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Podium Abstracts

A3642. Clinical Application of the I-LOC Angle-Stable Interlocking Nail in 100 Traumatic Fractures of the Humerus, Femur and Tibia

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Introduction: A novel angle-stable nail (I-Loc) was recently designed, in part to address acute perioperative instability documented with standard veterinary nails. While experimental studies demonstrated biomechanical efficacy, clinical evaluation of the I-Loc is lacking. Our objective was to describe the use of the 6, 7 and 8-mm I-Loc nails and provide clinically relevant recommendations.

Materials and Methods: Medical records of patients with traumatic femoral, tibial and humeral fractures treated with an I-Loc were reviewed. Data collected included affected bone, fracture pattern, body weight in relation to nail size; surgical technique, number of missed bolts and complications.

Results: One hundred fractures affected the femur (64%), tibia (28%) and humerus (8%); most were diaphyseal (81%) and complex (59%). The 6, 7 and 8-mm nails were used in 18, 36 and 56 patients weighing an average of 24.6, 29.7, 37.9 kg, respectively. Missed bolts (6%) were successfully reoriented intraoperatively in all but two cases (final missed rate 1.3%). All complications (10%) occurred in tibial fractures and required revision surgery in 3 cases. Complete or on going follow up, available in 80 cases showed appropriate bone healing and function in all cases. Twenty cases were lost to follow-up.

Discussion/Conclusion: This study suggests that diaphyseal, metaphyseal and juxta-articular fractures can be successfully treated using an I-Loc. Additionally, the rate of missed cannulations and complications were substantially lower than that reported for standard nails. Our results also suggest that 6, 7 and 8-mm nails can be safely recommended for dogs with mean body weights of 25, 30 and 38 kg, respectively.

Acknowledgement: The senior author of this clinical research is the inventor of the nail described in this study and as such receives a teaching honorarium from Bio-Medtrix as well as royalties from Michigan State University.

A3636. Percutaneous Tibial Fracture Reduction using CT Imaging, Computer Modeling and 3D Printed Constructs

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Introduction: Minimally invasive osteosynthesis (MIO) emphasizes preservation of fracture biology and is associated with multiple benefits. Widespread adoption has not occurred and is attributed to difficulty in achieving bone alignment and requirement for intraoperative fluoroscopy. We hypothesized that interaction pins, CT imaging, computer modeling and 3D printing could be used to create a minimally invasive reduction jig whereby reduction of the pins into the jig results in accurate stable alignment of the bone while allowing definitive MIO stabilization.

Materials and Methods: Diaphyseal fractures were created in 12 canine cadaveric tibiae. Interaction pins were placed into the proximal and distal articular bone segments. CT scans of the fractured tibia and pins were imported into modeling software and virtually reduced. A multicomponent 3D printed jig was created that encompassed the pins in their reduced configuration. Intact and jig-reduced joint angles and tibial lengths were evaluated and compared radiographically.

Results: Ten of twelve fractures met our criteria for alignment. Post reduction tibial lengths differed on the mediolateral and craniocaudal radiographs by an average of 1.55% and 1.43% respectively. Average differences in mechanical joint angles did not exceed our criteria of 5 degrees in the frontal or 10 degrees in the sagittal plane.

Discussion/Conclusion: Percutaneous reduction of cadaveric tibial fractures using CT imaging, computer modeling and 3D printing is feasible. While further research is necessary, this novel, and accurate technique to align fractures could reduce open surgical times and facilitate adoption of MIO techniques.

Acknowledgement: There was no proprietary interest involved or funding received.

A3616. Defining A Safe Entry Point for a Sacral Screw in Lateral Plating in Feline Iliac Fractures

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Introduction: Iliac fractures are common in cats. Lateral plating is the most commonly used technique for repair; however, it is associated with a high rate of screw loosening due to the limited bone purchase. A sacral screw has been

suggested to increase bone purchase. However, defining the exact position for a screw engaging the sacral body can be challenging. The purpose of this study was to define a safe entry point for a sacral body screw in lateral plating of feline ilial fractures.

Materials and Methods: Six cadaveric feline hemipelvises were used to define a safe entry point. An orientation pin and a parallel aiming guide were used to drive a second pin from the cut medial surface of the sacral body towards the lateral ilial surface. The ilial acetabular length (IAL) and ischial ilial height (IIH) were measured. Proportions of the position of the hole to the IIH and the IAL were calculated. This resulted in the initial definition of the safe entry point: **IAL/2.5** and **IIH/2**. Consecutively 10 hemipelvises were allocated randomly to the different groups: (1) surgical resident and (2) expert surgeon. Both performed the measurements and defined the safe entry point according to IAL/2.5 and IIH/2. Position of the hole in the sacral body was assessed. A Bland Altman analysis was performed for measurements.

Results: All holes were located in the central sacral body position in both groups. The Bland Altman analysis showed excellent results comparing the two observers.

Discussion/Conclusion: Using the proportion IAL/2.5 and IIH/2 allows safe and consistent sacral body screw placement

Acknowledgement: None.

A3675. Effect of Bidirectional Insertion of External Skeletal Fixation Pins on Axial Pullout Strength in Canine Cadaveric Bone

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Introduction: Effect of bidirectional insertion on axial pullout strength of tapered run out (TRO) and traditional 1/8" negative profile (TNP) pins was evaluated. Our null hypothesis was that no difference existed in axial pullout strength of TRO or TNP pins when inserted bidirectionally to the desired position (DP) (360° of thread exiting the trans cortex), remaining within the threads of the pin.

Materials and Methods: TRO pins were inserted unidirectional to DP (G1), bidirectional past DP, then backed up to DP (G2), and bidirectionally as described for G2, repeated twice (G3). TNP pins were placed similarly (G4–6). Additionally, TNP pins were driven unidirectionally to one thread before the thread/shaft interface (G7). A servohydraulic testing machine measured (1 mm/sec) and recorded peak axial pullout strength (N). One-way analysis of variance (ANOVA) was used for statistical evaluation ($p < 0.05$).

Results: Eighty-four pins were placed and extracted ($n = 12/\text{group}$). There was no significant difference in axial pullout strength with any insertion technique using a TRO or TNP pin. Unidirectional TRO pins (G1 = 3075.03N, SE 292.34N) had significantly greater axial pullout strength than TNP pins (G4 = 2365.96N, SE 143.41N) [$p = 0.0199$]. TRO pins, irrespective of pin insertion method, had greater axial pullout strength than TNP pins [$p = 0.0161$].

Discussion/Conclusion: Axial pullout strength can be preserved if the cis cortex is not violated with the pin shaft. TRO pins offered a stronger bone-pin interface than TNP pins. This supports pin adjustment during ESF placement.

Acknowledgement: Supported by Cohn Family Chair for Small Animals and IMEX Veterinary, Inc., Longview, TX, United States.

A3535. Use of a Veterinary Cuttable Plate in a Plate-ROD Construct for Repair of Diaphyseal Femoral Fractures in the Cat: 25 Cases

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Introduction: Cats have relatively straight femurs that make them ideal candidates for intramedullary implants, and one advantage of the veterinary cuttable plates (VCP) is the large number of screws per unit length. The objective of this study is to evaluate retrospectively the effectiveness of a VCP-rod construct for the treatment of diaphyseal femoral fracture in cats.

Materials and Methods: Twenty-five cats with diaphyseal femoral fracture that underwent stabilization with a VCP-rod construct were evaluated. Data collected included signalment, fracture characteristics, surgical information, postoperative radiographic assessment, and follow-up information.

Results: Seven fractures were simple and 18 were comminuted. Minimally invasive approach was elected in 9 cases and open approach in 16 cases. Pin diameter was 2 mm ($n = 15$) or 2.5 mm ($n = 10$) that corresponded to a percentage of pin occupation of 40.3% and 55.5% of the intramedullary cavity respectively. 2–2.7 mm VCP and 2-mm screws were used in all cases. The mean length of the VCP was 11.6 holes, and the mean number of screws placed in the plate was 5.7. Mean number of cortices engaged per fragment was 5.7. 98.7% of the screws were bicortical. One major complication (contracture of the quadriceps) was associated with an unacceptable functional outcome. Follow-up was available in 16 cases. Complete bone healing was present in 11/16 cases. Functional outcome was assessed in 21 cases and was considered as full in 18/21, acceptable in 2/21, and unacceptable in 1/21

Discussion/Conclusion: The use of VCP-rod construct for stabilization of diaphyseal femoral fracture in the cat is associated with good outcome and low complication rate.

Acknowledgement: None.

A3648. Transarticular Fixation of a Failed Anatomic Repair using an IMEX ROM Hinge to Allow Early Return to Function

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Case Description: A 5-year-old domestic short hair feline was presented after a failed anatomical repair of a total stifle subluxation with multiple ligament injuries. There was a severe medial patella luxation with medial and collateral instability. A cranial and caudal drawer was present in the stifle. On radiographs, a stifle subluxation was seen.

A lateral transarticular type I external fixator was placed across the stifle joint with three 2.4-mm Imex interface half pins in the femur and three 2.4-mm Imex interface half pins in the tibia. An Imex ROM hinge was placed with the hinge entered over the stifle. The hinge was set at a normal weight bearing angle judged on the contralateral leg. The hinge was tightened to allow no motion in the stifle for the first 2 weeks postsurgery. The patient was weight bearing on the leg 3days postsurgery. At 2 weeks, the hinge was loosened to allow 20% of the normal range of motion. Weight bearing decreased for the first 2days after allowing increased ROM but then returned to normal. At 4 weeks postsurgery, the

hinge was loosened to allow 60% range of motion. The patient continued to use the leg at all times.

At 6 weeks postsurgery, the hinge was removed and stability of the stifle assessed under sedation. There was a mild cranial and caudal drawer but no medial or lateral instability. The patient returned to full weight bearing after removal of the external fixator.

Acknowledgement: None.

A3670. A Retrospective Evaluation of Femoral Stem Subsidence in Patients undergoing Cementless Total Hip Replacement

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Introduction: The purpose of this study was to evaluate and compare subsidence and factors that may contribute to subsidence in patients undergoing THR with the traditional BFX, collared BFX, and BFX lateral bolt femoral stems. We hypothesized that patients undergoing THR with the lateral bolt stem would experience less stem subsidence compared with patients receiving a traditional BFX or collared stem.

Materials and Methods: Radiographs of 68 hips undergoing THR were evaluated. Parameters measured included subsidence, canal flare index, stem canal fill, stem orientation, and complications detected on radiographs. A proportion based on actual stem length, radiographically measured stem length and radiographically measured stem position was used to correct measured stem position on the cranio-caudal view. An ANOVA was used to compare subsidence and canal fill.

