Aquatic Therapy in the Treatment of Upper Extremity Injuries

HELEN BINKLEY, PhD, ATC-L, CSCS* D, and TRACI SCHROYER, ATC • Elon University

The use of water exercise has been well documented with respect to physiological and functional benefits for lower extremity injuries and cross training (Harvey, 1998; Lawton & Coberley, 1999; Prins & Cutner, 1999; Thein & Brody, 1998). Most benefits are attributed to the fact that water is denser than air and offers significantly greater resistance to movement. The properties that water offers (buoyancy, viscosity, and hydrostatic pressure) provide a therapeutic environment in which joints are unloaded and supported. Water also reduces pain and swelling and increases circulation and freedom of movement (Harvey). Three factors determine the resistance that an exerciser encounters in water: the volume of the exerciser’s body, its shape, and the speed of the movement performed. The term used to describe the resistance exerted by a fluid opposite the direction of movement is drag, which is influenced by these three factors. Increases in drag develop with changing patterns of water flow from laminar to turbulent over the body, and it occurs three-dimensionally (Costill, Maglischo, & Richardson, 1992). The drag and water viscosity can be used to increase strength in the body segment that is being exercised (Johnson, Stromme, Adamczyk, & Tennoe, 1977).

When the hydrodynamic principles described are used, water exercise is as effective as land-based exercise in developing muscular and cardiovascular strength and endurance. Hoeger, Gibson, Moore, and Hopkins (1993) evaluated 8-week water-aerobic and low-impact aerobic-dance programs and their effects on muscle strength. They found that knee-flexion, knee-extension, and shoulder-extension strength were increased, with the greatest improvement observed in the water-exercise condition. Johnson et al. (1977) compared identical calisthenic-type exercises performed on land and in water and found that friction and turbulence provide a greater load during water exercise than do the effects of gravity during land exercise. Avellini, Shapiro, and Pandolf (1983) compared exercise training on land and in water. They concluded that physical training in water produces similar adaptations of peak oxygen uptake despite lower heart rates than those produced on land. Oxygen uptake and heart rate during exercise on land and in water were evaluated by Johnson et al., who concluded that moderate-intensity exercise might be useful in conditioning, therapeutic, and rehabilitative programs.

A wide range of injuries can be rehabilitated in the water when land-based activity is restricted or limited because of pain. In addition, early water rehabilitation facilitates a
quicker transition to land-based activities. Costill (1971) determined the energy requirements of cycling on land and in water. He found that exercising in water reduced the efficiency of exercise because of the resistance of the water and that initially exercising in water is more effective at producing physiological adaptations. Applying these principles to the upper extremity, water exercise would enhance the rehabilitation and maintenance programs for athletes who predominantly use their upper extremity (i.e., tennis, baseball, softball, lacrosse, basketball, golf, volleyball, and football quarterbacks). This article presents exercise regimens that can be incorporated into current orthopedic rehabilitation or reconditioning programs for upper extremity athletes.

As with any rehabilitation program, there are indications and contraindications for aquatic therapy. The indications are high pain level, gait deviations, decreased mobility, weakness, poor coordination, limited weight bearing, poor muscle endurance, decreased cardiovascular endurance, joint contractures, decreased flexibility, and poor proprioception (Ruoti, Morris, & Cole, 1997). The common contraindications specific to aquatic therapy are contagious infections, open wounds, fever, chronic ear infections, abnormal blood pressure, excessive fear of water, epilepsy, and gastrointestinal disorders (Andrews & Harrelson, 1991; Bates & Hanson, 1996). If it is determined that water exercise is indicated, there are a couple of other safety measures that should be employed while administering a water-based program. One safety measure is to have all staff working in the area trained in cardiopulmonary resuscitation, and another is to have a trained lifeguard on duty. Following these guidelines will ensure a more safe and effective rehabilitative environment.

### Upper Extremity General Aquatic-Rehabilitation Plan

In this section, exercises are described that can be performed for an upper extremity rehabilitation program. The exercises are listed based on the phase of the program (adapted from Bates & Hanson, 1996; Koury, 1996; and Prins & Cutner, 1999).

Using equipment can aid in positioning, facilitate deepwater exercise, and provide additional resistance in the water. When deciding what type of equipment to use, one should consider the athlete, the injury, the treatment, and the budget. Types of equipment that can be used to individualize a program are shown in Figure 1 and include wrist or ankle cuffs, pull buoys, cervical floats or personal flotation devices, flotation vests or belts, kickboards, barbells, hand paddles (a variety of types), fins, surgical tubing, treadmills, steps, and water-movement resistance (jets or paddle wheels). Adding equipment to an exercise increases the resistance of that exercise, thus making it more difficult. Certain exercise equipment can be substituted in order to make a given workout more sport-specific (see Figure 2). These include baseball bats, tennis rackets, golf clubs, lacrosse sticks, and various balls (Thein & Brody, 1998).

**Phase I: Acute Injury or Postsurgical**

Aquatic therapy can be used for upper extremity injuries to gain active range of motion, normal function, and stability without risk of reinjury (Kelly, Roskin, Kirkendall, & Speer, 2000). Phase I should focus on range-of-motion activities, specific movement patterns, and correct technique in the water before performance on land. Research has suggested that water exercise might decrease the amount of joint effusion and facilitate greater functional improvements (Harvey, 1998; Jamison, 1999; Thein & Brody, 1998). The acute phase should consist of approximately 90% water activity and only 10% land-based activity. Therefore, in a 60-min exercise session, the water-based activities would last...