ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT

APTA Combined Sections

Mark your calendars now for February 15-18, 2017, and join us for the APTA Combined Sections Meeting in San Antonio, Texas. The Combined Sections Meeting is a key venue for the ARSIG to support members with educational opportunities in animal rehabilitation so your presence is greatly desired. Last year the SIG unfortunately had to cancel an outstanding preconference event on canine manual therapy of the cervical spine due to low early registration numbers. However, the two-hour programming on elite equine show jumping was accepted for the conference and achieved great success in attendance numbers with multiple questions from the audience.

So why is CSM so important to the SIG? Well basically it is the most widely attended event where thousands of PTs and PTAs come together to learn from others in the field and to facilitate new ideas. It is also an invaluable venue to network with others often leading to new adventures in physical therapist practice. Basically it is the place where the Animal Rehab SIG has the greatest potential to capture the largest number of individuals to learn about a very exciting and ever-growing area of PT practice. In other words, CSM is currently the life-blood for the SIG, which many of you know was organized historically to specifically provide therapists who treat animals a voice on a national scale.

Practice Analysis Update

The ARSIG Practice Analysis survey continues to move forward albeit with a slight delay since January. Task Force members recently met and will be finalizing the survey tool to be used for data collection on the current state of animal practice in the United States. A pilot study of select members will be conducted shortly before launching the survey to all SIG members, and as many non-SIG practitioners that can be reached. It will be important to get a high return rate on completed surveys to generate a well-rounded view of animal practice.

California Veterinary Medical Board

The latest update from California is that an Animal Rehab Task Force has been organized to address issues and concerns regarding physical therapists (PTs) practicing on animals. For the first time ever the Task Force will include the voice of PTs at the table to encourage a more "collegial" approach to language negotiations. The goal is for the committee to generate proposed regulatory language by January 2017. In addition, the California PTs formed an "Animal Physical Therapy Coalition" and hired a separate lobbyist to handle additional legislative activities involved in the process.

Due to the high cost of spearheading these important endeavors, the coalition formed a GoFundMe campaign. If you wish to donate to the fund, you may do so at https://www.gofundme.com/mqzmtu3g. A "must see" video was also posted on the same link demonstrating the value of including skilled physical therapy services as part of rehabilitating a canine patient who suffered a spinal cord injury from a car accident. Spare 4 ½ minutes of life and watch the video when you get a chance.

Unlicensed Individuals and False Advertising

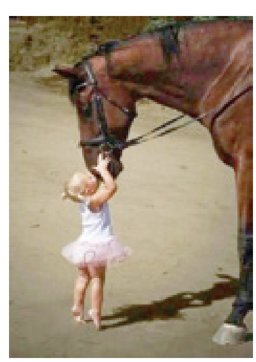
In the last edition of *OPTP,* I spoke to the value of engagement in the profession, and especially in the ARSIG, such as running for an elected office and participating in activities associated with political advocacy. In this edition, I would like to address the topic of skilled PT care being provided by appropriately educated professionals.

Over the past several months I have witnessed a few unfortunate cases where individuals, who were not appropriately credentialed or educated in animal rehabilitation, were treating animals nonetheless, and boldly calling themselves PTs or Physiotherapists. Adding to the frustration is that although authorities in charge of care for these particular animals were notified of the observed behaviors, no action was taken to address the issue.

In the human world, PTs generally frown upon uneducated or non-credentialed personnel treating individuals using techniques that took PTs years to learn through formal education. In fact, there are formal reporting mechanisms in most, if not all, states to alert regulatory authorities regarding questionable health care practice situations rendered by unlicensed individuals. Therefore, I can only surmise that all PTs and PTAs share my sense of personal duty to actively uphold the integrity of delivering quality rehabilitation when such care is classified as "physical therapy or physiotherapy."

Contributory Acknowledgment

In this edition of *OPTP*, Cheryl Riegger-Krugh PT, ScD, MS, provides an outstanding article on the canine cranial cruciate ligament in comparison to the human anterior cruciate ligament. Her contribution to advancing the knowledge of all therapists who treat animals in this edition of *OPTP* is exemplary…so thank you Cheryl for sharing your expertise with the profession.



