motion**
* **Prevent shutdown of the quadriceps muscles**
* **Gait training**

Postoperative Weeks 1 - 2

Control Pain and Swelling

1) Ice: Use a bag of ice (crushed ice is best) 20 minutes on and 60 minutes off as much as possible. If you purchased a Kodiak unit or Game Ready unit, use as directed.
2) Do not sit for long periods with your foot lower than your body as this causes increased swelling. When sitting for long periods, elevate your leg and foot
3) Use your pain medication as directed on the label
4) You may also take either Ibuprofen (600mg 3 times per day) or Naproxyn (440 or 500 mg 2 times per day). Take this as directed for the first 7 - 10 days.

Early Range of Motion and Extension

1) Passive extension of the knee by using a rolled towel. Note the towel must be high enough to raise the calf and thigh off the table. See Figure 1.
    - Remove the knee brace from your knee every 2 - 3 hours while awake
    - Position the heel on a pillow or rolled blanket with the knee unsupported
    - Passively let the knee sag into full extension for 10 - 15 minutes. Relax your muscles, and gravity will cause the knee to sag into full extension.

    This exercise can also be done by sitting in a chair and supporting the heel on the edge of a stool, table or another chair and letting the unsupported knee sag into full extension.
2) Active-assisted extension is performed by using the opposite leg and your quadriceps muscles to straighten the knee from the 90 degree position to 0 degrees. Hyperextension should be avoided during this exercise. See Figure 6:

Figure 6. Use the non-injured leg to straighten the knee

3) Passive flexion (bending) of the knee to 90 degrees. (See Figure 7 below)
    - Sit on the edge of a bed or table and letting gravity gently bend the knee.
    - The opposite leg is used to support and control the amount of bending.
    - This exercise should he performed 4 to 6 times a day for 10 minutes. It is important to achieve at least 90 degrees of passive flexion by 5 - 7 days after surgery.

Figure 7. Passive Flexion allowing gravity to bend the knee to 90 degrees

Exercising Quadriceps

1) You should start quadriceps isometric contractions with the knee in the fully extended position as soon as possible.
    - Do 3 sets of 10 repetitions 3 times a day.
    - Each contraction should be held for a count of 6 sec.

      This exercise helps to prevent shut down of the quadriceps muscle and decreases swelling by squeezing fluid out of the knee joint.
2) Begin straight leg raises (SLR) with the knee immobilizer on 8 sets of 10 repetitions 3 times a day. Start by doing these exercises while lying down.
    - This exercise is performed by first performing a quadriceps contraction with the leg in full extension. The quadriceps contraction "locks" the knee and prevents excessive stress from being applied to the healing ACL graft.
    - The leg is then kept straight and lifted to about 45-60 degrees and held for a count of six.
    - The leg is then slowly lowered back on the bed. Relax the muscles.

This exercise can be performed out of the brace when the leg can be held straight without sagging (quad lag). Once you have gained strength, straight leg exercises can be performed while seated. See Figure below.

Figure 8. Straight leg raises – lying (left) and seated (right)

Exercising Hamstrings

1) **For patients who have had ACL reconstruction using the hamstring tendons** it is important to avoid excessive stretching of the hamstring muscles during the first 6 weeks after surgery.
    - The hamstring muscles need about 6 weeks to heal, and excessive hamstring stretching during this period can result in a "pulled" hamstring muscle and increased pain.
    - Unintentional hamstring stretching commonly occurs when attempting to lean forward and put on your socks and shoes, or when leaning forward to pick an object off the floor.
    - To avoid re-injuring the hamstring muscles, bend your knee during the activities below, thus relaxing the hamstring muscles.
2) The hamstring muscles are exercised by pulling your heel back producing a hamstring contraction. See Figure 4
    - This exercise should be performed only if an allograft or your own patellar tendon graft was used to reconstruction the ACL.
    - If a hamstring tendon graft from your knee was used to reconstruct the ACL, this exercise should be avoided for the first 4 - 6 weeks, as previously mentioned.

Physical Therapy and Full Extension

1) Outpatient physical therapy will be modified during the first postoperative office visit.

REMEMBER THAT IT IS EXTREMELY IMPORTANT TO CONTINUE TO REMOVE YOUR LEG FROM THE KNEE IMMOBILIZER 4 TO 6 TIMES A DAY FOR 10 - 15 MINUTES AT A TIME TO MAINTAIN FULL EXTENSION.

