

## ACL RECONSTRUCTION PROTOCOL

\*The rehabilitation for hamstring tendon graft and patellar tendon graft is differentiated within the protocol. We are less aggressive initially with hamstring tendon grafts because soft tissue to bone healing takes longer (approx 12 weeks) in comparison to bone to bone (approx 8 weeks). There is no early aggressive hamstring resistive exercise because this can irritate the hamstrings. Avoid hamstring resistive work for 1<sup>st</sup> 6 weeks. The hamstring graft may be approximately 2 weeks later in starting the running and plyometric program.

PLC Repair/Reconstruction: Treat similar to ACL hamstring, with no hamstring resistive exercises for 8 weeks, and delay running/plyometric program 4 weeks compared to as listed below

### Phase I – Immediate post-operative phase

- Goals:** Educate the patient on precautions to protect the repair  
 Decrease pain and inflammation  
 Stimulate quad function and hamstring co-contraction  
**Attain ROM – especially patellar mobility and full extension by 2 weeks**  
 Teach proper gait with crutches and brace/weight bearing as tolerated  
 Improve neuromuscular control

### Week 1 (1-7 days)

- Ankle pumps
- Seated calf stretch with sheet, seated hamstring stretch, both with towel roll under ankle to promote full extension
- Gait with 2 crutches WBAT and brace locked in extension – may drop lock for sitting only after 5 days – make sure it is locked again for ambulation
- Patellar mobilization
- Seated PROM performed with opposite lower extremity
- Focus on obtaining full extension. Overpressure/low load into full passive extension
- Heelslides – may assist with towel if needed
- Quad sets – may use functional e-stim on quads as needed, towel roll under ankle to promoted full extension
- Hamstring sets for patellar tendon graft only
- Straight leg raises 4 ways (flex,ext, abd, add) – for flexion –Quad set 1<sup>st</sup> and provide assistance to keep full extension if there is a lag. May use E-stim on quads
- Ice-egs – Jobst if needed

### **Days 4-7 add:**

- Drop lock brace for sitting, lock for ambulation
- Multi-angle isometrics with foot on floor (60°, 90°)
- Standing weight shifts forward and sideways – progress to knee bend with weight shift
- Standing mini squats- bilateral LE
- Calf propping or prone hangs as needed to increase extension – low load to obtain full passive extension
- Standing hamstring curls for patellar tendon grafts only– (do not add open chain hamstring work with hamstring autograft)
- Standing closed chain terminal knee extension with light band above knee
- **No hamstring strengthening for 4-6 weeks for hamstring graft**

### **Goals:**

- **PROM 0-90**
- Quad control sufficient for SLR independently with no lag

### Week 2 (8-14 days)

- Gait with 1 crutch and brace locked for home. Gait in therapy—practice correct form: knee flexion in swing, terminal knee extension, weight shift in stance. If patient is amb with a flexed knee, practice weight shifts with manual overpressure to increase extension in stance
- March in place
- Bike – for ROM – start with rocking – make sure seat is close enough that knee does not hyperextend
- Standing gastroc/soleus stretch
- Add manual hamstring stretch with knee bent
- Add weight to SLR if no lag
- Cones – to increase flexion, and practice balance with 1 or 2 crutches (based on tolerance)
- Continue low load long duration stretching seated with theraband above knee, and weight hanging from theraband – light weight – 5 –6 minutes to obtain full passive extension
- Balance- weight shifts on KAT or minitramp week 2-3 as tolerated
- Box Drill with crutch assist—do not lock or twist knee – may vary knee flexion angle.
- Forward propulsion and retropulsion using on rolling stool alternating LE for patellar tendon graft. For hamstring graft, wait until week 5 for forward propulsion
- Leg Press: using bilateral LE – (40° to extension without locking) Use low weight (10-50% maximum of patients body weight. Add weight only if good control in terminal extension)

