TriHealth
Orthopedic & Sports Institute

Posterior Cruciate Ligament Repair

1. Defined
    a. The posterior ligament has insertions on the posterior aspect of the proximal tibia and the lateral aspect of the medial femoral condyle. The PCL functions as the primary restraint to posterior translation of the tibia and a secondary restraint to external rotation.
    b. Rupturing usually occurs in the midsubstance of the tissue and is typically from a direct blow to the proximal tibia.
    c. The graft can be an allograft or autograft. Typically taken from the achilles, anterior/posterior tibialis or sometimes even the hamstring.
2. Goals
    a. Protect healing tissue
    b. Control post-operative pain and swelling
    c. Improve post-operative range of motion
    d. Improve functional strength, stability, and neuromuscular control
3. Rehabilitation Principles
    a. Be aware of compromised and/or repaired tissue
        i. Understand graft strain concepts in order to protect the graft.
        ii. In the first 6-12 weeks of rehab the fixation of the graft itself rather than the graft is the limiting factor
        iii. At 6 weeks revascularization begins to occur and the graft itself is in its weakest state
        iv. Revascularization is complete at 12 weeks
        v. Protect the healing tissue by preventing any posterior translation of the tibia and avoidance of early hamstring activity.
        vi. Understand that rehabilitation after reconstruction of the PCL is significantly more conservative than after the anterior cruciate reconstruction.
        vii. Resistance for hip PRE's is placed above the knee for hip abduction and adduction; resistance may be distal for hip flexion.
    b. Healing tissue should never be overstressed but appropriate levels of stress are beneficial
        i. Inflammatory phase days 1-3
        ii. Tissue repair with proliferation phase days 3-20
        iii. Scar tissue most responsive to remodeling 21-60 days but occurs from 1 to 8 weeks
        iv. Final maturation taking as long as 360 days

v. Graft integration
    1. Revascularization begins at 6 weeks

c. Tissue reactivity of the knee and tissue healing will dictate the rehabilitation process. Reactivity is determined by the clinical exam
    i. Level I Reactivity
        1. Resting pain, pain before end range
        2. Aggressive stretching is contraindicated
        3. Grade I-II mobilization for neurophysiologic effect
    ii. Level II Reactivity
        1. Pain onset occurs with end range resistance
        2. Grade III and IV mobilization appropriate per patient tolerance
    iii. Level III Reactivity
        1. Engagement of capsular end feel with little or no pain.
        2. Pain occurs after resistance
        3. Grade III and IV mobilization and sustained stretching is appropriate
d. Eliminate inflammation as the cause of pain and neuromuscular inhibition
    i. Initially nonweightbearing with crutches unless indicated otherwise by physician (could be partial weight bearing)
    ii. Brace should be locked in full extension
    iii. Position pillow under proximal posterior tibia at rest to prevent posterior tibial sag
    iv. Utilize NMS for reactivation of quadriceps musculature, especially the VMO
e. Ensure return of appropriate joint arthrokinematics
f. Apply techniques in loose packed unidirectional and progress to close packed and multidirectional based on tissue healing and patient response
g. Identify motion complications early and begin low-load, long duration stretching activity
h. Range of motion may often be on the stiff side due to protective phase
    i. PROM before week 4 only if directed by MD
    ii. Week 4 – 6: 0 – 60 degrees
    iii. Week 7 – 8: 0 – 100 degrees
    iv. Week 9 – 16: full ROM
i. Facilitate performance of complex skills with proprioceptive and kinesthetic techniques: Low to high, sagittal to frontal, bilateral to unilateral, stable to unstable, slow to fast, fixed to unfixed surface
    i. Initiate early proprioceptive activity and progress by means of proprioception techniques
    ii. Incorporate comprehensive lower extremity (hip and calf) muscle stabilization and strengthening activities as well as core strengthening activities
    iii. Address limb confidence issues with progression of unilateral activity

iv. Address limb velocity issues during gait with verbal and tactile cueing

j. Encourage life-long activity modification. Educate on PPP, low impact aerobic exercises, etc
k. Encourage integration of core strengthening with therapeutic exercises
l. Factors that affect the rehab process
    i. Surgical approach
    ii. Tissue quality
    iii. Presence of concomitant pathology
    iv. Age of patient
    v. Comorbidities
    vi. Pre and intra-operative range of motion
    vii. Pain and sensitivity levels
    viii. Cognitive abilities

4. Post op functional guidelines
    a. Requires input from physician
        i. May reference physician preferences
    b. Dependant on functional range and strength, and neuromuscular control
    c. Drive
        i. No research to support recommendations for return to driving
        ii. Refer patient to drug precautions
        iii. Refer patient to auto insurance coverage
        iv. Dependent on left or right involvement
    d. Showering
        i. May begin showering one week post-op without brace – sponge until sutures removed (or tegaderm application)
    e. Work
        i. Sedentary up to 1-2 weeks
        ii. Medium to high physical demand level 12 -16+ weeks, which will be communicated with MD
    f. Sport
        i. Jogging on the treadmill
            1. Must refer to MD for specific clearance – probably no sooner than 4 months
            2. Observe and minimize limb velocity asymmetry
            3. Encourage lower impact activity
        ii. Acceleration Training
            1. Must refer to MD for specific clearance
        iii. Cutting and rotational activity
            1. Must refer to MD for specific clearance
        iv. Return to sport team
            1. May be as long as 9 months – MD preference
                a. Dependent upon good quad control, full range of motion, 80% score on hop test, normal KT test (when ordered or recommended by the PT) and

