

## A closer look at hydrotherapy *for* rehabilitation

By using the properties of water, patients with certain conditions can benefit from muscle relaxation, improved joint range of motion, muscle tone, strength, and endurance

**T**he use of water as a therapeutic modality in veterinary practice is becoming commonplace, but the therapeutic properties of water have been used in the human and animal worlds for hundreds of years. The Greeks were using public baths in 500 BC and the Romans had heated bathhouses in 350 AD. Arctic monkeys realized that during the winter, the hot springs kept them warm.

Hydrotherapy, a term used when water is a therapeutic modality,<sup>1</sup> covers the use of exercises, such as swimming, and walking on an underwater treadmill.<sup>2</sup> By using the properties of water, for conditions identified as pre- and postsurgical, neurologic, and orthopedic, as well as conditioning, patients can benefit from muscle relaxation, improved joint range of motion, muscle tone, strength, and endurance.<sup>3</sup>

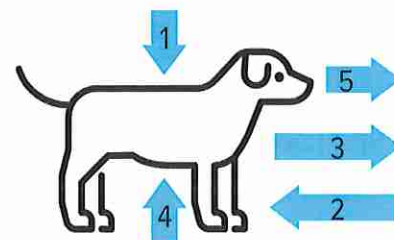
### PROPERTIES OF WATER

It is important to understand the properties of water and what water does to a body placed in it. The temperature, hydrostatic pressure, viscosity, and buoyancy will all influence the patient<sup>4</sup> and must be taken into consideration when planning therapeutic exercises in water. Forces exerted on a solid body in water include gravity, drag, thrust, buoyancy, and movement (Figure 1).

### TEMPERATURE

The temperature of the water is important, as are the thermal properties of water. The thermal conductivity of water is 0.6 m.K, which is the

Figure 1. Forces Exerted on a Solid Body in Water<sup>4</sup>



1, gravity; 2, drag; 3, thrust; 4, buoyancy; 5, direction of movement.





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exchange of thermal energy when a body comes into contact with water.<sup>5</sup>

Certain temperatures of the water can aid in soft tissue relaxation, decrease pain, and aid in circulation and tissue perfusion,<sup>6</sup> while also increasing tissue extensibility. The temperature of water typically used in veterinary hydrotherapy ranges from 83 to 88 °F. Care must be taken to monitor patients participating in hydrotherapy for signs of exhaustion and/or overheating, such as increased respiratory rate, lagging at the back of the underwater treadmill, and visual signs of an increase in stress.

## HYDROSTATIC PRESSURE

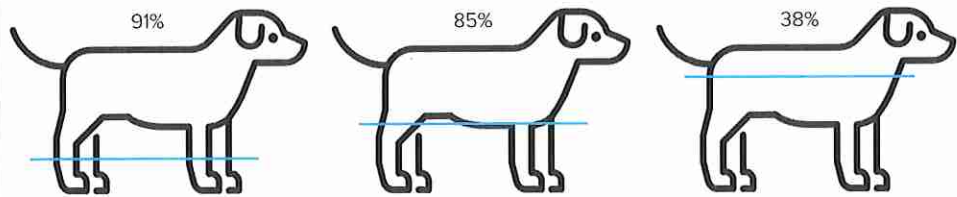
Pascal's law states that fluid pressure is exerted equally on all surfaces of an immersed body at rest and at a given depth. This also means that pressure increases with the density of fluid and depth of submersion and is expressed in pounds per square inch (PSI), which may be calculated as 1 PSI = pound of force (lbf) divided by square inch of the container. Some of these effects can be translated into benefits, such as decreased swelling to an area and decreased pain.<sup>4</sup> As there is a measured amount of pressure related to the water level, care must be taken in patients with cardiac, circulatory, and respiratory disease.

## RESISTANCE AND VISCOSITY

Frictional resistance is created by the cohesiveness or *stickiness* of fluid molecules.

Water is 15 times stickier than air, therefore, water resists the motion within it. There is a decrease in resistance to flow and resistance is dependent on speed, the velocity of the fluid, and the shape of the body within the fluid. Aquatic exercises can be fatiguing<sup>7</sup> so it is important to monitor patients for signs of fatigue, pain, lameness, and distress.

