

Mr Gilbert, Mr Coupe, Mr Sales
Sports Knee Clinic, Wrightington Hospital

POST-OPERATIVE POSTERIOR CRUCIATE LIGAMENT

OR COMBINED POSTERIOR CRUCIATE AND ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION PROTOCOL:

Ensure patient achieves milestone prior to progression

No return to contact sports prior to 9 months post-op

Return to gentle non-contact, non-competitive sports at physiotherapist's discretion but must be over 8 months post-op

Any problems during rehabilitation please contact Jo Armstrong or Dan Wright at Wrightington Physiotherapy Department 01257 256533

PHASE 1 POST-OP – Post reconstructive surgery (day 1-14)

Goal	Treatment	Milestones to Progress
Graft protection	<ul style="list-style-type: none"> Cricket pad splint to be worn at all times when mobilizing and for sleeping Use of crutches TOUCH WB ONLY 	<ul style="list-style-type: none"> Ensure patient has attended first post-operative clinic review (at 2 weeks post-op)
Minimise swelling and pain	<ul style="list-style-type: none"> Use of ice or Game Ready if available Elevate leg Ensure adequate pain relief 	
Prevent post-operative complications	<ul style="list-style-type: none"> Circulatory exercises Patella mobilizations 	
Maintain muscle strength	<ul style="list-style-type: none"> Regular static quads SLR if able 	

PHASE 2 2 weeks to 6 weeks

Goal	Treatment	Milestone to Progress
Graft protection	<ul style="list-style-type: none"> Hinged knee brace (ROM 0°- 90°) to be worn at all times when mobilizing. Cricket pad split to be worn in bed Use of crutches, PARTIAL WB ONLY 	<ul style="list-style-type: none"> Minimal effusion Full or nearing full extension 90° knee flexion SLR with no lag (10 reps) Normal, symmetrical gait pattern with crutches Ensure patient has attended their 6 week clinic review
Minimise swelling and pain	<ul style="list-style-type: none"> Use of ice or Game Ready Ensure adequate pain relief Elevate leg 	
Regain full range of extension	<ul style="list-style-type: none"> Active extension exercises: static quads Passive stretching Initially avoid hyperextension 	
Increase knee flexion as pain allows	<ul style="list-style-type: none"> Passive flexion exercises in prone (no active ROM, do not engage hamstrings) 	

	<ul style="list-style-type: none"> • Passive flexion over edge of bed • Patella mobilisations 	
Improve quads control and muscle strength	<ul style="list-style-type: none"> • Static quads, SLRs. Ensure patient can SLR with no lag • Co-contraction quads and hams • Active OKC Qs (60° to full extension) NO OKC QS IF COMBINED PCL & ACL • Early gluteal strengthening • Early core stability strengthening 	
Ensure flexibility	<ul style="list-style-type: none"> • Hamstrings stretches in supine • Calf stretches 	
Restoration of normal gait pattern	<ul style="list-style-type: none"> • Gait re-education with elbow crutches PWB 	
Attention to donor leg if graft harvested from contralateral side	<ul style="list-style-type: none"> • Restore full range of motion ASAP • Commence muscle strengthening • Commence muscle stretching 	

PHASE 3 6 weeks – 12 weeks

Goal	Treatment	Milestone to Progress
Graft protection	<ul style="list-style-type: none"> • Hinged knee brace (no restriction to ROM) to be worn at all times when mobilizing. Remove brace at 8 weeks post-op 	<ul style="list-style-type: none"> • Minimal/no activity related effusion • Full range of extension • Normal gait pattern without crutches • Full range of flexion • Single leg stand eyes shut at least 5 seconds • Bilateral squat, thighs parallel to floor with even, symmetrical weight bearing
Minimise swelling and pain (ensure no swelling before progression) Prevent anterior knee pain	<ul style="list-style-type: none"> • Continue as above, as necessary • Patella mobilisations 	
Regain/maintain full range of extension/hyperextension (compare to non-operative knee)	<ul style="list-style-type: none"> • Extension exercises as above • Heel props, prone hangs • Passive stretching 	
Restoration of normal gait pattern	<ul style="list-style-type: none"> • Commence FWB, wean off crutches • Treadmill walking 	
Regain full range of flexion	<ul style="list-style-type: none"> • Active flexion exercises with overpressure • Progress to quads stretch • Passive stretching as required • Hydrotherapy as required 	
Improve quads, hamstring and general lower limb strength	<ul style="list-style-type: none"> • CKC – wall slide squats (start at 60° flexion and progress), squats, leg press (start at 60° flexion and progress), single 	

