# Four Leg News

## THE HYDROTHERAPY REVIEW ISSUE!

Volume 8: Issue 2 - March-April 2019

This issue of Four Leg News is all about hydrotherapy! I tried to find new research as it pertains to the underwater treadmill and swimming. I had to throw in a handful of golden (but still brilliant) oldies, but all in all, it's new stuff! Read, learn, and enjoy this issue… and try not to get wet!

Cheers!

Laurie Edge-Hughes, BScPT, MAnimSt (Animal Physio.), CAFCI, CCRT

# Water Depth & Kinematics

**Wills AP, Barnicoat F. Effect of water depth on limb kinematics of the domestic dog (Canis lupus familiaris) during underwater treadmill exercise. Comparative Exercise Physiology. 2016, 12 (4) - Pages: 199 – 207.**

There is a need for evidence informed practice in therapeutic regimens which is currently lacking in the field of canine hydrotherapy. The objective of this study was to quantify the effect of four water depths (dry, mid tarsal, between the lateral malleolus and the lateral epicondyle and between the lateral epicondyle and the greater trochanter) on the duty factor, stride length and stride frequency of eight healthy dogs walking on a canine hydrotherapy treadmill.

Method: Eight clinically sound adult dogs (average age of 3.3 years). Circular reflective adhesive markers were placed onto the distal lateral aspect of the metacarpus and fifth metatarsal on the left side of the dog. 10 cm intervals were indicated and calibrated along the horizontal plane of the treadmill window. Limb movements were recorded with a digital video camera. The sessions consisted of the dogs exercising at each of the four water depths for 150 seconds with a minimum 10-minute break between trials.

Data Analysis: Duty factor was calculated from measurements of the stride time (s) and the stance time (s), using 150 seconds of video data. The mean duty factor (stance time/stride time) of the hind and forelimb for each speed and depth were calculated.

Results: Duty factor was affected by water height. Dogs walking on an UWT decreased their duty factor with increasing water depth (i.e. more time in the swing phase). Stride length increased with water depth and stride frequency was observed to decrease. There was no significant difference between duty factor of the forelimb and hindlimb when the water was between the lateral malleolus and lateral epicondyle (depth three), however, hind limb duty factor was higher than forelimb duty factor at the other three water depths.

Discussion: Dogs may alter their flight arc when walking in water due to the need to lift the limb through and above the water which may be due to biomechanical or speed constraints affecting stride length and frequency.

Potential applications of these findings include using deeper water depths to promote a longer stride length and therefore improving stride length postoperatively.

WATER Depth & Kinematics Continued…

With increasing water depth, more of the body is supported through buoyancy, effectively reducing the weight of the animal. Due to the increase in resistance with increasing water depth, dogs need to increase their energy expenditure to maintain the same speed, which may have implications for animals requiring weight loss.

The use of deeper water and therefore reduced stride frequencies whilst exercising patients with joint problems such as osteoarthritis may reduce the amount of mechanical wear on the joints. This could allow the dog to exercise and keep within a healthy weight whilst concurrently delaying the progression of osteoarthritis.

### Why do you care?

*Let's really start thinking about what you want to accomplish in your UWT session instead of going into 'autopilot'! Want a longer stride? Use the UWT. Early limb use (post-op, post-injury, OA joint), then use the UWT. Weight loss needed? Use the UWT. Beyond that, we don't know… based on this study! But it's a good place to start!*

## WATER DEPTH & GROUND REACTION FORCES

**Levine D, Marcellin-Little DJ, Millis DL, Tragauer V, Osborne JA. Effects of partial immersion in water on vertical ground reaction forces and weight distribution in dogs. Am J Vet Res 2010;71:1413–1416.**

The purpose of this study was to assess changes in ground reaction force (vGRF) and vGRF distribution in dogs standing on the ground without immersion and standing in water on a UWTM with immersion to the level of the tarsal, stifle, and hip joints

Methods: Ten mixed-breed health dogs. Each limb of each dog was placed on a separate scale, and the vGRF was recorded simultaneously. Then on a UWTM, similar measurements were taken with water at the level of the lateral malleolus (tarsal), lateral femoral epicondyle (stifle), and greater trochanter (hip). The sums of vGRF measurements from both thoracic limbs and both pelvic limbs were used for analysis.