80% isokinetic score (when ordered or recommended by the PT)

5. Post op equipment guidelines
    a. Polar care as needed for pain and inflammation
    b. Brace
        i. Locked at 0 degrees for 4 weeks or longer per MD preference
        ii. Unlock brace 0- 60 degrees from 4 – 6 weeks
        iii. Unlock brace 0 - 100 degrees from 6 - 8 weeks
        iv. Unlock brace at week 8
        v. D/C long leg brace at week 10/switch to custom PCL brace
        vi. D/C custom PCL brace except for sports activities at week 16
        vii. Must wear custom PCL brace for 12 months after return to sport
    c. Assistive device (crutch, cane, walker)
        i. 2 crutches (nonweightbearing) for 0 – 3 weeks
        ii. 2 crutches (Non to toe-touch weightbearing) for 3 – 6 weeks
        iii. At week 6, weightbearing as tolerated with one or two crutches
        iv. Full weightbearing at week 8
    d. Functional Brace
        i. Fit at week 10 in MD office by DME coordinator

6. Rehabilitation for PCL reconstruction with Bone Tendon Bone Graft

a. Week 1 -3: Protective ROM Phase

i. Precautions/Limits:
1. Swelling and effusion
2. Inhibit post-op muscle shut down
3. Avoid posterior tibial translation
4. No active knee flexion

ii. Clinical Expectations by the end of week 3
1. Working toward visible, balanced quad contraction
2. Independent straight leg raise without extensor lag (in brace) – no ‘sagging’
3. Minimization of swelling

iii. Treatment
1. Gentle scar and patellar mobilization
2. E-Stim, biofeedback, verbal, and/or tactile cuing for quad re-education (dispense home unit if indicated)
3. Straight Leg Raises – may do all directions except no prone extension leg raises (may do in standing weeks 3 -4)
4. Hamstring and calf stretching
5. Calf press with exercise bands

b. **Week 4 - 6: Protective ROM Phase and Early Weight Bearing**

i. Precautions/Limits
1. Swelling and effusion
2. ROM
3. Muscular inhibition

4. Avoid posterior tibial translation
5. No active knee flexion

ii. Clinical Expectations by the end of week 6
1. ROM: 0 degrees to 60 degrees
2. Balanced, solid quadriceps contraction
3. Independent straight leg raise without extensor lag
4. 4/5 abduction strength
5. Ambulation with 2 axillary crutches non or toe touch weightbearing

iii. Treatment
1. PROM for the knee – therapist applies posterior to anterior pressure on the tibia to protect PCL
2. Scar and patellar mobilization
3. E-Stim, biofeedback, verbal, and/or tactile cuing for quad re-education
4. Light knee extension from flexion limits to 40 degrees
5. Straight Leg Raises
6. Calf and hamstring stretching
7. Calf press with exercise bands
8. Abduction on multi-angle hip machine – resistance above the knee

c. Weeks 6 - 8 Weightbearing/Strengthening Phase

i. Precautions/Limits
1. Swelling and effusion
2. ROM precautions
3. Muscular inhibition
4. Quad control
5. Gait and proprioceptive deficits
6. still no active flexion
7. avoid posterior tibial translation

ii. Clinical Expectations by the end of week 8
1. ROM: 0 degrees to 100 degrees
2. Normalized straight leg raise and 4+/5 abduction strength
3. Ambulation with single crutch with minimal deviation

iii. Treatment
1. Continue PROM, scar and patellar mobilization as needed
2. Continue stretching all previous muscle groups, adding gentle, prone quadriceps stretching
3. Continue with e-stim, biofeedback, verbal, and/or tactile cueing for quad facilitation
4. Gait training with one crutch using cues for asymmetries
5. Begin bilateral standing exercises such as standing calf raises and light weight shifting
6. Carefully begin some unilateral standing exercises also if patient is judged to be of safe strength and performance
7. Gently progress knee extension exercises

