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# FOUR LEG NEWS



## PHYSICAL REHAB LITERATURE

... And research articles you can USE! This newsletter is filled with a collection of articles pertaining to (mostly) the stifle, and rehabilitation in various form. As well a couple of articles are in here pertaining to toe injuries in agility and phantom limb pain in dogs! All in all, News you can Use!

Enjoy this edition! Cheers, Laurie

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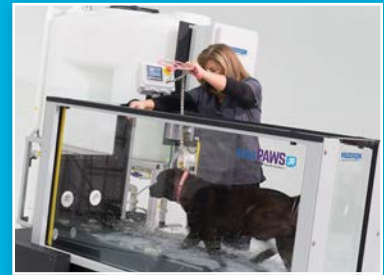
## UWT Water Levels...

**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, vol. 59, pp. 121-127, 2018.**

This study is a comparison of pelvic limb joint kinematics in dogs that have had surgery for cranial cruciate ligament instability. It compares the gait characteristics during land-based and underwater treadmill walking at four different water levels. The goal is to establish evidence based protocol to determine the best water level at which to rehabilitate dogs following surgical stifle stabilisation.

Ten dogs participated in the study. Each dog completed walking trials for four different water depths: Hip joint, stifle joint, hock joint, and no water. Their hair was clipped and high-contrast reflective markers were placed on the following anatomic markers of the affected limb: distal lateral aspect of the fifth metatarsal, lateral malleolus of the tibia, on the stifle between the lateral epicondyle of the femur and the fibular head, the greater trochanter of the femur, and the cranial dorsal iliac crest. A motion capture software system used these markers in video taken on the sagittal plane to record and analyze the gait of each dog. Data was collected on hip, stifle, and hock joint ROM, peak extension of all joints, peak flexion of all joints, gait cycle time, and stance phase percentage (the percentage of the gait cycle corresponding to paw placement on the belt, vs swing).

So many models to choose from!



Hudson



Oasis



HydroPhysio



Tudor Treadmill

Mean peak joint extension did not vary across water levels, however there were significant differences in joint flexion. Flexion of all joints increased as water levels increased, with the greatest degree of flexion seen at the highest (hip level) water level tested. ROM was also significantly different, with the hock having the greatest ROM at the hock deep water level, and the stifle having the greatest ROM at the stifle water level. Likewise, the hip ROM was greatest at the hip level water level.

As water level increased temporal gait changes also occurred, increasing gait cycle times and decreasing the stance phase percentage, likely due to increased buoyancy and fluid resistance at the deeper water levels, and is significantly affected by introducing water at any joint level. A stronger swing phase may lead to increased stifle flexion.

Since increased or improved stifle ROM has been shown to reduce the occurrence of lameness in dogs following CCL stabilization surgery then the most effective water level for rehabilitating dogs using a water treadmill following surgery may be the stifle or hip level, as that is where the ROM was most significantly increased.

The pelvic limb angles during walking with the water at hip level were also comparable to the pelvic limb angles of healthy dogs trotting at higher speeds, allowing these healthy limb angles to be achieved without the dog needing to be able to move at higher speeds.

Overall, the results of this study suggest that the use of an aquatic treadmill can optimise the biomechanics of the surgically stabilize joints during the post-op rehabilitation process.



## Physical Rehab vs Crate Rest...

**Romano, S., Cook, J.L., *Safety and functional outcomes associated with short-term rehabilitation therapy in the post-operative management of tibial plateau leveling osteotomy* Canadian Veterinary Journal, vol. 56, pp. 942-946, 2015.**

This retrospective study compared complication rates of TPLO surgery and the 8-week, 6 month, and 1-year functional outcomes, between rehabilitation and traditional post-operative management (cage rest).

Dogs were placed into 1 of 2 groups based on attending veterinarian's selected management: Group 1 was the "traditional" group where dogs were restricted to cage rest and leash walks, and Group 2 was "rehabilitation" group, where dogs were placed in a supervised physical rehabilitation program performed by a certified practitioner.

While there was no statistically significant difference in complication rates between the two groups, the rehabilitation group was 1.9 times more likely to reach full function at 8 weeks. Conversely, the traditional group was 2.9 times more likely be categorized as having unacceptable function at 8 weeks after surgery. This study suggests that rehabilitation may improve short-term outcomes when used in the initial postoperative management for dogs treated with TPLO.



