

AQUATIC EXERCISES

DEFINITION OF AQUATIC EXERCISE

use of multi-depth immersion pools or tanks that facilitate the application of various established therapeutic interventions, including stretching, strengthening, joint mobilization, balance and gait training, and endurance training.

GOALS AND INDICATIONS FOR AQUATIC EXERCISE

- Facilitate range of motion (ROM) exercise
- Initiate resistance training
- Facilitate weight-bearing activities
- Enhance delivery of manual techniques
- Provide three-dimensional access to the patient
- Facilitate cardiovascular exercise
- Initiate functional activity replication
- Minimize risk of injury or re-injury during rehabilitation
- Enhance patient relaxation

PRECAUTIONS AND CONTRAINDICATIONS TO AQUATIC EXERCISE

- **Precautions**

- **Fear of Water**

- can limit the effectiveness of any immersed activity.
- experience increased symptoms during and after immersion.....
- Often patients require an orientation period designed to provide instruction regarding the effects of immersion on balance, control of the immersed body, and proper use of flotation devices.

Neurological Disorders

- **Ataxic** patients may experience increased difficulty controlling purposeful movements.
- Patients with heat intolerant **multiple sclerosis** may fatigue with immersion in temperatures greater than 33C.
- **Seizures**
- Patients with controlled epilepsy require close monitoring during immersed treatment and must be compliant with medication prior to treatment

PRECAUTIONS AND CONTRAINDICATIONS TO AQUATIC EXERCISE

- **Cardiac Dysfunction**
- Patients with angina and abnormal blood pressure also require close monitoring.
- For patients with cardiac disease, **low-intensity aquatic exercise** may result in lower cardiac demand than similar land exercise.
- **Small Open Wounds and Lines**
- Small, open wounds and tracheotomies may be covered by waterproof dressings. Patients with intravenous lines, Hickman lines, and other open lines require proper clamping and fixation.

Contraindications

- Incipient cardiac failure and unstable angina.
- Respiratory dysfunction; vital capacity of less than 1 liter.
- Severe peripheral vascular disease.
- Danger of bleeding or hemorrhage.
- Severe kidney disease:...
- Open wounds, colostomy, and skin infections and ringworm.
- Uncontrolled bowel or bladder: Bowel accidents require pool evacuation, chemical treatment, and possibly drainage.
- Water and airborne infections or diseases: Examples include influenza, gastrointestinal infections, typhoid, cholera, and poliomyelitis.
- Uncontrolled seizures:....

PROPERTIES OF WATER

- **Physical Properties of Water**
- The properties provided by buoyancy, hydrostatic pressure, viscosity, and surface tension have a direct effect on the body in the aquatic environment.
- **Buoyancy (Fig. 9.1)**
- ***Definition.***
- *upward force opposite to gravity.*
- ***Properties.***
- Archimedes' principle::: immersed body experiences upward thrust equal to the volume of liquid displaced.
- ***Clinical Significance***
- weightlessness and joint unloading, active movt easy....
- Buoyancy allows the practitioner three-dimensional access to the patient.