WATER Depth & vGRF continued…

Results: Mean vGRF decreased significantly by 9% after immersion to the level of the tarsal joints, by 15% after immersion at the stifle joints, and by 62% after immersion at the hip joints. Mean vGRFs were significantly higher for the thoracic limbs than for the pelvic limbs before immersion and at all immersion levels. Dogs placed 64% of their body weight on the thoracic limbs before immersion. The thoracic limb-to-pelvic limb vGRF ratio did not differ significantly after immersion to the level of the tarsal or stifle joints, but was significantly larger after immersion to the level of the hip joints.

Discussion: The impact of immersion in water on joint loads and vGRF distribution while walking or trotting on a UWTM is not known in dogs and cannot be determined from this study. However, because joint loads are proportional to the vGRF, it is logical to assume that the vGRF decreases for dogs immersed in water while on the UWTM would lead to proportional decreases in joint loads during walking and trotting.

In humans with osteoarthritis, exercising in water appears to be associated with less pain and fewer adverse events than does exercising without immersion. However, the long-term functional benefits of aquatic therapy were inferior to the long-term benefits of exercise performed without immersion in a prospective controlled trial.

*Why do you care!*

*Okay… so water reduces the weight of the body (measured here a vertical ground reaction force). So, if this is what you want… early post-op, osteoarthritis, etc. then, the UWT is your friend. Now, as the dog improves, you need to lower the water. Then, for further improvement, take them out of the water, and exercise them on land! This needs to be your protocol!*


"Excuse me, can I get another bowl of water?"

# Golden Oldies on Water & Kinematics

**Jackson AM, Millis DL, Stevens M et al. 2002, Joint kinematics during underwater treadmill activity. Proceedings 2nd International Symposium on Rehabilitation and Physical Therapy in Veterinary Medicine. Knoxville, TN.**


- Joint flexion was greatest when the water is filled at or higher than the joint of interest (pertaining to the hip, stifle, shoulder and elbow). The flexion obtained was comparable to flexion ranges achieved during swimming.
- With water height at the greater trochanter, end stage propulsion (extension in the hip, stifle and shoulder) was reduced.
- Full active joint extension of the hip, stifle and hock was achieved during full limb cycles when compared to walking on land at the levels of the lateral malleolus and stifle.

**Tragauer VL, Levine D, Millis DL. 2002, Percentage of normal weight bearing during partial immersion at various depths in dogs. Proceedings 2nd International Symposium on Rehabilitation and Physical Therapy in Veterinary Medicine. Knoxville, TN.**

- Land weight bearing ratio of front legs: hind legs was 64:36. This same ratio was maintained with water heights at the lateral malleolus and lateral femoral condyle at the stifle. However, the ratio changed to 71:29 with water at the height of the greater trochanter.
- Table 1 describes the percentage of land weight resultant from partial water immersion at varying depths in the dog.

**Table 1. Percentage of body weight on land during partial immersion at various water depths in dogs**

| Water Height | % of Land Body Weight |
|---|---|
| Lateral malleolus | 91% |
| Lateral femoral condyles | 85% |
| Greater trochanter | 38% |

# Water Depth & Muscle Activity

**Parkinson S, Wills AP, Tabor G, Williams JM. Effect of water depth on muscle activity of dogs when walking on a water treadmill. Comparative Exercise Physiology, 2018; 14 (2): 79-89.**

Underwater treadmills (UWT) are often used in hydrotherapy for dogs with hind limb and spinal pathologies, as well as a fitness and conditioning tool for canine performance training. This study aimed to use surface electromyography (sEMG) to measure muscle workload in the Gluteus Medius (GM) and Latissimus Dorsi (LD) of sound dogs on the UWT at increasing water depths: no submersion (control), mid tarsal, mid stifle and the midpoint between the stifle and the greater trochanter.