	<ul style="list-style-type: none"> leg squats etc. NO LUNGES Progress OKC Qs – add resistance NO OKC QS IF COMBINED PCL & ACL Bridging on gym ball or feet on sofa (less than 30° flexion), progress to normal bridge (further knee flexion) Calf raises, hip extensions, hip abd/add, glut med/max 	
Increase aerobic capacity	<ul style="list-style-type: none"> Exs bike Treadmill walking (incline) Step ups Cross trainer Rower 	
Improve proprioception	<ul style="list-style-type: none"> Single leg stand eyes open/eyes closed Wobble board Sitfit Trampette 	
Neuromuscular control	<ul style="list-style-type: none"> Core stability work Knee alignment/prevent hip IR/knee valgus – squats, step ups (ensure good hip/knee/ankle alignment) 	

PHASE 4 – Upon achievement of phase 3 milestones and no sooner than 12 weeks post-op

Goal	Treatment	Milestone to progress
Control activity related swelling and pain	<ul style="list-style-type: none"> Use of cryotherapy post exercise if knee swells with increased activity 	<ul style="list-style-type: none"> Minimal/no activity related effusion Full ROM Normal gait and stair pattern – good alignment and control 10 x single leg squats to 60° with good biomechanical alignment and control (i.e. no valgus and good hip/knee/ankle alignment)
Regain/maintain full range of movement	<ul style="list-style-type: none"> Continue stretches 	
Normalise gait and stair pattern	<ul style="list-style-type: none"> Treadmill walking – forward/backward/incline 	
Improve quads, hamstring, and general lower limb strength	<ul style="list-style-type: none"> Continue CKC – double & single leg press, squats, single leg squats, commence lunges, increase weight OKC Qs – increase load Commence OKC Hamstring curls – double & single leg, increase weight gradually Gluteals, calf, adductors 	

Increase aerobic capacity	<ul style="list-style-type: none"> • Exs bike • Treadmill walking • Step ups • Cross trainer • Rower • Pool walking/running 	
Improve proprioception	<ul style="list-style-type: none"> • Single leg stand eyes closed • Wobble board • Sitfit • BOSU • Trampette 	
Neuromuscular control	<ul style="list-style-type: none"> • Core stability work • Knee alignment/prevent valgus as above – add trunk rotation 	
Commence bilateral load acceptance/ early plyometrics	<ul style="list-style-type: none"> • Bilateral drop jumps • Jumps with symmetrical squat landing • Progress to straight line jogging when good load acceptance 	

PHASE 5 – Upon achievement of phase 4 milestones

Goal	Treatment	Milestone to progress
No swelling or pain	<ul style="list-style-type: none"> • Continue as above if necessary 	<ul style="list-style-type: none"> • Normal straight line running pattern • Single leg press >75% body weight • Single leg stand eyes shut >80% unaffected leg • Hop tests >85% LSI: single hop, triple hop, cross over hop, 6m timed hop, side to side hop
Normal straight line running pattern without pain and in full control	<ul style="list-style-type: none"> • Progress from jogging to running • Increase speed/distance • Change surface/incline • Forward running/backward running 	
Increase muscle strength and endurance	<ul style="list-style-type: none"> • Increase load on strengthening exs (60-80% 1RM) • Single leg press – push for >75% x body weight • Commence open chain quads if not already performing and gradually increase resistance 	
Improve proprioception	<ul style="list-style-type: none"> • Increase dynamic proprioception 	
Progress bilateral load acceptance/commence unilateral load acceptance/plyometrics	<ul style="list-style-type: none"> • Tuck jumps with stable landing • Squat jumps, forward/ back/ rotational 	

	<ul style="list-style-type: none"> • Bilateral plyometric static and multi-plane exs • Single leg hop with controlled landing • Forward, side hops/ drops from step with controlled single leg landing • Unilateral plyometric static and multi plane activities 	
--	--	--

