

## Anterior Cruciate Ligament Reconstruction Protocol

The anterior cruciate ligament, or ACL, is one of the major stabilizing ligaments in the knee joint. Damage to this ligament commonly results in “giving way” or buckling of the knee and a progressive loss of function. Surgical reconstruction of the ACL is usually required in order to restore normal function.

When the ACL is reconstructed using a patellar tendon autograft, the middle one third of the patellar tendon is harvested along with a “plug” of bone from the tibia and femur. The resultant bone-tendon-bone graft is placed such that one bone plug is inserted in the femoral tunnel and one in the tibial tunnel. Both bone plugs are usually secured with a screw in each tunnel. Patients with patellar tendon grafts will usually have more anterior knee pain due to the trauma to the extensor mechanism. Therefore, aggressive resisted knee extension exercises are usually delayed for the first 6 – 8 weeks.

When the ACL is reconstructed using a hamstring autograft, a strip of the semitendinosus and gracilis tendons is harvested. The tendons are doubled over such that the resultant graft consists of 4 strands. The graft is then secured in the femoral tunnel using the bone mulch screw system and in the tibial tunnel with the washerloc system. Patients with hamstring grafts will usually have more posterior knee pain where the graft was harvested. Therefore, aggressive resisted knee flexion exercises (e.g. hamstring curls) are usually delayed for the first 4 – 6 weeks.

---

---

### Pre-Op Protocol

1. Briefly explain the surgery using the knee model.
2. Review and issue ACL Patient Information Packet emphasizing pre- and post-op goals and expectations.
3. Review pre- and post-op exercises, and issue a comprehensive home exercise program.
4. Schedule first post-op visit.

### Post-Op Protocol

#### **0 - 4 Days**

- **Full passive extension immediately post-op.**
- ROM 0-90 degrees.
- CPM at home.
- Ambulate WBAT with 2 crutches unless otherwise instructed by the physician.
- Begin SLR's in hospital.
- Use ice and elevation to decrease pain and swelling (4-5x/day).

#### **5 Days - 2 Weeks**

- Emphasize full passive extension/hyperextension equal to uninvolved knee unless  $\geq 5^\circ$  of hyperextension.
- ROM 0-110 degrees until sutures removed, then flexion to tolerance.
- Progress to FWB as soon as patient achieves adequate quad control (e.g. able to ambulate without flexed-knee gait and no increase in effusion).
- Discontinue CPM after first post-op MD appointment (~ 10 days).

*Developed in conjunction with the physicians at OrthoCarolina*

*Protocol developed in conjunction with The Sports Medicine Center at Miller Orthopaedic Clinic*

1. Gait training with assistive device (as appropriate).
2. Electrical stimulation to facilitate volitional quad control.
3. Biofeedback for quad strengthening exercises (e.g. knee extension isometrics, SLR's, etc.).
4. Patella mobilization. Instruct patient in self-mobilization technique with emphasis on superior glide and scar tissue massage as incision heals.
5. Multi-angle isometrics for quads ( $\geq 60^\circ$  knee flexion) and hamstrings.
6. AA/AROM exercises to increase flexion (e.g. knee flexed over table edge with support of opposite leg, wall slides, etc.).
7. Leg press (ROM as tolerated) and calf exercises on leg press machine.
8. Supine SLR's with weight of leg only. Add weight as tolerated only if full knee extension is maintained.
9. SLR's for hip adduction, abduction, and extension with added weights as tolerated.
10. Hamstring curls with added weights as tolerated.
11. Partial squats (ROM as tolerated but not to exceed  $90^\circ$  knee flexion).
12. Anterior lunge weight shifting with crutches as needed.
13. Calf raises.
14. Hamstring and calf stretching.

**2 - 6 Weeks**

- **Effusion should be  $\leq 3$  cm (at mid-patella) by 2 weeks.**
  - Continue to emphasize full knee extension and control of effusion.
  - ROM to tolerance (flexion should be  $\geq 120^\circ$ ).
  - **Gait should be normalized by 6 weeks.**
1. Continue with aggressive patellar mobilizations and scar tissue massage.
  2. Stationary bike for ROM. May begin exercise program if effusion is controlled.
  3. Lateral step-ups/downs beginning at 2" and progressing height only if proper technique is maintained (i.e. no hip substitution).
  4. Closed kinetic chain (CKC) terminal knee extensions standing with theraband resistance (may begin sooner if patient is FWB).
  5. Retro-ambulation to facilitate quad control and dynamic extension.
  6. Rocker board for static balance with two-leg stance (may begin sooner if patient is FWB).
  7. Hamstring curls on isotonic machine.
  8. Continue with squats (progressing from double-leg to single-leg as tolerated), emphasizing lower ranges (e.g.  $60-90^\circ$  of knee flexion) and proper technique (e.g. knees over/behind toes).
  9. Multi-hip machine.
  10. Versa Climber. Begin with 4"-6" step height and minimal resistance. Progress as tolerated. Patient should avoid patellofemoral pain.
  11. Static single-leg balance on floor. Progress to dynamic single-leg balance activities (e.g. upper or lower extremity reaching, 4-way theraband, etc.) as lower extremity muscle control allows.
  12. Sport cord activities (e.g. marching, lateral stepping in squat position, lunging, etc.).
  13. Hip hiking.
  14. Lunges (e.g. anterior, lateral, etc.) emphasizing proper alignment and mechanics.