Results: The lateral bolt stem group experienced significantly less subsidence than the collared group ($p = 0.018$) and the BFX group ($p = 0.004$). There was no significant difference in subsidence between collared and BFX groups. A significant difference was identified in coronal CF between the BFX and collared groups ($p = 0.031$), and between all three groups for sagittal canal fill.

Discussion/Conclusion: BFX stems had the highest coronal canal fill but still experienced the greatest subsidence. Addition of a lateral bolt may increase implant resistance to subsidence in the presence of a slightly undersized femoral stem. We accept our hypothesis as patients undergoing THR with a lateral bolt stem experienced less stem subsidence compared with patients receiving a traditional BFX or collared stem.

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

A3628. Mechanical Analysis of Suture Attachment Methods in Toggle Suture Constructs

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Introduction: The goal of this analysis was to provide information which can be applied to decrease surgeon-controlled variability in open coxofemoral luxation repair and early failure of toggle suture constructs.

Materials and Methods: Mechanical testing was performed on toggle-suture constructs utilizing eight variable attachment methods of number 5 OrthoFiber to a 1/8" toggle rod. A servo-hydraulic materials testing machine was used to test each construct to determine mean load to failure, cycles

to failure, construct stiffness and suture elongation with static and cyclic loading.

Results: There was a significant difference in mean load to failure, method of failure and construct stiffness based on suture attachment method to the toggle with acute load to failure testing. Mean load to failure was greatest for the "straight through" and "bow tie" constructs. Construct stiffness was greatest for the "straight through" and "loop de loop" constructs. A significant difference was found in total and cyclic suture elongation and cycles to failure based on suture attachment method to the toggle with cyclic testing. Greatest cycles to failure were noted in the "straight through" and "bow tie" constructs.

Discussion/Conclusion: Suture attachment method of number 5 OrthoFiber to a 1/8" toggle rod significantly impacts construct performance. While no one construct out-performed the others in all areas of testing, the "straight through" construct was a top performer in mean load to failure, cycles to failure and construct stiffness. Pre-tensioning of suture constructs was identified as an area of future research.

Acknowledgement: Number 5 OrthoFiber and 1/8" Securos toggle stem were supplied by Securos Veterinary Orthopedics Inc., Sturbridge, MA.

A3669. Evaluation of Cementless Femoral Stem Subsidence on Mediolateral Projection Radiographs

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Introduction: Limb positioning can affect the apparent radiographic position of the femoral stem following total hip replacement. The purpose of this study was to evaluate the accuracy of measuring femoral stem subsidence on the mediolateral radiographic projection.

Materials and Methods: Cementless femoral stems were inserted into eight canine cadaver femurs at two levels of subsidence. Mediolateral radiographs were taken of each femur at 0°, 10°, and -10° angulation in the frontal plane and 0°, 15°, 30°, -15°, and -30° rotation in the axial plane. Stem position was measured and a proportion was used to determine corrected stem position. ANOVA tests were used to compare actual, radiographic, and corrected stem position.

Results: The greater trochanter was not visible at any degree of internal rotation. No significant differences were identified between radiographic and actual stem position at 0° of rotation and 0°, 10° or -10° of frontal plane angulation at either subsidence level. Significant differences between radiographic and actual stem position were associated with increasing degrees of external rotation and magnitude of subsidence. 56% of the corrected stem measurements were significantly different from actual stem positions and 22% of the radiographically measured stem positions were significantly different from actual stem positions.

Discussion/Conclusion: These data show that femoral stem position can be accurately measured on the mediolateral radiographic projection, assuming the trochanter is visible. As external rotation and subsidence increase, accuracy of the femoral stem position decreases. The corrective proportion didn't increase the sensitivity of the femoral stem measurement.

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

A3625. Fatigue Fracture of Co-Cr-Mo Femoral Stems after Canine Cemented Total Hip Replacement

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Introduction: Complications of canine total hip replacement have been reported in 3 to 11% of patients. Fatigue fracture of the femoral stem following cemented THR is an infrequent complication reported in 1.5% of cases. Two fractured stems underwent metallographic analysis after explantation to determine if material factors contributed to implant failure.

Materials and Methods: Cases of Cobalt-Chromium-Molybdenum (Co-Cr-Mo) femoral stem fracture were identified in dogs receiving cemented THR. Two Co-Cr-Mo stems were explanted after mid-stem fracture and subjected to metallographic analysis. Scanning electron microscopy utilizing secondary and backscattered electron imaging modes was used to investigate primary fracture surfaces, adjacent exterior stem surface, and transverse and longitudinal cross-sections.

Results: Cemented THR was performed on two juvenile canines. Orientation, sizing, and mantle quality were deemed appropriate postoperatively. Transverse fractures of the femoral stems occurred 3 years postoperatively and subsequently explanted. Metallographic analysis identified clear signs of fatigue failure causing stem fracture, namely fatigue striations and secondary cracking. Cross-sectional analysis identified significant porosity and propagation of cracks through these pores.

Discussion/Conclusion: Metallographic analysis confirmed that the mechanism of stem fracture was fatigue failure. Quality control during manufacturing should be emphasized to reduce material imperfections. Both patients demonstrated substantial postoperative weight gain that exacerbated alloy imperfections by increasing cyclic loading of the THR, pushing stems to fatigue threshold. Lean body weight should be emphasized postoperatively to prevent excessive stem loading and potential failure. Implants used in these cases have been re-designed and are now obsolete.

Acknowledgement: There was no proprietary interest of funding provided for this project.

A3562. Percutaneous Repair of a Ruptured Common Calcaneal Tendon in a Dog

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Introduction: Common calcaneal tendon injuries are common in dogs, may be partial or complete, and may involve any combination of the three tendons. Traditional surgical repair techniques for complete rupture of the tendon describe tenorrhaphy by an open approach using a fascia late autograft or polypropylene mesh for support. The purpose of this article is to describe the novel application of a well-described human surgical procedure for repair of a ruptured common calcaneal tendon in a dog, using the Arthrex Percutaneous Achilles Repair System (PARS).

Case Details An adult male neutered Pit bull was presented with a plantigrade stance on the right hindlimb after suffering a laceration, with an associated complete tear of the common calcaneal tendon. Each end of the tendon was isolated within the tendon sheath, the inner arms of the PARS jig were placed adjacent to the Achilles tendon on either side,

within the tendon sheath, and the tendon portions were secured with three interlocking strands of fibreWire, as described by Arthrex. The opposing strands of fibreWire were then sutured together on either side of the tendon ends. A half cast was applied to the caudal portion of the distal extremity postoperatively and maintained for 4 weeks.

Discussion/Conclusion: To our knowledge, this is the first reported use of a well-described human surgical procedure using the PARS for repair of an acute common calcaneal tendon rupture in a dog.

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

A3588. Morphovolumetric Analysis of the Equine Hoof

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Introduction: Historically, conformation of the limbs has been used as a predictor of injury predisposition and athletic performance. Investigations have developed from a subjective visual assessment to increasingly quantitative methods; yet, volumetric (3D) data are missing. Functional anatomy of the hoof is intricate, and thus, its impact on musculoskeletal injuries is not well understood. Recognition of pathological changes within the hoof internal anatomy necessitates understanding of such relationship in normal/healthy hooves. This work aims to quantify the 3D anatomical relationships of the normal foot.

Materials and Methods: The T1-weighted MR images from 18 Standardbred horses (5.8 ± 2.6 years) were examined. Two 1 cm³ spheres were placed in image field and used for calibration. All measurements were performed using *Image J* software. Six volumetric and nine linear variables were measured. Pairwise correlations among measurements were examined using Pearson's product moment correlation coefficient and *p*-values < 0.05 were considered significant.

Results: Patterns of pairwise correlations were found. The distal phalanx volume (DP-V) was correlated with its width (*r* = 0.739) but not its length. However, digital cushion volume was correlated with its length (*r* = 0.802). Navicular bone width was correlated with distal phalanx width (*r* = 0.710) but not deep digital flexor tendon width (*r* = 0.541). The DP-V and total hoof volume were correlated with the weight of the horse.

Discussion/Conclusion: These data provide a basis for the use of morphogeometric analysis of the equine foot in investigation of clinical lameness, prevention of predisposed injuries and predicting future performance.

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A3668. Mechanical and Microstructural Properties of Navicular Bones with a Range of Navicular Degeneration

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Introduction: Radiographic abnormalities in diseased navicular bones include enlarged synovial invaginations,

enthesophytosis, flexor cortical lysis, and medullary sclerosis. However, the functional relationships among radiographic findings, bone microstructure, and biomechanical properties are unknown. The objectives of this study were to quantify and correlate navicular microstructural features with structural mechanical properties.

Materials and Methods: Navicular bones from 18 horses with a range of navicular disease were imaged using radiography and microcomputed tomography. Bones were assigned a radiographic grade (0–4). Morphometric data were collected from medullary cavity, cortices, and whole bone volumes of interest. Bones were nondestructively compressed and then failed in 3-point bending. Spearman correlations were assessed.

Results: Age correlated positively with radiographic grade ($r = 0.68$) and negatively with trabecular number and maximum bending energy ($r = -0.74, -0.73$). Radiographic grade correlated positively with trabecular spacing ($r = 0.70$), and negatively with maximum bending energy and degree of anisotropy (DA; $r = -0.75, -0.78$). Whole bone DA positively correlated with pre-yield stiffness and yield and bending moment energies ($r = 0.46, 0.53$ and 0.78). Whole bone trabecular spacing negatively correlated with pre-yield stiffness ($r = -0.63$) and yield and bending moment energies ($r = -0.71, -0.85$), while trabecular number positively correlated with pre-yield stiffness ($r = 0.54$).

Discussion/Conclusion: With age, evidence of radiographic disease increased. Increasing disease severity was associated with trabecular disruption and deteriorating mechanical properties.

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A3651. Correlation and Prognostic Value of Abnormalities on MRI and Navicular Bursoscopy in Horses with Foot Lameness

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Introduction: Hyperintense masses dorsal to the supraspinous deep digital flexor tendon are often identified on MRI of horses with foot lameness. Endoscopic surgery of the navicular bursa often identifies collagenous clumps of tissue. We hypothesized that these were the masses on MRI, and prognosis following surgery was limited by any tendon lesion.

Materials and Methods: A retrospective study of horses following MRI and navicular bursoscopy. Size of any mass and abnormalities of the DDFT on MRI and surgery were subjectively graded. Correlation of MRI and surgical findings was compared by Spearman Rank non-parametric correlation.