Weight Bearing with Immersion

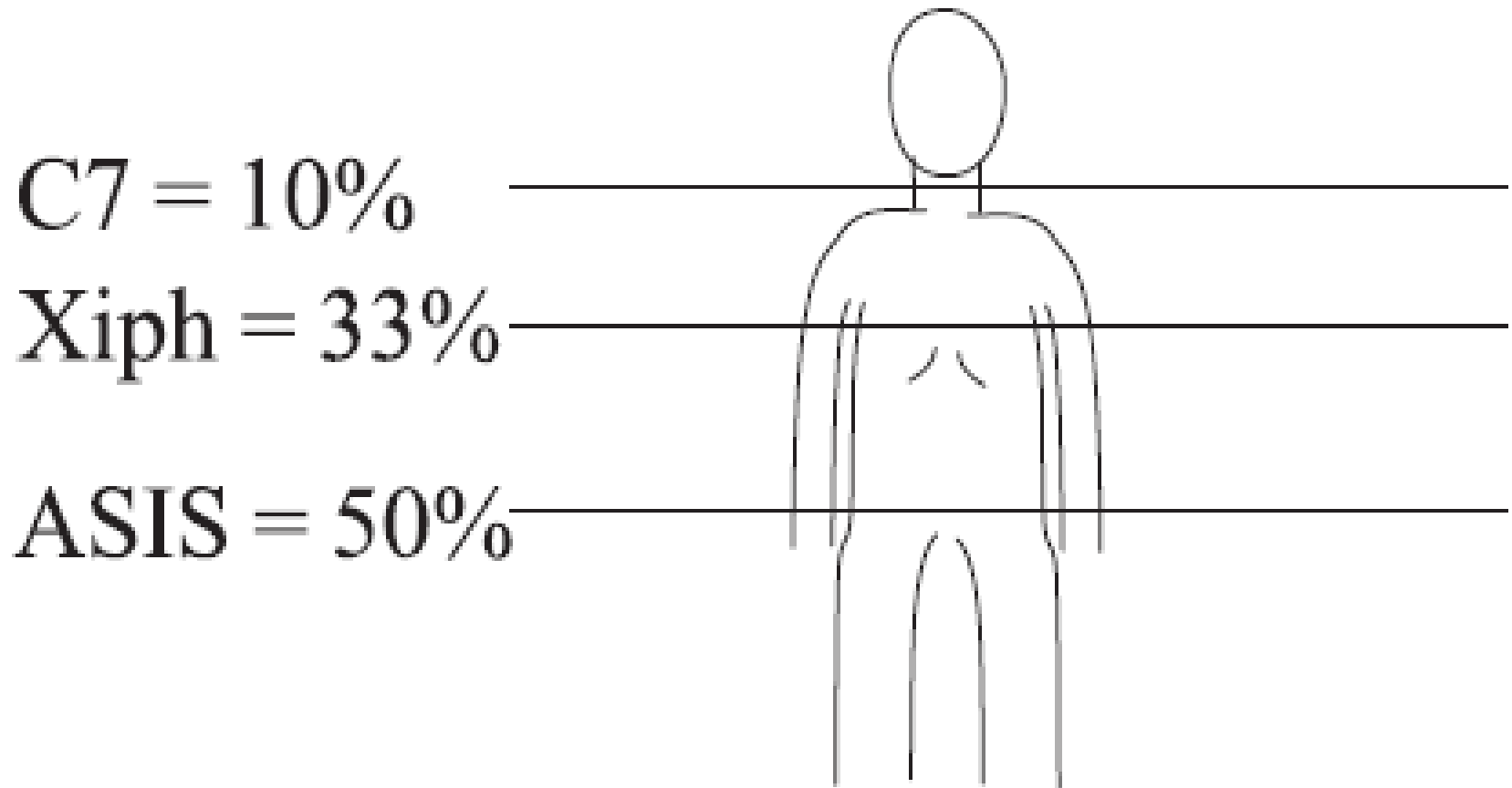


FIGURE 9.1 Percentage of weight bearing at various immersion depths.

Hydrostatic Pressure

- *The pressure exerted on immersed objects.*
- *Properties*
- Pascal's law states that the pressure exerted by fluid on an immersed object is equal on all surfaces of the object.
- Increase with density of water and depth of immersion.
- *Clinical Significance*
- Reduces or limits **effusion**,
- **assists venous return**,
- **induces bradycardia**,
- **centralizes peripheral blood flow.**
- Allows patients to perform exercise more easily when closer to the surface.

viscosity

- **Viscosity:**
- *Friction between molecules* of liquid resulting in resistance to flow.
- ***Properties.***
- Resistance from viscosity proportional to the velocity of movement through liquid.
- ***Clinical Significance***
- Resistance with all active movements.
- During manual resistance exercises stabilizing an extremity proximally require the patient to perform more work.
- Stabilizing an extremity distally requires the patient to perform less work.
- Increasing the surface area moving through water increases resistance.

Surface Tension

- *The surface of a fluid acts as a membrane* under tension. Surface tension is measured as force per unit length.
- ***Properties***
- The attraction of surface molecules is parallel to the surface. The resistive force of surface tension changes proportionally to the size of the object moving through the fluid surface.
- ***Clinical Significance***
- more work on surface,equipment at the surface of the water increases the resistance.

Hydromechanics

- ***physical properties*** and characteristics of fluid in motion.
 - ***Components of Flow Motion***
- ***Laminar flow.*** *Movement where all molecules move parallel to each other, slow movement.*
- ***Turbulent flow.*** *Movement where molecules do not move parallel to each other, typically faster movements.*
- ***Drag.*** *The cumulative effects of turbulence and fluid viscosity acting on an object in motion.*
- ***Clinical Significance of Drag***
- As the speed of movement through water increases, resistance to motion increases.
- Moving water requires the patient to work harder to maintain his/her position in pool.
- Application of equipment (glove/paddle/boot) increases drag and resistance as the patient moves the extremity through water.