Get To "The Pointe"

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Relative Risk of Cranial Cruciate Compared to Anterior Cruciate Ligament Injury

Cheryl Riegger-Krugh PT, ScD, MS

The canine cranial cruciate ligament (CCL) is at high risk for injury and is an important focus in canine rehabilitation.[1] In addition, with CCL injury there is risk of deficiency to the contralateral CCL, due to compensatory overuse.

The anterior cruciate ligament (ACL) is the analogous ligament in humans to the CCL in dogs. Knowledge and clinical skills of physical therapist professionals provide a foundation for applying and modifying intervention for ACL injury to intervention for CCL injury in dogs. Physical therapists, who are adequately trained in canine rehabilitation, provide a unique contribution in evaluating and managing dogs with CCL dysfunction. Rehabilitation includes the continuum of CCL deficiency, disease, laxity, injury, rupture, postsurgery, and prevention.

The primary function of the CCL and ACL is preventing *displacement* or excessive translation of the tibia in a cranial (toward the head) direction in dogs[1] and an anterior direction in humans,[2] respectively. While the joint motions restrained by the CCL and ACL are the same in dogs and humans, a number of factors, such as the magnitude of the degrees of freedom at the canine stifle/human knee and adjacent joints, characteristics of bones, joints, muscle action, type of stance, and functional movement modify the level of risk for injury of the CCL versus the ACL.

The purpose of this article is to present some of the *differences* in the anatomy and biomechanics of the CCL and ACL with the goal of developing a foundation for rehabilitation for CCL deficiency.

JOINTS

- Canine: The stifle joint consists of the medial and lateral femorotibial joints, the femoropatellar joint, and the proximal tibiofibular joint[3] (Figure 1). While there is no absolute convention, bones in canine joints often are named by the proximal bone first and distal bone second, eg, the femorotibial joints. Because there is significant constraint to normal canine tibiofibular motion, function of the stifle joint with and without inclusion of the proximal tibiofibular joint likely would be the same as motion of the femorotibial and femoropatellar joints alone.

  The coxofemoral (or hip) joint, distal tibiofibular joint, tarsal (or tarsocrural or talocrural or ankle) joint, and the hock are critical to normal stifle function. The term hock includes the distal tibia, distal fibula, and some of the proximal tarsal bones.[3] Because the distal tibiofibular joint and joints between the tarsal bones and the distal tibiofibular joint normally are very constrained, normal motion of these joints plus the tarsal joint likely would be very close to motion at the tarsal joint alone.
- Human: The knee joint consists of the medial and lateral tibiofemoral joints and the patellofemoral joint.[2,4] (Figure 2). While there is no absolute convention, bones in human joints often are named by the distal bone first and the proximal bone second, eg, the tibiofemoral joints.

  The hip; proximal, middle and distal tibiofibular joints; ankle (or talocrural) joint; and distinct inter-tarsal joints, such as the subtalar (or talocalcaneal) joint and transverse tarsal (or mid-tarsal) joint; are critical to normal knee function, with each joint contributing in a distinct and significant way. Analogous human joints to those included in the hock have less constrained motion due to shapes of bony surfaces, axes of rotation, and less-constraining ligaments. Motion at these collective joints is not representative anatomically or functionally of motion at the ankle joint.

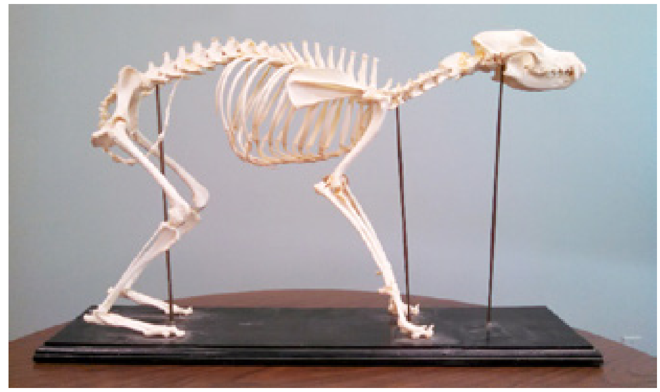

Figure 1. Anatomic position - canine stifle.