Results: Forty horses that had 1 year of follow-up were included. There was good correlation of the size of the mass ($R = 0.751$). However, correlation of DDFT lesions was not strong ($R = 0.48$). The prognosis was guarded, with 12 horses (30%) returning to previous level of exercise. There was no effect on prognosis and only 3/16 (19%) horses with large synovial masses but minimal tendon lesions on MRI returned to exercise.

Discussion/Conclusion: Hyperintense masses adjacent to the dorsal border of the deep digital flexor tendon are predictive of masses of collagenous tissue. Our hypothesis of a good prognosis for a horse with a large mass but no visible tendon disease on MRI was not confirmed. There was poor correlation of MRI and surgical findings concerning tendon

lesions, due to horses with minimal tendon lesion on MRI, but surface erosion of the deep digital flexor tendon at bursoscopy.

Acknowledgement: There was no proprietary interest or funding for this project.

A3534. Biomechanical Analysis of a Novel Equine Cervical Stabilization Technique

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Introduction: Cervical vertebral malformation is a common cause of neurologic deficits. The authors have developed a novel cervical stabilization technique utilizing pedicle screws and rod construct with interbody device (PSR). To further validate this novel technique and understand its true biomechanical properties, we aimed to evaluate nondestructive range of motion kinematics. We hypothesize that the PSR technique will result in reduced ROM and compliance.

Materials and Methods: Nondestructive range of motion (ROM) and compliance kinematics in the equine cervical spine after single-level stabilization was performed using a custom-built testing system to apply pure moments in flexion, lateral bending, and axial loads.

Results: The PSR technique had decreased compliance at the adjacent level for the flexion axis. The PSR technique ROM for the treated level in the axial axis had increased compliance and ROM. The pedicle screw construct without an interbody device (R) technique had decreased ROM and compliance for the flexion axis at the treated level. The R technique had increased ROM and compliance at the adjacent level for flexion and lateral movement when compared with PSR and control.

Discussion/Conclusion: The PSR technique had increased the ROM and compliance for treated level in the flexion axis. It is likely that the interbody cage offers a higher point of leverage responsible for the increase in extension at the ventral aspect of the spine, which translates into the increased flexion–extension movement. The PSR technique does not result in significant stability of the adjacent FSU, which may decrease risk of the domino effect or degeneration.

Acknowledgement: Young Investigators Award at Colorado State University.

A3599. Frequency of Normal versus Support Trot in the Healthy German Shepherd Dog

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Introduction: Current sports medicine textbooks suggest German Shepherd Dogs (GSDs) utilize a support trot, lacking a suspension phase, due to instability from extreme angulation of the hindquarters. A standard (normal) trot includes a suspension phase between footstrikes. The GSD

trot has never been scientifically evaluated. The objective of this study was to characterize the trot and describe morphometric relationships. The hypothesis was that GSDs have a standard trot with a suspension phase and thus no relationship with joint angulation.

Materials and Methods: Eighteen healthy, adult GSDs were enrolled in this study to date. Height, weight, body length, standing limb distance, and standing joint angles were measured. Dogs were trotted over a pressure walkway collecting five valid trials. Each trial was categorized by the presence or absence of the suspension phase and the percent of standard trot trials was calculated. Logistic regression was used to explore the relationship of morphometric measurements and standard and support trotters.

Results: Of the dogs analyzed, 38.8% demonstrated a standard trot in all five trials, 55.6% of dogs utilized a support trot intermittently, and one dog solely utilized a support trot in all trials. Body length and weight influenced whether the dog used a standard or support trot ($p < 0.01$). There was no correlation between joint angles and utilization of a support trot.

Discussion/Conclusion: Most GSDs demonstrate a mix of support and standard trots, which is unrelated to standing joint angles.

Acknowledgement: No conflict of interest.

A3667. Heel Expansion and Deformation vary with Horseshoe Nail Positions

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Introduction: Long toe/low heel (underrun heel) hoof conformation has been associated with increased risk for fetlock injuries. Our objective was to determine if nails used to secure a horseshoe to the hoof have an impact on hoof deformability which could lead to an underrun heel.

Materials and Methods: Nine cadaveric normal forelimbs were studied. Hooves were instrumented for measurements of heel expansion and hoof wall distortion using rosette strain gauges and kinematic markers. Hoof motions were measured during axial limb compression to canter midstance load (6700 N). Treatments consisted of no shoe (noshoe), toe nails (2nail), toe plus quarter nails (6nail), and toe plus quarter plus heel nails (10nail) and were compared using a repeated measures analysis of variance ($p < 0.05$).

Results: Heel expansion was greater for the noshoe compared with all nail treatments. Nail treatments resulted in hoof wall principal strain directions moving dorsally and the heels moving proximodorsally.

Discussion/Conclusion: Application of shoes retards hoof expansion, and thus could adversely affect load attenuation. The pattern of hoof wall distortion was consistent with development of the underrun heel hoof conformation.

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A3560. Retrospective Analysis of Prosthesis use by Dogs with Partial Limbs

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Introduction: Exoprostheses for treatment of distal limb pathology are becoming increasingly prevalent in veter-

inary medicine; however, only a single case series documenting outcomes of this treatment in dogs has been published in the current peer-reviewed literature. The objective of the present study is to retrospectively evaluate outcomes and identify prognostic factors associated with dogs receiving exoprostheses for partial limbs.

Materials and Methods: An online survey was developed to evaluate owner-reported outcomes associated with exoprostheses for canine patients. The survey inquired about the residuum, concurrent disease, prosthesis use, rehabilitation, activity, complications, and owner satisfaction. Medical records and radiographs were obtained where available. The survey was analyzed by assigning numeric scores to responses.

Results: The response rate was 50/137 (36.5%); 47 responses were analyzed. Forty-six of 47 owners reported positive satisfaction; 1/47 was displeased. Forty-two of 47 dogs were scored to have positive clinical outcomes; 5/47 had poor clinical outcomes. A 61.7% short-term complication rate and a 19.1% long-term complication rate were reported. Skin sores were the most common complication. Residual limb factors, concurrent disease, and rehabilitation had no relationship to satisfaction or outcome. Time spent in the prosthesis had a positive association with satisfaction and outcomes.

Discussion/Conclusion: Results of this survey suggest a high degree of owner satisfaction despite substantial complication rates. Based on this preliminary data, further evaluation of exoprostheses as a limb-sparing option for treatment of distal limb pathology should be considered. Prospective clinical trials with objective outcome measures are required to draw firm conclusions.

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

A3627. Development of a Perceived Exertion Scale for Dogs Exercising on a Land Treadmill using Selected Physiologic Parameters

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Introduction: Our objective was to develop a perceived exertion scale (PES) for dogs exercising on a land treadmill and to assess intra- and inter-observer variability.

Materials and Methods: Fifteen dogs participated in paired exercise trials. Complete blood count, biochemical panel, urinalysis and lactate were obtained before, during and after exercise. Heart rate, temperature, respiratory rate, regional tissue oximetry (rSO₂) and PES score were also recorded. Data were analyzed using Spearman correlation coefficients (significance $p < 0.05$).

Results: Thirteen dogs completed both trials. There were positive correlations between manual heart rate and glucose, respiratory rate and temperature in trials 1 and 2. Respiratory rate was positively correlated with lactate and temperature in both trials. Trial 1: glucose was positively correlated with respiratory rate and temperature. Glucose and lactate were negatively correlated. Holter heart rate was positively correlated with temperature, respiratory rate, glucose and PES score. For each incremental increase on the PES,

glucose decreased 2.112 g/dL. Trial 2: Holter heart rate was positively correlated with PES. rSO₂ decreased, respiratory rate increased, and temperature increased for each incremental increase on the PES. Spearman correlations were positive between inter-observer PES score in both trials. There was no significant difference between the results of the first and second trials.

Discussion/Conclusion: There was consistent and repeatable use of a PES for monitoring dogs exercising on a land treadmill. Further validation is needed before clinical application.

Acknowledgement: Funded by the University of Illinois, College of Veterinary Medicine Companion Animal Research Grant Program (Wayne D. and Josephine H. Spangler Fund).

A3589. The Effect of Routine Hoof Trimming on Regional Hoof Kinetics

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Introduction: With each foot step equine hoof bares extreme forces from the weight of the animal and the ground reaction forces. Hoof balance is critical to absorb and dissipate such stresses. Historically, hoof balance has been primarily evaluated by visual assessment rather than an objective evaluation.

Materials and Methods: Ten sound horses were walked on a calibrated pressure plate before and after routine hoof trimming; the distribution of the force, pressure and contact area in medio-lateral and toe-heel regions of the hoof were examined before and after trimming.

Results: We found that peak contact pressure at the toe increased ~21% after trimming; however, it only slightly (5%) decreased at the heel. Significant changes were found in the contact pressure ($p = 0.012$) and peak contact pressure ($p = 0.013$) at the toe region before and after hoof trimming.

Discussion/Conclusion: The greater pressure toward the toe and medial regions may help achieve gait stability and balance by shifting pressures from the heel and lateral soles. Asymmetrical force and pressure distribution will transfer the excess to more sensitive structures either within the hoof or toward more proximal structures, causing subsequent injury. Our results provide a benchmark for kinetic data on mediolateral and to-heel regions of the equine hoof which should be considered by farriers and veterinarians to better assess the horses' hooves balance.

Acknowledgement: This study was supported by Arabian Horse Foundation.

A3608. Evaluation of Ultrasound for Detection of Changes in Muscle Mass Recovery after Tibial Plateau Leveling Osteotomy in Dogs

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Introduction: Manual thigh circumference (TC) measurement has been used as an objective outcome measure for detection of changes in muscle mass. Recently, the accuracy of this method in dogs has been questioned. Advanced imaging (CT or MRI) provides a more objective and reliable outcome measure; however, these techniques are costly and less

practical. Hence ultrasonographic (US) evaluation has been suggested as an alternative. The purpose of this study was to compare serial, TC and US measurements for detection of changes in muscle mass in dogs recovering from tibial plateau leveling osteotomy (TPLO).

Materials and Methods: Medium-large breed dogs ($n = 7$) undergoing pet-owner elected TPLO were enrolled. Manual TC, US, and objective gait analysis were performed at 0, 2, 4 and 8 weeks after surgery. CT-scans, as the gold standard, were compared with TC and US at 0 and 2 weeks. Data W analyzed for main effect of time within modalities and correlations to CT were calculated.

Results: Statistically significant improvement in gait data confirmed continuous improvement in limb function over duration of study. CT-muscle mass significantly decreased at 2 weeks and was significantly related to the US measurement locations 'proximal, medial muscle to bone distance ($p = 0.004$; $r = 0.81$)' and 'proximal, lateral muscle to bone distance ($p = <0.001$; $r = 0.82$)'. Both US locations detected a significant increase in muscle mass at wk-8 versus wk-2, whereas manual TC measurements did not ($p = 0.199$).