PHASE 6 SPORTS SPECIFIC – Upon achievement of phase 5 milestones

Goal	Treatment	Milestone to progress
Increase muscle strength and endurance	<ul style="list-style-type: none"> • Increase load on resistance work 	<ul style="list-style-type: none"> • Symptom free sports specific training • Hop tests >90% LSI : single hop, triple hop, cross over hop, 6m timed hop, side to side hop • Single leg stand eyes shut, equal to unaffected side
Progress unilateral load acceptance and work to fatigue	<ul style="list-style-type: none"> • As above – increase speed/intensity to fatigue 	
Commence sports specific running agility drills	<ul style="list-style-type: none"> • Sprinting • Cutting and pivoting • Acceleration/deceleration 	
Commence sports specific skills	<ul style="list-style-type: none"> • Ball skills • Dribbling • Boxing • Kicking • Sports specific activity with controlled opposition e.g. one on one practice drills 	
Neuromuscular control following fatigue	<ul style="list-style-type: none"> • Ensure ability to control alignment under random practice and after fatigue 	
Return to non-contact sports (only when nearing 8 months post-op)	<ul style="list-style-type: none"> • Golf/gentle racquet sports 	

PHASE 7 FULL UNRESTRICTED SPORTS TRAINING– Upon achievement of phase 6 milestones: MUST BE AT LEAST 9 MONTHS POST-OP

Goal	Treatment
Symptom free training	<ul style="list-style-type: none"> • Full, unrestricted training
ROM and muscular flexibility equal to other side	<ul style="list-style-type: none"> • Continue stretching
Good results of all functional testing	<ul style="list-style-type: none"> • Functional tests prior to returning to contact sports
Return to full unrestricted, confident activity	<ul style="list-style-type: none"> • Progress to uncontrolled practice situations and competition

References

- Cavanaugh, J, Saldivar, A, Marx, R (2015) Postoperative rehabilitation after posterior cruciate ligament reconstruction – posterolateral corner surgery. *Operative Techniques in Sports Medicine*, 23 (4), 372-384
- Cox, C, Spindler, K, (2008) Multiligamentous Knee Injuries – surgical treatment algorithm. *North American Journal of Sports Physical Therapy*, 3 (4), 198-204
- Edson, C, Fanelli, G, Beck, J (2011) Rehabilitation after multiple-ligament reconstruction of the knee. *Sports Med Arthrosc Rev*, 19 (2), 162-166
- Escamillia, R, Macleod, T, Wilk, K, Paulos, L, Andrews, J (2012) Anterior cruciate ligament strain and tensile forces for weight-bearing and non-weight-bearing exercises: a guide to exercise selection. *Journal of Orthopaedic & Sports Physical Therapy*, 42 (3) 208-220
- Glass, R, Waddell, J, Hoogenboom, B (2010) The effects of open versus closed kinetic chain exercises on patients with ACL deficient or reconstructed knees: a systematic review. *North American Journal of Sports Physical Therapy*, 5 (2), 74-84
- Herrington, L, Myer, G, Horsley, I (2013) Task based rehabilitation protocol for elite athletes following Anterior Cruciate Ligament reconstruction: a clinical commentary. *Physical Therapy in Sport*, 14, 188-198
- Imwalle, L, Myer, G, Ford, K, Hewett, T (2009) Relationship between hip and knee kinematics in athletic women during cutting manoeuvres: a possible link to noncontact anterior cruciate ligament injury and prevention. *J Strength Cond Res*, 23 (8), 2223-2230
- Kim, J, Lee, Y, Yang, B, Oh, S, Yang, S (2013) Rehabilitation after posterior cruciate ligament reconstruction: a review of the literature and theoretical support. *Arch Orthop Trauma Surg*, 133, 1687-1695
- Kruse, L, Gray, B, Wright, R (2012) Rehabilitation after anterior cruciate ligament reconstruction. *Journal Bone Joint Surg Am.*, 94, 1737-1748
- Lee, B, Nam, S (2011) Rupture of Posterior Cruciate Ligament: Diagnosis and treatment principles. *Knee Surg Relat Res*, 23 (3), 135-141
- Manske, R, Hosseinzadeh, P, Giangarra, C (2008) Multiple Ligament Knee Injury: Complications. *North American Journal of Sports Physical Therapy*, 3 (4), 226-233
- Mikkelsen, C, Werner, S, Eriksson, E (2000) Closed kinetic chain alone compared to combined open and closed kinetic chain exercises for quadriceps strengthening after anterior cruciate ligament reconstruction with respect to return to sports: a prospective matched follow-up study. *Knee Surg, Sports Traumatol, Arthrosc*, 8, 337-342
- Moatshe, G, Chahla, J, LaPrade, R, Engebretsen, L (2017) Diagnosis and treatment of multiligament knee injury: state of the art. *JISAKOS* [online] Available <https://jisakos.bmj.com> [27 June 2017]
- Morrissey, M, Drechsler, W, Morrissey, D, Knight, P, Armstrong, P, McAuliffe, T (2002) Effects of distally fixated versus non-distally fixated leg extensor resistance training on knee pain in the early period after anterior cruciate ligament reconstruction. *Physical Therapy*, 82 (1), 35-43
- Morrissey, M, Hudson, Z, Drechsler, W, Coutts, F, Knight, P, King, J (2000) Effects of open versus closed kinetic chain training on knee laxity in the early period after anterior cruciate ligament reconstruction. *Knee Surg, Sports Traumatol, Arthrosc*, 8, 343-348