This conclusion mirrors studies in humans where the addition of rehabilitation has been found to be safe and to increase functional outcome. It is encouraging to see that rehabilitation appears to return patients to full function sooner, and mitigates unacceptable outcomes. However, this could be misleading since the traditional group may be restricted from engaging in the activities that would otherwise allow them to be classified as full function, despite the dogs being capable of those activities, due to their restriction to cage

rest and leash walks. However, this restriction of activity does not explain the increase in the 8 week unacceptable outcomes in the traditional group.

This study suggests that canine patients benefit from receiving rehabilitation therapy after surgery compared with the traditional post-operative protocols of cage rest and restriction of exercise. This study also suggests that rehabilitation is not only effective, but is also safe.

## Diet & physical rehab for TPLO recovery...

**Baltzer, W.I., Smith-Ostrin, S., Warnock, J.J., Ruaux, C.G., *Evaluation of the clinical effects of diet and physical rehabilitation in dogs following tibial plateau leveling osteotomy* Journal of the American Veterinary Medical Association, 252(6), pp. 686-700, 2018.**

The specific objective of this study was to assess the effects of a diet enriched with omega-3 fatty acid and protein as a stand alone and while combined with a physical rehabilitation program for dogs who have had a TPLO.

48 dogs were divided into four groups. The TF group received the test food (a dry food enriched with omega-3s and with a crude protein of 31%) and no rehabilitation program, the TF+R group received the test food combined with a physical rehabilitation program, the CF group received a regular adult dog food formula (no added omega-3 and a crude protein of 21%), and the CF+R group received the regular adult dog food formula while on a physical rehabilitation program.

The dogs were assessed over a period of six months and data was collected on ground reaction force, tibial plateau angle, limb circumference, subjective pain and lameness, and daily activity. Information on body weight and body condition score was also recorded.

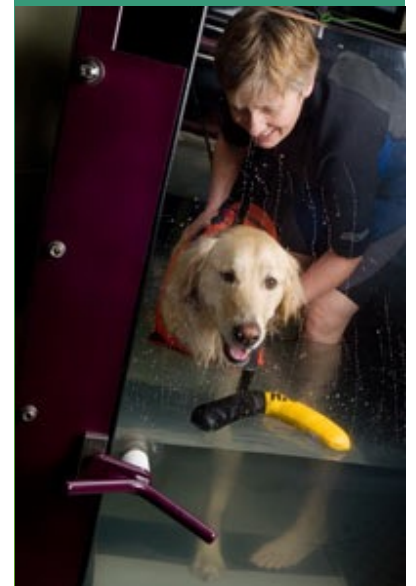
The diets were started the first meal following the surgery and were continued for the six month duration of the study. All dogs were given instructions for passive range of motion exercises and instructions for gradually increasing the length of leashed walks. Two weeks post op the rehabilitation group started specific exercises.

Ground reaction force (Peak vertical force [PVF] and vertical impulse [VI]) was measured with a pressure sensitive platform, thigh circumference was measured, and each dog wore an activity monitor at evaluation intervals. Pain and lameness were provided as subjective measures by the dogs' owners.

The significant difference found in this study was in the ground reaction forces, where the PVF and VI were improved in the TF and the TF+R groups. Rehabilitation was also shown to have a significant improvement on PVF in both the rehab groups, but there was not a significant difference in VI in these groups. TF groups also had a significantly lower instances of lameness as reported by the owners.

These effects were also shown to increase with relation to time, with significant improvements seen as early as the eight week time point.

The researchers suggest that these results might be a response to the TF acting to inhibit inflammation in the dogs, which allowed for reduced pain and more effective participation in the rehabilitation program, resulting in the improvements seen. Increased protein may have also aided in increasing muscle mass at a greater rate than the control diet. Similar results have been



observed in human patients eating a protein supplemented diet during recovery from knee surgery.

Overall, the researchers conclude that the addition of an Omega-3 and a protein rich diet can decrease the recovery period post TPLO.