Discussion/Conclusion: Ultrasound detects muscle mass changes in dogs recovering from TPLO with greater accuracy than manual TC measurements.

Acknowledgement: Funding for this project was provided by Nestlé Purina PetCare.

A3531. Postoperative Rehabilitation Protocols following Canine Cranial Cruciate Ligament Repair: A Survey of Veterinary Surgeons

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Introduction: Postoperative rehabilitation following stabilization surgery in cranial cruciate ligament (CrCL) deficient dogs has increasingly gained interest within the veterinary community, although evidence for its effectiveness is still lacking. The goal of this study was to investigate the clinical practices and current attitudes of veterinary surgeons toward postoperative rehabilitation after surgery for CrCL insufficiency as groundwork for future research.

Materials and Methods: An online survey was administered to members of the ACVS/ECVS, ACVSMR, VOS, DVG and recipients of the OrthoVetSuperSite's e-newsletter. The survey contained 18 questions covering multiple postoperative rehabilitation topics.

Results: A total of 376 responses were received. Only 1.9% of respondents did not recommend postoperative rehabilitation after CrCL surgery. Ice pack without compression was the most frequently used rehabilitation technique prior to discharge from the hospital; passive range of motion was the second most common prior to discharge. Furthermore, a significantly higher percentage of respondents were more likely to recommend postoperative rehabilitation after extra-

capsular stabilization (17.0%) than after osteotomies (9.3%) ($p = 0.0142$).

Discussion/Conclusion: The majority of respondents recommended postoperative physical rehabilitation. However, major differences between how strongly rehabilitation is recommended were noticeable. It is possible that the lack of agreement on a standard approach to rehabilitation after CrCL surgery is due to the lack of strong evidence demonstrating the efficacy and benefits of postoperative rehabilitation, and specific recommendations regarding the rehabilitation protocol. Based on our results we conclude that a set of guidelines on postoperative CrCL surgery rehabilitation may be beneficial to guide surgeons in their recommendations.

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

A3552. Bovine Autologous Platelet Concentrate: Production, Hematologic Classification and In Vitro Biologic Characterization

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Introduction: Processing method and in vitro characterization of autologous platelet concentrates (APC), used for tissue healing, have not been validated for bovine whole blood (WB). The objective of the study was to compare hematologic findings of processing methods for APC production, and to compare cytokines and growth factors (GF) concentrations.

Materials and Methods: APC were prepared from WB of four cows (Group 1) with single-step centrifugation using 16 processing methods. The two protocols that yielded the highest platelet to lowest WBC concentrate were APC-1 (2200 rpm, 5 minute) and APC-2 (2500 rpm, 3 minute). They were subsequently reproduced and compared using WB from eight cows (Group 2). Hematologic findings were quantified, cytokines (IL-1 β) and GF (PDGF, TGF- β , bFGF) measured, and enrichment factors compared between samples and processing methods.

Results: Hematologic characteristics and platelet enrichment varied among tested protocols. APC-2 had a significantly ($p = 0.001$) greater degree of platelet enrichment (mean 156%) than APC-1 (125%). Both protocols diluted WBC and had similar mean GF enrichment (124–125% PDGF, 95–100% TGF- β , 102–104% bFGF and 56–74% IL-1 β) without significant differences between APC ($p = 0.08$ and $p = 0.32$ –0.96).

Discussion/Conclusion: Platelet enrichment and cellular reproducibility of APC-2 was confirmed and could be used as a successful processing method. GF measurement showed that APC may have healing modulation properties, but further studies are needed to determine their influence in vivo and impact on clinical outcomes.

Acknowledgement: The commercial kits used in this study were donated by the manufacturer (Arthrex). All other costs were covered by institutional funding. None of the authors received any financial support.

A3626. A Preliminary Field Trial Evaluating the Efficacy of 4% Polyacrylamide Hydrogel in Horses with Osteoarthritis

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Introduction: Polyacrylamide hydrogel (PAHG) is being investigated for the treatment of osteoarthritis. A field trial utilizing 4% intraarticular PAHG in equine joints with naturally occurring osteoarthritis is indicated to determine effectiveness. The objective of this field trial is to investigate intra-articular 4% PAHG in horses with naturally occurring osteoarthritis.

Materials and Methods: Horses were selected for inclusion in the study based on a lameness examination including intra-articular localization and radiographic examination. Twenty-eight horses that met study criteria were included in the primary outcome evaluation. For primary outcome, success was defined as at least 1 grade decrease in lameness and/or a combined reduction of at least 3 grades among the scores for pain, range of motion and joint swelling from treatment to day 45.

Results: There was a significant ($p < 0.001$) decrease in median (range) lameness score from 2 (1 to 4.5) to 1 (0 to 3) with 23/28 (82%) of the horses improved based on study criteria. Additionally, 21/28 (75%) of the horses met study criteria for success at day 90. Throughout the study period there were 43 injections of PAHG, which included eight horses that had the material administered two times and there were no adverse events recorded in any horses.

Discussion/Conclusion: PAHG was effective in decreasing lameness in naturally occurring osteoarthritis in horses. The limitation of this study was that there was no control group and study follow-up was a maximum 90 days.

Acknowledgement: This study funded by Nucleus Regenerative Therapies.

A3613. Clinical and Histologic Evaluation of Polyacrylamide Gel in Normal Equine Metacarpal/Metatarsal-Phalangeal Joints

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Introduction: Polyacrylamide hydrogel (PAHG) is being developed to treat osteoarthritis in horses. Prior to application in osteoarthritic joints, evaluation in normal joints is indicated. The objectives of this study are to evaluate the clinical, cytologic, histologic and metabolic effects of PAHG in normal fetlock joints.

Materials and Methods: This study is an in vivo controlled study utilizing six horses that had four fetlocks assigned to a 7, 28, 56 day or control group. Synovial fluid was collected prior to administration of 2.5 mL of 4% PAHG and again at the completion of the study for macroscopic, cytologic, and cartilage metabolism evaluation. The completion of the study included gross and histologic examination of the cartilage and synovial membrane.

Result: There was a small but significant ($p = 0.0242$) increase in cell count in the synovial fluid at 7 days. There were significant changes in the synovial membrane histology score ($p = 0.0277$) as a result of hypertrophic synoviocytes. Biomarkers indicated a small increase in cartilage turnover 7 days after PAHG administration. The PAHG was visible on the

surface of the synovium at 7 days and PAHG appeared in the interstitial spaces of the synovium and intracellular at days 28 and 56.

Discussion/Conclusion: Data from this study provide information about tolerance and disposition on intraarticular PAHG in a normal fetlock joint during a 56-day study. There were no major or permanent detrimental effects seen with the administration of PAHG in normal joints.

Acknowledgement: Study funded by Nucleus Regenerative Therapies.

A3665. Tenoscopic Treatment of Physeal 'Spike' Remnants of the Caudal Radius in the Thoroughbred Racehorse

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Introduction: New bone on the caudal distal radial physis can traumatize the surface of the deep digital flexor tendon (DDFT), resulting in hemorrhage and tenosynovitis.

Materials and Methods: Racehorses that underwent tenoscopy for removal of physeal 'spike' exostoses were identified. The presenting signs and surgical details were recorded. Days from surgery to first start and maximum rating were obtained from racing records. When horses had raced before surgery, ratings were compared using Wilcoxon Matched Pairs test.

Results: Sixty-nine racehorses underwent surgery on 72 occasions, aged 1 to 12 years (median 2 years). Carpal sheath effusion was identified in 59 (85%) horses. Haemorrhagic fluid or haemosiderin was found in 65 horses (94%). There was damage to the cranial surface of the DDFT in 67 horses (97%). New bone was identified on the radius in all cases and on the contralateral radius in 65 horses (94%). Fifty-three horses (77%) raced after surgery, after a median time of 211 days (range 60–690 days). Of 28 cases that raced before and after surgery, the median maximum rating fell by 3lb ($p = 0.37$).

Discussion/Conclusion: New bone on the caudal radial physis was consistently identified radiographically, not an unusual finding in the young Thoroughbred. In the large majority of cases the surgical findings included evidence of extensive haemorrhage in the tendon sheath. Tenoscopic surgery for impingement by a physeal 'spike' was a successful procedure, with the large majority of horses returning to full racing.

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

A3640. The Effects of Carprofen and Phycocyanin in Dogs with Naturally Occurring Clinical Elbow Osteoarthritis: A Randomized, Double-Blinded, Multicenter Pilot Study

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Introduction: The purpose of this study was to examine the comparative effects of treatment with Phycocyanin-based nutraceutical or carprofen in dogs with clinical elbow osteoarthritis (OA).

Materials and Methods: Twenty-one client-owned dogs with unilateral or bilateral elbow joint OA were selected

for the randomized, double-blinded, multicenter study. Two groups were used; treatment group: Phycocyanin, control group: carprofen. All dogs were treated for 24 weeks. Assessments made before and during the treatment period included force plate analysis, accelerometry, goniometry, pain and lameness evaluations, canine brief pain inventories, and synoviocentesis for concentrations of select inflammatory and degradation markers. Statistical analysis was performed using a split-plot ANOVA and Bonferroni corrections post-hoc with significance at $p < 0.05$.

Results: Final enrollments: Phycocyanin group = 10 dogs, carprofen group = 10 dogs. There were no differences between groups in ground reaction forces or clinical lameness scores. The Phycocyanin group recorded greater accelerometer activity at 12 weeks ($p = 0.046$) and joint extension at 24 weeks ($p = 0.0003$). Pain scores were lower for the carprofen group at 20 and 24 weeks ($p = 0.008$, $p = 0.001$). Synovial concentrations of matrix metalloproteinase-3 were lower in the Phycocyanin group at 24 weeks ($p = 0.013$), while PGE₂ was lower in the carprofen group at 12 and 24 weeks ($p = 0.047$, $p = 0.023$).

Discussion/Conclusion: Although Phycocyanin and carprofen provide clinical efficacy when treating OA patients, Phycocyanin may provide a greater potential to modulate the biochemical OA environment in the dog.

Acknowledgement: Funded by a grant from Dechra. Funding sponsor had no influence on study design, results, or preparation of manuscripts.

A3676. The Effectiveness of Marine-Based Fatty Acid Compound (PCSO-524) Alone and Combined with Previcox in the Treatment of Canine Osteoarthritis

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Introduction: The purpose of this study is to assess the effectiveness of a marine-based fatty acid compound alone and in combination with firocoxib (a NSAID) for treatment of osteoarthritis-associated pain in dogs using objective measures of limb use and validated subjective assessments.