- Myer, G, Ford, K, Brent, J, Hewett, T (2007) Differential neuromuscular training effects on ACL injury risk factors in “high-risk” versus “low risk” athletes. *BMC Musculoskeletal Disorders*, 8 (39), 1-7.
- Myer, G, Ford, K, Brent, J, Hewett, T (2012) An integrated approach to change the outcome part 2: Targeted neuromuscular training techniques to reduce identified ACL injury risk factors. *The Journal of Strength and Conditioning research*, 26 (8) 2272-2292
- Myer, G, Paterno, M, Ford, K, Hewett, T (2008) Neuromuscular training techniques to target deficits before return to sport after anterior cruciate ligament reconstruction. *Journal of Strength and Conditioning research*, 22 (3), 987-1014
- Narducci, E, Waltz, A, Gorski, K, Leppla, L, Donaldson, M (2011) The clinical utility of functional performance tests within one-year post-ACL reconstruction: A systematic review. *The International Journal of Sports Physical Therapy*, 6 (4), 333-342
- Nasab, S, List, R, Oberhofer, K, Fucentese, S, Snedeker, J, Taylor, W (2016) Loading patterns of the posterior cruciate ligament in the healthy knee: a systematic review. *PLoS ONE* [online], 11 (11) Available <https://www.ncbi.nlm.nih.gov/pubmed/27880849> [27 June 2017]
- Perry, M, Morrissey, M, King, J, Morrissey, D, Earnshaw, P (2005) Effects of closed versus open kinetic chain knee extensor resistance training on knee laxity and leg function in patients during the 8 to 14 week post-operative period after anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*, 13, 357-369
- Pierce, C, O'Brien L, Griffin, L, LaPrade, R (2013) Posterior cruciate ligament tears: functional and postoperative rehabilitation. *Knee Surg Sports Traumatol Arthrosc*, 21, 1071-1084
- Reid, A, Birmingham, T, Statford, P, Alcock, G, Giffen, J (2007) Hop testing provides a reliable and valid outcome measure during rehabilitation after anterior cruciate ligament reconstruction. *Physical Therapy*, 87 (3), 337-349
- Risberg, M, Holm, I, Myklebust, G, Engebrestsen, L (2007) Neuromuscular training versus strength training during first 6 months after anterior cruciate ligament reconstruction: a randomized clinical trial. *Physical Therapy*, 87 (6), 737-750
- Risberg, M, Lewek, M, Snyder-Mackler, L (2004) A systematic review of evidence for anterior cruciate ligament rehabilitation: how much and what type? *Physical Therapy in Sport* 5 125-145
- Silvers, H, Mandelbaum, B (2007) Prevention of anterior cruciate ligament injury in the female athlete. *Br J Sports Med*, 41 (Suppl 1), 52-59
- Thomeé, R, Kaplan, Y, Kvist, J, Myklebust, G, Risberg, M, Theisen, D, Tsepis, E, Werner, S, Wondrasch, B, Witvrouw, E (2011) Muscle strength and hop performance criteria prior to return to sports after ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc*, 19, 1798-1805
- Thomeé, R, Neeter, C, Gustavsson, A, Thomeé P, Augustsson, J, Eriksson, B, Karlsson, J (2012) Variability in leg muscle power and hop performance after anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*, 20, 1143-1151