Method: Seven health dogs were used. Surface EMG sensors were used to measure muscle activity of the GM and LD muscles, over the maximum circumference of the muscle belly and perpendicular to the direction of the muscle fibres. During each session, each dog walked (at their preferred speed) for 2 min continuously on the WT at each water depth: no submersion (depth 1), mid-tarsal (depth 2), between the lateral malleolus and lateral epicondyle (depth 3) and between the lateral epicondyle and greater trochanter (depth 4).

Results: Although descriptive increases in estimated workload were observed at depth 2 (mid-tarsal) compared to the dry treadmill (depth 1) in all participants, these were only found to be significant for mean estimated workload in the right GM. Higher water depths reduced mean estimated workload in the GM and LD muscles for participating dogs. This suggests that water levels above the stifle translate to reduced recruitment of GM and LD in dogs undertaking walk exercise on a WT.

Discussion: The results suggest that WT exercise at higher water levels would be appropriate during the early stages of canine rehabilitation regimes where stability is prioritised as a key goal over strength. As rehabilitation progresses and the challenge to the patient needs to be increased to facilitate greater muscular action, then tarsal water height would be recommended. The water depth used must be selected with sound clinical reasoning and be altered according to presenting movement patterns and post hydrotherapy response.

## Why do you care?

*Well, exactly as the discussion points out: If in the early stages of rehab, higher water depths are likely appropriate; If in later stages of rehab, then reduce the water level (or get the dog out of the darn water treadmill and move onto land exercises!*

Figure 2. Water depths used during study. (A) no submersion (depth 1), (B) mid-tarsal (depth 2), (C) between the lateral malleolus and lateral epicondyle (depth 3) and (D) between the lateral epicondyle and greater trochanter (depth 4). Line represents the water level.

# KINEMATICS IN CCL-DEFICIENT POST-OP STIFLES

**Bertocci G, Smalley C, Brown N, Bialczak K, Carroll D. Aquatic treadmill water level influence on pelvic limb kinematics in cranial cruciate ligament-deficient dogs with surgically stabilised stifles. Journal of Small Animal Practice (2018) 59, 121–127.**

The objective of this study was to compare pelvic limb joint kinematics and temporal gait characteristics across land-based and aquatic-based treadmill walking in dogs that have undergone surgical correction for unilateral CrCL deficiency.

Methods: Ten client-owned dogs that had previously undergone unilateral CrCL corrective surgery (intracapsular/extracapsular) were recruited for this study. High-contrast reflective markers were placed on the skin surface of the affected limb at the distal lateral aspect of the fifth metatarsal, lateral malleolus of the tibia, stifle joint between the lateral epicondyle of the femur and the fibular head, greater trochanter of the femur and the cranial dorsal iliac crest. Subjects completed walking trials for four different water levels [water level superimposed with the marker at the hip joint, stifle joint and hock joint, and no water] at a constant speed of 0.45 m/s.

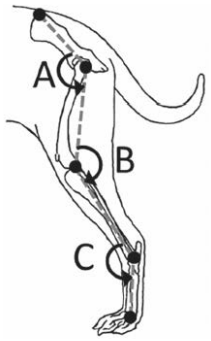



**FIG 1. Canine pelvic limb marker locations and the measurement protocol for hip (A), stifle (B) and hock (C) joint angles**

Results:
STIFLE: Mean stifle joint minimum angle was significantly higher, indicating less flexion, for the land-based water level compared to the hip, stifle and hock water levels. Mean stifle joint minimum angle was also significantly higher (less flexion) for the hock water level compared to the hip water level. Stifle ROM at the stifle water level was significantly greater as compared to the hock and land-based water levels. Stifle ROM at the land-based water level was also significantly lower than at the hock and hip water levels. Stifle flexion increased during swing as water level increased, while stifle extension decreased during stance for the land-based, hock and stifle water levels. Stifle extension was similar at the start and end of stance for the hip water level.

HIP: Mean hip joint minimum angle at the hip water level was significantly lower, indicating greater flexion, compared to the stifle and land-based water levels. Hip ROM at the hip water level was significantly greater as compared to the stifle, hock and land-based water levels.

HOCK: Hock ROM was significantly greater at the hock water level as compared to the land-based water level.

