



## Veterinary Orthopaedic Society 40<sup>th</sup> Annual Conference Abstracts

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### Part II

#### 44 Treatment of medial patellar luxation and distal femoral varus by distal femoral osteotomy in dogs

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**Introduction:** The importance of distal femoral varus in the pathophysiology of medial patellar luxation (MPL) is becoming increasingly evident. The aims of this study were: (1) to report on the population of large breed dogs with MPL treated by distal femoral osteotomy (DFO); (2) to report on radiographic and clinical outcome of this technique. Our hypothesis is that treatment of MPL by DFO would result in a low recurrence rate of patellar luxation.

**Materials and Methods:** Medical records of dogs treated for MPL by DFO at two university teaching hospitals were reviewed. Surgery reports, pre-, post-operative, and follow-up radiographs were evaluated, and the aL DFA was determined.

**Results:** DFO was performed on 50 limbs. The mean pre- and postoperative aLDFAs were 107.5+/-4.9° and 94.7+/-4.7°, respectively. Cranial cruciate ligament (CrCL) disease was identified in 23/50 affected limbs and tibial deformity in 9/50 limbs. Radiographic follow-up until osteotomy healing was available on 35/50 limbs. The mean time to union was 69.4 +/- 33 days with a patellar re-luxation rate of zero. Complications included infection (2/35), fixation failure (1/35), delayed healing (1/35) and persistent lameness (1/35).

**Discussion/Conclusion:** This report further substantiates DFO as a successful and repeatable component of surgical treatment for dogs with MPL associated with femoral varus. This study also provides further evidence of a high rate of concurrent CrCL disease in cases of large breed MPL, and supports an association between stifle instability and MPL.

**Acknowledgments:** There was no proprietary interest or funding provided for this project.

#### 45 An evaluation of the axial pullout and yield strengths of 2.0mm and 3.0mm cancellous screws

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**Introduction:** Cancellous bone screws are commonly used for osteosynthesis. 2.0 mm and 3.0 mm cancellous screws are commercially available, but no biomechanical investigations have been performed. Our hypotheses were that, in a small bone model, the 2.0 mm and 3.0 mm cancellous screws would demonstrate superior axial pullout strength and yield strength when compared to their cortical counterparts.

**Materials and Methods:** Synthetic cancellous and bicortical blocks were used for all testing. 2.0 mm and 2.7 mm cortical screws and 2.0 mm and 3.0 mm cancellous screws were inserted to create 15 screw-block constructs of each configuration, which were then tested to failure in axial pullout. Axial pullout strength and yield strength were calculated. Data was analyzed using a 1-way ANOVA.

**Results:** In the cancellous model, axial pullout and yield strengths were significantly lower for the 2.0 mm cortical screws compared to the 2.0 mm cancellous screws, while no statistically significant differences were identified between the 2.7 mm cortical screws and 3.0 mm cancellous screws. In the bicortical model, axial pullout and yield strengths were significantly greater for the 2.0 mm and 2.7 mm cortical screws compared to the 2.0 mm and 3.0 mm cancellous screws, respectively.

**Discussion/Conclusion:** *In vitro*, small fragment cancellous screws do not provide an advantage in axial pullout or yield strengths compared to their cortical counterparts.

**Acknowledgments:** Veterinary Orthopedic Implants, St. Augustine, FL for all drill bits, taps, and screws. Dr. Yuh-Jin Chao and Cui Tong (University of South Carolina, Mechanical Engineering Department) for technical assistance.

#### 46 Modulation of inflammation and oxidative stress in canine chondrocytes

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**Introduction:** Osteoarthritis (OA) is a chronic progressive disease affecting diarthrodial joints. Its pathogenesis is characterized by the release of inflammatory mediators and reactive oxygen species. Currently little research has focused on the role of oxidative stress in the pathogenesis of canine OA.

**Materials and Methods:** Chondrocytes were maintained at 37°C with 5% CO<sub>2</sub> for 24 hours. For oxidative stress, two stimuli were used: (1) hydrogen peroxide (H<sub>2</sub>O<sub>2</sub> at 100, 200, 300 µM) and (2) a cytokine combination of Interleukin-1 beta (IL-1β, 10 ng/ml) and tumor necrosis factor alpha (TNF-α 1 ng/ml). For inhibition of oxidative stress, cells were pre-incubated for 24 hours with N-acetyl-cysteine (NAC, 10 mM) before exposure to H<sub>2</sub>O<sub>2</sub>. Supernatants were obtained for prostaglandin E<sub>2</sub> (PGE<sub>2</sub>) analysis or frozen at -80°C for subsequent measurement of superoxide dismutase enzyme (SOD) activity and reduced glutathione (GSH) levels in cell lysates.

**Results:** Chondrocytes responded to the oxidative stressor by reduction in SOD activity and GSH levels. The anti-oxidant NAC increased SOD activity in H<sub>2</sub>O<sub>2</sub> stressed chondrocytes to enzyme activity levels comparable to non-H<sub>2</sub>O<sub>2</sub> stressed chondrocytes, and induced significant increases in GSH concentrations. Activation with IL-1b and TNF-α decreased SOD levels and increased PGE<sub>2</sub> production.

**Discussion/Conclusion:** Canine chondrocytes responded to the oxidative stress stimuli: H<sub>2</sub>O<sub>2</sub> and cytokines. The oxidative stress response can be modulated by anti-oxidant treatments. These findings suggest that exposure to oxidative stress stimuli could result in the disruption of chondrocyte and cartilage homeostasis and could contribute to the pathophysiology of canine OA.

**Acknowledgments:** Funding provided by Nutramax Laboratories, Inc.



#### 47 Biomechanical study of traction (ex-vivo) tibial tuberosity osteotomy in dogs with stabilized fixed plate for fork or screw

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**Introduction:** Tibial tuberosity advancement (TTA) is one of the techniques for treatment of cruciate ligament rupture in dogs developed by Montavon, Damur and Tepic (2002). The success of the technique in reducing or eliminating the forces of cranial tibial displacement in knees with ruptured cranial cruciate ligament has been documented in experimental and clinical studies. In the post-operative technique, implant failure is reported in 1–5% of hindlimbs operated. This number was attributed to technical error or the initial design of the implant that was considered insufficient.

**Materials and Methods:** To compare the biomechanical strength between two different plates TTA and minimize the incidence of implant failures, biomechanical tests were performed on 10 pairs of hindlimbs cadaver dogs, the right hindlimb fixed plate and a fork in the left pelvic limb plate fixed by screws. Assays were performed using a universal mechanical testing Kratos<sup>®</sup> model KE3000, equipped with a load cell of 5000N with a test speed of 20mm/min. The strength parameter and graphs generated were recorded via analog acquisition system.

**Results:** The mean load to failure was 128.70 kg/F (minimum 104.55 Kg and maximum 151.80 Kg/F) and 141.99 Kg/F (minimum 111.60 Kg/F and maximum 169.65 Kg/F) in the group using “fork” and screws respectively. The standard deviation of the groups “fork” and bolt was low, 12.99 and 17.21 respectively. Significant difference ( $p = 0.0309$ ) between the means of the groups.

**Discussion/Conclusion:** Results show that there is statistically significant difference between the two plates in biomechanical test and the plate fixed with screws is stronger.

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#### 48 Evaluation and validation of the petsafe vet therapy stance analyzer in normal dogs

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**Introduction:** There are currently few objective outcome measures available for monitoring progression through a physical rehabilitation program or following surgery. The PetSafe Stance Analyzer is a product that measures static body weight distribution and may be an available tool in establishing evidence based rehabilitation programs.

**Materials and Methods:** Body weight distribution (BW%) was measured in all four limbs of 13 dogs with normal orthopedic and neurologic exams. The 13 dogs were evaluated by two different handlers for a total of 10 repetitions while in two different positions. Statistical analysis was performed using a four factor ANOVA.

**Results:** Significantly more body weight was distributed to the left forelimbs compared to the right, in both positions with both handlers ( $P < 0.05$ ). When dogs were facing the exam room door, there was more body weight distributed to the left hindlimb.

