ACL Reconstruction Protocol

The primary emphasis of this ACL rehab protocol is on functional weight bearing exercises with a focus on restoring the balance between the quadriceps and hamstrings muscles, needed to maintain appropriate patellofemoral mechanics. Neuromuscular coordination of the trunk, hips and lower extremities is emphasized to regain eccentric stability. Soft tissue mobilization and joint mobilization, as well as modalities, will be implemented as indicated.

We prefer to start the ACL protocol prior to surgery to educate the patient in proper post operative care. This will include ROM and flexibility exercises, isometric exercises, and anti-inflammatory modalities to facilitate an early recovery from the time of surgery through the first post-operative clinic visit.

This is a six phase protocol that serves strictly as a guideline. Goals and criteria for progression are explicitly outlined in each phase. All criteria should be met before the patient progresses to the next phase of the rehabilitation process. Each patient will be progressed by the physician/physical therapy team recommendations. Progression of the rehabilitation program is based on surgical findings, complications, and success in attaining the goals established by the team.

I. PRE-OP PHASE.

This begins shortly after injury and ends following surgery. Preoperative treatment is used to educate patients and resolve impairments that may delay or compromise the post-surgical rehabilitation process.

GOALS:

1. Management of pain and swelling.
2. Establish full passive range of motion (ROM) into both flexion and extension that is equal to the contralateral knee.
3. Establish a strong volitional isometric Quadriceps contraction while in full knee extension.
4. Allow Weight Bearing (WB) to tolerance as joint stability allows with/without an assistive device.
5. Progress exercises as tolerated to increase functional status.
6. Fit patient for neoprene hinged knee brace to provide external stability.
7. Attend physical therapy for 1-3 visits to establish baseline measurements, instruct/establish a home exercise program (HEP), provide the patient & family with education regarding the surgery, prognosis and expectations, and educate the patient and family on a post operative home exercise program.

CRITERIA FOR PROGRESSION:

1. Minimal pain and swelling.
2. Full Passive extension, equal to contralateral limb.
3. Active & Passive flexion ROM equal to contralateral limb. (Slight deficit is OK)
4. Patient able to ambulate with a normal gait pattern, using an assistive device and/or brace, as needed.

5. Patient is able to establish a volitional quadriceps contraction.
6. Patient able to demonstrate good mechanics while performing partial squats, if stability allows.
7. Patient demonstrates fair to good single leg balance stability for 10 seconds on the involved side, on a level surface, with their eyes open.
8. Physician will schedule surgery

II. IMMEDIATE POST OPERATIVE PHASE.

Begins on day of surgery and continues until patient begins physical therapy.
WEEK 1: 1st-7th day post op, or first week of clinical care through 2nd week

GOALS:

1. Control swelling and pain.
    - Continue to encourage icing frequently (not >20 minutes, multiple times/day), and use of compression garment (i.e. Tensogrip) to assist in minimizing edema.
    - Patient should keep leg elevated, perform repeated ankle circles, and ankle DF/PF to create a muscle pump to assist with edema management
    - If pain is interfering with ROM progress, consider use of TENS or IFC.
2. Protect healing graft by wearing the brace 24 hours/day and abiding by the ROM and WB precautions
3. Establish full passive knee extension.
4. Improve active & passive flexion to tolerance.
5. Use CPM at home, up to 8 hours daily (minimum of 6 hours).
    - ACL-R only: 0-60°, 0-90° @ 2 weeks
    - ACL-R + Meniscus Repair: 0-90° @ 4 weeks
6. Partial WB at 50% of body weight with knee immobilizer brace locked at 0° if straightforward ACL-R. (NWB 4-8 weeks if Meniscus Repair &/or chondral defect w/ marrow stimulating procedure)
7. Minimize Quadriceps inhibition: establish good isometric Quadriceps contraction in terminal knee extension (TKE). (i.e. use Quad Sets, NMES)
8. Schedule PT evaluation w/in 1 week of surgery. Attend physical therapy 1-3 x/week.

CRITERIA FOR PROGRESSION:.

1. Minimal swelling and pain.
2. Full passive extension
3. Patient is PWB at 50% of body weight using 2 axillary crutches and knee immobilizer brace locked in TKE, with emphasis on normal gait mechanics
4. Good isometric Quadriceps contraction in TKE.

