

Aquatic Therapy and the ACL – Current Concepts on Prevention and Rehab

Mary LaBarre, PT, DPT, ATRIC

Anterior Cruciate Ligament (ACL) tears are a common knee injury in athletic rehab. Each year, approximately 150,000 people injure their ACL (1). Although ACL injuries that occur with contact sports, like football, are more well known, 70% of ACL injuries occur in non-contact situations. Female athletes can be up to 6-8 times more likely to tear their ACL compared to male athletes. Women are at greater risk of ACL injury due to muscle imbalance between quadriceps and hamstrings and ACL laxity during pre-pubescence and puberty. Skeletal differences in women compared to men also can lead to hip weakness and misalignment with landing activities, causing increased stress to ACL (2).

Goals of ACL Rehabilitation

Rehabilitation can actually begin before surgery. Goals of pre-surgery rehab include: reduce swelling, inflammation and pain, restore normal range of motion (ROM), normalize gait, and prevent muscle atrophy prior to surgery (3). The primary goals of ACL rehabilitation include: achieve full passive knee extension, restore patellar mobility, reduce postoperative inflammation, re-establish voluntary quadriceps control, achieve full active knee ROM, progress strengthening and progress to sport-specific training (3).

Rehabilitation following ACL repair can be influenced by several factors including type of graft used, origin of the graft and presence of other injuries in addition to the ACL tear. Patellar tendon grafts (bone-tendon-bone attachment) typically heal within 6-8 weeks. Hamstring tendon grafts (tendon-bone attachment) take 8-12 weeks. Due to the increased time for the graft to integrate into the bone tunnels, hamstring graft rehab is typically less aggressive. Some surgeons opt for using allograft, most often from cadaveric specimens. Although similar to autograft tissues during initial rehab, allograft repairs typically take longer to progress to higher level strengthening and plyometrics due to the increased time to fixate the graft into the bone tunnels, often 4-6 months post-surgery(3).

Other injuries to the structures of the knee that can occur with an ACL tear include: bone bruise (articular cartilage lesions), medial collateral ligament (MCL) tear, lateral collateral ligament (LCL) tear, and meniscal tears. 13% of all ACL tears have an additional MCL injury (3). If a patient has an additional MCL tear, there is increased risk of scar tissue formation. The location of the MCL tear can determine amount of stiffness or laxity in graft. The patient may have increased difficulty in obtaining full knee extension due to the associated injury. Though LCL tears are less frequent in combination with ACL tears (1%), these tears may also require

additional surgical intervention. Rehab following ACL/LCL repair, typically delays progression of weight bearing (WB) to allow adequate healing. Isotonic hamstring strengthening may also be delayed up to 8 weeks. Bone bruises occur in approximately 80% of traumatic ACL injuries. Some bone bruises can take up to 42 weeks to heal. Due to the increase in tissue healing time, the most obvious change in ACL rehab with a bone bruise is a slower progression of WB and ROM. Meniscal tears are another frequent injury with ACL tears, occurring in up to 75% of ACL injuries. Typically, a partial meniscectomy does not alter rehab time. However, if a larger meniscal tear is present, running and jumping programs can be delayed (3). Other ACL rehab modification can include slower ROM and WB progression, avoiding deep squats for 12 weeks and later initiation of isotonic hamstring strengthening. Good communication with the patient and surgeon can assure improved healing with these complications in ACL rehab.

ACL Injury Prevention Programs

ACL injury prevention programs have been shown to decrease ACL injury by 52% in female athletes and 85% in male athletes (4). Most programs include neuromuscular strength, control and balance, landing strategies, plyometrics and single leg stabilization training. One well known prevention program is the Prevent injury and Enhance performance Program (PEP) from The Santa Monica ACL Prevention Project (5). The PEP program is a 15-20 minute dynamic warm up incorporating stretching, strengthening, plyometric, and agility training. NCAA female soccer players showed 74% reduction in in-game ACL injuries and 100% reduction in practice ACL injuries after the first year the program was implemented.