**Discussion/Conclusion:** The PetSafe Vet Therapy Stance Analyzer may provide beneficial information in objectively monitoring response to rehabilitation and post-operative treatment. However, the results of our study suggest participants leaned away from the handler and thus the results may not accurately reflect true weight distribution. Further studies are indicated to determine guidelines for its use in a clinical setting with additional studies of specific disease processes and interventions to follow.

**Acknowledgments:** The PetSafe Vet Therapy Stance Analyzer and funding for statistical analysis was provided by PetSafe Vet Therapy.

#### 49 Extracellular matrix as an inductive template for temporomandibular joint meniscus reconstruction

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**Introduction:** Temporomandibular joint (TMJ) luxation or subluxation, TMJ dysplasia, or TMJ fracture, can cause TMJ meniscal damage, with subsequent degenerative joint disease and osteoarthritis. Currently no alloplastic alternatives exist to effectively replace a degenerative TMJ meniscus. Several regenerative medicine approaches to replacement of the TMJ meniscus have been investigated. In the present study we investigate the use of a biologic scaffold device composed of extracellular matrix (ECM) to promote the de novo formation of site-appropriate, functional TMJ tissue.

**Materials and Methods:** A porcine-derived ECM device configured to mimic the canine TMJ meniscus was implanted into ten dogs following bilateral disectomy. After six months the joints underwent gross morphologic, histologic, biochemical, and biomechanical analysis.

**Results:** In joints implanted with the ECM device gross examination revealed little to no pathologic changes on the articulating surfaces. Histologic evaluation of the remodeled tissue showed an aligned matrix of dense collagenous tissue, with no evidence of the implanted ECM scaffold. Biochemical and biomechanical testing showed that the remodeled ECM device had similar collagen content and compressive properties to that of the native disk.

**Discussion/Conclusion:** Remodeling of the ECM device into functional TMJ tissue likely involved modulation of the innate immune response, degradation of the scaffold with release of biologically active matricryptic peptides, recruitment of stem and progenitor cells, and site-appropriate response to mechanical stimuli. These results suggest that a xenogenic ECM scaffold material can serve as an inductive substrate for TMJ meniscus reconstruction.

**Acknowledgments:** There was no proprietary interest or funding provided for this project.

#### 50 Accuracy of measuring three-dimensional femorotibial joint poses in tibial plateau leveling osteotomy treated dogs using non-invasive, fluoroscopic kinematic analysis

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**Introduction:** Joint kinematics can be measured by tracking implants and bones on fluoroscopic images. The purpose of this study was to assess the accuracy of a non-invasive single-plane fluoroscopic technique for determining three-dimensional femorotibial poses in tibial plateau leveling osteotomy (TPLO)-treated dog stifles.

**Materials and Methods:** A computed tomographic (CT) scan of the pelvic limbs in a 25kg dog cadaver was obtained. The left cranial cruciate ligament was transected and a TPLO was performed; radiopaque beads were implanted into the femur and tibia and the CT-scan was then repeated. Orthogonal fluoroscopic images of the left stifle were obtained at flexion angles from 110° to 150°. Joint poses were calculated from the bi-planar images using radiostereometric analysis (RSA) and were compared to kinematic measurements obtained using hybrid bone-implant models, matched to the single-plane, lateral view fluoroscopic images. Single-plane measurements were performed by two observers and repeated three times by the primary



observer. Mean absolute differences between RSA and single-plane fluoroscopy were determined. Measurements were compared between observers and within the primary observer.

**Results:** The mean absolute differences between the single-plane fluoroscopic analysis and RSA measurements were 0.34 mm, 1.05 mm and 0.48 mm for cranio-caudal, proximo-distal and medio-lateral translations respectively; and 0.56°, 0.85° and 1.08° for flexion-extension, abduction-adduction and internal-external rotations respectively. Intraobserver and interobserver mean absolute translations and rotations did not vary observers by more than 0.53 mm and 0.56° respectively.

**Discussion/Conclusion:** Single-plane fluoroscopic analysis is a non-invasive technique for accurately measuring three-dimensional femorotibial poses in TPLO-treated stifles of dogs.

**Acknowledgments:** Funded by Intramural College of Veterinary Medicine, University of Florida Grant.

## 51 Effect of dorsal acetabular rim loss on the stability of cementless acetabular cups: an ex-vivo analysis

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**Introduction:** Attrition of dorsal acetabular rim (DAR) commonly seen in dysplastic hips may contribute to acetabular cup loosening in canine total hip replacement. The purpose of this study was to assess cementless cup stability with loss of DAR.

**Materials and Methods:** Polyurethane blocks were reamed and 24mm acetabular cups were manually impacted. Two patterns of loading were performed: Offset push-out and centered loading. Blocks were prepared with 0%, 25%, 50%, and 75% DAR loss (n=6). Offset and centered load at 1mm displacement and acute failure were compared between groups using one-way ANOVA. Paired hemipelvises from eight large breed dog cadavers were templated and 24mm cups were manually impacted. Left and right hemipelvises were randomly assigned to a control or 50% DAR loss group and axially loaded to failure. Load at failure, stiffness, and energy of paired hemipelvises were compared using paired t-tests.

**Results:** Mean offset load at 1mm displacement was not different between groups (P=0.425). Mean centered load to failure was greatest in blocks with 0% DAR loss (P<0.001). Loss of 25%, 50%, and 75% of DAR resulted in a 20%, 32%, and 38% decrease in load to failure in blocks. Mean load to failure (P=0.067), stiffness (P=0.707), energy (0.228) were not different between control and paired 50% DAR loss cadaveric hemipelvises.

**Discussion/Conclusion:** Loss of clinically relevant levels of DAR (up to 50%) does not appear to affect the stability of this cementless acetabular cup.

**Acknowledgments:** We acknowledge Biomedtrix Inc. for materials donation, and Merial Veterinary Scholars Program for funding.

## 52 Comparison of kinetic and temporospatial parameters in male and female cats

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**Introduction:** The aim of this study was to compare the kinetic and temporospatial parameters of clinically healthy male and female cats using a pressure-sensitive walkway.

**Materials and Methods:** Eighteen crossbreed adult cats were divided into two groups: G1 had ten male cats aged from 1 to 4 years and weighing 3.1–6.8

kg; G2 had eight female cats, aged from 1 to 6 years and weighing 3.3–4.75 kg. The peak vertical force (PVF), vertical impulse (VI), gait cycle time, stance time, swing time, stride length, and percentage body weight distribution among the four limbs were determined.

**Results:** No significant differences were observed in each group in either the forelimbs or the hind limbs or between the left and right sides for any of the variables. For both groups, the PVF (%BW), the VI, and the percentage body weight distribution were higher at the forelimbs than the hind limbs. The stride length was larger for males; however, the other kinetic and temporospatial variables did not show any statistically significant differences between the groups. The lengths of the forelimbs and hind limbs were larger in male cats. There was a correlation between the stride length and the length of the limbs.

**Discussion/Conclusion:** In conclusion, the only difference observed between male and female cats was the stride length, and this was due to the greater body size of male cats.

**Acknowledgments:** We are grateful to FAPESP, CNPq, and CAPES.

## 53 Biomechanical comparison of two transcondylar positional implants utilized for stabilization of an incomplete ossification of the humeral condyle model

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**Introduction:** The Fitz Fenestrated Tubular Transcondylar (F<sup>2</sup>T<sup>2</sup>) osteointegration screw is used in the surgical management of incomplete ossification of the humeral condyle. This study compared the biomechanical characteristics of normal humeri to humeri with an intracondylar osteotomy (IO) and humeri with an IO stabilized with a F<sup>2</sup>T<sup>2</sup> screw to a standard cortical screw.

**Materials and Methods:** Paired humeri from 10 cadaver dogs were alternately assigned (right vs. left humeri) to one of two preparation groups and axially loaded to failure. Ten additional humeri with IO were alternately assigned to one of two stabilization groups: insertion of a positional 5.85-mm F<sup>2</sup>T<sup>2</sup> screw or 4.5-mm cortical screw and axially loaded to failure. Stiffness, yield load, and load at failure were compared between groups. P < 0.05 was considered significant.