### Week 3 (15-21 days)

- Gait with brace locked and no crutches if patient's pain/edema allow. Unlock toward end of 3<sup>rd</sup> week if SLR with no lag and quad control good. Concentrate on correct form with gait without brace in therapy.
- Initiate walking program with normal pattern – treadmill forward, no incline
- Prone knee flexion ROM assisted with belt/opposite leg
- Calf raises—bilateral start on ground and progress to over step
- Open chain knee extension 90 to 40°
- Leg press: do not twist or lock knee – bilateral and unilateral – for unilateral, start concentric minisquat on minitramp – hold 2-3 seconds at 30° flexion (greatest amt of hamstring and quad co-contraction at 30° flexion in squat)
- multi angle hip machine – do not twist or lock the weight bearing leg
- elliptical machine/stair climber – forward/backward on both
- backward on treadmill on incline – may progress to theraband resistance around waist if good form and control
- increase balance work: unilateral stance eyes open, unilateral stance on minitramp or disc, box drill with no crutch, bilateral stance on bosu ball, unilateral stance with opposite limb movement/perturbations – make sure involved knee does not lock or twist during balance activities
- Bilateral seated pogo or physioball
- Pool program: walk forward, backward, sideways, straight leg raise 4 ways, minisquats, stretching, unilateral stance balancing, knee bends (if incision closed)
- Sidestep with theraband around thighs with knees flexed week 3 to 4 as strength allows
- Cones: forward, lateral, backward. Change speeds. Land and balance with slightly flexed knee
- Step up – forward and lateral – start 2 inch
- Weight shift into minilunge forward and lateral – Patient instructed to lunge to side, land on a slightly flexed knee and hold 1-2 seconds before returning to starting position
- Week 3-4 add soft tissue mobilization to hamstring graft site, and continue low load and focus on full extension

### **Goals:**

- ROM 0-100
- Good quad control with unilateral stance

#### Week 4 (Day 22-28)

- Continue stretches
- If quad control allows, unlock brace for ambulation, then D/C brace
- Progress step up exercises – do not allow knee to twist or knees to pass toes
- Wall squats – make sure knee does not twist or pass toes
- Progress to unilateral eccentric leg press (conc and ecc)
- Minisquats on BOSU
- Unilateral lower extremity seated pogo or physioball
- Progress balance to unilateral stance eyes closed – unilateral stance bosu, box drill – make sure knee does not twist or lock – vary knee flexion angle – focus on keeping at least 30° knee flexion for females, unilateral stance on foam or minitramp – with ball toss, etc. Keep knee bent 30 degrees
- Add perturbation (ie sport cord or varying resistance to cones)
- “Butt burner” exercises – hip abduction and external rotation- clam in sidely with resist at knee
- Scar massage
- Pool program: add resistive equipment to previous exercises- add step up
- Bilateral squat to 90°- narrow and wide base of support – on ground and BOSU
- Unilateral modified knee bend to 35-45° with UE support and contralateral limb supported on box/bench behind the patient

#### **Goals**

- ROM 0-115
- Gait with full extension in stance and flexion in swing without brace or crutches

#### Intermediate Phase: Weeks 5 –9 (Day 29-63)

##### **Goals**

- Normalize gait all surfaces
- Increase strength entire lower extremity: focus on quad, hamstring, gastroc/soleus, gluteus medius and hip ext rotation for correct hip and knee positioning and stability
- Correct posture and control during exercise: knee not passing toes, no valgus at knee (no knee twisting/hip IR), no locking of knee during exercise
- Increase neuromuscular control/balance/proprioception at a variety of hip/knee angles (functional for sport)

#### Week 5-6 (Day 29-42)

- Progress stretches: add standing quadriceps, IT band, hip flexors, hip adductors
- Hamstring work – add open chain for hamstring graft, and progress to high speed theraband hamstring for patellar tendon graft. Add forward propulsion on a rolling stool to hamstring graft
- Step downs
- Add weight/theraband and increase height of step up – may add perturbations to increase neuromuscular control (IE sportcord)
- Dip walk on balance beam. Patient laterally steps up onto beam, steps forward with opposite LE, then steps down on other side (alternating legs) Forward and backward
- Squats with narrow and wide base of support – may use a medicine ball, or upper extremity activity to increase difficulty
- Unilateral stance with arm reach – vary knee flexion angle and do not allow lock or twist
- Mini lunges – lunge matrix
- **Week 6** – progress pool program to add cardiovascular/agility drills: jogging forward/backward, sidestep

- **Cross friction massage to scar/hamstring massage for hamstring graft as needed**

#### Week 7-9 (Day 43-63)

- Incorporate dynamic warm up/stretching
- Unilateral stance functional drills – ie throw or kick while standing on dynamic surface. Stand with knee flexed on disc or foam and perform random UE movements with medicine ball
- Full lunges – make sure knee does not pass foot or twist. Make sure weight stays on involved leg. May start with lunge in split-step position, progress to step lunge, then walking lunges – lunge matrix. Incorporate arms overhead to increase quad and trunk activation, toe touch with forward step to increase hamstring and glut contributions, and rotations to improve neuromuscular control
- Smith Press
- **Week 9:** may progress to lunge onto a dynamic surface (ie BOSU ball), lateral lunges – reach low to flex hips to fire gluteals
- **Week 8:** increase intensity of unilateral eccentric leg press
- Unilateral squat- prevent knee twisting or locking. May start with double leg down, single leg up
- **Week 8-9:** step up onto wobble board, step down from wobble board or dynamic surface forward and backward
- Increase perturbations with step up, lunge and balance activities. May use theraband to dip walk
- **Week 9 Pool Program:** kickboard flutter kick (maintain knee extension), backlying flutter kick with full knee extension, resistive kickboard running, carioca

