

The Vulnerable Knee: Anterior Cruciate Ligament Injury and Aquatic Exercise Therapy

Article by Norm Hanson published in CALA Wavelink newsletter
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Each ski season physiotherapy departments across the country treat hundreds of anterior cruciate (ACL) injuries. Advances in ski binding technology have made the sport safer, but it is impossible to eliminate the risk of this unfortunate injury. The most "unfortunate" part of this injury as many patients will attest is the long course of rehabilitation involved. Perhaps some of your aquafitness participants are suffering from ACL damage. Find out more about how aquatic exercise can help.

Diagnosing the Injury

The mechanism of injury provides the first clue in diagnosing an ACL injury. The three most common causes are:

- a) external rotation, abduction, and straight anterior forces to the tibia
- b) internal rotation of the femur on the tibia; and
- c) hyperextension of the knee

With respect to skiing, ACL injury is often caused by severe outward twisting of the lower leg. The binding usually has not released soon enough. This may also injure the medial collateral ligament and the medial meniscus. An injury of this nature is often referred to as the "unhappy" or "terrible" triad(2) Immediate assessment of the patient usually produces a typical set of signs and symptoms. The patient often recalls a popping sensation which may have been audible at the time of injury. They may be unable to continue skiing. The degree of pain on the outside and behind the knee) varies with each patient. The most significant sign is a marked instability in comparison to the uninjured knee.

The skier should be examined by an orthopedic surgeon as soon as possible. The trend is away from immediate surgery for these patients as AGE, reconstruction is not risk free and does have variable results.(3) *Aquatic exercise increases circulation in the injured area.*

There have also been conflicting results of long term studies comparing the overall function of surgically and conservatively treated ACL deficient knees(3). Hence, a doctor may adopt a "wait and see" approach. The doctor assesses how the patient fairs with rehabilitation alone before they decide to perform surgery. With or without surgery, the course of rehabilitation is practically identical.

Treatment Goals

Generally speaking, the main goals of rehabilitation of this injury are to:

- a) restore full range of motion of the knee

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- b) facilitate normal neuromuscular patterns of movement, end
- c) restore normal strength, endurance and flexibility(').

Recent studies also indicate that the ACL has an important role in proprioception(3) (sense of bodily movement and position in space). ACL injuries are typically followed by a period of inactivity. This causes muscles to atrophy and adhesions to form which may limit the range of motion(4). Pain, swelling and decreased activity of joint receptors can also interfere with the ability to contract surrounding musculature(4). We are, therefore, faced with a trade off between immobility (where the graft repair or injured ligament are not stressed) and exercise. The early use of aquatic exercise therapy can help address this dilemma.

Hydrostatic pressure will help control swelling by applying a compressive force to the knee. Increased mobility in water can be attributed to the reduced effect of gravity and a reduction in pain

Short Term Goals

When discussing the short-term goals of ACL rehab, it is easy to see how aquatic therapy can play an important role. Short term goals for this condition include:

- 1) Protecting the involved areas
- 2) Decreasing pain
- 3) Decreasing inflammation
- 4) Decreasing swelling
- 5) Increasing joint range of motion
- 6) Minimizing strength loss in surrounding muscle groups

When submerged, the ligament is protected because the buoyancy of water decreases the weight that the body bears. Control Theory, some reduction in pain may result from the increased stimulation of mechanoreceptors (sensory receptor that responds preferentially to mechanical stimuli such as bending, twisting or compressing) that occurs with the increased joint movement while in water. This theory also attributes some pain relief to the warmth or coldness of the water(s). Aquatic exercise increases circulation in the injured area. This mobilizes nutrients to the site and metabolites (substance produced by metabolism) away(6). Hydrostatic pressure will help control swelling by applying a compressive force to the knee. Increased mobility in water can be attributed to the reduced effect of

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gravity and a reduction in pain(s). It is important to remember that range of motion restrictions placed on an individual by his surgeon are intended to maintain surgical tightening of the ligament(7). Finally, the water is an excellent medium to exercise adjacent muscle groups such as hip abductors, hip extensors, hip adductors, plantar flexors, and knee flexors