**Results:** Mean stiffness, yield load, and load at failure were greater for intact humeri and for humeri stabilized with a cortical screw.

**Discussion/Conclusion:** Performing an IO adversely affects mechanical integrity. Humeri stabilized with a F<sup>2</sup>T<sup>2</sup> screw have an 11% lower a yield load, a 12% lower maximum load at failure, and are 18% less stiff than humeri stabilized with a cortical screw. Cyclic implant testing is needed to evaluate implant fatigue life.

**Acknowledgments:** All F<sup>2</sup>T<sup>2</sup> implants were designed, manufactured, and provided by OrthoFitz, UK, of which the co-author is a director.

## 54 How does fetlock extension, collateromotion and axial rotation influence bone strain on the dorsoproximal cortex of the proximal phalanx of the horse?

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**Introduction:** Sagittal fractures of the equine proximal phalanx (P1) are thought to result from compression and twisting of the third metacarpal bone (MC3) sagittal ridge into the P1 sagittal groove. We hypothesised that metacarpophalangeal joint (MCPJ) hyperextension would be accompanied by collateromotion and axial rotation of P1, with an increase in P1 bone compressive and shear strains.





**Materials and Methods:** Unilateral limbs from 6 cadavers were instrumented with bone reference markers for measuring MCPJ extension, collateromotion and axial rotation during limb loading to 10,500N. Strain gauges (one rosette, one uniaxial) were attached to dorsoproximal P1. Bone reference markers, recorded by video, were digitized and analysed to determine motion of P1 relative to MC3 during loading. Strain gauge data were reduced to determine principal and shear strain magnitude and direction.

**Results:** MCPJ extension, external axial rotation and collateromotion angles increased with increasing load. Minimum principal strain was negligible until 7000–8000N load, after which compressive strain increased rapidly to –1500  $\mu$ strain. Shear strain maximum increased to 3000  $\mu$ strain with a power relationship to load. The direction of P1 principal compressive strain shifted approximately 40° as load increased from 5400N to 10,000N, moving from a proximolateral to a proximodistal axis.

**Discussion/Conclusion:** At near maximal fetlock extension, with concurrent axial rotation and collateromotion, there is a rapid, pronounced increase in dorsoproximal P1 compressive and shear bone strains and a change in principal strain direction. These circumstances could promote sagittal fracture of P1.

**Acknowledgments:** There was no proprietary interest or funding provided for this project.

### 55 Radiation therapy in painful osteoarthritis in dogs – analgesic efficacy and duration of the analgesic effect

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**Introduction:** Degenerative joint disease is among the most common reasons for severe lameness. Besides the usual treatment radiation therapy is an established option in humans. The purpose of this study is to evaluate the analgesic effect of radiation therapy on a subjective and objective base in dogs with painful osteoarthritis (OA). It was hypothesized that low-dose radiation therapy in dogs with OA leads to excellent and long lasting pain control.

**Materials and Methods:** Patients included in this study were dogs suffering from OA refractory to common treatment protocols. Radiation therapy consisted of 3 fractions of 2 Gy. Veterinary-assessed mobility index (VAMI) was collected in week 1, 2, 4, 6, 14, 22, 30. Furthermore the dogs were evaluated utilizing a Visual analogue scale (VAS) and the GAIT4DOGS Electronic Walking System (Gait4) at each follow up. Owners were asked to complete the Helsinki chronic pain index questionnaire (HCP).

**Results:** Ten dogs were included with a mean age of 8.5 years and mean weight of 35.7 kg. Results of the VAMI showed improvement in 9 of 10 dogs. A reduction in the VAS was seen in 80% and according to the HCP 60% of the owners recognized improvement. Results gained by the Gait4 were constant.

**Discussion/Conclusion:** Veterinary-assessed mobility index showed obvious improvement in 90% of the dogs over the median follow up time (4 months). Low dose radiation therapy is an excellent treatment option for dogs with OA.

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### 56 Evaluation of the drawer test and the tibial compression test for differentiating between cranial and caudal stifle subluxation associated with cruciate ligament instability

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**Introduction:** There are no reports of the sensitivity and specificity of the DT when stifle pathology extends beyond the cranial cruciate ligament (CrCL). We hypothesized the drawer test (DT) would poorly distinguish between CrCL, caudal cruciate ligament (CdCL), and rupture of both cruciate ligaments (TCL); combining the DT and tibial compression test (TCT) would increase the sensitivity and specificity of evaluator's final diagnosis; and evaluator experience level would correlate with diagnostic accuracy.

**Materials and Methods:** Cruciate ligaments from pelvic limbs disarticulated at the coxofemoral joint were kept intact or the CrCL, CdCL, or both were transected. Evaluators performed the DT and the TCT and a diagnosis was recorded following the DT and then based on the combination of the 2 tests. Sensitivity, specificity, and 95% confidence intervals (CIs) were calculated for the DT alone and for the test combination, based on evaluator category. The  $\chi^2$  test was used to evaluate differences between evaluator categories. For all analyses, values of  $P < .05$  were considered statistically significant.

**Results:** Sensitivity and specificity of the DT ranged from 26–69% and 79–97%, respectively, for determining the cause of instability associated with CrCL, CdCL and TCL injury. Utilization of the TCT and evaluator experience did not change the sensitivity and specificity values, as all 95% CIs overlapped.

**Discussion/Conclusion:** Participant's ability to determine the cause of stifle instability was poor. Our results suggest that when stifle pathology extends beyond the CrCL, the diagnostic performance of the DT and TCT dramatically decreases.

**Acknowledgments:** Dr. Jim Lincoln for his support of the project.

### 57 Three dimensional morphological analysis of the lateral surface of the canine femur

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**Introduction:** A reliable template for contouring bone plates preoperatively would be invaluable for surgical planning. Our objective was to analyze the lateral surface of the femur of mature non-chondrodystrophic dogs to determine locations for plate bend/twist and assess femoral variability. We hypothesized that mature femurs were sufficiently analogous to provide a pattern for bone plate contouring.

**Materials and Methods:** CT images of 30 normal femurs were uploaded to surgical planning software and 13 points of interest and their respective bend/twist angles were identified on the lateral surfaces. Mean, standard deviation, coefficient of variation and range were calculated for each bend/twist angle. Hierarchical Clustering and Fast Fourier Analyses were used to segment the population. Distribution of age, breed, sex and weight was evaluated between clusters with an exact Wilcoxon-Mann-Whitney test.

**Results:** The coefficient of variation of bending ranged from 17% to 46% and twisting ranged from 21% to 58%. Although there were no differences between dogs in proximal femur anatomy, two clusters of 9 and 21 dogs each were identified due to differences in bend/twist angles in the distal femur. There was no difference between clusters for age ( $P=0.85$ ), breed ( $P=0.62$ ) and sex ( $P=0.15$ ), however, weight differed ( $P=0.03$ ) but was not predictive.



**Discussion/Conclusion:** Although distal femoral lateral surfaces varied sufficiently to result in two population clusters, further analysis is needed to determine if the differences prevent using the mean bending and twisting parameters as a template for clinical applications.

**Acknowledgments:** There was no proprietary interest or funding provided for this project.

## 58 The effect of tibial plateau angle on cranial cruciate ligament strain: an ex vivo study in the dog

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**Introduction:** Changing the tibial plateau angle (TPA) is commonly used for the treatment of dogs with complete rupture of the cranial cruciate ligament (CCL). Changing the TPA has been proposed for treatment of a partial rupture of the CCL. It has been suggested that the CCL has the ability to heal and prophylactic TPA techniques for dogs that predisposed to disease of the CCL may be protective. The objective of this study was to evaluate the relationship between TPA and strain in the intact CCL during axial loading.

**Materials and Methods:** Six adult canine cadaveric knee specimens were collected. A bi-radial saw was used to perform the osteotomy and a custom designed plate was secured to the leg. Each knee was loaded and CCL strain and axial displacement were recorded. TPA was adjusted to -20, -10, 0, +10, +20 degrees of normal. Change in strain was assessed during the axial loading period.