Kinematics CCL-D continued…

GAIT CYCLE: The stance phase percentage was
significantly higher at the hock water level than at the hip water level, indicating greater paw contact with the treadmill belt at the hock water level. However, stance phase percentage was significantly lower for the hock water level than the land-based water level. Likewise, stance phase percentage at the stifle water level was significantly higher than at the hip water level and significantly lower than at the land-based water level. There was no significant difference in cycle time or stance phase percentage between the hock and stifle water levels.

Discussion: Stance phase percentage can be significantly reduced by introducing water at any joint level. Joint ROM was found to be greater for the hip, stifle and hock water levels compared to the land-based water level. Stifle ROM increased as water level increased but peak stifle extension was not affected by water level.

*Why do you care?*

*UWT walking creates more stifle flexion that on land for surgically corrected CrCL-deficient dogs. Extension of the stifle was best with hip height water. This study also found that stance time is reduced with the addition of water. So, again, for your early post-op, this sounds good. All in all, the UWT is merely A TOOL for your early post-operative CrCL-repaired patients. Beyond this early stage, we need to think about what the patient needs!*


"It'll take us forever to fill that thing up again…"

# WATER & WEIGHT LOSS

**Chauvet A, Laclair J, Elliott DA, German AJ. Incorporation of exercise, using an underwater treadmill, and active client education into a weight management program for obese dogs. Can Vet J 2011;52:491–496.**

Benefits of a weight reduction program have been reported in obese dogs with osteoarthritis. The aim of the current study was to examine the effect of an organized exercise program and lifestyle education on the rate of weight loss in obese client-owned dogs.

Methods: Eight client-owned dogs were taken through a 3-month weight management program that consisted of subsidized diet food and regular exercise sessions on an underwater treadmill (UWT).

The program included regular exercise sessions on an underwater treadmill at elbow level with a speed range of 0.8 to 8.0 km/h. Each dog was exercised at a steady walk for its size and weight; heart rate was monitored to assess response, and both treadmill speed and session duration tailored to the capabilities of the patient. Also, all dogs were walked at least once daily based on capabilities, and attended weekly obedience classes for additional exercise and socialization.

The aim was to maintain a rate of weight loss of between 1% to 2% of starting body weight (SBW) per week.

On average, each dog did 13 treadmill exercise sessions at 30 minutes each. Average speed was 1.9 km/h and distance walked was 0.97 km. Over the course of the study, the mean session speed, session duration, and distance that the dogs were able to travel per session increased significantly.

Outcomes: Mean percentage of SBW lost was 7.4% at 33 d, 10.9% at 54 d, and 18.9% at 86 d. Mean rate of weight loss for the whole 3 mo was 1.5% SBW/week. Finally, over the course of the weight-loss program, thoracic and abdominal girth declined by 15% and 25%, respectively.

Discussion: It is noteworthy that the overall rate of weight loss in this study was faster than the rates reported in previously published clinical reports using client-owned dogs with naturally occurring obesity. Over the course of the study, a gradual increase in exercise capabilities was noted for the dogs which indicates that there may have been improvements in fitness levels as the weight program progressed and activity increased.

# Swimming & Elbow Dysplasia

**T. Preston, A.P. Wills. A single hydrotherapy session increases range of motion and stride length in Labrador retrievers diagnosed with elbow dysplasia. The Veterinary Journal 234 (2018) 105–110.**

Canine elbow dysplasia (ED) is a common developmental disorder affecting the cubital joint. It is a generic term that includes fragmented medial coronoid process, ununited anconeal process, osteochondrosis and osteochondritis dissecans of the medial humeral condyle. We investigated the effect of a single session of hydrotherapy on elbow ROM and stride parameters on a treadmill of both healthy dogs and dogs with ED.

Methods: Six clinically sound Labradors and six Labradors with bilateral elbow dysplasia were recruited for the study. Three reflective adhesive markers were placed on the left and right forelimb: one distal to the elbow joint, another near the rotation centre of the joint, and a third proximal to the joint. All dogs were recorded walking on a dry treadmill before and after they underwent a hydrotherapy session.