## Diet & physical rehab and joint inflammation...

**Verpaalen, V.D., Baltzer, W.I., Smith-Ostrin, S., Warnock, J.J., Stang, B., Ruaux, C.G., *Assessment of the effects of diet and physical rehabilitation on radiographic findings and markers of synovial inflammation in dogs following tibial plateau leveling osteotomy* Journal of the American Veterinary Medical Association, 252(6), pp. 701-709, 2018.**

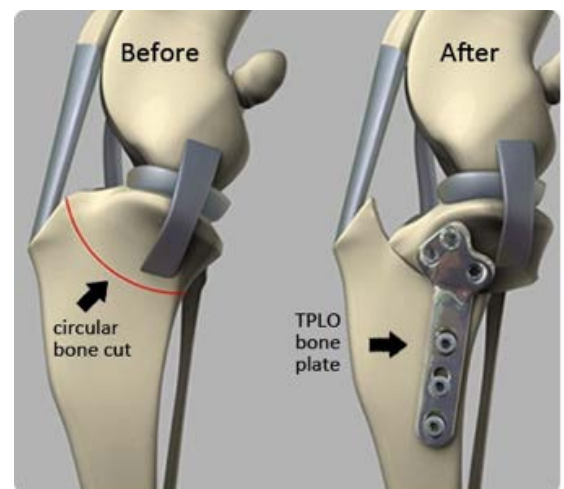
This study further investigated the effects seen in the previously discussed study on the inflammation experienced by the dogs across the four the study groups. The researchers looked at the concentration of pro-inflammatory factors prostaglandin (PG) E2 and interleukin-1(IL-1), radiographic osteoarthritis scores, osteotomy site healing, and patellar ligament thickness were assessed at intervals for six months following TPLO surgery.

Synovial fluid samples to determine the concentration of PGE2 and IL-1 were collected immediately prior to surgery during pre-surgical radiographs, and while the dogs were also sedated for radiographs at 8 and 24 weeks post op. An addition radiograph of each dog was taken immediately after surgery. Radiographs (both mediolateral and craniocaudal views) were used to determine the tibial plateau angle, measure patellar ligament thickness, to score osteoarthritis using a modified human grading scale, and to assess the healing of the osteotomy site using the quality of callus and the presence of fracture line. The osteotomy was declared healed at the evaluation if there was complete iso-opaque bridging of two or more cortices.

Diet, rehab, or any combination thereof was not associated with significant differences in IL-1 concentration in the synovial fluid. However, dogs fed the test food had significantly lower PGE2 concentrations at the post operative assessment points than the dogs fed the controlled food, regardless of whether they were in the rehabilitation group or not. The addition of rehabilitation to the test food fed dogs did not further alter these results significantly. Dogs in both TF groups also had lower osteoarthritis scores and dogs in the TF +R group had significantly lower osteoarthritis scores than all the other three groups. The osteoarthritis score for both rehab groups, regardless of the food fed, progressed slower over time.

There was no significant effect of diet or rehab on the thickening of the patellar ligament, important to note, as some vets are reluctant to recommend physical rehabilitation for fear of patellar ligament thickening.

Dogs in the two TF groups, however, actually showed slower healing of the osteotomy site than the dogs in the CF groups. Higher concentrations of PGE2 is associated with increased incidents of lameness in post-op TPLO dogs and with increased osteoarthritis, but it also influences the replication and differentiation of osteoblastic and osteoclastic cells and therefore the stimulation of bone formation and remodelling, resulting in a slowing of the osteotomy healing when PGE2 concentration is reduced. However, none of the dogs in the study experienced hardware failure or significant changes in the angle of the tibial plateau in the six months following surgery, which may indicate that the slowed healing of the osteotomy site is of no clinical significance, and therefore the benefits of feeding the omega-3 fatty acid enriched, higher protein diet may outweigh the consequences of slower bone healing.





## Stifle Orthotics for CCL-deficiency...

**Carr, B.J., Canapp Jr, S.O., Meilleur, S., et al., *The use of canine stifle orthotics for cranial cruciate ligament insufficiency* Veterinary Evidence, 1(1), pp. 1-13, 2016.**

The goal of this study was to evaluate weight bearing of patients diagnosed with a unilateral cranial cruciate ligament insufficiency while wearing a stifle orthotic.

Ten pet dogs were studied to assess the effectiveness of a canine stifle brace in conservative management of a CCL insufficiency.

Of the ten patients identified, the right stifle was affected in 50% of the cases and the left stifle affected in 50% cases. Patients with bilaterally affected stifles were excluded from the study. One of the ten patients presented with a suspected meniscal tear.