**Results:** For all specimens linear displacement of the femur and CCL strain increased with increasing axial load. Mean change in strain was 4.41, 5.26, 6.02, 6.3 and 7.39 at -20°, -10°, 0°, 10° and 20°, respectively. The R-squared for the linear regression equation was 0.91 suggesting a predictable relationship between change in TPA and CCL strain.

**Discussion/Conclusion:** The mechanical testing model used found an expected relationship between axial load, tibial translation and CCL strain. CCL strain increased with increasing axial load regardless of the TPA.

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## 59 In vivo heterotopic model of osteogenic differentiation of equine bone marrow and muscle mesenchymal stem cells in fibrin glue scaffold: a pilot study

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**Introduction:** Autologous mesenchymal stem cells (MSCs) have been used in potential cell based therapy in different animal and human diseases. Their differentiation capacity makes them useful as a novel strategy in the treatment of tissue injury where the healing process is affected or delayed. In horses, bone healing is slow often taking a minimum of 6–12 months.

**Materials and Methods:** The osteogenic capacity of equine bone marrow and muscle MSCs mixed with fibrin glue or PBS as a scaffold was tested in nude mice. Bone production by the following groups was compared: Group 1: Bone marrow (BM) MSCs in fibrin glue. Group 2: Muscle (M) MSCs in fibrin glue. Group 3: BM MSCs in phosphate buffered saline (PBS). Group 4: M MSCs in PBS and, Group 5: fibrin glue without cells. BM and M MSCs underwent osteogenic stimulation for 48 hours prior to intramuscular injection in nude mice. After 4 weeks, nude mice were euthanized; muscle samples were collected, evaluated for bone formation and mineralization using radiology, histochemistry and immunohistochemistry.

**Results:** Positive bone formation and mineralization were confirmed in nude mice from Group 1 based on calcium deposition, presence of osteocalcin and collagen type I, and observation of a radiopaque area. No evidence of mineralization or bone formation was observed in Groups 2, 3, 4 and 5.

**Discussion/Conclusion:** In this animal model, equine BM MSCs mixed with fibrin glue were shown to have a better osteogenic differentiation capacity compared to BM MSCs in PBS and M MSCs in either carrier.

**Acknowledgments:** Funding: ACOA

## 60 Microcomputed tomography, microradiography and histology to assess subchondral bone changes in osteochondritis dissecans lesions in dogs

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**Introduction:** Microcomputed tomography ( $\mu$ CT) is a robust and efficient tool for quantitative analysis of bone microarchitecture. The goal of this study was to evaluate the utility of  $\mu$ CT and microradiography in quantifying changes in subchondral bone microstructure in dogs with OCD. We hypothesized that there would be significant differences between two-dimensional (2D) microradiographic data and three-dimensional (3D)  $\mu$ CT data, and that volumetric data from 3D  $\mu$ CT reconstructions would differ from those calculated with less data-intensive 2D  $\mu$ CT reconstructions.

**Materials and Methods:** Osteochondral specimens from five affected joints were bisected and processed in parallel for descriptive histology and quantitative analysis of fractional trabecular bone content (BV/TV) using microradiography and  $\mu$ CT.

**Results:** By microradiography, mean ( $\pm$ SD) BV/TV were 86.53 $\pm$ 4.93% (lesion) and 75.53  $\pm$ 5.52% (reference) respectively ( $p=0.07$ ). Mean ( $\pm$ SD) depth of bone involvement in the lesion was 8.46 $\pm$ 3.27 mm (range 1.52 to 12.67 mm). 2D  $\mu$ CT estimates of BV/TV were 71.58 $\pm$ 25.83% (lesion) and 47.63 $\pm$ 7.68% (reference) ( $p=0.029$ ). Equivalent data for the 3D (volumetric)  $\mu$ CT measurements were 71.19 $\pm$ 26.30% (lesion) and 46.97 $\pm$ 7.72% (reference) ( $p=0.03$ ). A strong correlation was identified between microradiography and both 2D ( $r=0.794$ ,  $p=0.002$ ) and 3D  $\mu$ CT ( $r=0.790$ ,  $p=0.002$ ). There was perfect correlation between 2- and 3D  $\mu$ CT data ( $r=1.00$ ,  $p<0.0001$ ).

**Discussion/Conclusion:** Microradiography provides an accurate estimate of subchondral bone microstructure in OCD. Subchondral bone disruption is extensive in both width and depth, and this has important implications for the rational use of osteochondral grafts in the management of canine OCD.

**Acknowledgments:** Supported by an intramural grant from the College of Veterinary Medicine.

## 61 Evaluation of two techniques for femoral guide pin placement in canine hip resurfacing

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**Introduction:** The objective of this study was to compare the accuracy of guide pin placement in the femoral neck using either a free-hand technique or a fluoroscopic-guided technique.

**Materials and Methods:** The free-hand technique was performed on one hip and the fluoroscopic-guided technique on the other hip of ten cadavers based upon a coin flip. Pins were placed by one surgeon (SPF). For the free-hand technique the hip was exposed by a craniolateral approach, the femoral head removed, and a K-wire driven from the cut surface through the proximal lateral femur. For the fluoroscopic technique the femoral head was not removed and the tip of a C-guide was placed immediately dorsal to the round ligament. The other end of the guide was positioned on the lateral femur under fluoroscopic guidance and the K-wire driven from the lateral femur through



the femoral head. Radiographs were made and the placement error defined as the angle between the femoral neck axis and pin axis. Errors in the frontal and sagittal planes were combined ( $\sqrt{\text{error in the frontal plane}^2 + \text{error in the sagittal plane}^2}$ ) to quantify the maximum error. Maximum errors were compared using a paired t-test.

**Results:** The mean error using the free-hand technique was  $13.9^\circ (\pm 8.26)$  and was significantly greater than the mean error using fluoroscopy ( $5.7 \pm 2.95$ ;  $p=0.017$ ).

**Discussion/Conclusion:** Pin placement was significantly more accurate when fluoroscopy was used.

**Acknowledgments:** The C-guide was provided by Arthrex.

## 62 Genetic marker tests to predict cranial cruciate ligament rupture in the Newfoundland and the Labrador

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**Introduction:** Rupture has a high prevalence in some breeds suggesting a genetic component. The purpose of this research was to try to identify a genetic test for RCCL in the Newfoundland and Labrador retriever breeds of North America.

**Materials and Methods:** Affected dogs had RCCL before two years of age or had bilateral RCCL. Normals were at least eight years of age. Dogs randomly assigned to group 1 (decision tree creation) or group 2 (decision tree trial). Genomic DNA was genotyped on Illumina CanineHD SNP arrays. For group 1, logistic regression tests determined the SNPs most significantly associated with disease and correction for multiple testing was applied using phenotype label-swapping permutations. The alleles for the most significant SNPs were subjected to Black-Box Probabilistic Modeling resulting in a decision tree where the alleles of SNPs could be used to best predict RCCL in dogs from Group 1. This decision tree was subsequently applied to the genomic data from group 2 dogs to determine accuracy via Sanger sequencing.

**Results:** The decision tree that best predicted disease status included three SNPs for the Newfoundland and six SNPs for the Labrador. For the Newfoundland, sensitivity was 79%, specificity was 71%, disease prevalence was 22%, NPV was 9.2%, and PPV was 43.5%. For the Labrador sensitivity was 64%, specificity was 80%, disease prevalence was 7.34%, NPV was 2.2%, and PPV was 22.3%.

**Discussion/Conclusion:** These genetic tests improve risk assessment for a dog that will develop RCCL.

**Acknowledgments:** None

## 63 Mechanical torsional properties of tibiae following modified maquet technique or tibial tuberosity advancement

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**Introduction:** The purposes of this study were to quantify the variations in biomechanical torsional properties of the tibia following Modified Maquet Technique (MMT) or Tibial Tuberosity Advancement (TTA), and compare MMT versus TTA.