III. EARLY FUNCTIONAL REHABILITATIVE PHASE.

2 to 4 weeks post-operative, or second through fourth week of clinical care.

GOALS:

1. Continue to encourage icing frequently and use of compression garment (i.e. Tensogrip) to assist in minimizing edema. If pain is interfering with ROM, consider use of TENS or IFC.

2. Protect healing graft. *(The first 6 weeks post-operatively are the most tenuous times for graft fixation healing.)*
3. Obtain/maintain full passive knee extension. Increase active and passive flexion to tolerance. Wean from CPM as ROM improves.
4. ROM brace locked during ambulation if necessary (i.e. poor LE control or an inhibited quadriceps muscle).
5. Encourage a normal gait pattern, increasing WB to tolerance; Encourage use of functional neoprene hinged brace at 4 weeks. May need to modify WB status due to graft fixation healing:
    - Patellar tendon graft: Use crutches PRN, WBAT in brace-wean off of brace when good quadriceps control and stability are noted (by 4 weeks)
    - Hamstring graft, ACL revision, or fixation concerns: Use crutches, TDWB in brace for 4 weeks, then PWB for 2 weeks, with full WB at 6 weeks with good quadriceps control and stability; *No isolated resisted isotonic hamstring strengthening until 6 weeks post op. Use caution with any isolated stretching to the graft host site until 6 weeks post op.*
    - Allograft: revascularization is slower: continue brace and crutches x 6 weeks
6. Begin patellar mobilization, with focus on normalizing the superior glide; instruct patient in self-patellar mobilization
7. Improve soft tissue and scar mobility. Instruct patient in self-scar tissue mobilization when the incisions have healed.
8. Establish and progress isometric Quadriceps function. Continue to use NMES as indicated.
9. Progress dynamic closed kinetic chain exercises with focus on regaining strength and coordination between the gluteals, quadriceps, hamstring and calf muscles.
10. Begin proprioception and kinesthetic awareness training (i.e. balance and PNF activities) in WB, using brace PRN.
11. Begin appropriate cardiovascular conditioning. (i.e. stationary bike, pool exercises once incisions have completely healed; no swimming, breast stroke or kick boarding)
12. Encourage UE strengthening and core exercises in appropriate positions
11. Perform Lower Extremity Functional Evaluation (Tegner-Lysholm Knee Score) for baseline measures at end of phase. (Tegner-Lysholm Knee Score available at http://www.orthopaedicscores.com)
12. Attend physical therapy 1-3 x/week.

CRITERIA FOR PROGRESSION:

1. Full passive knee extension. Passive flexion of 120 degrees by end of phase.
2. FWB gait with 1 assistive device (preferably no AD). By end of phase, patient comfortable using neoprene hinged knee brace.
3. Patellar mobility is improving and nearing normal.
4. Patient demonstrates strong volitional isometric Quadriceps contraction. Patient is able to perform a supine SLR without extensor lag.
5. Patient performs double leg partial squat to 30-45° of knee flexion with good trunk, hip and LE control, and without pain.

6. Patient demonstrates controlled balance while in double limb support and controlled dynamic stability of the uninvolved leg. Patient demonstrates minimal postural sway while performing single limb balance activities on the surgical leg, while on level surfaces.
7. Patient demonstrates "Poor" to "Fair" rating (40-65 points) on the Tegner-Lysholm Knee Score.

IV. MID FUNCTIONAL REHAB PHASE.

5-8 weeks post-operative, or fifth through eight week of clinical care.

GOALS:

1. Minimal to no joint effusion.
2. Protect the healing graft. *(Ligamentization continues- graft becomes vascularized and develops new properties)*
3. Maintain full Active extension. Progress to full flexion ROM as tolerated in prone and supine.
4. Wean completely from crutches. Continue use of functional neoprene hinged knee brace. No limping.
5. Normalize patellar & soft tissue mobility. Patient demonstrates good scar mobility.
6. Continue to progress the return-to-activity program: functional LE strengthening with closed kinetic chain dynamic exercises to include the trunk & hip.
7. Continue proprioception and kinesthetic awareness training.
    - Patient demonstrates controlled balance with double limb support on an unstable surface, controlled balance with single limb support on a level surface, and controlled dynamic stability in double limb support.
8. Improve cardiovascular endurance.
9. Perform Lower Extremity Functional Evaluation at end of phase (Tegner-Lysholm Knee Score).
10. Continue with physical therapy 1-3 x's/week.