*Developed in conjunction with the physicians at OrthoCarolina*

## 6 - 10 Weeks

- Effusion should be  $\leq 1$ cm by 6 weeks.
  - P/AROM should be equal, bilaterally, by 10 weeks.
  - Emphasize concepts of frequency, duration and intensity of training.
  - Continue to emphasize supervised balance and endurance training in the clinic.
  - Encourage continuation of lower extremity strengthening at local gym or health club.
1. Progress endurance training (e.g. bike, Versa Climber, etc.). Initiate high RPM (e.g. 100-120) bike sprints as tolerated.
  2. Progress static and dynamic single-leg balance activities to unsteady surfaces (e.g. pillow, half foam roll, BAPS board, etc.) as lower extremity muscle control allows.
  3. Begin knee extensions on isotonic machine (40-90° only) if minimal effusion (i.e.  $\leq 1$ cm), patellofemoral pain and/or patellar tendon pain.
  4. At 8 weeks, begin isokinetics for quad and hamstring strengthening with anti-shear device (ASD) if no increase in effusion and no patellofemoral complaints. Start with high speeds (180-300°/sec) and gradually introduce slower speeds.
  5. Begin mini-tramp marching.

## 10 - 16 Weeks

- Re-assess patient's independent strengthening program, ensuring proper weight progressions, training intensity, etc.
  - At 12 weeks (or 16 weeks depending on physician preference), perform isokinetic (180 and 240°/sec. with ASD), KT-1000, functional and subjective rating testing. Appointment with M.D.
1. Progress isotonic knee extension strengthening (0-90°). Continue to monitor patellofemoral joint and patellar tendon.
  2. Fitter and/or slide board.
  3. Mini-tramp jogging.

## 16 - 24 Weeks

- Re-assess patient's independent strengthening program, ensuring proper weight progressions, training intensity, etc.
1. Begin straight ahead jogging (may begin earlier only with MD approval).
  2. May begin progressive functional activities (in brace if required by M.D.) if isokinetic values from 12 week (or 16 week) test are within 15% of opposite side and if M.D. approves.

## 24 Weeks

- Perform isokinetic (60, 180, 300°/sec, no ASD required), KT-1000, functional and subjective rating testing. Appointment with M.D.
  - Functional testing may be delayed if patient has complaints of pain or swelling, has deficits  $>15\%$  documented by isokinetic testing, or A-P displacement is significant.
  - Fit for functional brace (if applicable).
1. Functional hop tests are performed.
    - 1) 6 meters for time.
    - 2) Triple cross-over hop for distance.
  2. Continue to progress functional activities and sport specific drills as tolerated.

*Developed in conjunction with the physicians at OrthoCarolina*

## REFERENCES

1. De Carlo M, Klootwyk TE, Shelbourne KD. ACL surgery and accelerated rehabilitation: revisited. *J Sport Rehab* 6: 144-156, 1997.
2. Irrgang JJ, Harner CD. Recent advances in ACL rehabilitation: clinical factors that influence the program. *J Sport Rehab* 6: 111-124, 1997.
3. Isear JA, Erickson JC, Worrell TW. EMG analysis of lower extremity muscle recruitment patterns during an unloaded squat. *Med Sci Sports Exerc* 29: 532-539, 1997.
4. Lephart SM, Pincivero DM, Giraldo JL, et. al. The role of proprioception in the management and rehabilitation of athletic injuries. *Am J Sports Med* 25: 130-137, 1997.
5. Mangine RE, Kremchek TE. Evaluation-based protocol of the anterior cruciate ligament. *J Sport Rehab* 6: 157-181, 1997.
6. Shelbourne KD, Patel DV, Martini DJ. Classification and management of arthrofibrosis of the knee after anterior cruciate ligament reconstruction. *Am J Sports Med* 24: 857-862, 1996.
7. Swanik CB, Lephart SM, Giannantonio FP, et. al. Reestablishing proprioception and neuromuscular control in the ACL-injured athlete. *J Sport Rehab* 6: 182-206, 1997.
8. Wilk KE, Escamilla RF, Fleisig GS, et. al. A comparison of tibiofemoral joint forces and electromyographic activity during open and closed kinetic chain exercises. *Am J Sports Med* 24: 518-527, 1996.
9. Wilk KE, Romaniello WT, Soscia SM, et al. The relationship between subjective knee scores, isokinetic testing, and functional testing in the ACL-reconstructed knee. *J Orthop Sports Phys Ther* 20: 60-73, 1994.
10. Wilk KE, Zheng N, Fleisig GS, et. al. Kinetic chain exercise: implications for the anterior cruciate ligament patient. *J Sport Rehab* 6: 125-143, 1997.
11. Manal TJ, Snyder-Mackler L. Practice guidelines for anterior cruciate ligament reconstruction: a criterion-based rehabilitation progression. *Oper Tech Sports Med* 6(3): 190-196, 1996.

*Developed in conjunction with the physicians at OrthoCarolina*

Anterior Cruciate Ligament Reconstruction.1

Page 4 of 4

Revised May 2005