The treadmill was started at a low speed that was increased gradually until the dogs were walking at 1.2 m/s, decreased to 1.0 m/s if the dog could not walk comfortably. Once the dog established a steady gait in walk recording was commenced for two minutes. The hydrotherapy sessions included timed intervals or laps in the water guided by a therapist with a focus on ROM in the elbow joint, lasting twenty minutes.

Video analysis included calculating the ROM of the elbow by maximum extension minus maximum flexion of the right and left elbow joint. For each dog, a total of 160 strides were analysed for parameters including stride length, stride time and stride frequency.

Results: Healthy Labradors showed a greater ROM of the right and left elbows than Labradors with ED, before and after the session. However, Labradors with ED increased the ROM of right and left elbows more than healthy Labradors after the hydrotherapy session. Healthy Labradors had a longer right and left limb stride length than Labradors with ED at baseline. Hydrotherapy increased stride length of both limbs when all dogs were examined together.

Discussion: Overall, our findings suggest that hydrotherapy represents a valid therapeutic intervention for Labradors with ED and that alterations in gait parameters are evident immediately after a session.

*Why do you care?*

*Now, we are seeing that the kinematics that were described in the earlier papers are showing up to be beneficial with our clinical cases. What is not shown (or rather has yet to be studied) is whether the increase in ROM would translate to meaningful clinical changes for the patients.*

# Swimming & OA Biomarkers!

**Nganvongpanit K, Tanvisut S, Yano T, Kongtawelert P. Effect of Swimming on Clinical Functional Parameters and Serum Biomarkers in Healthy and Osteoarthritic Dogs. ISRN Veterinary Science, Volume 2014, Article ID 459809, 8 pages.**

Due to the lack of effective monitoring methods of joint homeostasis during swimming in OA dogs, this study aimed to determine if swimming could improve the function of OA in canine hip joints using two serum biomarkers, chondroitin sulfate epitope WF6 (CS-WF6) and hyaluronan (HA), during the 8-week swimming program. Increased levels of CS-WF6 and reduced levels of HA biomarkers are indicative of osteoarthritis.

Methods: Fifty-five dogs were recruited for the study, of which 22 dogs were in the OA swimming group, 18 dogs were in the healthy swimming group, and 15 were in the non-OA no-swimming group.

An outdoor pool at 30-35°C was used for aquatic exercise for a total of 8 weeks in order to collect the data. The protocol consisted of 20-minutes cycles of swimming followed by a 5-min resting period, 2 – 3 times a week. Clinical signs, range of motion, and blood collection were performed before starting exercise program and repeated every 2 weeks until week 8. Radiographs of the hip joints were taken prior to the study and at the end of the study period at week 8.

Efficacy of the treatment was assessed by means of a clinical scoring system which assessed a specific animal's lameness, joint mobility, pain on palpation, weight-bearing, and overall score of clinical condition by looking at the dog walking and trotting for 12 meters; followed by palpation of the hip joint for joint mobility and pain evaluation by the two veterinarians 30 min apart.

Results: Clinical evaluation of the OA-SW group found that nearly all parameters showed significant improvement at week 8, while pain on palpation was significantly improved at week 6. For range of motion (ROM) evaluation, both extension and flexion of the hip joint were found to be significantly improved in the OA-SW and H-SW groups at week 8 compared to pre-treatment, while the control group (H-NSW) showed no difference.

The relative level of serum CS-WF6 in the OA-SW group was dramatically decreased beginning at week 4, but it was found to be significantly different compared with pre-exercise level at weeks 6 and 8. The relative level of serum HA in the OA-SW group increased beginning at week 2 and then continued to rise steadily. Moreover, the levels of serum HA of the H-SW group were significantly higher than pre-exercise level.

Discussion: The finding of decreased levels of serum CS-WF6 after exercise reflects an alteration in the metabolism of the cartilage. In chronic OA, the level of CS-WF6 is higher than normal because the native CS chain in cartilage is degraded and released into the blood stream. The decrease of CS-WF6 in this study indicated that swimming could increase the anabolism and decrease the catabolism in OA joints. It is also possible that swimming could increase the blood supply to the joint, thus increasing the metabolism in cartilage and surrounding tissue.