Weight bearing was tested using a pressure sensitive walk way and recorded as a percentage of total pressure index (TPI%). Dogs were tested at baseline, and then again at 90 days, with and without the orthotic in place. Between the 90 day test and the baseline test there was a significant increase in TPI% in the affected limb even without the orthotic in place, and an additional significant increase in TPI% when the orthotic was in place. The difference, on average, in the TPI% when the dog was and was not wearing the orthotic was 3%.

The present study demonstrates that custom canine stifle orthotics allow for improved weight bearing in patients with unilateral cranial cruciate ligament insufficiency.

In addition to the result from the pressure sensitive walkway, a survey was given to the owners, five of the ten owners completed this survey, and of those, every owner reported overall improvement in terms of function and complete satisfaction with the orthotic.

While surgery is still considered the gold standard treatment for treating cranial cruciate ligament insufficiency, this study showed that custom stifle orthotics can still help improve overall function. In the one case where a meniscal click, pain on deep flexion, and positive McMurray test for meniscal injury was identified, this patient also had improved weight bearing while wearing the stifle orthotic. Further study would be needed to fully assess the outcome of custom stifle orthotics in dogs with concurrent meniscal injury. Whether surgery is declined for medical or financial reason, custom stifle orthotics can be offered to help improve function.



## Phantom Limb Pain in Dogs

**Menchetti, M., Gualtierio, G., Gallucci, A., et al., *Approaching phantom complex after limb amputation in the canine species* Journal of Veterinary Behavior, vol 22, pp. 24-28, 2017.**

This study investigated the prevalence, risk factors, and consequences for quality of life of phantom limb complex in dogs. Phantom complex is defined as any of the following:

1. Phantom limb sensation - Any sensation other than pain in an absent limb.
2. Stump pain - Pain located in the remaining stump. This usually subsides following the initial healing period.

3. Phantom limb pain - Pain perceived in the missing limb. This particular form of phantom complex is reported in 60-80% of human patients in the first two years following amputation, and persists for life in a reported 10%



Data was gathered via a 69 question survey for the owners of 3-legged dogs who's pets were at minimum three months post amputation. This timeline was chosen based on human patient information used to differentiate between signs of post surgical pain and phantom complex in non-verbal patients. The questionnaire asked about pre-amputation conditions and pain, pain related

behaviours, post-surgical complications,

therapies, and quality of life. In addition, there were questions about the owner's satisfaction with the result of their pet's limb amputation, specifically in the context of social life. Not all respondents responded to every question on the questionnaire and a minimum response to 80% of the questions was required for a participants answers to be included in the results. 107 questionnaires were included in the final analysis.

Pre-amputation pain was reported in 82% of the dogs, and post-amputation pain was reported in 85%, with no significant association between onset of pre-amputation pain with the onset of post-amputation pain. However, there was a significant relationship between the early onset (one month or more prior to limb amputation) of pain and the occurrence of post-amputation pain. Owners described pre-amputation pain as "waxing and waning" in



45% of cases, and “persistent” in 40%. However, in the month following amputation the descriptor in 53% of cases changed to “sudden and transient” and no owners reported persistent pain following amputation. Pain was reported to have manifested as muscle twitching, stump licking, chewing, or scratching, vocalizations, and restlessness.

In the 3-6 month period post amputation owners reported decreases in activity levels, playful, and decreases in friendliness to other pets, both in and outside of the family. Appetite loss and a negative emotional state were also reported.

To address pain the most frequently administered medications were pain killers, followed by anti-inflammatory drugs, and neuropathic pain specific treatments.

Adaptation was described as good or very good in 94% of dogs, 74% of dogs were walking within the first week post-amputation and dogs who were reported to have a higher degree of adaptation were also reported to have a lower occurrence of post-amputation pain.

Overall, 89% of the owners reported that they did not regret the amputation decision for their pet, and 92% of the owners felt they had been well informed by their veterinarian prior to making the decision.