Thermodynamics

- **Specific Heat**

- **Definition.** *Specific heat is the amount of heat (calories) required to raise the temperature of 1 gram of substance by 1C.*

- **Properties.**

- The rate of temperature change is dependent on the mass and the specific heat of the object.

- **Clinical Significance**

- Water retains heat 1000 times more than air.
- Differences in temperature between an immersed object and water equilibrate with minimal change in the temperature of the water.

- **Temperature Transfer**

- Water conducts temperature 25 times faster than air.
- Heat transfer increases with velocity.
- A patient moving through the water loses body temperature faster than an immersed patient at rest.

Center of Buoyancy

- Center of buoyancy, rather than center of gravity, affects the body in an aquatic environment.
- **Definition.**
- *A reference point* of an immersed object on which buoyant (vertical) forces of fluid act.
- **Properties.**
- *Vertical forces that do not intersect the center* of buoyancy create rotational motion.
- **Clinical Significance**
- In the vertical position, the human center is located at the sternum.
- In the vertical position, posteriorly placed buoyancy devices cause the patient to lean forward; anterior buoyancy causes the patient to lean back.
- During unilateral manual resistance exercises the patient revolves around the practitioner in a circular motion.
- A patient with a unilateral lower extremity amputation leans toward the residual limb side when in a vertical position.
- Patients bearing weight on the floor of the pool (i.e., sitting, kneeling, standing) experience aspects of both the center of buoyancy and center of gravity.