Our results found that, after 8 weeks of a swimming regimen, the rate of HA synthesis was higher in OA dogs than in normal dogs. It is possible that swimming induced HA synthesis by synoviocytes and chondrocytes from increased blood supply to the joint.

The results show the beneficial effect that exercise has on patients with OA. Swimming appears to be a useful strategy for regaining movement and function in with OA joint.

*Why do you care?*

*What's fascinating here is that swimming showed not only improvements in things such as ROM, lameness, and pain, but also in blood chemistry! That tells us that we are affecting more than just muscle and pain tolerance. This means we're able to affect the joint cartilage itself! Okay, so looking for a reason to prescribe swimming for your OA dog, here it is! Now, please, someone should also do this for UWT use. Is it that same or different? Inquiring minds want to know!*

## Swimming, A Life Vest & Heart Rate!

**Medcalf O, Wills AP. The effect of a buoyancy jacket on the heart rate of dogs during swimming. Poster, Hartpury College, July 2017.**

During swimming, the use of buoyancy jackets is recommended to provide support and ensure a neutral spinal position, particularly for weak and vulnerable patients. The aim of this study was to assess the effect of a buoyancy aid on the heart rate of swimming dogs and to quantify the effect of a buoyancy jacket on displacement above the water surface.

Method: Seven healthy adult dogs (various breeds) of an average age of 2.5 years. All dogs did six laps of a hydrotherapy pool with and without a buoyancy jacket along with a heart rate monitor.

Results: The results showed that the minimum heart rate was significantly lower in the buoyancy jacket compared to the harness but there was no significant difference in maximum heart rate. Minimum and maximum displacement were significantly higher for dogs swimming in the jacket compared to the harness. Dogs were displaced further out of the water when swimming wearing a buoyancy jacket.

Discussion: Swimming with a buoyancy aid resulted in a decreased heart rate, compared to swimming in only a harness. This may be of benefit for dogs with cardiovascular conditions or those lacking fitness. Whilst buoyancy jackets help to reduce the energetic demands of swimming for weak and vulnerable patients, safety harnesses may be better suited to ensure biomechanically normal swimming in fit, healthy dogs.

*Why do you care?*

*I think the authors sum it up perfectly in their last line. If you are swimming a fit healthy dog (that knows how to swim), simply use a safety harness. If swimming a weak or vulnerable patient, the buoyancy jacket may provide some benefit.*

# Swimming Water Temperatures

**Nganvongpanit K, Boonchai T, Taothong O, Sathanawongs A. Physiological Effects of Water Temperatures in Swimming Toy Breed Dogs. Kafkas Univ Vet Fak Derg 20 (2): 177-183, 2014.**

This study has investigated the effects of water temperature on some physiological changes in dogs during swimming.

Methods: Twenty-one healthy small breed dogs were trained to swim in a mobile whirlpool prior to the start of the experiment. Dogs were allowed to swim for 20-minutes for collection of data in three different temperatures (37°C, 33°C, and 25°C). Physiological data - including heart rate, respiratory rate, body temperature, blood glucose, and blood lactic acid - were measured. The heart and respiration rates of subjects were measured at 5 min intervals, from pre-swimming (0 min) to the end of the testing period (20 min).

Results:
Heart rate increased during 20 min of swimming in all three water temperatures, however, heart rate in 25°C showed a significantly higher increase than the other two temperatures throughout the time intervals. After 20 min, the heart rate of dogs swimming in 33°C water was significantly higher than that of dogs swimming in 37°C water.

Respiration rate increased during 20 min of swimming only in dogs swimming in 37°C, and dogs swimming in 25°C water had significantly lower respiration rate after 10, 15 and 20 min of swimming.