#### Week 10-16 (Day 64-112)

- Continue lunge matrix
- Unilateral squat with 5 point touch hand or opposite foot
- Slide board
- Balance/reach arm/leg with involved leg on dynamic surface
- Functional reaches/Reach test (measure of eccentric knee control/dynamic balance). Forward and lateral reach on single leg with toe tap. Avg of 3 trials taken to compare side to side for distance
- Plyo jumps on total gym 50% bodyweight – concentrate on correct landing form – no lock or twist, land with “soft knee” on ball of foot
- Mat jumps week 12: measure controlled landing/stability/knee position. Start 6inch height, progress to 12 inch. 2-2 jumps, 2-1 jump, 1-1 jump. Step off box and land, do not jump up from box and land. Grade either controlled or uncontrolled.
- Lateral step test. 6 inch step height, number of reps in 15 seconds with good knee and trunk control. Compare bilaterally
- Leg Press test: measurement of single leg strength. Number of reps at specific weight documented. Calculate 1 Rep Max
- KT test (week 10-12)
- **Fit for sport/functional brace per physician order**
- Functional retraining/work conditioning/simulation
- Isokinetic training (limit knee extension to 30 degrees) at 120, 180, 240 and 300 degrees/second – place shin pad proximally
- Isokinetic testing at 12 weeks – 120, 180, 300 degrees/second
- **Begin running program approximately 12 weeks when criteria met** (see below)
- **Week 12 to 14:** If appropriate strength/balance/proprioception may begin plyometric training. Avoid straight leg landing and knee twisting. In females- train to land with at least 30 degrees of knee flexion. Start with bilateral lower extremity plyos, off one and land bilat plyos, and off bilat and unilateral land and “stick” drills – landing with knee flexion

- **Week 12:** Swimming (avoid breast stroke and whip kick), vertical jumping, agility patterns, diagonal cutting drills, resisted running with jets
- Begin agility drills/sports specific training when criteria met/as appropriate

### **CRITERIA TO START PLYOMETRIC/RUNNING/AGILITY PROGRAM**

- Land with good control and correct form on mat jumps
- MMT at least 5/5, ROM equal to uninvolved side or at least 0-125
- Normal gait pattern at least 20 minutes without symptoms
- Leg Press test within 75-80% of contralateral LE
- Reach test within 75-80% of contralateral LE Hamstring and quadricеп strength 70 % of the involved side isokinetically,
- Lateral step test within 75-80% of contralateral LE
- Hamstring and quadricеп strength 70 % of the involved side isokinetically,
- Less than 3 mm difference in joint arthrometer testing at 30 pounds
- No pain, crepitus, edema or giving way
- Clearance from MD

*At week 12 to 16 may discharge to a home/gym/running&agility/plyo program if equipment available and patient is independent with good technique. Schedule rechecks/biodex/KT tests as needed until final discharge at approximately 6 months.*

### **CRITERIA TO RETURN TO SPORTS**

- Completion of running and agility/plyometric program without symptoms with good form
- Quadriceps strength 85-90 %
- Quad torque to body weight ratio:  
Males: @180°/sec 65-75%, Females 50-60%; @ 300°/sec males 45-55, females 35-45
- Hamstring strength 100% for patellar tendon graft, at least 85% for hamstring graft
- Hamstring to quadriceps ratio is 65%
- Good balance and proprioception
- Functional tests (single leg hop for distance, single-leg triple crossover hop, 6 meter timed hop) is 85% compared to opposite LE
- KT test  $\leq$  3mm laxity compared to non-involved side
- LEFT test meet norms:
 

Males	females < 25 yrs/age	females > 25 yrs/age
90 sec – good	100 sec – good	120 sec – good
100 sec – avg	120 sec – avg	150 sec – avg
125 sec – below avg	140 sec – below avg	180 sec – below avg
- Vertical Jump 85%
- Leg Press 85%
- Lateral shuttle – between 3 meter line, timed for 10 reps (5 in each direction). Look for knee control, knee position and or compensation

**Please call with any questions!**