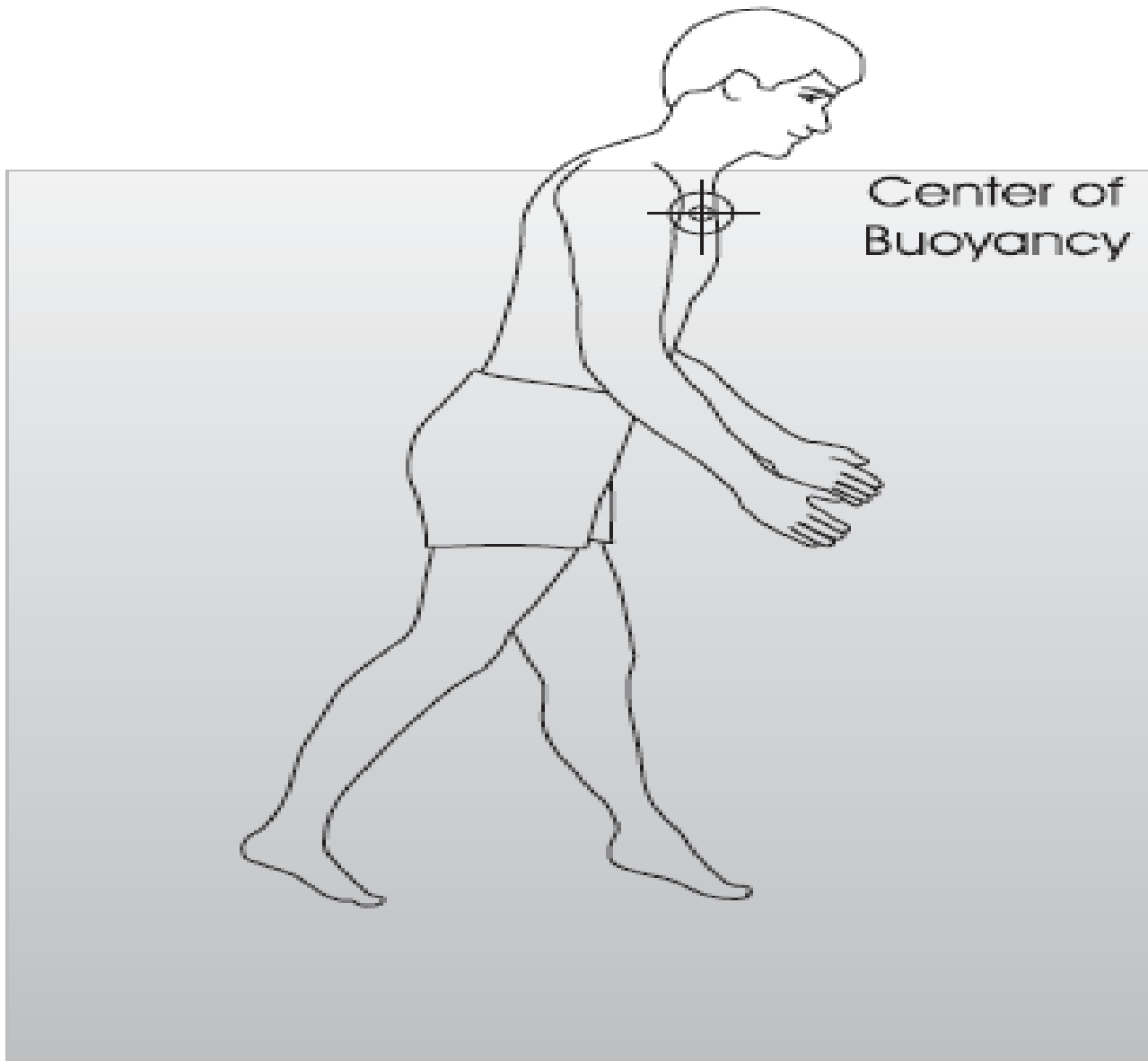


FIGURE 9.2 Center of buoyancy.

AQUATIC TEMPERATURE AND THERAPEUTIC EXERCISE

- **Temperature Regulation**
- Heat dissipation different in water than air.
- With immersion less skin exposed to air, less opportunity to dissipate heat through normal sweating mechanisms.
- Water conducts temperature 25 times faster than air—more if the patient is moving through the water.
- Patients perceive small changes in water temperature more profoundly than small changes in air temperature.
- Internal temperature changes inversely proportional to subcutaneous fat thickness.
- Patients are unable to maintain adequate core warmth during immersed exercise at temperatures less than 25C.
- Conversely, exercise at temperatures greater than 37C may be **harmful** if prolonged or maintained at high intensities.
- Hot water immersion may increase the cardiovascular demands at rest and with exercise.

AQUATIC TEMPERATURE AND THERAPEUTIC EXERCISE

- **Mobility and Functional Control Exercise**
- Aquatic exercises, including
- **flexibility, strengthening, gait training, and relaxation,**
may be performed in temperatures between **26C and 33C.**
- Therapeutic exercise performed in warm water (33C) may be beneficial for patients with acute painful musculoskeletal injuries because of the effects of relaxation, elevated pain threshold, and decreased muscle spasm.
- **Aerobic Conditioning**
- Cardiovascular training and aerobic exercise should be performed in water temperatures between **26C and 28C.**
- This range maximizes exercise efficiency, increases stroke volume, and decreases heart rate.
- **Intense aerobic training** performed above 80% of a patient's maximum heart rate should take place in temperatures between **22C and 26C** to minimize the risk of heat illness.

SPECIAL EQUIPMENT FOR AQUATIC EXERCISE

- **Collars, Rings, Belts, and Vests**
- Patient support, buoyancy assistance can be applied to the neck, extremities, or trunk.
- Inflatable cervical collars are used for the supine patient to support the neck and maintain the head out of the water.



FIGURE 9.3 Cervical collar. (Courtesy of Rothhammer International Inc., San Luis Obispo, CA)

Collars, Rings, Belts, and Vests

- Flotation rings come in various sizes and are used to support the extremities in any immersed position.
- wrists and ankles rings, during manual techniques to assist with patient positioning and relaxation.
- Belt assist buoyancy of extremity and whole body.
- Belts and vests are used to position patients supine, prone, or vertically for shallow and deep water activities.