Overall, the results of this study showed that 14% of owners felt their animals were experiencing pain in the amputated limb for 1-6 months following limb removal. The pattern is similar to reports in human cases, where 5-10% of amputees report persistence of pain beyond the initial post-surgical healing period. Since in both cases, the pain may be reported to worsen in the period following initial wound healing, becoming persistent neuropathic pain, it suggests that patient care should continue well beyond the initial post-operative healing stages. Also similar to human results, patients who experience pain pre-amputation for a period longer than one month leading up to the amputation are significantly more likely to experience phantom limb pain after the amputation. Unfortunately, treatment of pre-amputation pain does not seem effective in preventing post-amputation pain in humans, and this was not factored into this study on dogs.

## Risk Factors for Digit Injuries in Agility Dogs

**Sellon, D.C., Martucci, K., Wenz, J.R., et al., *A survey of risk factors for digit injuries among dogs training and competing in agility events* Journal of the American Veterinary Medical Association, 252(1), pp. 75-83, 2018.**

This study was a survey conducted to identify potential risk factors for digit injuries among agility dogs.

Questionnaires were completed for 1,081 dogs, of them 207 had digit injuries and 874 did not. Note, however, that veterinary medical records of dogs were not requested to confirm the accuracy of handler-reported diagnoses, and handlers were not asked whether the injuries had been reported to a veterinarian.

These injuries are common in sporting dogs. Injuries to the paws have been estimated to represent 13% to 24% of total injuries in agility dogs.

The most common obstacles reported for the injury was the A-Frame, followed by the dog walk, open tunnel, jumps, and the closed tunnel.

In navigating the A-frame, dogs approach the obstacle at speed, stride across the apex, and then decelerate sharply to stop at the bottom if a stopped performance is trained. 71% of the injuries which occurred on the A-Frame were in dogs who were trained to decelerate or stop completely at the end of the obstacle was associated with a higher risk of digit injury.

In some agility venues (dependent on the host organization) the A-frame has horizontal slats at the base to increase traction and aid in deceleration. Contact of the dog's feet with the slats during descent may result in repeated concussive forces on the digits. These concussive forces may be less severe if a dog strides across the A-frame without attempting

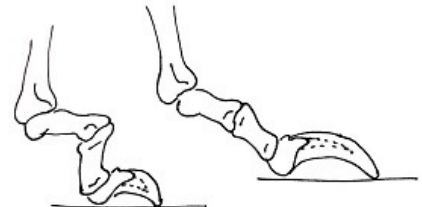
to stop or decelerate at the bottom. A definitive association between injury and the presence of A-frame slats could not be made on the basis of results of the present study.

The study also revealed that almost 70% of the digit injuries occurred when dogs are running agility courses built on grass or dirt. The reported injury rate was 28% when the course was built on artificial turf or rubber mats. Only 2% of the injuries occurred on sand. (Note that the validity of this data lacks the support of information regarding the frequency of competition and training on these surfaces, and the increase in injury rates seen by surface may be attributed to where courses are most commonly set, not on the quality of the surface.)

Factors which do appear to contribute significantly to injury whilst competing in agility include the following:

a) Long nails.

Longer nails may act as a fulcrum and transfer forces proximally to the digit. Longer nails may also be at risk for catching or jamming on uneven surfaces or the slats of contact equipment.



b) The absence of front dewclaws.

The front dewclaws are proposed to have a functional role in preventing torque on the limb, and as such, their removal may predispose to injury.



c) A greater height to weight ratio.

The dog's weight-to-height ratio was significantly associated with risk of digit injury, suggesting that overweight dogs are at increased risk for injury.



d) Being a Border Collie.

Border Collies are perhaps the most common breed of dog competing in agility, and this breed has been previously reported as having an increased risk of injury presumably as the result of their speed, intensity, and focus on task completion. Additionally, digit injuries are more likely to occur in the forelimbs rather than the hind limbs. Border collies are highly front driven animals.

The results of the present study provided information to guide recommendations for training and management of agility dogs and decrease risk of digit injury. Specifically, nail maintenance, retaining otherwise healthy dew claws, managing weight, and ensuring the clear education of owners who handle young at risk breeds such as the border collie.



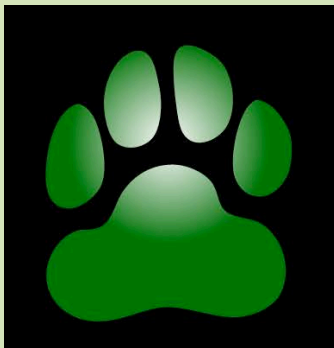
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