CRITERIA FOR PROGRESSION:

1. Full active and passive extension, equal to opposite limb.
2. Passive flexion of 90% or greater compared to the contralateral limb.
3. Patient able to ambulate with near normal gait mechanics with use of neoprene hinged knee brace and without an assistive device.
4. Patella mobility and patella position are normal; scar mobility is normal
5. Patient performs a 2-3 inch step down with appropriate trunk, pelvis and LE control and without pain.
6. Patient demonstrates minimal postural sway or hip/knee/ankle strategy when performing single limb balance activities on level ground.
7. Patient able to perform double leg squat to 90 degrees of knee flexion with proper lumbar/pelvis/hip stability, lower extremity alignment, and with bilateral symmetry
8. Patient demonstrates "Fair" rating (65-83 points) on Tegner-Lysholm Knee Score.

V. LATE FUNCTIONAL REHAB PHASE

9-16 weeks post op, or ninth to sixteenth week of clinical care.

GOALS:

1. No joint effusion.
2. Protection of the graft. *(Tensile strength of the graft at 3 months is at 50% of the strength at implantation. Graft is at its weakest point, but recovers in the following months, although never comparable to the original.)*
3. Full active and passive ROM in extension and flexion.
4. Normal gait mechanics without a brace.
5. Maintain normal patellar mobility and mechanics.
6. Emphasize functional gluteal control: begin **controlled** lateral movement as exercise tolerance, gluteal strength, and leg and trunk control allow *(delay if meniscal repair has been performed)*
7. Progress all functional and resistive exercises.
8. Progress proprioceptive and kinesthetic awareness exercises. Incorporate balance activities with eyes closed to limit reliance on visual system to maintain stability.
9. Progress lateral stability exercises near end of phase.
10. Progress cardiovascular training. Patient may begin swimming freestyle at 3 months. No breast stroke.
11. Good stability with manual Lachmans test (or KT 1000, IF ordered by M.D.)
12. Perform Lower Extremity Functional Evaluation (Tegner-Lysholm Knee Score) at end of phase.
13. Physical Therapy decreased to 1-2 x's/week, as indicated.

RESTRICTIONS:

1. No cutting or pivoting
2. Avoid resistance with Open Kinetic Chain (OKC) knee extension
3. No running until 4 months post operatively

CRITERIA FOR PROGRESSION:

1. Normal gait mechanics without a brace.
2. Patient tolerates a minimum of 20 minutes of aerobic exercise.
3. Patient is able to perform full double leg squat with proper lower chain mechanics, trunk and pelvis stability, and without pain.
4. Patient is able to perform single leg squat to 90 degrees without pain, or to the degree symmetrical to the contralateral limb.
5. Patient must have good strength, agility and coordination, balance and postural control, and endurance with the return-to-activity exercises specific to the patient's goals.
6. Patient demonstrates good mechanical stability with Lachman test. Normal KT 1000 results, with < 2-3 mm difference when compared to uninvolved knee (IF testing was requested by M.D.).

7. Patient demonstrates minimum of "Good" rating (84-90 points) on the Tegner-Lysholm Knee Score.

VI. FUNCTIONAL PROGRESSION TO SPORT

4-9 months post op, or fourth through ninth month of clinical care

1. Rehabilitation during the return-to-sport phase should be **criteria-driven**:
    a. Advancement to full contact and pivot sports is based on development of confidence, strength, agility and coordination, balance and postural control, endurance, and mechanical and functional stability (SEE SPECIFIC CRITERIA BELOW).
    b. Return to cutting and pivoting sports ONLY after clearance by the M.D.
2. **Start with controlled activities** (i.e. avoid uneven surfaces, contact situations, and fatigue.)
3. **Avoid high-risk activity to START** i.e. jumping, twisting, pivoting, cutting, and OKC knee extension. May begin OKC knee extension at 6 months
4. Use **Sport-specific Drills** to determine progression to unrestricted activities. Patient must be able to dynamically stabilize the knee in sport and activity positions before return to sport.