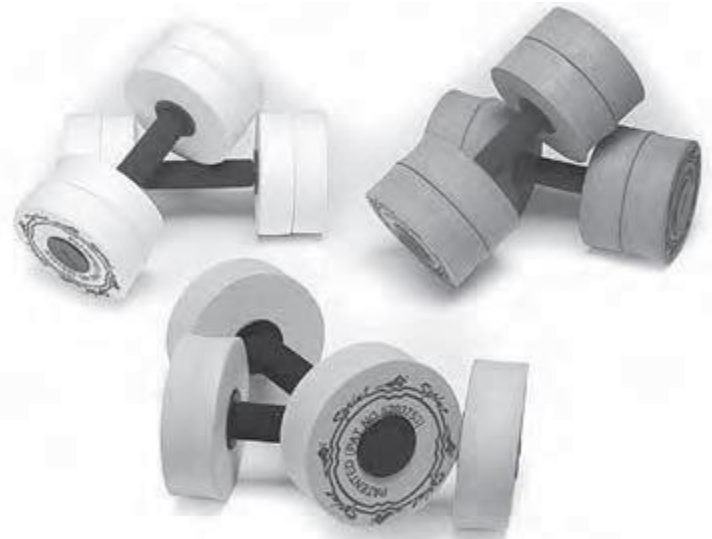
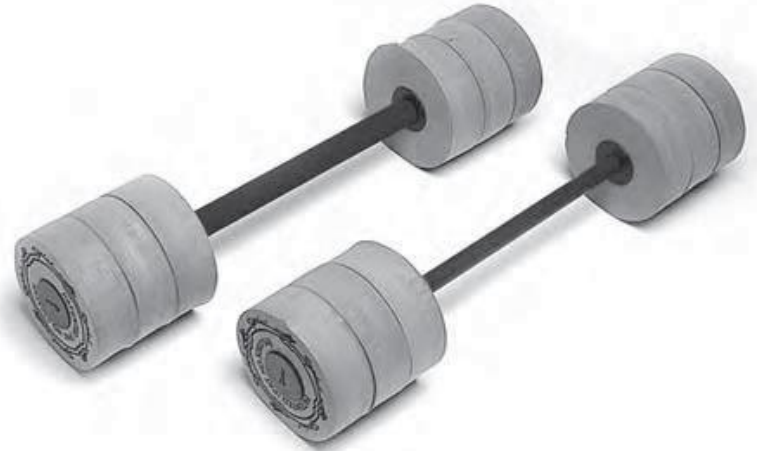
FIGURE 9.4 Flotation rings. (Courtesy of Rothhammer International Inc., San Luis Obispo, CA.)



FIGURE 9.5 Buoyancy belts. (Courtesy of Rothhammer International Inc., San Luis Obispo, CA.)

Swim Bars

- Buoyant dumbbells (swim bars) are available in short and long lengths.
- They are useful for supporting the upper body or trunk in upright positions and the lower extremities in the supine or prone positions.
- Patients can balance (seated or standing) on long swim bars in deep water to challenge balance, proprioception, and trunk strength.



Gloves, Hand Paddles, and Hydro-tone® Balls

- Resistance to upper extremity movements is achieved by applying webbed gloves or progressively larger paddles to the hands.
- Hydro-tone bells are large, slotted plastic devices that increase drag during upper extremity motions.
- Bells more resistance than gloves or hand
- paddles.



Fins and Hydro-tone® Boots

- The application of fins or boots to the feet during lower extremity motions generates resistance by increasing the surface area moving through the water.
- Hydro-tone boots are most effective during deep water walking and running



Kickboards

- Extensive shapes and styles of kickboards .
- effective aquatic tool for augmenting any exercise program.
- provide buoyancy in the prone or supine positions, create resistance to walking patterns in shallow water when held vertically,
- or used to challenge seated, kneeling, or standing balance in the deep water.



BOX 9.1**Summary of Motions Used for Upper and Lower Strengthening Exercises****Shoulder**

Flexion/extension
Abduction/adduction
Horizontal abduction/adduction
Internal/external rotation
Unilateral diagonals
Bilateral diagonals

Elbow

Flexion/extension
Diagonals
Push/pull

Hip

Flexion/extension
Abduction/adduction
Internal/external rotation
Unilateral diagonals
Bilateral diagonals

Knee

Flexion/extension
Diagonals

Summary of Lumbar Spine– Strengthening Exercises

Standing

Walking patterns: forward, backward, lateral, lunge walk, high stepping
Unilateral/bilateral stance with upper extremity motions

Semi-reclined

Bicycling
Hip abduction/adduction
Flutter kick
Bilateral lower extremity PNF patterns
Unilateral/bilateral hip and knee flexion/extension

Supine

Bridging with long dumbbell placed at knees

Prone

Deep water

Swimming kicks
Swimming kicks
Vertical stabilization exercises; abdominal bracing with arm and leg motions in the pike and iron-cross positions
Seated on dumbbell; abdominal bracing and balance while performing unilateral or bilateral arm motions
Standing on a kickboard or dumbbell; abdominal bracing and balance while performing bicycling motions and/or arm motions