Photos courtesy of Kirk Peck

Figure 2. Anatomic position - human knee.

Stifle/Knee Bony Characteristics Relevant to CCL and ACL Function

Relevant characteristics of bones are those preventing cranial/anterior displacement of the tibia on the femur, or equally stated, restraint of caudal/posterior displacement of the femur on the tibia.

Shape of the Femoral Condyles

Canine femoral condyles are flatter than human femoral condyles. Normal cranial/anterior translation of the tibia occurs during stifle/knee extension. Flatter canine femoral condyles provide for normal cranial translation of the tibia during stifle extension but in turn allow a greater tendency for cranial displacement of the tibia. In comparison, human femoral condyles are more convex allowing for anterior translation during knee extension but with less tendency for anterior displacement of the tibia.

Tibial Plateau Angle

In dogs, a tibial plateau angle (TPA) or tibial plateau slope that is oriented more craniodistally than normal increases the tendency for cranial displacement of the tibia and is a risk factor for CCL disease.[5,6] Cranial displacement occurs with inadequate restraint from the CCL and also surrounding muscles. The normal craniodistally angled TPA promotes cranial translation of the tibia. In one study,[1] average craniodistal TPA in dogs with CCL injuries was 23.8°-24.7°, significantly greater than average TPA of 18.1° in dogs without CCL injuries. In normal canine stance, the tibia tips more craniodistally. During gait, especially at end stance time, the tibial plateau tips even more craniodistally.

The TPA is structural and not modifiable without surgery. The tipping factor is positional and could be modified, eg, by bracing.

In humans, a posterior or posterodistal TPA has been identified as a risk factor for posterior displacement of the femur, ie, anterior displacement of the tibia, in ACL injury.[7-9] The posterior TPA promotes posterior translation of the femur. In one study,[9] average posterior TPA on the lateral tibial condyle in people with ACL injury was 6.7° and significantly greater than average 5.6° in people without ACL injury. Average posterior TPA on the medial tibial condyle in people with ACL injury was 5.5° and significantly greater than average 4.7° in people without ACL injury. Normal human stance does not tip the tibia more posterodistally. However, at initial contact and loading response during normal gait, the tibial plateau appears to tip slightly more posterodistally than in static stance.

In dogs, the TPA and additional craniodistal tipping appear to produce a larger magnitude composite, constant shear force, and constant tendency in the direction of cranial translation of the tibia. The constant shear force is one mechanism of injury that could result in CCL laxity or strain. In humans, the TPA and additional posterior tipping in gait appear to produce a small magnitude composite and slightly increased but intermittent shear force in the direction of posterior translation of the femur. Multiple limb stance in dogs versus single limb stance in humans would enter into the overall effects of the TPAs.

There are other stifle/knee bony characteristics that are relevant to CCL risk of injury, but they have not been studied as much. They include femoral anteversion angle, which is excessive internal torsion of the femur distal to the lesser trochanter,10 and is analogous to human femoral anteversion or antetorsion or torsion.

MUSCLE FUNCTION AND FUNCTIONAL MOVEMENT

There are some significant differences in muscle function. The implications of the differences include (1) avoiding assumptions about muscle function based on the analogous muscle actions for humans, (2) interpreting electromyographic findings on the basis of muscle function for dogs, and (3) using surface palpation and other assessments to verify and interpret muscle activity, including variation from the norm, the same as you would for humans.

In hind limb digitigrade stance, the moment arm from the ground reaction force (GRF) is very large for tarsal flexion, large for stifle flexion and digit extension, and medium for coxofemoral flexion. Visualize the line of the GRF starting at the contact of the ground with the digits and extending proximally to a position that is just cranial to the coxofemoral joint. The position of this line results in resistance or demand moment (torque), which would appear to be very large for tarsal flexion, large for stifle flexion and digit extension, and medium for coxofemoral flexion. In human stance, the moment arms from the GRF at the analogous joints are minimal to none.