**Materials and Methods:** Twenty dogs were randomly assigned to MMT ( $n=10$ ) or TTA ( $n=10$ ) group. For each dog, one tibia was assigned for MMT or TTA and the contralateral tibia was used as a control. Tibiae were embedded in a polyester resin and tested up to failure at a constant  $1^\circ/s$  rate of

internal rotation. Torsional strength, twist angle, rotational stiffness and energy absorbed at failure were calculated.

**Results:** When compared to the control leg, torsional strength and energy absorbed at failure were decreased for MMT and TTA ( $p < 0.01$ ). There was no difference between MMT and TTA for these 2 parameters. Rotational stiffness was decreased for TTA  $p=0.02$ , but not for MMT. The difference between MMT and TTA was significant.

**Discussion/Conclusion:** Both techniques decrease the biomechanical torsional properties of the tibia. Extending the osteotomy of MMT in the proximal diaphysis does not result in a higher decreased torsional strength and energy absorbed when compared to drilling 2 holes in the proximal diaphysis with TTA. Decreased rotational stiffness with TTA may be due to the diaphyseal screw holes. Considering that clinically TTA is not commonly associated with tibial fracture, tibiae with MMT are likely to withstand physiological torsional loading *in vivo*.

**Acknowledgments:** There was no proprietary interest or funding provided for this project

## 64 The effect of lysophosphatidic acid on bone healing in dogs – a pilot study

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**Introduction:** The purpose of this study was to determine the ideal dose of LPA incorporated into a collagen sponge that would maximally stimulate bone healing in dogs. Our hypotheses were that bone defects containing LPA on a collagen sponge would have greater bone healing characteristics compared to defects containing a saline soaked collagen sponge, and greater LPA concentrations would improve bone healing over lower concentrations.

**Materials and Methods:** Bilateral ulnar osteotomies were performed on 4 purpose bred beagles split into two groups. Control defects were filled with a saline soaked collagen sponge, while treatment defects were filled with a collagen sponge containing a 1mM (Group A) or 5mM (Group B) LPA solution. Dual-energy X-ray absorptiometry (DXA) was performed 48 hours after surgery and biweekly for 10 weeks after surgery. Total bone area (TBA), mineral density (BMD) and mineral content (BMC) were collected at each time point. Data was analyzed using repeated measures ANOVA with the Bonferroni multiple comparisons test used post-hoc to determine relationships between the effect of treatment over time on TBA, BMC and BMD.

**Results:** There was no significant difference in TBA ( $p=0.078$ ), BMC ( $p=0.77$ ), or BMD ( $p=0.063$ ) over time between treatment and control groups.

**Discussion/Conclusion:** We suspect critical size defects contributed to the lack of healing. Based on ectopic bone formation achieved with the use of BMP-2 in other studies, the osteoinductive capability of LPA, at the concentrations used, is not equivalent to that of BMP-2.

**Acknowledgments:** We wish to thank the Comparative Orthopedic Research Laboratory staff for their valuable assistance in conducting this project. This study was funded by an intramural grant.

## 65 Biomechanical comparison of 3.0 mm headless compression screw and 3.5 mm cortical bone screw in a canine lateral humeral condylar fracture model

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**Introduction:** Lateral condylar fractures are the most common humeral fractures in dogs. Headless compression screws (HCS) are cannulated, simplify





ing placement and minimizing soft tissue impingement compared to traditional cortical bone screw lag fixation (CBS). We hypothesized that there will be no significant differences between the mechanical properties of CBS vs HCS stabilized humeri.

**Materials and Methods:** Standardized osteotomies were stabilized with 3.0mm HCS in one limb and 3.5mm CBS in the contralateral limb. Condylar fragments were loaded to walk, trot and failure loads while measuring proximal and rotational displacements of the fracture fragment.

**Results:** No significant differences ( $p < 0.05$ ) were found for proximal and rotational fragment displacements at walk and trot loads, however residual proximal displacements for HCS and CBS fracture fragments were statistically greater than zero. Although fragment rotation was not statistically different between screws, rotation was statistically different from zero and correlated with moment arm length ( $R^2 0.25$ ). Mean stiffness was significantly greater for CBS than HCS constructs.

**Discussion/Conclusion:** Both constructs yielded above physiologic walk and trot loads. HCS are a viable option in the repair of traumatic lateral humeral condyle fractures in dogs, but should be supplemented with antirotational fixation.

**Acknowledgments:** HCS were provided at a discounted rate.

## 66 Validation of a novel radiographic method for tibial plateau angle measurement in large and giant breed dogs

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**Introduction:** Accurate tibial plateau angle (TPA) measurement is crucial for proper TPLO execution. Centering the x-ray beam over the stifle and collimation to include the tarsus results in the most accurate TPA measurement. Tibial length in large and giant breed dogs prevents inclusion of both the stifle and tarsus in a stifle-centered radiograph. Contemporary digital imaging software permits 'stitching', or combining two separate radiographs, a stifle-centered and a tarsus-centered, into a single image analogous to a properly centered and collimated image. We hypothesized that the novel image 'stitching' technique would result in more accurate TPA measurements when compared to the traditional method in large and giant breed dogs.

**Materials and Methods:** Three medio-lateral radiographic projections were obtained from 34 paired pelvic limbs. Each of eight observers performed image stitching and traditional (tTPA) and stitched (sTPA) measurements. Anatomic TPA (aTPA) was measured as previously described.

**Results:** There was no statistically significant difference between observers for tTPA and sTPA measurements. No significant difference was observed in the mean TPA between the tTPA, sTPA, and aTPA.

**Discussion/Conclusion:** This novel method produced radiographic TPA measurements consistent with the aTPA. However, no difference was shown between this technique and a tibia-centered view. Regardless, this novel digital imaging technique provides an alternative method for measuring TPA without the need for the traditional TPLO view. This may be useful in large and giant breed dogs because of their size, or in patients where visualization of the tibial plateau is difficult due to severe osteoarthritis or ALD.

**Acknowledgments:** This study was funded by the PVM Student Grant Program in the Center for Companion Animal Studies at Colorado State University.

## 67 Influence of orchietomy on hormonal status and bone metabolism in horses

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**Introduction:** Musculoskeletal pathologies are common in horses. Aim of this study was to evaluate whether orchietomy (O) affect bone cell activity evaluated by serum biochemical bone markers in horses.

**Materials and Methods:** Twenty stallions, aged 2 to 3 years (mean 2.59 SD  $\pm$  0.09 years), were blood sampled eight times during a nine-months period. Nine stallions were castrated (Group C); 11 stallions remained as control group (Group S). Venous blood sampling was performed four days before O ( $T_{-4D}$ ), the day of O ( $T_{0D}$ ), in five four-week intervals after O ( $T_{+4w}$ ;  $T_{+8w}$ ;  $T_{+12w}$ ;  $T_{+16w}$ ;  $T_{+20w}$ ) and 36 weeks after O ( $T_{+36w}$ ). Routine blood-, fibrinogen-, creatinine- and gamma-glutamyl-transferase-activity (GGT) sampling was performed at  $T_{0D}$ . Serum samples were analyzed for their content of osteocalcin (OC), bone alkaline phosphatase activity (BALP), carboxyterminal crosslinking telopeptid of type-I-collagen (CTX-I), testosterone (T) and estrogen ( $E_2$ ).

**Results:** Routine blood samples, GGT, content of creatinine and fibrinogen were normal. Bone formation markers were higher in Group C after O. In Group C, serum OC values were significantly higher at  $T_{+12w}$  and  $T_{+16w}$  ( $p < 0.05$ ) and serum BALP activity was significantly higher ( $p < 0.05$ ) at  $T_{+36w}$ . Serum CTX-I concentrations were significantly higher at  $T_{+12w}$  and  $T_{+16w}$  ( $p < 0.05$ ) in Group C. Serum T and  $E_2$  values were significantly lower ( $p < 0.001$ ) in Group C after O compared to Group S.

**Discussion/Conclusion:** Orchietomy leads to higher bone turnover with higher activities in bone resorption and formation over the observed period.  $E_2$  and T seem to have bone saving effects in stallions.