Postoperative Weeks 3-6

Goals:
*** Maintain full extension**
*** Achieve 100 – 120 degrees of flexion**
*** Develop enough muscular control to use the knee brace unlocked from 0 – 90 degrees**
*** Control swelling in the knee**

MAINTAINING FULL EXTENSION AND DEVELOPING MUSCULAR CONTROL ARE IMPORTANT

Maintain Full Extension

Continue with full passive extension (straightening), gravity assisted and active flexion, active-assisted extension, quadriceps isometrics, and straight leg raises.

Work toward 100 - 120 degrees of flexion (bending)

Develop Muscular Control

1) Stationary bike
    - The seat position is set so when the pedal is at the bottom, the ball of the foot is in contact with the pedal and there is a slight bend at the knee.
    - No or very low resistance used. Maintain good posture throughout the exercise.
    - As your ability to pedal the bike with the operative leg improves, you may start to increase the resistance (around 5-6 weeks).
    - Your objective is to slowly increase the time spent on the bike starting first at 5 minutes and eventually working up to 20 minutes a session.
2) Start Toe Raises.
    - Using a table for stabilization, gently raise the heel off the floor and balance on the ball of the feet.
    - Hold for 6 seconds and ease slowly back down.
    - Do 3 sets of 10 repetitions each day.

Figure 9. Toe Raise

Phase 2 "Early strengthening phase" : Postoperative Weeks 7 - 12

Goals:
*** 125 degrees of flexion pushing toward full flexion by weeks 8 - 10**
*** Begin strength building**
*** Introduce treadmill**
*** Aqua training**
*** Discontinue knee brace after 8 weeks**

1) Your expected range of motion should be full extension to 125 degrees. Start to push for full flexion. More aggressive wall slides added if your flexion range of motion is less than desired.
2) Continue quad sets, patellar mobilization, straight leg raises, toe raises, stationary bike
3) Hamstring reconstruction patients can start leg curls in a sitting position. If you develop hamstring pain then decrease the amount of weight that you are lifting, otherwise you can increase the weight as tolerated
4) Tilt board or balance board exercises. This helps with your balance and proprioception (ability to sense your joint in space)
5) Double knee bends/partial squats, Double leg bridges, cord exercises
6) Begin walking on a treadmill. Start flat and advance to a 7 degree incline
7) Starting in week 10 can do FLAT outdoor biking

NO MOUNTAIN BIKING OR HILL CLIMBING!

Phase 3: "Strength and endurance phase" Postoperative Weeks 12 – 20

Goals:
*** Continued strength and flexibility**
*** Introduce jogging and light running**
*** Determine need for ACL functional brace**

1) Continue all of Phase 2 strengthening exercises.
2) Start straight, forward and straight, backward jogging.
3) Start functional running program after jogging program is completed at week 16
4) Optional fitting for ACL functional brace at week 12 (this is usually recommended on a case by case basis, highly recommended for skiers/snowboarders.

Phase 4: "Agility phase" Postoperative Weeks 20 - 24

Goals:
* **Continued strength and flexibility**
* **Introduce agility drills**
* **Begin plyometric program as appropriate for patient's goals**
* **Begin sports specific drills**

1) Increase running distance and speed

2) Agility progression from single plane to multidirectional

- Side steps
- Crossovers
- Figure 8 running
- Shuttle running
- One leg and 2 leg jumping
- Cutting

3) Initiate sports specific drills as appropriate

Phase 5: "Return to sports phase" 24 Weeks Postoperative (6 months)

This is the earliest you should plan on returning to full activity/sports. It is not uncommon for high level/professional athletes to be delayed until months 8 – 9 to return to sports. It is much better to wait an extra 2 months to return to sports than to return too early and damage the ACL graft.

If this was your second ACL surgery, return to sports will likely be delayed until 8 – 10 months post operatively.

For allograft reconstruction, return to full sports may be delayed until a minimum of 8 months post operative to allow the graft to fully heal.

Return to sports is by MD release

To return to sports you should have:

- Quadriceps strength equal to the normal leg
- Hamstring strength equal to of the normal leg
- Full motion
- No swelling
- Good stability
- Ability to complete a running program
- Optional sports test