Figure 2. Level of water in relation to percentage weight bearing<sup>9</sup>



From left to right: 1, 2, and 3

Figure 2 depicts the amount of weight bearing sustained when the water level is at: 1) the lateral malleolus, 2) the lateral epicondyle, and 3) the greater trochanter.

## BUOYANCY

Buoyancy is the force exerted on an immersed object that is opposite gravity.<sup>8</sup> Archimedes' principle states that when a body is partially or wholly immersed in fluid, it experiences upward thrust equal to the weight of displaced fluid. Therefore, as the water depth increases, weight bearing decreases. (Figure 2<sup>9</sup>) When working with buoyancy, it is also important to understand specific gravity (SG), which is the ratio of the density of a substance to the density of a standard, usually water for a liquid or solid. The SG of water is 1.0. How well a pet "floats" depends on SG. Pets with lean body structure and lower amounts of body fat have an average SG of 1.10, whereas pets with a higher amount of body fat have an average SG of 0.93. Therefore, patients with a lower SG can float a little better than others.

## FLUID DYNAMICS

Fluid dynamics is a description and study of liquids and gases and in part involves the study of the motion of a given fluid. Laminar flow is the smooth flow or straight flow of water particles moving in 1 direction and speed where all molecules are parallel. Turbulent flow has a more chaotic, non-linear motion where the water particles flow in all directions, creating more dynamic pressure differentials, so the resistance increases with velocity.

Drag is anything that increases resistance. In the case of hydrotherapy in veterinary practice, the drag relates specifically to hair coat, type, and length, as all of these create drag and increase resistance.<sup>10</sup>

## SPEED

A general rule is that the taller and longer the dog, the higher the speed of the treadmill belt is required to reach a normal walking gait. Increased turbulence, resistance, and friction can cause increased exertion. Movement, hair coat, weight, and speed all influence overall exercise exertion.<sup>10</sup>

## POOL VS UNDERWATER TREADMILL (UWTM)

Swimming allows for non-weight-bearing exercise, is relatively low impact, is an excellent upper body workout with active range of motion (AROM)

of all joints,<sup>11</sup> especially the front limbs, which are affected more with increased workload,<sup>12</sup> and improves core and trunk strength. Davis et al indicated that hip range of motion was not affected significantly by swimming compared with walking.<sup>2</sup>

Patients beginning swimming should not be left unsupervised and a flotation device should be utilized to aid in buoyancy. Care should be taken to ensure the patient acclimates gently to decrease stress and anxiety, as not all patients inherently know how to swim. Excessive forelimb motion due to stress or anxiety will increase turbulent flow and make moving through the water more difficult, which will likely increase the stress level further.

## UWTM

Walking on an underwater treadmill can be a relatively more controlled form of aquatic exercise. Less stress is placed on the joints and spine,<sup>13</sup> making it a more appropriate form of hydrotherapy for early rehabilitation of patients. It can provide variable and adjustable weight-bearing exercise, improved AROM, proprioceptive gait training, and improved balance when walking, can build lean muscle mass, and is a starter for swimming. Patients also have the benefit of proprioception—the ability to identify the place and position of one's own body part, which involves balance.<sup>14</sup> It also allows for engagement of the triceps brachii and quadriceps femoris, which are essential for weight bearing and ambulation.

## CONCLUSION

Hydrotherapy is growing in the veterinary field and is an important tool for the rehabilitation professional. Hydrotherapy proves to be an integral part of a multimodal approach to canine and feline physical rehabilitation. It can be used to introduce early weight-bearing exercise in postoperative patients, improve proprioception and balance in the neurologic patient, and aid in the improvement of joint range of motion in the osteoarthritic patient, while aiding in the development of muscle mass, strength, and endurance.

Understanding the properties of water and the effects on the patient while undergoing hydrotherapy will assist the rehabilitation team in providing the right type of hydrotherapy based on these factors. ●

References available online at [dvm360.com](http://dvm360.com)