## 68 Non-invasive measure of bone density to predict mechanical properties of the vertebral endplate in the canine cervical spine

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**Introduction:** Implant subsidence is a clinically significant problem in humans and dogs with cervical interbody cages, grafts or disc replacements. A reliable and predictive method of endplate fracture risk is required to further minimize postoperative complications. We hypothesized that the structural properties (stiffness and peak load) of the endplate would correlate to the endplate bone mineral density (BMD) measured on computed tomography (CT) and dual-energy x-ray absorptiometry (DEXA).

**Materials and Methods:** Ten skeletally mature cervical spines (C3-C6) underwent quantitative CT scan, DEXA and indentation testing of the cranial endplate.

**Results:** No correlation was found between trabecular BMD measured by DEXA and QCT. Mean ( $\pm$  SD) initial stiffness and peak load of the endplate were  $776.85 \pm 32.2$  N/mm and  $537.4 \pm 47.94$  N, respectively. Mean ( $\pm$  SD) area of the endplate was  $157.2 \pm 4.5$  mm<sup>2</sup>. No significant difference was found across the cervical levels for any variable. Endplate BMD was weakly but significantly correlated to initial stiffness ( $r^2 = 0.14$ ,  $p = 0.027$ ). A stronger relationship was identified between endplate BMD and peak load ( $r^2 = 0.65$ ,  $p = 0.0001$ ). There was no association between initial stiffness ( $p = 0.57$ ) and peak load ( $p = 0.71$ ) when compared to endplate area.

**Discussion/Conclusion:** The results from this study demonstrate that endplate BMD measured by QCT predicts the mechanical properties of the endplate. These findings suggest that preoperative assessment of BMD may be useful as a guide to patient and surgical technique selection in dogs that are being evaluated as candidates for interbody fusion or total disc replacement.

**Acknowledgments:** There was no proprietary interest or funding provided for this project.



## 69 Static stress magnetic resonance imaging of the canine stifle: a cadaveric feasibility study

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**Introduction:** Imaging under loading stress has been hypothesized to improve the diagnostic value of magnetic resonance imaging (MRI) for musculoskeletal conditions in humans. The objective of this study was to determine the feasibility of two techniques of stress MRI in the evaluation of the canine stifle.

**Materials and Methods:** right or left stifles of 10 cadavers of various breeds (20–30 kg) underwent MRI (1.5 T) under conditions of loading stress simulating tibial compression test (MRI-TCT) or cranial drawer (MRI-CD). Stifle were tested with an intact and transected CrCL. Medial and lateral femorotibial subluxation induced by MRI-TCT and MRI-CD were compared using a one way ANOVA repeated measures ( $p < 0.05$ ). Measurement were performed by three different observers to define interobserver agreement.

**Results:** No statistically significant difference was found between the femorotibial poses measured between the stress MRI techniques. With MRI-TCT, the mean $\pm$ SD cranial tibial translations in the medial and lateral compartments were 9.64 $\pm$ 3.7 mm and 10.06 $\pm$ 4.1 mm, respectively. With MRI-CD the mean $\pm$ SD cranial tibial translations in the medial and lateral compartments were 8.38 $\pm$ 3.3 mm and 9.5 $\pm$ 3.5 mm, respectively. The agreement between observers was strong (ICC = 0.99).

**Discussion/Conclusion:** Our results showed that both techniques caused cranial tibial subluxation and may be used for stress MRI. Further studies are needed to evaluate the role of stress MRI in the diagnosis of stifle abnormalities in dogs.

**Acknowledgments:** None

## 70 Comparison of the tibial mechanical joint orientation angles in dogs with unilateral, unilateral with subsequent rupture and bilateral cranial cruciate ligament rupture

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**Introduction:** Variation in stifle joint anatomy has been implicated as a risk factor for cranial cruciate ligament rupture (CrCLR). The objective was to compare the tibial mechanical joint orientation angles (TMJOAs) and tibial plateau angle (TPA) between dogs with unilateral rupture (UR-w/o-SR), unilateral with subsequent rupture (UR-SR), and bilateral rupture (BR) and determine whether tibial alignment, when assessed in this manner, can be used to predict the development of contralateral CrCLR.

**Materials and Methods:** Medical records of dogs with CrCLR from July 2006 to June 2007 were reviewed and the TMJOAs and TPA were measured bilaterally. The median TMJOAs and TPA were compared between dogs with UR-w/o-SR, UR-SR and BR, and also between the index and contralateral limbs for the UR-w/o-SR and UR-SR groups.

**Results:** The median TMJOAs and TPA were not statistically different between the UR-w/o-SR (n=34), UR-SR (n=38), and BR (n=20) groups. The median mechanical cranial distal tibial angle (mCrDTA) of the index and contralateral limbs was statistically different for the UR-SR group ( $P=0.014$ ). The median mechanical medial proximal tibial angle (mMPTA) of the index and contralateral limbs was statistically different for the UR-w/o-SR group ( $P=0.022$ ).

**Discussion/Conclusion:** The TMJOAs and TPA in the range studied ( $<35^\circ$ ) were not useful predictors of the development of contralateral CrCLR; at the time of initial presentation or subsequent to the initial diagnosis. The difference between the mCrDTA and mMPTA of the index and contralateral limbs, for the UR-SR and UR-w/o-SR, respectively was small and likely of limited clinical significance.

**Acknowledgments:** None

## 71 Radiographic, 2D and 3D CT measures on juvenile canine hips indicate osteoarthritis at maturity

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**Introduction:** To evaluate relationships among radiographic, 2D and novel 3D computer tomography (CT) measures with hip osteoarthritis (OA) from youth to maturity in a homogenous canine population.

**Materials and Methods:** Measures were performed on one hip (n=46) at 16, 32 and 104 weeks of age. Distraction index (DI) and OA severities were obtained from PennHIP. Norberg angle (NA) was measured on ventrodorsal radiographs. The center-edge (CE), ventral acetabular sector (VASA), dorsal acetabular sector (DASA), horizontal acetabular sector (HASA), horizontal toit externe (HTE) and acetabular anteversion (AA) angles, acetabular index (AI) and percent femoral head coverage (CPC) were measured on 2D CT images. Femoral head (FHV) and neck (FNV) volumes, neck angle (FNA), head (FHR) and neck radius (FNR) were measured on 3D CT reconstructions. Stepwise regression and ANOVA models were performed ( $p < .05$ ).

**Results:** Most 2D and 3D measures had significant linear relationships with each other across and within ages within dimension type, relationships were limited relationships between dimension types. The 16 and 32 week DI, CE, DASA, HASA, CPC, AI and NA and the 32 week FNA were significantly different among 104 week OA severities. The 16 week DI and CE and 32week DASA and NA best represented 104 week OA.

**Discussion/Conclusion:** There are differences in canine hip morphology as early as 16 weeks among dogs that develop different hip OA severities at maturity. Combined measures have a stronger relationship with adult hip OA than any single measure, but the best combinations differ among ages.

**Acknowledgments:** None

## 72 Evaluation of the analgesic properties of tramadol using a reversible lameness model in dogs

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**Introduction:** Tramadol is a synthetic and codeine-derived analgesic widely used for the treatment of pain in small animals. Although the pharmacokinetic properties of per os (PO) tramadol have been evaluated in dogs 1–4, the professed analgesic properties provided by the drug without combination of other analgesics has yet to be quantitatively determined. A humane, simple, repeatable, non-invasive/ topical, and reversible pain model in normal dogs would be ideal to objectively assess the analgesic properties of tramadol.

**Materials and Methods:** 12 healthy dogs were used for the study. A toy jack was placed into the paw pad recesses of the thoracic and pelvic limbs. Dogs were trotted over an imbedded force plate. Peak vertical force (PVF), vertical impulse (VI), and stance time were recorded before and following tramadol administration (5 mg/kg, PO).