Materials and Methods: A randomized prospective clinical trial was performed with 31 dogs. Dogs were randomly allocated to a PCSO-524 group (PCSO) or a Firocoxib + PCSO-524 (FCX-PCSO) group. Owners were masked to the presence of firocoxib by using identical placebo tablets in the PCSO-524 group. Force plate gait analysis and the owner-completed Canine Brief Pain Inventory tool were used to evaluate patients at 0, 2 and 4 weeks. Data were analyzed using repeated measurement analysis with significant level set a 5% ($\alpha = 0.05$).

Results: Peak vertical force (PVF) values were significantly increased over baseline at week 2 and week 4 in both groups ($p < 0.05$). A significant decrease in the CBPI scores (improvement) was seen in both groups at week 2 and week 4 ($p < 0.05$) compared with the pre-treatment values. No differences were seen between the groups.

Discussion/Conclusion: These data suggest that marine-based PCSO-524 alone, and the combination of firocoxib and PCSO-524 are equally beneficial in treating dogs with

osteoarthritis. Further investigation is warranted to determine the beneficial effects of PCSO-524 alone.

Acknowledgement: Funding for this project was provided by Vetz Petz USA.

A3568. Randomized Pilot Trial of the Effects of an Egg-Shell Membrane-Based Supplement (Movoflextm) on Mobility and Serum Biomarkers of Inflammation in Dogs with Osteoarthritis

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Introduction: Despite increasing interest in nutritional supplements, evidence of analgesic efficacy is lacking beyond the omega-3 fatty acids. The purpose of this pilot study was to evaluate the mobility enhancing and systemic anti-inflammatory effects of an eggshell membrane-based nutritional supplement (Movoflex) in dogs with osteoarthritis (OA)-associated pain and mobility impairment.

Materials and Methods: Twenty-seven dogs with OA-associated pain were enrolled into a randomized, double-masked, placebo-controlled, parallel group, proof of principle pilot study and received either placebo or Movoflex over a 12-week period. Inflammatory biomarkers (IL-2, IL-6, IL-8, TNF α , C-reactive protein [CRP], S100A12, N-methylhistamine) were measured and owner questionnaires (CBPI and LOAD) completed at Day 0, Day 42 and Day 84.

Results: Twenty-two dogs completed the study. Inflammatory biomarkers all decreased in the Movoflex group compared with the placebo group over 12 weeks, significantly for IL-2 at an α level of 0.1 ($p = 0.06$, Wilcoxon). CBPI scores were not different between the groups at any time point, but Day 84 LOAD scores were significantly lower in the Movoflex group compared with placebo group ($p = 0.034$, Wilcoxon), indicating an improvement in client observed mobility.

Discussion/Conclusion: These pilot results suggest administration of Movoflex for 12 weeks may decrease systemic inflammatory biomarkers (IL-2, IL-6, IL-8, TNF α , CRP, S100A12, N-methylhistamine) and improve mobility in dogs with osteoarthritis. These pilot results will allow an appropriately powered definitive study to be performed.

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A3580. Synovial Fluid Cytokine Concentrations Are Influenced by Disease Etiology

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Introduction: Establishing patient specific outcomes in dogs to document severity of joint inflammation and pain at one or several times remains challenging. Cytokines re-

sponsible for inflammation and pain are present in synovial fluid and are available as biomarkers for OA. The objective of this study was to evaluate synovial fluid cytokine concentrations (substance P, bradykinin, MMP's (1, 2 and 3) and TIMP's (1, 2, 3 and 4), interleukins 1, 6 and 8, TNF- α) in dogs with different etiology of OA (CHD, FMCP, OCD, acute CCLD and chronic CCLD).

Materials and Methods: Dogs with OA were enrolled if they had a history of lameness, abnormal physical examination, radiographic evidence of OA and had surgery to confirm etiology of disease. Synovial fluid cytokines were measured using previously validated methods. Groups were compared by establishing effect size (Cohen's d).

Results: Fifty dogs ($n = 10$ /group) were enrolled. Effect sizes > 0.6 were found in nearly 40% of comparisons between etiology groups. For example, CHD and OCD differed from each other and other etiologies for multiple cytokines. In contrast, acute and chronic CCLD were more similar than different, with a large Cohen's d for only IL-6.

Discussion/Conclusion: We reject the null hypothesis that etiology of OA would not influence synovial fluid cytokine concentrations. Synovial fluid remains as an important tool for clinical research and may evolve into an outcome measure that can help document modulation of pain, inflammation or OA. Understanding that disease etiology contributes to variation in synovial fluid cytokine concentrations will assist in study design.

Acknowledgement: None.

A3620. Computed Tomography-Guided Lag Screw Placement for Treatment of United Anconeal Process in 5 Dogs

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Case Description: United anconeal process (UAP) in juvenile dogs is commonly treated with lag screw fixation with or without proximal ulnar osteotomy or fragment removal. Previous reports of lag screw placement describe an open technique to allow for direct visualization; however, minimally invasive techniques are becoming more widely used in veterinary medicine. The purpose of this study was to describe the technique of lag screw placement using CT guidance for the treatment of UAP in dogs.

This was a single center retrospective study of five dogs diagnosed with UAP and treated with CT guided lag screw placement. Sequential focused CT imaging of the proximal ulna was performed to facilitate guide wire placement from the olecranon into the ununited fragment followed by placement of a cannulated lag screw.

In all cases, a lag screw was successfully placed with a median placement time of 59.8 minutes (range 39–75minutes). Four out of five dogs also had a proximal ulnar osteotomy performed. Intraoperative complications included guide wire breakage ($n = 1$). Postoperative complications included seroma formation ($n = 2$), and screw removal secondary to implant infection and/or implant loosening ($n = 3$).

The median time to follow-up was 23 months postoperatively (range: 11 months–3.5 years). Follow-up radiographs showed minimal healing ($n = 2$), moderate healing ($n = 2$) and complete healing ($n = 1$) of the UAP. Owners of all dogs reported clinical improvement with absent to only occasional lameness. Based on these results, CT guidance can be considered when planning treatment for UAP in dogs.

Acknowledgement: None.

A3563. Average Tibial Plateau Angle of 3,922 Stifles Undergoing Surgical Stabilization for Cranial Cruciate Ligament Rupture

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Introduction: At the author's institution, it is noted that the majority of dogs that present with cranial cruciate ligament (CCL) insufficiency have a higher tibial plateau angle (TPA) than what is currently reported in the literature. The purpose of this study was to determine the average TPA in a large sample dogs with CCL insufficiency and to see if breed-specific TPAs could be determined. Our hypothesis is that the average TPA will be higher than what is reported, and that some breeds will have higher TPAs versus others.

Materials and Methods: Medical records from 2006 to 2015 were reviewed for dogs that were diagnosed with CCL rupture and underwent CCL stabilization. The patient's signalment, weight, body condition score, examination findings, surgery report, and preoperative TPA were reviewed.

Results: 3,249 dogs underwent CCL stabilization surgery from 2006 to 2015. Of the 3,249 dogs, 3,054 dogs met the inclusion criteria for a total of 3,922 stifles to be evaluated. The overall average preoperative TPA was 29° (29 ± 3.683°). Average breed-specific preoperative TPAs (breeds consisting of 20 or more dogs) ranged from 27° to 35.1°.

Discussion/Conclusion: Our reported overall preoperative TPA in a large series of dogs is higher than what is currently published. In reviewing 3,922 stifles the average and median preoperative TPA was 29°. In addition, we report the average preoperative TPA in specific breeds. This updated information may guide clinicians in management decisions regarding treatment for CCL rupture.

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

A3638. The Use of a Needle Arthroscopy for the Diagnosis of Shoulder- and Elbow-Related Lameness in Canine Patients

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Introduction: Needle arthroscopy (NA) is a new diagnostic tool for human and veterinary medicine. The purpose of this study is to report initial experience of the use of NA for the evaluation of elbow and shoulder joints in affected dogs under sedation.

Materials and Methods: Canine patients presenting for shoulder- or elbow-related lameness were sedated with intravenous 5 µg/kg dexmedetomidine and 0.1 mg/kg hydro-morphone for NA evaluation. The positioning, skin preparation, scope and egress sites for NA were similar to previously reported for traditional arthroscopy (TA). Findings, complications and time needed for both NA and TA (if performed) were recorded.

Results: Twelve elbow joints in seven dogs were evaluated. The median time (range) for TA was 9 minutes (3–15), and NA was 10 minutes (4–23). Additional sedation was necessary for three dogs. Medial coronoid and humeral kissing lesion could be identified in all joints. Complications included ulnar cartilage damage in four joints and periarticular oedema in three joints.

Six shoulder joints in five dogs were evaluated. The medial, cranial and caudal compartment could be visualized in all joints. The median time (range) for NA was 12 minutes

(10–23), and TA was 18 minutes ($n = 3$, 14–25). Humeral OCD was diagnosed in one joint, subscapularis muscle tear was diagnosed in four joints. Inadvertent penetration of medial glenohumeral ligament occurred in one joint.

Discussion/Conclusion: With proper training, NA can be performed under sedation and as an outpatient procedure to evaluate canine shoulder and elbow joints.

Acknowledgement: Partly funded by the Center for Companion Animal Health at UC Davis.

A3646. Complication Rates following Equine Elective Arthroscopy: Comparison of Inpatient Versus Outpatient Surgery

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Introduction: To report the complications following elective arthroscopic surgery in horses and to determine whether surgery performed on an outpatient basis increases postoperative complication rates.

Materials and Methods: Three hundred and fifty-seven horses (366 surgical procedures) were included in this retrospective case series. These horses had arthroscopic surgery performed at a single institution between January 2008 and February 2015. Data included signalment, travel time to the hospital, clinical signs, joint(s) operated on, lesion (s) diagnosed, medications administered, anaesthesia and surgery times, details of the procedure (including closure and surgeons involved), and hospitalization status. Inpatients were horses that remained hospitalized overnight, while outpatients were discharged in the afternoon following surgery. These were analysed together with follow-up information to identify factors associated with postoperative complications.

Results: One hundred and sixty-eight outpatient surgical procedures (47%) and 198 inpatient surgical procedures (53%) were included. Standardbreds were overrepresented in the outpatient group ($p = 0.016$). Anaesthesia and surgery times were longer ($p < 0.001$) for the inpatient group. Complications present in the study population included bandage sores, catheter problems, colic, diarrhoea, postoperative discomfort, esophageal impaction, fever, incisional drainage, post-anaesthetic myopathy, persistent synovitis, persistent lameness, septic arthritis, and osteochondral fragments not removed during the original surgery. None of these complications were associated with postoperative discharge times.