EXAMPLES:

1. **Running Progression:**
    - Meet Criteria for Return to jogging (i.e. good lumbo/pelvic/hip control, good eccentric quadriceps control, etc. during single leg squat and step downs)
    - Treadmill walk/jog intervals (self-paced to begin with)
    - Treadmill running
    - Track: run straight parts, walk the turns
    - Track: run straight parts and the turns
    - Run on the road
    - Run on the surface specific to the athlete's sport

Take 1-2 days off between running days or as instructed by medical professional

2. **Plyometric and Agility Progressions:**
    - Double leg jumps→Single leg hops
    - Single plane→Multiple planes
    - Stable→Unstable surfaces
    - Controlled→Uncontrolled situations
    - Teach the 3 L's
        1) Soft *L*anding following jumps at all times.
        2) Stay *L*ow while running at all times
        3) Keep your knees in *L*ine with your feet at all times

CRITERIA FOR PROGRESSION TO SPORT:

1. Patient tolerates functional progression to sport program without difficulty and without exacerbation of symptoms.
2. No effusion.
3. Full ROM
4. Before returning to their sport, the athlete MUST DEMONSTRATE the confidence, strength, agility, coordination, balance, postural control, endurance, and mechanical and functional stability to the degree necessary for their specific sport.
   a) Confidence: Use patient reported outcome measures: IKDC, Tegner-Lysholm Knee Score (Tegner Lysholm Knee Score = "Excellent": > 90)

   b) Strength: (MMT, Isokinetic strength, functional strength)
      - Quadriceps/thigh circumference should be within 1 cm of the uninvolved (if normal) side.
      - Quadriceps MVIC should be within 90% of the uninvolved side
      - Isokinetic Strength tests: Quadriceps and Hamstrings are 85-90% of the uninvolved side (isokinetic, 180 degrees/sec. and 300 degrees/sec.)
      - *(Mattacola et al 2002, Kobayashi et al 2004: quadriceps strength can take b/w 18-24 months to return to values within 10-15 % of the CL limb)*

   c) Functional stability: mimic functional activities specific to their sport to make correlations for readiness for return to sport
      - Testing can guide your treatment: assess for bilateral asymmetries (use timed or measured trials)
      - All hop tests should be within 85-90% of the uninvolved side before return to sport.

        Examples:
        - Drop vertical jump: *(Paterno et al. CJSM 2007: patients favor CL limb during landing and jumping 2 yrs. following surgery)*
        - Single limb hop for distance
        - Single leg triple hop
        - Single leg cross over hop
        - Single leg timed hop
        - Single leg vertical hop
        - Shuttle runs
        - Side shuffle runs
        - Carioca running
        - Etc.
        - *(Paterno et al 2007: asymmetry with landing and jumping can still be present 2 years post ACLR)*

   d) Mechanical Stability:
      - Lachman, Pivot Shift *(Pivot Shift: Kocher MS et al. AJSM 2004)*
      - KT 1000, KT 2000 IF ordered by M.D.

e) Dynamic Stability:
   - *(Mattacola et al JAT 2002, Harrison et al. Phys Ther 1994: takes 18 months post op for dynamic stability to return, 9-10 months for static stability to return)*
   - Biosway, etc.

5. **After discharge from physical therapy, patient should continue with CHOC's ACL Injury Prevention Program (See additional hand out)** (*Athletes with prior ACL injury are at greater risk for future ACL injury: Souryal et al AJSM 1998, Shelbourne et al AJSM 1996, Pinezewski et al AJSM 2007, Orchard et al AJJSM 2001)*

6. **"Soreness Rules": use as a guide to activity progression**

"Soreness Rules" (Adapted from University of Delaware Physical Therapy Clinic)

Criterion	Action
Soreness during warm-up that continues into the activity/training session	2 days off, drop down intensity level
Soreness during warm-up that goes away during the activity/training session	Stay at intensity level that led to soreness
Soreness during warm up that goes away but redevelops during activity/training session	2 days off, drop down 1 intensity level
Soreness the day after the activity/training session (not muscle soreness)	1 day off, do not advance program to next intensity level
No soreness	Advance 1 intensity level/week or as instructed by healthcare professional