Weight bearing, even while the knee is flexed, can stress

Long Term Goals Long term goals include:

- 1) increasing flexibility
- 2) increasing strength
- 3) increasing endurance
- 4) increasing balance and proprioception
- 5) progressive returning to functional activities

When strengthening hip muscles in water, resistive devices should be attached just above the knee rather than at the ankle. This will minimize stress on the knee(7). The water environment is a great place to start balance and functional activities due to the reduced effect of gravity which decreases stress on the ligament. The patient should also be told to "under do" and be cautious with any new exercise to avoid pain later. This is especially important when dealing with aquatic exercise because joints have more mobility in the water than they do on land. Finally, incorporate functional activities on land into the patient's routine which will facilitate the eccentric phase of muscle contraction.

Treatment Plan

Many orthopedic surgeons have specific treatment protocols for patients with ACL injuries. Always consult the physician before taking the risk of progressing the patient too quickly. The most important questions to ask the doctor refer to the amounts of knee extension and active quads exercises desired. Knee extension stresses the repaired or damaged ligament.

The aquatic exercise protocol used in our facility at the Kelowna General Hospital Therapeutic Pool identifies four states of rehabilitation of ACL injuries(7). Phase I addresses the exercises to be performed when the injury is in the acute phase. The patient is then gradually progressed to more demanding exercises. By the time the patient has mastered phase IV exercises, they are ready to embark on a normal fitness routine.

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Phase I generally lasts from 2 weeks post surgery (or post injury, if no surgery is performed) to 4 weeks. It is performed in neck deep water. The warm up includes walking forwards and sideways. The flexibility component consists mainly of active range of motion exercises within pain free range. Strengthening exercises include active hip movements and bicycling while floating in an inner tube or with a buoyancy belt.

Phase II takes the patient from 4 weeks "post op" to 8 weeks. Add a lunge stretch (to increase knee flexion), calf stretches, and a mild form of hamstring stretch to the flexibility component. Add strengthening exercises including heel raises and squats. Progress the hip muscle and hamstring exercises by adding resistive paddles to the patients leg.

For Phase III (8 to 12 weeks postop) start by exercises with the water level at chest depth. To the warm-up component, add heel walking, toe walking, and slow jogging. Flotation ankle cuffs may be used during walking. The strengthening exercises are progressed by using larger resistance paddles. Add isolated quadriceps exercises with the consent of the doctor.

In Phase IV add more functional exercises such as hopping on two feet and leg exchanges. Let the patient jog as aggressively as they can. Encourage patients to stretch the hamstrings and exercise the quads in isolation as aggressively as possible. Start swimming using any stroke, excluding the "whipkick". In summary, rehabilitating an ACL injury is a long and involved process. Starting these patients in the water is an excellent way to put them on the road to recovery. With careful and progressive treatment, the happy patient will be ready to ski again next season.

References

- 1) Gould, J.A., and G.J. Davies. Orthopedic and Sports Physical Therapy, 1985, Mosby, Toronto.
- 2) Klafs, C.E., and D.D. Ornheim. Modern Principles of Athletic Training, 5th Ed., 1981, Mosby, Toronto.
- 3) Beard, D.J. and C.M. Fergusson. The conservative management of anterior cruciate ligament deficiency: a nationwide survey of current practice. *Physiotherapy*, 78(3): 181-6, March 1992.
- 4) Draper, V. Electromyographic biofeedback and recovery of quadriceps femoris muscle function following ACL reconstruction. *Physical Therapy* 70(1): 11-7, January 1990.
- 5) Brenoster, C. E., et al. Rehabilitation for Anterior Cruciate Reconstruction. *Journal of Orthopedic and Sports Physical Therapy* 5(3): 121-78, Nov-Dec. 1983.
- 6) Huey, Linda. Water Healing Workout lecture syllabus, Aquatic Exercise Association's 1992 Aquatic Therapy Symposium.
- 7) Bates, Andrea and Norm Hanson, *Aquatic Exercise Therapy*, 1992.