Indications for Aquatic Therapy

An aquatic environment can be beneficial for ACL rehab before and after surgery. The buoyancy of the water can allow normalized functional mobility earlier, especially in those individuals with WB restrictions. Buoyancy can also assist with ROM and support the trunk for posture retraining, neuromuscular retraining post-surgery. The hydrostatic pressure can assist with edema reduction, leading to improved ROM. Warm water exercise can assist with decreasing joint stiffness and allow increased ease of motion. The resistance created by the viscosity of water assists with strengthening. Deep water conditioning activities can assist with maintenance of aerobic conditioning while still limited in running and plyometric training on land. The aquatic environment is often used to initiate return to sports activities, when the patient is not yet appropriate to do start on land. Research of aquatic exercise for ACL rehab has found no increase in shear forces on the ACL compared to land exercise and decreased joint effusion with higher functional activity levels compared with land activities (6, 7). Based on the properties of water, rehab professionals should consider the aquatic environment for patients undergoing ACL rehab.

Aquatic Exercise for Plyometric Training for Injury Prevention and Rehab

Aquatic plyometrics have been shown to achieve similar improvements in functional performance compared to land plyometrics, without muscle soreness attributed to the land based exercise programs. There have been several research studies to look at the use of aquatic exercise as supplemental training in a variety of sports. Jumping programs, when performed in water, resulted in similar or greater amount of force production with less impact when compared to land based programs. Aquatic program participants also reported less pain, less stiffness and improved function compared to land programs (8,9,10).

Considerations for Return to Sport

The top priority of any athlete, no matter what age, is to get back to their sport activities. Accelerated rehab programs can have the athlete back to sport participation in as soon as 3-6 months. Research has shown the likelihood of gait deviations present one year after ACL reconstruction (11). Other research has shown the importance of quadriceps strength/stabilization in return to sport. Aquatic therapy can help initiate sport-related activities earlier in rehab than on land, in the hopes of a quicker return to sport. It is imperative that the rehab professional communicate with the physician, athlete (and/or family) and coach in order to prevent re-injury or other injuries related to postural compensations during the rehab process.

References

- (1) Sports Medicine Media Guide 2011 - American Orthopaedic Society for Sports Medicine and the American Academy of Orthopaedic Surgeons.
http://www.sportsmed.org/uploadedFiles/Content/Media/News_Room/Sports%20Media%20Guide%202011%20Final.pdf
- (2) Mayo Clinic: ACL injury. <http://www.mayoclinic.com/health/acl-injury/DS00898/DSECTION=risk-factors>
- (3) Wilk KE et al. Recent Advances in the Rehabilitation of Anterior Cruciate Ligament Injuries. *J Orthop Sports Physic Ther* 2012; 42(3): 153-171.
- (4) Sadoghi P et al. Effectiveness of Anterior Cruciate Ligament Injury Prevention Training Programs. *J Bone Joint Surg. Am* 2012; 94: 769-76.
- (5) PEP Program. Santa Monica ACL Prevention Project. <http://smsmf.org/smsf-programs/pep-program>
- (6) Tovin BJ, Wolf SL, Greenfield BH, Crouse J, Woodfin BA. Comparison of the Effects of Exercise in Water and on Land on the Rehabilitation of Patients With Intra-articular Anterior Cruciate Ligament Reconstructions. *Phys. Ther.* 1994; 74:710-719.
- (7) Biscarini A, Cerulli G. (2007). Modeling of the knee joint load in rehabilitative knee extension exercises under water. *Journal of Biomechanics*; 40(2):345-55

- (8) Martel GF, Harmer ML, Logan JM, Parker CB (2005) Aquatic plyometric training increases vertical jump in female volleyball players. *Med Sci Sports Exercise* 37(10): 1814-1819
- (9) Robinson LE, Devor RT, Merrick MA, et al. The effects of land vs aquatic plyometrics on power, torque, velocity, and muscle soreness in women. *Journal of Strength and Conditioning Research*, 2004; 18(1):84-91.
- (10) Triplett NT, Colado J, Benavent J, et al. Concentric and impact forces on single-leg jumps in an aquatic environment versus on land. *Medicine and Science in Sports and Exercise*, 2009; 41(9):1790-1796.
- (11) White, et al. Gait Asymmetries Persist 1 Year After Anterior Cruciate Ligament Reconstruction. *Orthopaedic Journal of Sports Medicine*, 2013; 1(2): 1-6.