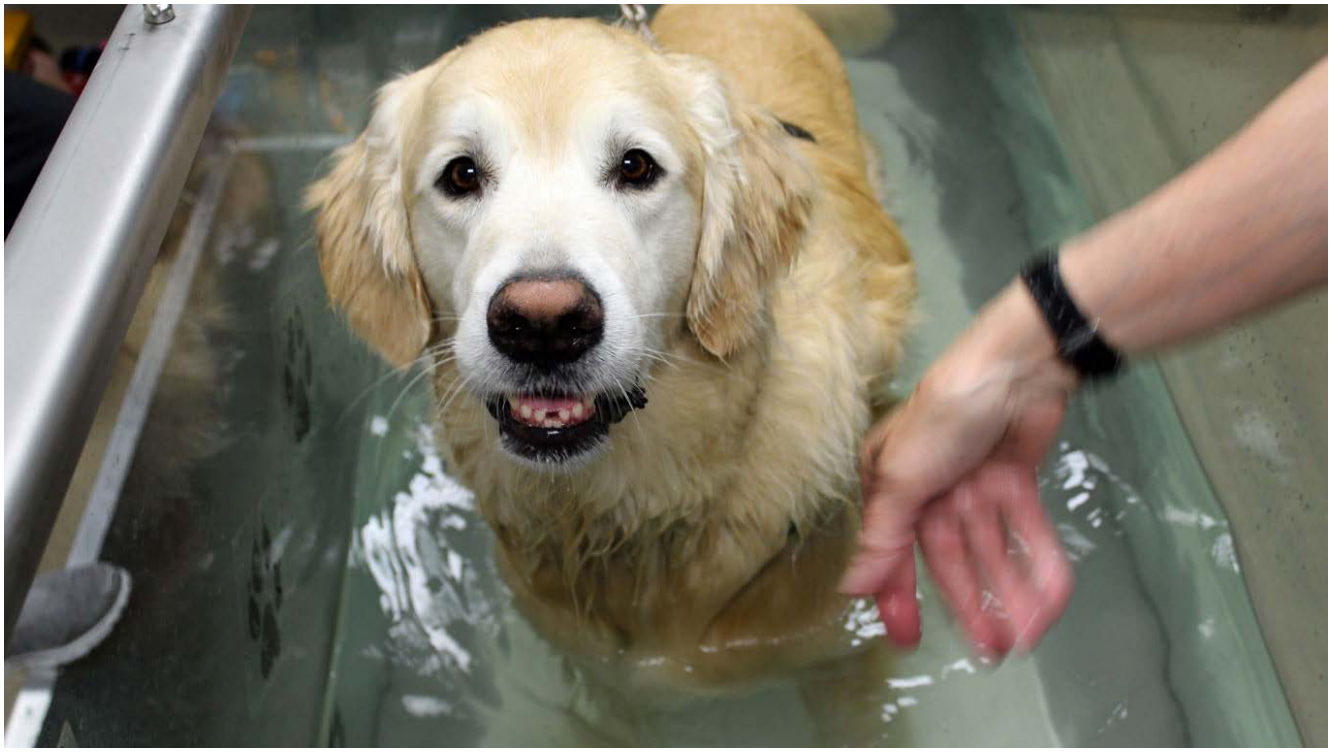
Body temperature after swimming was significantly different compared to pre-swimming at all temperature levels. After swimming in 33°C and 37°C water, body temperature increased. Conversely, swimming in 25°C water resulted in a decrease in body temperature. However, the relative changes of body temperature after swimming in all water temperatures were not significantly different

The relative changes of blood glucose after swimming in different water temperatures were not significantly different. The relative changes of blood lactic acid after swimming in different water temperatures were not significantly different.

Discussion: Based on the results of this study, swimming in a water temperature between 25-33°C is recommended for older dogs or for dogs with heart and/or respiratory disease in order to prevent tachycardia, hyperventilation and hyperthermia.

*Why do you care?*

*This paper actually came to my attention within my own clinic when we were trying to come up with an appropriate water temperature to swim dogs. What we've also found is that staff get cold in water at or below 31°C. So, our pool is set at 33°C now!*



# UWT Speed & Heart Rate

**Miles Z, Wills A. The effect of different speeds on canine heart rate whilst walking in water on an underwater treadmill. Hartpury Student Research Journal, Issue 1 (Summer 2015).**

The aim of the research is to determine the effect of different treadmill speeds on canine heart rate in an underwater treadmill.