Discussion/Conclusion: Elective arthroscopy in horses can be performed safely and without any increase in complications on an outpatient basis.

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

A3637. Spontaneous Osteonecrosis in a Thoroughbred Racehorse

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Introduction: Spontaneous osteonecrosis is a progressive, painful condition recognized in people due to an underlying subchondral insufficiency fracture. The diagnosis is best made using magnetic resonance imaging in people with joint arthroplasty usually performed. Similar conditions occur in dogs such as avascular necrosis of the femoral head or necrosis of the distal femur in foals secondary to osteochondrosis or sepsis. To our knowledge spontaneous osteonecrosis

as described in human literature has not been reported in the horse. We aim to describe the clinical findings of spontaneous osteonecrosis in the phalanges of a horse and the imaging features with nuclear scintigraphy, radiography, computed tomography and magnetic resonance imaging.

Materials and Methods: A 3-year old Thoroughbred filly presented for nuclear scintigraphy with grade 4 of 5 lameness after a breeze with no previous history of performance limiting lameness.

Results: Nuclear scintigraphy and MRI were the only two modalities that showed severe abnormalities of the proximal, middle, and distal phalanges, which was confirmed as osteonecrosis on histopathology. The filly was humanely euthanized due to laminitis in the affected limb following attempts at medical and surgical management.

Discussion/Conclusion: Spontaneous osteonecrosis has been associated with mechanical, biochemical and traumatic origins in people that leads to loss of blood supply to the bone. We suspect that one of these mechanisms was responsible for the findings in this horse and may require a combination of nuclear scintigraphy and MRI to make a diagnosis.

Acknowledgement: There were no proprietary interest or funding provided for this project.

A3624. Traumatic Ossifying Fasciitis Presenting as a Large Flank Mass in a Standardbred Gelding

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Introduction: An 8-year old pacer was presented with a large, firm pendulous swelling off the right flank. The swelling had been present for at least 3 years.

Physical Examination The gelding was healthy. The swelling was ovoid, ~7 × 5 inches in size, very firm, and adherent to the underlying musculature. Ultrasonographically, multiple 'shadows', indicating mineralized tissue, were evident, deep to the capsule. The ribs beneath the mass had a roughened, irregular surface, suggesting previous trauma.

Case Management The skin around the mass was desensitized and the mass was excised via a lenticular incision. The mass was radiographed after the excision, demonstrating an inner 'spheroid' of irregularly ossified tissue.

Histologic Findings Cellular reactive fibrous tissue was present within the lesion's fibrous capsule. Large fragments of maturing bone, intermediate between woven and lamellar bone were present. Small irregular spicules of woven bone were also evident, set in a loose amorphous matrix. Cartilaginous nodules were also present in the central region. The diagnosis was 'traumatic ossifying fasciitis'.

Discussion Ossifying fasciitis/myopathy lesions develop at sites of previous trauma. We speculate that thoracic wall trauma was responsible for the initial fasciitis. In horses, ossifying myopathy is most commonly encountered within and between the semimembranosus/semitendinosus muscles, where the surrounding fascia and intermuscular planes restrict the lesions to a flattened, linear shape. In this case, flank musculature and fascia provided little or no constraint to the lesion expansion, generating this unusual presentation.

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

A3673. Clodronate Improves Lameness in Horses Independent of Anti-Resorptive Effects In Vivo

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Introduction: Clodronate has become a popular choice for veterinarians treating chronic lameness issues in the horse. Despite its clinical popularity, little research has been done to understand the effects of clodronate in the horse.

Materials and Methods: Our objective was to determine if clodronate at the clinically approved dose altered bone remodelling or bone cell recruitment and lameness. Twelve university-owned horses randomly received either 1.4 mg/kg clodronate (CLOD, $n = 6$) or an equivalent volume of LRS (CONT, $n = 6$) as treatment in a blinded manner. Blood was evaluated weekly for 16 weeks around treatment for bone turnover markers. Lameness evaluations and coach questionnaires were performed to assess for change in lameness or performance. Bone cell recruitment was evaluated in vitro 2 weeks before and after treatment.

Results: There was no difference in in vitro bone cell recruitment from whole bone marrow. There were no differences in markers of bone turnover, osteocalcin or CTX-I. There was a significant difference (reduced lameness) of both forelimb and hindlimb lameness in CLOD horses versus CONT. Coaches identified an improvement in performance significantly more often in CLOD versus CONT.

Discussion/Conclusion: Clodronate appears to reduce lameness with minimal effects on bone turnover.

Acknowledgement: This project was supported by a Department grant and a College endowment for equine research.

A3663. Postnatal Development of the Functional Specialization of the Equine Superficial Digital Flexor Tendon

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Introduction: The superficial digital flexor tendon (SDFT) is adapted to its function of both withstanding high loads, as well as providing a structure, which is fatigue-resistant, elastic and stores energy. We have shown previously that many of the unique SDFT properties are derived from a specialized compartment of tendon, known as the inter-fascicular matrix (IFM). We were interested in understanding how the SDFT develops its unique structure from birth to the end-of-development. Understanding this process may lead to development of methods which could be used to optimize tendon structure for future resilience to athletic use.

Materials and Methods: We undertook histology/immunohistochemistry and proteomics on dissected fascicular matrix (FM) and IFM, and hierarchical biomechanical testing of fascicles and the IFM in tendons collected from horses from 0 to 24 months.

Results: The FM shows little adaptation post-natally; its proteome showed little alteration through development, and little alteration in biomechanical properties other than a slight increase in viscoelastic properties at the end of growth. In contrast the IFM demonstrates adaptation of its proteome,

structure and biomechanical properties throughout the whole period of development.

Discussion/Conclusion: We demonstrate that the SDFT develops its unique functional properties throughout the whole period of growth (0–2 years). While there is some adaptation of this tendon immediately after birth, most of the specific specialization of this tendon occurs at the yearling stage and continues on until the end of growth. To optimize tendon development any interventions will have to be targeted at the full period of development, not just the immediate postnatal period.

Acknowledgement: Funding: HBLB.

A3657. Correlations between Biomechanical and Acoustoelastographic Variables in the Equine DDFT

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Introduction: Tendinous lesions are common in horses with the DDFT commonly injured. Acoustoelastography (AEG) is a new ultrasonographic technique that evaluates tissue strain based on changes in tissue length when an external force is applied. The purpose of this study was to evaluate AEG and biomechanical properties of the DDFT. Due to the differences in weight distribution between forelimb and hindlimb and the morphological change between the proximal (cylindrical) and distal (ribbon-like) appearance of the DDFT, we hypothesized that differences would exist in AEG parameters among these limbs and locations.

Materials and Methods: Eight horses were sedated and subsequently euthanized for reasons unrelated to the study. Cineloops of DDFTs transitioning through the loading phase of the limb were made in vivo and then after harvesting tendons ex vivo. Software was then used to determine the strain of the tendons via AEG.

Results: A two-way ANOVA with limb and location as factors was performed along with linear regression. A p -value < 0.05 was considered significant. For maximal strain, there were significant differences between proximal and distal regions ($p < 0.001$) but no significant differences were identified between fore and hindlimbs.

Discussion/Conclusion: During loading movements in vivo, the DDFT is subjected to translation and strain underneath the skin in relation to the transducer; ex vivo, the transducer only identifies pure strain. These data indicate that biomechanical function of the DDFT changes from the proximal and distal regions and the caution should be used when making inferences between ex vivo and in vivo data.

Acknowledgement: Supported by a grant from the Surgical Translation and Research Laboratory, UF.

A3582. A Refined and Clinically more Relevant, Preclinical Osteochondral Defect Model in Rabbits

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Introduction: An osteochondral defect in the femoral trochlear groove of the rabbit is a well-described animal model to study cartilage regeneration and repair. Current models are performed via open arthrotomy. The objective of

this study was to evaluate if the use of arthroscopy in this model will reduce the animal burden and also decrease the effects of the surgical approach on the study outcome.

Materials and Methods: Twelve New Zealand White Rabbits were used for this study. In six rabbits (group 1), an osteochondral defect was created in the medial trochlear ridge of the femur with arthroscopic technique. In the remaining six rabbits (group 2), the same defect was created via open arthrotomy. The effect of the surgical procedure on general condition and activity of the rabbits was monitored. After euthanasia and macroscopic evaluation of the operated stifle joint, the distal femora were fixed and processed for histology.

Results: Creation of a standardized defect was possible in 11 out of 12 rabbits. Clinically and on video evaluation no difference in behavior between the two groups was observed. In the macroscopic cartilage repair assessment ICRS group 1 reached a grade II; nearly normal, the score of Group 2 correlated with grade III; abnormal. Statistical results from the activity tracking and histology are pending.

Discussion/Conclusion: A standardized osteochondral defect in the trochlear ridge of the femur can be created arthroscopically in rabbits. Both rabbit groups showed normal behaviour after surgery. The macroscopic cartilage repair assessment ICRS showed a better overall repair in the arthroscopic group.

Acknowledgement: The study was financed by AO Trauma.

A3611. The Effects of Autologous Mesenchymal Stem Cell Therapy on Elbow Osteoarthritis in Dogs: A Pilot Study

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Introduction: Mesenchymal stem cells (MSC) have been used to treat osteoarthritis (OA), but reported treatment outcomes remain sparse in veterinary medicine. MSC can regenerate and repair damaged tissues and provide anti-inflammatory effects in joints. Recently, adipose derived MSC injected into canine elbows with elbow dysplasia improved lameness and regenerated hyaline cartilage 1 year post-injection. Our objectives were to evaluate treatment using bone marrow (BM)-derived MSC and platelet-rich plasma (PRP) administered intra-articularly into the more affected limb in dogs with bilateral elbow OA.

Materials and Methods: Elbow OA was evaluated using owner, veterinary and objective gait evaluation. A double blinded, randomized, design evaluated BM MSC or placebo (saline) was injected into the injured elbow.

Results: Six dogs completed this pilot study. Three received BMMSC treatment and three the placebo. A significant decrease in peak braking force (-15.6 to -11.2% BW; $p < 0.05$) was found in the affected limb and decreased peak vertical force (100.8 to 93.0% BW; $p < 0.05$) and vertical impulse (17.8 to 16.2% BW; $p < 0.05$) were found in the contralateral limb 12 weeks post injection. An inverse correlation was found between peak propulsion force and owner lameness scores ($r = -0.95$, $p < 0.05$). No other significant differences were identified.

Discussion/Conclusion: These pilot results demonstrate that BMMSC injected into an arthritic elbow is safe and revealed some improvements in force plate analysis of gait. A larger sample size and longer post-injection re-evaluation period are required to determine the therapeutic effect of BMMSC.