**Results:** Compared to baseline, jack placement on the thoracic and pelvic limb paws resulted in greater mean reduction of PVF ( $p=0.0001$  and  $p=0.0065$ , respectively) and VI; thoracic limb paws ( $p=0.0042$ ) and a trend for pelvic limb paws ( $p=0.0547$ ), compared to baseline. Tramadol administration did not change PVF or VI for thoracic or pelvic limb paws with jack





placement. Thoracic or pelvic limb stance time was not affected by the administration of tramadol.

**Discussion/Conclusion:** Although our model produced lameness in dogs, oral tramadol did not significantly improve the ground reaction forces or stance time when the noxious stimulus was generated during gait.

**Acknowledgments:** Funding support provided by the Comparative Orthopedic Research Laboratory.

### 73 Distal tibial tuberosity translation for the treatment of canine patella alta

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**Introduction:** Patella alta is defined as a patellar length (P) to patellar tendon length (L) of greater than 2 and may contribute to patella luxation in large breed dogs. This study aims to describe a novel surgical technique and the clinical outcome in large breed dogs. We hypothesized that distal tibial tuberosity translation and fixation using TTA hardware will correct patella alta in dogs weighing more than 20 kg and lead to resolution of lameness.

**Materials and Methods:** Dogs with radiographically confirmed patella alta underwent a distal tibial tuberosity transposition that was secured using a TTA plate and fork. Radiographs were reviewed for OA scoring, osteotomy union and implant positioning. An owner questionnaire modified from a previously validated model was used to assess outcome.

**Results:** Eleven stifles from 9 dogs had a mean pre-operative L:P ratio was 2.497 (range 2.1–2.833). Mean body weight was 33.5kg (range 20.3kg–54.5kg) and the mean age was 19.5 months (range 10–42 months). The mean translation distance of the tibial tuberosity was 13.9mm (range 9mm–20mm). OA scores were not significantly different pre- or post-operatively for global OA score ( $p=0.083$ ), or joint effusion ( $p=1.00$ ), but were significant for osteophyte formation ( $p=0.046$ ). There were no complications, all the osteotomies healed within 8 weeks, and owner satisfaction was excellent.

**Discussion/Conclusion:** Patella alta may contribute to lameness and patellar instability. A significant number of dogs in this study had lameness without directional luxation suggesting the patellar instability is due to the proximal position of the patella within the trochlear groove.

**Acknowledgments:** None.

### 74 Characterization of intra-articular structures and carpal joint communication in the canine antebrachio-carpal joint using computed tomography

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**Introduction:** Carpal injuries in the canine can be difficult to diagnose accurately, and are not uncommon in athletic dogs. Ability to visualize intra-articular structures of the antebrachio-carpal joint in the dog would be useful in the diagnosis of forelimb lameness. Additionally, the degree of communication between the canine carpal joints has not been described, but an understanding of this anatomy would improve pre-surgical planning and treatment. The goal of this study was to determine joint communication between the carpal joints and characterize the stabilizing soft tissue structures of the antebrachio-carpal joint using computed tomography (CT).

**Materials and Methods:** CT was performed on 18 canine cadaver forelimbs using a 64 slice helical Toshiba Aquilion computed tomography scanner at 80–120 kVp, 350 mA. Contrast (iopamidol 370mg I/ml, diluted to a 10% solution) was then injected into each antebrachio-carpal joint to distension and the CT scan was repeated. All images were evaluated in transverse, sagittal, and frontal planes, in soft tissue and bone kernels.

**Results:** In two limbs, the carpal joints were not positioned in extension, precluding accurate interpretation of the images. The arthrogram, followed by the soft tissue kernel, allowed for the clearest visualization of intra-articular ligaments.

**Discussion/Conclusion:** There was no joint communication between the antebrachio-carpal joint and other carpal joints. The majority of the antebrachio-carpal intra-articular structures were best seen on the frontal plane, due to the naturally compressed conformation of the carpus. This anatomic knowledge may help in the diagnosis and treatment of canine carpal injuries.

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### 75 Pharmacological evaluation of phycox® and constituents

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**Introduction:** Phycox® is a line of joint support supplements for dogs and horses for the treatment of osteoarthritis and relief of arthritic pain. Many of the active constituents, including c-phyco-cyanin, are recognized anti-inflammatory and antioxidant agents. Phycox® Soft Chews for dogs were investigated in this study.

**Materials and Methods:** Antioxidant activity as well as COX-1, COX-2 and LOX inhibition activity of Phycox® and select constituents were evaluated using commercially available assay kits. An *in vitro* canine chondrocyte inflammation model was designed to assess the anti-inflammatory effects of Phycox® and active ingredients compared to carprofen in the production of various mediators released during inflammation; nitric oxide, prostaglandin E<sub>2</sub>, sulfated glycosaminoglycans, matrix metalloproteinase-3, soluble collagen, tumor necrosis factor- $\alpha$  and interleukin-6 using commercially available assay kits.

**Results:** The antioxidant activity was concentration-dependent with grape seed extract, ascorbic acid and Phycox® having the greatest activity. All constituents showed potent COX-1 and COX-2 inhibition with slightly greater inhibition of COX-2. Concentration-dependent LOX inhibition was shown by many constituents. Dose-dependent relationships were seen in the reduction of various inflammatory mediators.

**Discussion/Conclusion:** Phycox® and its individual components have potent antioxidant and anti-inflammatory properties. Further studies are ongoing to characterize the pharmacokinetics of select ingredients of Phycox® as well as to determine clinical efficacy of Phycox® in canines.

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### 76 Torsional analysis of 5 mm clamp rod internal fixator/intramedullary rod and 3.5 mm limited contact dynamic compression plate/intramedullary rod constructs in a canine femoral gap model

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**Introduction:** The objective of this study was to determine the torsional rigidity and permanent angular deformation of CRIF/rod and LC-DCP/rod constructs. We hypothesized that the CRIF/rod construct would possess lower rigidity and higher deformation when examined in torsion.



**Materials and Methods:** Five pairs of canine femora were randomly treated with 40 mm ostectomies and CRIF/rod or LC-DCP/rod constructs. Constructs were rotated 30 deg at 0.2 deg/sec with a torsion load frame. The load was then removed allowing the device to recoil. Residual rotation was recorded as permanent angular deformation. Torsional rigidity of a given construct was determined by performing linear curve fit to the averaged load-deformation data for the respective construct. Statistical significance was determined using t-tests ( $p < 0.05$ ).

**Results:** The CRIF/rod constructs exhibited bi-phasic behavior wherein a distinct transition in torsional rigidity was observed. While there was similar rigidity from 0–4.5Nm torque, the LC-DCP device was significantly more rigid above 4.5Nm. The CRIF experienced substantial permanent angular deformation, remaining rotated by an average of 23 deg +/- 0.89 deg. The LC-DCP also experienced deformation, but to a significantly lower extent (7.5 deg +/- 2.08 deg).

**Discussion/Conclusion:** These data demonstrate that while the CRIF system is comparable to the LC-DCP system at low torque, it is less rigid at higher loads. These findings should be considered when utilizing CRIF/rod fixation in a clinical setting.

**Acknowledgments:** There was no proprietary interest for this study. The study was funded internally. Implants were generously provided by Synthes-Vet.

## 77 Arthroscopy and pre-operative radiography and computed tomography findings in 224 canine elbows

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**Introduction:** The elbow joint is a common location for orthopedic disease in dogs, frequently manifesting as clinical lameness. Arthroscopy is a minimally invasive procedure that allows both visual inspection of the elbow joint and surgical treatment for many common pathologies. The purpose of this study is to describe the predictive value of radiography and computed tomography (CT) as imaging modalities for surgical planning and arthroscopic findings for elbow disease.

**Materials and Methods:** Medical records from 2006–2012 were retrospectively reviewed for information on signalment, date of arthroscopy, date and form of preoperative imaging (radiographs and/or CT), imaging findings, and arthroscopic findings. Arthroscopic findings from 224 elbow procedures (134 canine patients) were compared to radiographic and/or CT reports preoperatively.

**Results:** Pathologies noted on arthroscopic evaluation included fragmented medial coronoid process/coronoid injury (154), osteochondrosis dissecans (29), joint incongruity (3), degenerative joint disease/synovitis (195), ununited anconeal process (7), fractures (4), and subchondral bone cyst (1). Of the patients who had preoperative radiographs and CT, findings were consistent with arthroscopic findings in 143/185 and 146/197 elbows, respectively.

