



	<ul style="list-style-type: none"> <li>active ROM, do not engage hamstrings)</li> <li>• Passive flexion over edge of bed</li> <li>• Patella mobilisations</li> </ul>	
Improve quads control and muscle strength	<ul style="list-style-type: none"> <li>• Static quads, SLRs. <b>Ensure patient can SLR with no lag</b></li> <li>• Co-contraction quads and hams</li> <li>• Active OKC Qs (60° to full extension) <b>NO OKC QS IF COMBINED WITH ACL</b></li> <li>• Early gluteal strengthening</li> <li>• Early core stability strengthening</li> </ul>	
Ensure flexibility	<ul style="list-style-type: none"> <li>• Hamstrings stretches in supine</li> <li>• Calf stretches</li> </ul>	
Restoration of normal gait pattern	<ul style="list-style-type: none"> <li>• Gait re-education with elbow crutches PWB</li> </ul>	
Attention to donor leg if graft harvested from contralateral side	<ul style="list-style-type: none"> <li>• Restore full range of motion ASAP</li> <li>• Commence muscle strengthening</li> <li>• Commence muscle stretching</li> </ul>	

**PHASE 3 6 weeks – 12 weeks**

Goal	Treatment	Milestone to Progress
Graft protection	<ul style="list-style-type: none"> <li>• Hinged knee brace (no restriction to ROM) to be worn at all times when mobilizing.</li> </ul>	<ul style="list-style-type: none"> <li>• Minimal/no activity related effusion</li> <li>• Full range of extension</li> <li>• Normal gait pattern without crutches</li> <li>• Full range of flexion</li> <li>• Single leg stand eyes shut at least 5 seconds</li> <li>• Bilateral squat, thighs parallel to floor with even, symmetrical weight bearing</li> <li>• <b>Ensure patient has attended 12 week clinic review</b></li> </ul>
Minimise swelling and pain (ensure no swelling before progression) Prevent anterior knee pain	<ul style="list-style-type: none"> <li>• Continue as above, as necessary</li> <li>• Patella mobilisations</li> </ul>	
Regain/maintain full range of extension/hyperextension (compare to non-operative knee)	<ul style="list-style-type: none"> <li>• Extension exercises as above</li> <li>• Heel props, prone hangs</li> <li>• Passive stretching</li> </ul>	
Restoration of normal gait pattern	<ul style="list-style-type: none"> <li>• FWB gait re-education</li> <li>• Treadmill walking</li> </ul>	
Regain full range of flexion	<ul style="list-style-type: none"> <li>• Active flexion exercises with overpressure</li> <li>• Progress to quads stretch</li> <li>• Passive stretching as required</li> <li>• Hydrotherapy as required</li> </ul>	
Improve quads, hamstring and general lower limb strength	<ul style="list-style-type: none"> <li>• CKC – wall slide squats (start at 60° flexion and progress), squats, leg press (start at 60° flexion and progress), single</li> </ul>	

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

**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"> <li>Use of cryotherapy post exercise if knee swells with increased activity</li> </ul>	<ul style="list-style-type: none"> <li>Minimal/no activity related effusion</li> <li>Full ROM</li> <li>Normal gait and stair pattern – good alignment and control</li> <li>10 x single leg squats to 60° with good biomechanical alignment and control (i.e. no valgus and good hip/knee/ankle alignment)</li> </ul>
Regain/maintain full range of movement	<ul style="list-style-type: none"> <li>Continue stretches</li> </ul>	
Normalise gait and stair pattern	<ul style="list-style-type: none"> <li>Discontinue brace on instruction at 12 week clinic review (<b>continue with brace if patient has not attended clinic</b>).</li> <li>Treadmill walking – forward/backward/incline</li> </ul>	
Improve quads, hamstring, and general lower limb strength	<ul style="list-style-type: none"> <li>Continue CKC – double &amp; single leg press, squats, single leg squats, commence lunges, increase weight</li> <li>OKC Qs – increase load</li> <li>Commence OKC Hamstring curls – double</li> </ul>	

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

### **PHASE 5 – Upon achievement of phase 4 milestones**

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

unilateral load acceptance/plyometrics	<ul style="list-style-type: none"> <li>• Squat jumps, forward/ back/ rotational</li> <li>• Bilateral plyometric static and multi-plane exs</li> <li>• Single leg hop with controlled landing</li> <li>• Forward, side hops/ drops from step with controlled single leg landing</li> <li>• Unilateral plyometric static and multi plane activities</li> </ul>	
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**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"> <li>• Increase load on resistance work</li> </ul>	<ul style="list-style-type: none"> <li>• Symptom free sports specific training</li> <li>• Hop tests &gt;90% LSI : single hop, triple hop, cross over hop, 6m timed hop, side to side hop</li> <li>• Single leg stand eyes shut, equal to unaffected side</li> </ul>
Progress unilateral load acceptance and work to fatigue	<ul style="list-style-type: none"> <li>• As above – increase speed/intensity to fatigue</li> </ul>	
Commence sports specific running agility drills	<ul style="list-style-type: none"> <li>• Sprinting</li> <li>• Cutting and pivoting</li> <li>• Acceleration/deceleration</li> </ul>	
Commence sports specific skills	<ul style="list-style-type: none"> <li>• Ball skills</li> <li>• Dribbling</li> <li>• Boxing</li> <li>• Kicking</li> <li>• Sports specific activity with controlled opposition e.g. one on one practice drills</li> </ul>	
Neuromuscular control following fatigue	<ul style="list-style-type: none"> <li>• Ensure ability to control alignment under random practice and after fatigue</li> </ul>	
Return to non-contact sports (only when nearing 8 months post-op)	<ul style="list-style-type: none"> <li>• Golf/gentle racquet sports</li> </ul>	

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

### References

- Bien, D, Dubuque, T (2015) Considerations for late stage ACL rehabilitation and return to sport to limit re-injury risk and maximize athletic performance. *The International Journal of Sports Physical Therapy*, 10 (2), 256-271
- 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
- LaPrade, R, Johansen, S, Agel, J, Risberg, M, Moksnes, H, Engebretsen, L (2010) Outcomes of an anatomic posterolateral knee reconstruction. *J Bone Joint Surg Am*, 92, 16-22
- 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
- Thoméé, 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
- Thoméé, R, Neeter, C, Gustavsson, A, Thoméé 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
- Weber, A, Kopydlowski, N, Sekiya, J (2015) Nonsurgical management and postoperative rehabilitation of medial instability of the knee. *Sports Med Arthrosc Rev*, 23 (2), 104-109