Acknowledgement: The authors report that this study was funded by a Centers of Excellence (COE) grant.

A3594. Clinical Efficacy of Platelet Rich Plasma for the Treatment of Elbow Osteoarthritis in Twenty Dogs

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Introduction: The purpose of this study was to evaluate efficacy of platelet-rich plasma (PRP) for the treatment of canine elbow osteoarthritis.

Materials and Methods: Twenty dogs with elbow osteoarthritis and previous elbow arthroscopy were randomized and assigned to two groups, the treatment group and the control group. Ten patients in the treatment group received an intra-articular injection of 2.0 mL of PRP in the affected elbow(s). Ten patients were placed in the control group and did not receive any treatments. All dogs were evaluated at Day 0, 14, 30, 60, and 90 with an examination with bilateral goniometric measurement of the elbow and temporospatial gait analysis. Clients completed the Canine Brief Pain Inventory (CBPI) at each evaluation. Statistical analysis significance established at < 0.05 was performed.

Results: Fourteen dogs had bilateral elbow osteoarthritis, three dogs had left elbow osteoarthritis, and three dogs had right elbow osteoarthritis. Mean elbow flexion at Day 0 and 90 were 50.3° and 43.9°, respectively, in the PRP treatment group, and 48.4° and 46°, respectively, in the control group. Mean TPI% at a walk at Day 0 and 90 were 28.8% and 29.6%, respectively, in the PRP treatment group, and 28.6% and 29.4%, respectively, in the control group. Statistical analysis results are pending.

Discussion/Conclusion: PRP should be considered for the treatment of canine elbow osteoarthritis.

Acknowledgement: Funding for this study was provided by Companion Regenerative Therapies.

A3656. Surface Electromyography Repeatability of the Vastus Lateralis, Biceps Femoris and Gastrocnemius Muscles at a Trot in Normal Dogs: A Pilot Study

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Introduction: The objective of this study was to document the repeatability of surface electromyography (sEMG) activity of the vastus lateralis (VL), biceps femoris (BF) and gastrocnemius (GN) muscles bilaterally in healthy dogs at a trot over two time periods. We hypothesized that the sEMG data from these muscles would be accurate and repeatable over time.

Materials and Methods: Five client-owned normal dogs were selected for the study. sEMG surface electrodes were bilaterally placed on the VL, BF and GN muscles. sEMG data were recorded while simultaneously collecting ground reaction force measurements at a trot on day 0 (T1) and 14 days later (T2). sEMG data were processed for comparative analysis and to normalize the data to 100% of the maximum amplitude (maximum–minimum = %MM). The maximum % MM of each muscle during a gait cycle was assessed for

repeatability using repeated measures ANOVA for parametric data or a Friedman's test for non-parametric data. Significance was set at $p < 0.05$.

Results: There was no statistical difference between T1 and T2 for sEMG data for VL ($p = 0.16$), BF ($p = 0.22$), and GN ($p = 0.65$). Waveforms generated for VL, BF and GN were consistent in morphology over time.

Discussion/Conclusion: The sEMG activity observed in this study for the VL, BF and GN was accurate, consistent and repeatable, supporting our hypothesis. The repeatability of sEMG data will provide additional diagnostic features for current and future therapeutic modalities for hip and stifle joint-related diseases.

Acknowledgement: Funding for this study was provided by the Comparative Orthopedic Research Laboratory, Washington State University and a grant from Dechra.

A3633. Canine Mesenchymal Stem Cell-Mediated Bone Regeneration is Enhanced in the Presence of Sub-Therapeutic Concentrations of RbBmp-2 in a Murine Critical-Size Calvarial Defect

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Introduction: Canine mesenchymal stem cells (cMSCs) require supplementation with BMP-2 to consistently undergo osteogenesis in vitro. Interestingly, murine calvarial defects treated with canine adipose MSCs exhibited markedly reduced healing when compared with defects treated with human MSCs. We hypothesized that healing of calvarial defects in vivo would be enhanced by supplementation with a sub-therapeutic concentration of BMP-2.

Materials and Methods: Unilateral calvarial defects (4 mm diameter) were created in 60 days Nu/J mice ($n = 5$ mice/group). Defects were treated with 2×10^6 canine marrow MSCs, 6 µg/mL rhBMP-2, or a combination of MSCs and BMP-2. A negative control group ($n = 4$) did not receive treatment. At 4 weeks, mice were terminated and quantitatively assessed for healing with radiography. Healing indices (HI) were generated for each defect (0 = no healing, 1 = complete healing). Micro-CT images were obtained to further assess the healing response. Healing indices were evaluated using one-way ANOVA with Dunnett's multiple comparisons post-test.

Results: HI were negative control (0.18 + 0.11), MSCs (0.23 + 0.17), BMP-2 (0.16 + 0.09), and MSCs + BMP-2 (0.49 + 0.15). Treatment of calvarial defects with MSCs + BMP-2 resulted in a significantly higher healing index ($p = 0.009$). Micro-CT imaging confirmed these results.

Discussion/Conclusion: Canine MSCs supplemented with sub-therapeutic BMP-2 are capable of inducing bone regeneration in vivo. These results represent a substantial advancement for the field of canine MSC bone regeneration and will serve as a foundation for future canine bone healing efforts.

Acknowledgement: There was no proprietary interest. Funding provided by CST*R and the Bone and Joint Fund, Texas A and M Foundation.

A3614. Differential BMP Expression and Activities Impact the Osteogenic Capacities of Equine Bone Marrow and Adipose Stem Cells

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Introduction: In equine practice, stem cell therapies primarily utilize cells from bone marrow (BM) and adipose tissue (ADI). Although adipose-derived stem cells are easily accessible, the biological activities and responses of ADI cells are less robust than those of BM cells. We addressed the hypothesis that poor osteogenic capacity of ADI cells is a result of inadequate endogenous BMP ligand expression and/or induction.

Materials and Methods: Bone marrow and adipose collections from four horses were approved by our institutional IACUC. Bone marrow aspirates and adipose cells were seeded at low density and expanded through two passages. P3 cells were transferred to control or osteogenic cultures for up to 10 days. BMP ligand and osteogenic gene expression was assessed by QPCR. Alkaline phosphatase (ALP) activity was measured by an enzymatic assay. Mineralized matrix formation was monitored by Alizarin Red staining.

Results: Under basal conditions, both BMP-2 and -4 expression was consistently four to seven times higher in BM cells than in ADI cells. BMP-2 and -4 expressions increased by over 100-fold by day 10 in BM osteogenic cultures. In contrast, there was little change in expression of either BMP in ADI cell cultures. Exogenous BMP-2 significantly increased Runx2, Osterix and ALP expression in osteogenic ADI cultures.

Discussion/Conclusion: These findings suggest that differential osteogenic capacities of BM and ADI cells derive from differential intrinsic BMP activities. Exogenous BMP stimulation will likely be necessary if ADI cells are used to support bone repair.

Acknowledgement: This research was supported by USDA Hatch Research funds and The Companion Animal Research Fund.

A3671. Double-Blinded, Placebo Controlled Study Evaluating the Safety and Efficacy of Intravenous Allogeneic Adipose Stromal Cell Therapy for Canine Osteoarthritis

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Introduction: Allogeneic adipose-derived stromal cells (ASCs) provide numerous advantages over autologous cells for osteoarthritis.

Objectives were assessing safety and efficacy of intravenous allogeneic in a randomized, double-blinded, controlled study. We **hypothesize** that if allogeneic ASC therapy is safe and effective, then treated dogs will show measurable clinical improvements with lack of increased adverse events.

Materials and Methods: Seventy client-owned dogs with radiographic OA were recruited into this study. Dogs were fitted with an accelerometer, and data were gathered for 7 days prior to therapy. Intravenous injections were administered at 0 and 6 weeks. The activity counts were averaged for the pre-therapy week, 6 weeks and 12 weeks.

Results: Sixty-six dogs completed the study. Withdrawals from the study were unrelated to therapy. There were no reports of adverse events correlated with administration of allogeneic ASCs. Both groups had an overall decrease in activity counts over the course of the study. There was no statistical significance between groups at any time point.

There were no statistical differences between pre- and post-therapy activity counts in either group.

Discussion/Conclusion: No adverse events correlated to ASC injections were encountered. Activity counts decreased over time, regardless of treatment group, which may be due to progression of disease or confounding behaviours influenced by the nature of the study.

Acknowledgement: The authors would like to thank Morris Animal Foundation for funding this study.

A3623. An Objective Assessment of the Effect of Desensitizing the Median Nerve on Lameness Originating from the Cubital Joint

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Introduction: The median nerve is often desensitized along with the ulnar nerve when performing a lameness examination. Due to the close proximity of the median nerve to the cubital joint, proximal migration of local anesthesia is possible resulting in amelioration of a lameness originating from the cubital joint. The objective was to determine if performing a median nerve block will desensitize the cubital joint.

Materials and Methods: A forelimb lameness was induced in six healthy horses by injecting 100 ng of recombinant equine interleukin IL-1 β into the cubital joint. The median nerve of the lame leg was anaesthetized using 10 mL of local anaesthetic solution. Successful block was confirmed by loss of skin sensation and thermographic images. Lameness was assessed at 20-, 40- and 60-minute intervals using the Lameness Locator. A full-factorial repeated measures ANOVA was used to compare treatment effect across time.

Results: IL-1 β administration resulted in significant transient lameness in all horses ($p < 0.00001$). The median nerve block was successfully performed in all horses and did not result in significant improvement of lameness as quantified by the total differential head vector sum ($p = 0.3234$).

Discussion/Conclusion: Complete desensitization of the median nerve did not ameliorate lameness originating from the cubital joint. This result has relevant clinical application as it suggests, when performing a lameness examination, it is unlikely that blocking the median nerve with a low volume of local anaesthetic will block a lameness originating from the cubital joint.

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

A3639. Evaluation of the Short-Term Effects of Intra-Articular Administration of Platelet-Rich Plasma in Horses with Experimentally Induced Synovitis

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Introduction: Platelet-rich plasma is used with increasing frequency as a treatment for equine osteoarthritis despite the lack of studies evaluating its effect on the synovial environment, and the exact composition of PRP used is rarely defined. We hypothesized that horses treated with a leukocyte-poor PRP following induction of an acute synovitis would have lower lameness scores and an improved synovial environment with less inflammation and decreased cartilage catabolism.

Materials and Methods: Six horses with no apparent forelimb lameness and minimal osteoarthritis changes on metacarpophalangeal radiographs were studied. Each metacarpophalangeal joint acted as both the control or treatment in this crossover design. Synovitis was induced with 0.5 ng of LPS and serial lameness examination and synoviocentesis were performed. Synovial fluid evaluation included ELISA for collagen cleavage (C2C) and inflammation (PGE2) as well as white blood cell count and total protein. Results were assessed with a two-way ANOVA for repeated measures ($p < 0.05$).