Methods: Six healthy dogs with a mean age of 3.3 years were used for this study. All were acclimatized to the UWT and the wearing of a heart rate monitor, harness, & reflective markers. During data collection, a standing HR (bpm) was taken once water depth reached mid femur, between the femoraltibial joint and greater trochanter.

Each dog then underwent 6 x 150 second trials in a randomised order at six different speeds: comfortable walk (CW), comfortable trot (CT), and 20% above and below the comfortable values. A rest period occurred between each 150 second trial and lasted until the HR returned to the standing HR value. The second repeat occurred one week after the first session. Water temperature ranged from 31-34°C for the duration of the study.

Results: The results from this study showed that there was a significant difference between all of the walk speeds, as well as between the walk speeds and the trot speeds, as demonstrated by a gradual yet significant increase in HR as speed increased from speed 2 (CW) up until speed 4 (20% below CT), and a significant increase in median HR of 25.5 bpm from the slowest speed 1 (20% below CW) to the fastest speed 6 (20% above CT).

The current study also found that there was no significant difference between the comfortable trot and both 20% above and below it.

Discussion: The results found a significantly higher HR during trot speeds than at walk speeds, which demonstrates the benefit of faster speeds on cardiovascular fitness, and can be used with healthy athletic dogs. However, as no significant difference was found between comfortable trot (CT) and 20% below and above, it could be suggested that use of CT would be more effective at increasing exertion during fitness sessions, particularly in dogs that tend to float or abduct their limbs

Within the current study water depth remained constant between the femoraltibial joint and greater trochanter. The effect of different depths at different speeds needs to be researched to increase scientific knowledge and understanding in canine hydrotherapy. The current study provides preliminary data for future research within canine hydrotherapy.

*Why do you care?*

*As the last paragraph says, this is preliminary data, and it will be good to build upon. What I find fascinating is that comfortable trot and trotting at 20% below or 20% above that state did not change heart rate. Might it change biomechanics or muscle activation instead? As well, if you are looking for cardiovascular fitness, this study might tell us that you don't need to push beyond a comfortable trot! Hmmm! I look forward to the follow-up studies that include water depth as part of the variables!*

# One last Oldie but Goody!

**Monk ML, Preston CA, McGowan CM. Effects of early intensive postoperative physiotherapy on limb function after tibial plateau leveling osteotomy in dogs with deficiency of the cranial cruciate ligament. Am J Vet Res. 2006, 67(3): 529-536.**

OBJECTIVE: To determine effects of early intensive postoperative physiotherapy on limb function in dogs after tibial plateau leveling osteotomy (TPLO) for deficiency of the cranial cruciate ligament (CCL).
PROCEDURE: 8 adult dogs with CCL-deficiency and subsequent TPLO surgery, dogs underwent a physiotherapy program 3 times/wk (physiotherapy group; n = 4) or a walking program (home-exercise group; 4). All dogs were evaluated before surgery, 1 and 10 days after surgery, and 3 and 6 weeks after surgery. Thigh circumference (TC), stifle joint flexion and extension range of motion (ROM), lameness, and weight-bearing scores were recorded.
RESULTS: Before surgery, CCL-deficient limbs had significantly reduced TC and reduced flexion and extension ROMs, compared with values for the contralateral control limb. Six weeks after TPLO, the physiotherapy group had significantly larger TC than the home-exercise group, with the difference no longer evident between the affected and nonaffected limbs. Extension and flexion ROMs were significantly greater in the physiotherapy group, compared with values for the home-exercise group, 3 and 6 weeks after surgery. Six weeks after surgery, the difference in flexion and extension ROMs was no longer evident between the affected and nonaffected limbs in the physiotherapy group. Both groups had improvements for lameness and weight-bearing scores over time, but no difference was found between the 2 groups.
CONCLUSIONS AND CLINICAL RELEVANCE: After TPLO in CCL-deficient dogs, early physiotherapy intervention should be considered as part of the postoperative management to prevent muscle atrophy, build muscle mass and strength, and increase stifle joint flexion and extension ROMs.