**Discussion/Conclusion:** Radiographs and CT alone were both predictive for UAP, fractures, and subluxation. However, diagnostic value was variable for medial coronoid injury, OCD, joint incongruity, and subchondral bone cyst that were detected on arthroscopic exploration. Though arthroscopy is the gold standard diagnostic for elbow joint assessment, complementary advanced imaging is important to gain the most information about joint congruency and pathology.

**Acknowledgments:** There was no proprietary interest or funding provided for this project.

## 78 The effect of the lateral collateral ligament in medial coronoid loading

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**Introduction:** The objective of this investigation was to determine the contribution of the lateral collateral ligament (LCL) on the load sustained by the radial head (RH) and medial coronoid process (MCP) during loading of canine cadaver forelimbs to 200 Newtons (N) ex vivo. Our hypothesis was that the lateral collateral ligament reduces the relative load placed on the MCP relative to the RH during weight-bearing of the canine forelimb to 200N of force and 135° elbow angle.

**Materials and Methods:** Eight thoracic limbs from skeletally mature dogs were placed in a materials testing system and loaded to 200N in 135°. Sensors placed in the MCP and RH recorded the relative load through the joint with the LCL intact, LCL transected, ulnar crus transected and radial crus transected. Following prosthetic ligament placement, each limb was loaded again and the relative pressure determined on the MCP and RH.

**Results:** Transection of the LCL completely or the radial crus only, significantly increased the load through the MCP ( $P < 0.001$ ). Loading of the MCP was reduced when only the ulnar crus of the LCL was transected. Placement of a prosthetic radial crus ligament placed similar pressure on the MCP as an intact LCL ( $P > 0.05$ ), whereas an ulnar crus prosthetic or complete LCL prosthetic reduced loading of the MCP ( $P < 0.001$ ).

**Discussion/Conclusion:** Loading of the MCP is dependent, in part, on the LCL in ex vivo loading to 200N of the canine thoracic limb in a neutral position with 135°. Further research is warranted to determine what change, if any occurs to the peak contact pressure and location of peak contact pressure in the joint with alterations in the LCL. In addition, further understanding of the individual variation in contact areas within the joint is indicated.

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## 79 Developing standardized landmarks for measuring humeral torsion in the dog using computed tomography

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**Introduction:** The purpose of this study was to develop a standardized technique in which computer tomography (CT) can be used to determine the humeral torsion angle in canines. Results of this study will be used to assess normal humeral torsion, and investigate its role in breed variations and disease processes.

**Materials and Methods:** This is a retrospective study of six CT scans collected from a specialty veterinary practice. The humeral torsion angle was measured from the axis of the greater tubercle in relation to the transepicondylar axis. Degree of reproducibility was determined by interobserver and intraobserver correlations coefficients.

**Results:** In the six measurements the average angle was 87.9° with a standard deviation (SD) of 5.9°. The average SD in intraobserver was 1.69°.

**Discussion/Conclusion:** This technique has preliminarily shown to be a reliable way of measuring humeral torsion, and that variations within observer and between observers will produce similar results. Using these landmarks may prove useful as they are externally palpable points and can be used in humeral fracture planning. Future research to establish the normal degree of torsion must be done before it can be correlated with disease processes.

**Acknowledgements:** There was no proprietary interest or funding provided for this project.



## 80 Dog center europe the US army's veterinary referral hospital in Europe

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Dog Center Europe (DCE) is the US Army's premier veterinary referral hospital in Kaiserslautern, Germany. The primary mission of DCE is to provide full spectrum care to DoD working dogs with a secondary mission of providing veterinary medical support to pets owned by US DoD personnel within the Kaiserslautern Military Community. Two board certified veterinary specialists, currently two ACVS surgeons, lead the team of professionals serving heroes every day. Staffed with seven veterinarians (four Army and three civilian), twenty veterinary technicians (eight Army and twelve civilian) and five civilian administrative support staff, DCE performs over 12,500 outpatient visits annually. Ramstein Air Base, a ten minute drive from DCE, enables the use of military aircraft and the aeromedical evacuation system to bring patients from all over Europe, the Middle East, and Africa to DCE for treatment. DCE is the first stop outside of Afghanistan where four-legged warriors receive treatment for their battlefield injuries. Similar to non-military veterinary referral hospitals in the US, DCE is equipped with a significant amount of high quality, specialized equipment to include in-house laboratory, digital radiography, ultrasound, fluoroscopy, endoscopy, laparoscopy, arthroscopy, CO<sub>2</sub> laser, extensive soft tissue, orthopedic, neurologic and dental surgical instrumentation and physical rehabilitation equipment complete with an underwater treadmill. The nearby US Army hospital, Landstuhl Regional Medical Center, provides CT and MRI imaging as needed for DoD working dogs. Dog Center Europe – professionals serving heroes every day.

## 81 Treatment of cranial cruciate ligament rupture associated with recurrent medial patellar luxation using a modified TTA/MMT transposition technique in three dogs

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Three dogs (age ranging between 3 and 14 years and weight ranging between 5.6 and 24 Kgs) were presented with a history of rear limb lameness of varying duration. Clinical examination and radiographic findings revealed CCL incompetence and recurring medial patellar luxation of varying degree. All the patients underwent surgery consisting in a modified Tibial Tuberosity Advancement Transposition using titanium TTA cages and PLX<sup>(TM)</sup> spacers. No plate was used to stabilize the Tibial Tuberosity. While cases # 1 and 2 had a complete osteotomy of the Tibial Tuberosity, in case #3 the distal cortex was left intact as described in the Modified Maquet Technique. Case #1 suffered a fracture of the Tibial Tuberosity 2 weeks postoperatively that required revision surgery and internal fixation. The remaining cases had uneventful convalescences. All patients had a complete recovery and returned to normal function within three months after surgery.

## 82 Angle-stable interlocking nail fixation for distal femoral corrective osteotomy associated with medial patellar luxation

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**Introduction:** Correction of excessive femoral varus via distal femoral osteotomy (DFO) has been proposed to address medial patellar luxation (MPL) in large breed dogs. The use of an interlocking nail to stabilize the osteotomy may provide both technical and mechanical advantages over bone plating. This case series describes the use of an angle-stable ILN (AS-ILN) for the stabilization of DFO for the treatment of MPL.

**Materials and Methods:** A corrective DFO was performed using the center of rotation of angulation methodology in 5 dogs with MPL associated with femoral varus deformity. Stabilization was achieved with an AS-ILN. Additional procedures to correct the MPL were performed as needed. Pre-operative and post-operative varus angles were measured. Post-operative outcome and complications were documented.

**Results:** All dogs (age: 2–5 years; BW: 30–56kg) included had grade 3/4 MPL. The median varus angle was 17.9° preoperatively (range: 15.3°–23.0°) and 7.9° postoperatively (range: 2.5°–11.2°). Median time to clinical union was 62 days (range: 42–70 days). No major or minor complications were recorded in this limited case series. Three dogs had a mild residual lameness and 2 dogs returned to normal function. Patellar luxation on the operated side was not detected in any dog after surgery.

**Discussion/Conclusion:** The surgical and clinical outcomes as well as the absence of complications in this short case series suggest the use of an AS-ILN is a valid alternative to bone plating in the treatment of excessive distal femoral varus associated with MPL.

**Acknowledgements:** One author is the AS-ILN inventor.

## 83 Foreign body reaction to a retained surgical sponge (gossypiboma) mimicking an implant associated sarcoma

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A dog was presented with the complaint of an acute onset left pelvic limb lameness three years after a right tibial plateau leveling osteotomy had been performed. Radiographs taken at the time of presentation showed signs that were consistent with a diagnosis of an implant associated sarcoma. At revision surgery, a retained surgical sponge was identified, leading to a diagnosis of a gossypiboma. This is the first reported case of a gossypiboma as a complication of a tibial plateau leveling osteotomy surgery.