The GRF during stance on a normal stifle joint produces a joint reaction force that not only compresses the femur and tibia but also produces cranially directed shear or translation force on the tibia. Additional craniodistal tipping during walking and running produces more cranial shear force and promotes more cranial translation of the tibia.

The most important muscles to prevent CCL deficiency in canine stance would be those that produce combinations of needed muscle strength and adequate caudal shear force on the proximal tibia. Therefore, net (or total or overriding) muscle strength (or muscle moment) must be very large for tarsal extensors, large for stifle extensors and digit flexors, and medium for coxofemoral extensors. Net caudal shear force on the proximal tibia must be greater than net cranial shear force on the proximal tibia. Factors producing or promoting shear forces at the stifle joint include the TPA, positional tipping, GRF, muscles and other internal and external forces.

Muscle attachment sites can be found in many resources.[4,12,13] With knowledge of muscle attachment sites, lines of muscle pull, moment arms of muscles, joint surface shape, ligamentous restraint, etc, muscle joint actions and translations can be determined. Physical therapists are skilled at this process and can apply these concepts to determine joint and translational motions produced by canine muscles, as well as those from external and other internal forces.

There are some notable differences in joint and translational motions produced by stifle and knee muscles. Published charts link direction(s) of translation to joint motion but not to muscle pull. Note how many muscles produce cranial translation. After CCL laxity, joint and translational motions and shear forces likely change.

The modifiable components of posture and movement with coordinated muscle activity would be targets for rehabilitation. Coordination requires muscle activity that is well timed and with the right balance of forces. This dynamic coupling of muscle activity emphasizes the importance of neuromotor factors related to movement function.[11]

A few examples of significant differences in muscles, muscle function, and functional movement are:

- Muscles included in the canine calcaneal tendon (or Achille's tendon), which are primarily the gastrocnemius and flexor digitorum superficialis (or superficial digital flexor) and secondarily the gracilis, the caudal head of the biceps femoris, and the semitendinosus. All of these muscles are tarsal extensors, which are needed in large magnitude and consistently in canine weight bearing. All 5 are stifle flexors, indicating the need for additional stifle extensor strength than that needed to overcome the effect of the GRF. The gracilis, the caudal head of the biceps femoris, and the semitendinosus produce caudally directed force on the tibia. The gastrocnemius and flexor digitorum superficialis produce caudally directed force on the femur, ie, cranially directed force on the tibia.
- Dogs do not have a soleus. If dogs had a soleus with comparable human soleus anatomy, it would produce tarsal extensor force in stance, but at a shortened length.

- Dogs weight bear on hindpaw digits II-V. The canine flexor hallucis longus (or lateral digital flexor) is attached to the dog's dewclaw. It loses the importance of the human flexor hallucis longus during lateral to medial weight shift on the foot at terminal stance in gait.
- From the digitigrade posture, the caudal sartorius, gracilis, and semitendinosus appear to produce a sling to support the proximal tibia and spare the CCL.
- With CCL laxity and due to the attachment sites and angle of pull on the tibia, the semitendinosus could produce craniodistal tipping of the tibial plateau, in combination with or instead of stifle flexion and caudal translation. The caudal translation might become caudal motion of the tibia distal to the tibial plateau while the tibial plateau tips craniodistally.
- The canine gracilis is a coxofemoral extensor, as is the human gracilis but only when the hip is positioned in flexion.
- Tilt of the canine pelvis increases the leverage of the hamstrings in dogs, which increases their importance as coxofemoral extensors. The canine superficial gluteal, structurally analogous to the human gluteus maximus, is comparatively very, very small.
- Palpation of the caudal head of the biceps femoris can represent muscle activity needed at the tarsal and/or stifle joints, but would not indicate muscle activity needed at the coxofemoral joint.

Future research to investigate when comparing relative risk of CCL injury to ACL injury may include comparison of limb alignment, physical activities, surgical techniques, out of sagittal plane mechanisms of injury, and outcomes of rehabilitation interventions. The modifiable aspects of all factors would appear to be the best targets for rehabilitation intervention.

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