8. Progress knee extension 90º-40º to 2#
9. Begin leg press and four way multi-angle hip machine
10. Light multi-angle isometrics on knee extension machine
11. Begin light active knee flexion

d. Weeks 8-10: Strengthening Phase

i. Precautions/Limits
1. Swelling and effusion
2. ROM
3. Progression dependent on quad control and limb confidence
4. Avoid posterior tibial translation

ii. Clinical Expectations by the end of week 10
1. Work gently toward full PROM
2. Ambulation without crutch or deviation

iii. Treatment
1. Continue AROM, PROM, scar and patellar mobilization as needed
2. Continue comprehensive lower extremity stretching program
3. Gait training as needed, cueing for proper form without assistive device or deviation
4. Progress bilateral and unilateral closed chain activities to increase limb confidence as well as proprioception, and RNT
5. Initiate unilateral flexion activity under weight bearing
6. Progress knee extension exercises
7. Progress lower extremity and core strengthening exercises

e. Weeks 10-6 months: Functional Strengthening Phase

i. Limits/Precautions
1. Swelling and effusion
2. Full ROM
3. Progression dependent on quad control and limb confidence
4. Graft is at its weakest during revascularization

ii. Clinical Expectation by the end of week 12
1. Full, pain-free ROM (note: it is not unusual for flexion to be lacking 10-15 degrees for up to 5 months after surgery)
2. Good, symmetrical quad contraction
3. Ambulation without crutch or deviation with symmetrical limb velocities
4. Increased open and closed chain hamstring strength (without undue posterior knee irritation)

iii. Treatment
1. Work toward full ROM
2. Continue comprehensive lower extremity stretching program

3. Cue for proper gait without assistive device and address any limb velocities
4. Progress bilateral and unilateral closed chain activities to improve limb confidence, proprioception, and RNT
5. Progress unilateral flexion activity under weight bearing
6. Progress knee extension strength, as well as open chain hamstring strength
7. Progress lower extremity and core strengthening program
8. Treadmill walking – 12 weeks
9. Swimming (no frog kick) – 12 weeks
10. Jogging in pool with vest or belt – 12 weeks
11. Initiate and progress basic, single plane, bilateral hopping activities that require leaving the ground with emphasis on quality and short distances
    a. Base height and distance on lower limb control and form

f. 6 months – 9 months: Initiate Return to Sport Training

i. Limits/Precautions
1. Swelling and effusion
2. Address any limb velocity asymmetries
3. Progression dependent on quad control and limb confidence

ii. Clinical Expectations by the end of 9 months
1. Symmetrical quad contraction
2. Able to demonstrate good landing with plyometric activity to include the following:
    a. Good athletic posture (spine erect and shoulders back)
    b. No valgus position at the knees with landing
    c. Soft landing
    d. Stabilize the landing
3. Able to land with symmetrical landing pattern with basic unilateral hopping activities
4. Demonstrate 80% score on the single let hop test (if returning to competitive sports)
5. Proper coordination with higher – level, single plane, dynamic activities

iii. Treatment
1. Continue comprehensive lower extremity stretching program
2. Cue for proper gait and address any limb velocity asymmetries
3. Progress bilateral and unilateral closed chain activities to improve limb confidence, proprioception, and RNT
4. Progress unilateral flexion activity under weight bearing

5. Progress knee extension strength
6. Progress lower extremity and core strengthening program
7. Progress basic bilateral hopping drills to unilateral activities that require leaving the ground with emphasis on quality and short distances
8. Progress basic bilateral plyometric activities including jump training from different heights and increased distances
9. Initiate higher-level, sports-specific, single place, agility activities (forward, retro and lateral only – no cutting activities)

g. 8-9 months: Return to Sport

i. Clinical Considerations

1. CMP
2. Patellar Tedonitis/Bursitis
3. Quad Control
4. Patient Goals
5. Level of Sport or Activity
6. Isokinetic testing
7. Force Plate Testing through Tekulve
a. Contact Rocky Tekulve during patient's rehab if appropriate
8. BOOST Program

References

Brigham and Women's Hospital: Department of Rehabilitation Services (Copyright 2007). "PCL Reconstruction Protocol".

Brotzman and Wilk (D'Amato and Bach). **Clinical Orthopaedic Rehabilitation**. 2nd Edition. Mosby. 293-308.

Bullis DW, Paulos LE. Reconstruction of the Posterior Cruciate Ligament With Allograft. *Clinical Sports Medicine* 1994;13:581-597.

Harner CD. Biomechanical Analysis of a Double-Bundle Posterior Cruciate Ligament Reconstruction. *American Journal of Sports Medicine* 2000;29:144-151.

Makino, A. Anatomic Double-Bundle Posterior Cruciate Ligament Reconstruction Using Double-Double Tunnel With Tibial Anterior and Posterior Fresh-Frozen Allograft. *Arthroscopy: The Journal of Arthroscopic and Related Surgery*. 2006:22:684e1-684e5.

M.J. Matava. Surgical Treatment of Posterior Cruciate Ligament Tears: An Evolving Technique. *Journal of American Academy of Orthopaedic Surgeons*. 2009;17:435-446.

R.F. Laprade, S. Johansen J. Outcomes of an Anatomic Posterolateral Knee Reconstruction. *Journal of Bone and Joint Surgery*. 2010;92:16-22.

Shields CL. **Rehabilitation of the Knee in Athletes**. The Lower Extremity and Spine in Sports Medicine, Volume 1. St. Louis, CV Mosby, 1986.