Results: Treated horses were less lame at 24 and 48 hours compared with controls ($p < 0.05$). There was a significant increase of cell count and total protein at 8 and 24 hours but no significant difference between groups ($p < 0.05$). C2C and PGE2 had no significant differences between groups but had a significant increase at 24 hours ($p < 0.05$).

Discussion/Conclusion: Leukocyte-poor PRP had no deleterious effects on synovial environment and it may be an effective therapy in acute synovitis when corticosteroids are unable to be administered. Serial administration or a leukocyte-rich PRP may have supported hypothesis.

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A3615. Equine Mesenchymal Stem Cells Possess Antimicrobial Properties

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Introduction: Increasing incidence of infections with multi-drug resistant (MDR) organisms and rapid development of antibiotic resistance necessitate the development of novel therapeutics. Stem cell-based therapies have antimicrobial activity and thus are an attractive alternative. Our objectives were to assess antimicrobial activity of eqMSC in vitro against gram-positive and negative bacteria and determine if eqMSC produced antimicrobial peptides. Our hypotheses were that eqMSC exerted a direct antimicrobial effect in vitro against gram-positive and negative bacteria and would produce antimicrobial peptides.

Materials and Methods: Conditioned medium was collected from bone marrow-derived eqMSC and assessed for antibacterial activity in vitro. Log phase bacteria were added to eqMSC conditioned medium and incubated and quantitative cultures were performed. Bacteria utilized included laboratory strains of methicillin-resistant *Staphylococcus aureus* (MRSA) and *Escherichia coli*. Results were compared utilizing an ANOVA with Tukey posttest and significance set at $p < 0.05$. Immunofluorescent antibodies were utilized to determine if eqMSC produced antimicrobial peptides (AMP) in the cathelicidin family.

Results: Equine MSC conditioned medium demonstrated marked inhibition of bacterial growth of *S. aureus* and *E. coli*. Equine MSC produced cathelicidin AMPs.

Discussion/Conclusion: This study did not address potential indirect immunomodulatory effect of eqMSCs or effectiveness in vivo. The antimicrobial action of eqMSC may be effective as a therapy where conventional pharmaceutical therapies are ineffective at clearing infection, such as infectious arthritis, orthopaedic implant or musculoskeletal infection with MDR bacteria.

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

A3678. Intramedullary, Interlocking Nail Fixation Alone or in Combination with a Cranial Bone Plate to Repair Diaphyseal Femur Fractures in 16 Foals Weighing Less than 250 kg (1993–2016)

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Introduction: The reason for performing this study was to evaluate the safety, complications and success rate of a novel procedure to repair diaphyseal femur fractures in foals less than 250 kg. We hypothesized that diaphyseal femur fractures in foals could be successfully repaired with an intramedullary interlocking nail (IIN) alone, or a combination of an IIN and plate applied to the cranial cortex in foals of large stature or with complex fractures.

Materials and Methods: Sixteen foals were presented for surgical repair of a mid-diaphyseal femur fracture. A standard lateral approach to the femur was used to access the fracture, sequentially ream the medullary cavity, and reduce the fracture. A 12.7-mm diameter solid stainless steel IIN was inserted through the trochanteric fossa into the distal femur and secured in place with 5.5-mm cortex screws placed transcortically through holes in the IIN in the proximal and distal fracture segments. In nine foals, a cranial DCP or LCP plate was applied due to concern for the strength and stability of the bone-IIN construct because of the size of the foal or characteristics of the fracture.

Results: Fourteen of 16 horses survived to discharge. Long term follow-up was available for 9 horses. Five horses were used for their intended purpose, 3 were used as broodmares, and 1 was used for pleasure riding.

Discussion/Conclusion: Mid-diaphyseal fractures in foals less than 250 kg can be successfully repaired with an IIN alone or in combination with a cranial bone plate with a fair to good prognosis for return to function.

Acknowledgement: None.

A3587. Effect of Proximal Abducting Ulnar Osteotomy (Paul) on Thoracic Limb Alignment in a Canine Ex Vivo Simulated Weight-Bearing Model

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Introduction: The objective of this study was to determine the effect of PAUL on thoracic limb alignment using an ex vivo canine cadaveric model.

Materials and Methods: Fifteen pair of thoracic limbs were obtained from skeletally mature Labrador Retrievers. A custom designed limb press was used to obtain standing and recumbent caudocranial radiographs before and after 2 mm and 3 mm PAUL. Manus lateralization and rotation were directly measured during limb loading. Mean \pm SD mechanical (m) joint angles were determined using full limb radiographic montages with the CORA method for pre (p) or post op (po2/po3) radiographs in both standing and recumbent positions. Mixed linear modeling was used to identify differences in limb alignment values and manus position.

Results: Significant differences were detected for medial proximal radioulnar angle (mMPRUA): $80.6 \pm 2.5^\circ$ (p), $82.6 \pm 2.4^\circ$ (po2), $84.0 \pm 2.4^\circ$ (po3); thoracic humeral angle

(mTHA): $3.9 \pm 1.7^\circ$ (p), $2.4 \pm 1.4^\circ$ (po2), $2.6 \pm 1.5^\circ$ (po3); humeral radioulnar angle (mHRUA): $8.9 \pm 2.8^\circ$ (p), $6.1 \pm 2.7^\circ$ (po2), $5.2 \pm 2.7^\circ$ (po3); elbow mechanical axis deviation (eMAD): $1.9 \pm 1.1\%$ (po), $0.9 \pm 1.1\%$ (po2), $0.4 \pm 1.4\%$ (po3); and elbow compression angle (ECA): $1.4 \pm 1.3^\circ$ (p), $1.0 \pm 0.9^\circ$ (po2), $0.8 \pm 1.0^\circ$ (po3). There was significant lateralization and external rotation of the manus after PAUL.

Discussion/Conclusion: In the ex vivo setting, PAUL resulted in translation of the mechanical axis of the thoracic limb from a medial to lateral direction though alterations in the limb alignment values associated with the elbow, humerus and proximal radius/ulna. The CORA method may prove useful in the evaluation of thoracic limb alignment in client-owned dogs pre- and post-PAUL.

Acknowledgment There was no proprietary interest. Funded by the Ginn Fund, Texas A and M University. Implants were provided by Kyon (Boston, MA).

A3609. Biomechanical Comparison of Three Lumbar Stabilizing Implant Devices in Canine Cadavers

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Introduction: Degenerative lumbosacral stenosis (DLSS) is the most common cause of progressive lower back pain in large breed companion and working dogs. Pins/PMMA and SOP systems have been previously shown to provide stability of the canine L7-S1 junction. Polyaxial pedicle screws and rod fixation systems are commonly used in human spinal stabilization; however, canine-specific implants (cPSRC) have never been investigated in canine cadaver models.

Materials and Methods: Twenty-four dissected lumbosacral large canine breed spinal sections were randomly assigned to Pins/PMMA, SOP or cPSRC following routine dorsal laminectomy. The spines were stabilized using 3.2 mm shaft/4.0 mm thread diameter in the Pins/PMMA group, 3.5 mm screws for SOP locking plates and 5 mm rods and 4.5 mm diameter screws for the cPSRC system. Non-destructive cyclic three-point bending (axial, lateral, flexion/extension) applied pure moments of -5.0 N-m to the constructs and load to failure in dorsiflexion on two samples each.

Results: Analysis showed equivalence between the groups for range-of-motion and compliance/stiffness. Clinically, cPSRC implants should provide similar initial stiffness to other recognized L7-S1 stabilizing devices. Implant placement accuracy was found to be 87.5% for SOP, 87.5% for Pins/PMMA and 75% for cPSRC.

Discussion/Conclusion: The novel cPSRC system should be used to fixate an unstable L7-S1 junction in canines. Although not superior, the cPSRC systems were equivalent in stiffness in torsion, bending and flexure load testing to predicate lumbosacral stabilization constructs.

Acknowledgment: This study was funded by the College Research Council, CVMBS-CSU. The implants were donated from Orthomed, IMEX Veterinary and ArteMedics. The authors have no conflict of interest.

A3581. Development of a 3D Type I Collagen Assay to Evaluate Chondrogenesis of Canine Bone Marrow-Derived Mesenchymal Stem Cells

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Introduction: Chondrogenic differentiation of canine MSCs (cMSCs) has been described using the classic micro-mass technique. However, cMSCs appear to respond inconsistently using this method. The objectives of this study were (1) to develop a collagen-based 3D serum-free system to facilitate consistent cMSC chondrogenic cultures; (2) to qualitatively and quantitatively assess the effect of various chondrogenic media on cMSC chondrogenesis.

Materials and Methods: cMSCs were polymerized in 100 μ L of Type I Collagen gel (5 mg/mL) at 10^7 cells/construct. Constructs were assessed using morphometry, live/dead staining, and histology after 21 days in 10 various chondrogenic media. cMSCs were next cultured with four promising media and quantitatively assessed for early cytotoxicity (LDH assay) and chondro- versus osteogenesis (GAG content; qPCR for Col I, II, X, Sox 9, Aggrecan, Osteocalcin and Osterix).

Results: In the presence of dexamethasone and TGF- β 3, both BMP-2 and bFGF generated larger constructs although BMP-2 was required for histologic characteristics of early MSC chondrogenesis. Constructs cultured with dexamethasone, TGF- β 3, BMP-2, and bFGF exhibited a significant decrease in LDH concentrations at day 3. GAG content was significantly increased in these constructs at day 3, 10, and 21. Both osteogenic and chondrogenic transcripts were temporally induced in response to dexamethasone, TGF- β 3, BMP-2, and bFGF.

Discussion/Conclusion: The collagen assay proved useful in assessing cMSC differentiation and holds much promise as a model system to both characterize cMSC chondrogenesis and to produce future tissue engineering constructs.

Acknowledgment: Bone and Joint Fund, Texas A and M Foundation; CVM Graduate Student Training Grant.

A3547. Evidence-Based Protocol Changes to Reduce Implant-Associated Infection Rate after Tibial Plateau Levelling Osteotomy in Dogs

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Introduction: Surgical site infection following orthopaedic surgeries leads to increased patient morbidity, as well as increased financial burden for clients. The goal of this study was to determine if a significantly reduced implant-associated infection (IAI) rate could be achieved by implementing evidence-based protocol changes during and after the tibial plateau levelling osteotomy (TPLO) procedure in dogs.

Materials and Methods: Medical records were reviewed and a total of 703 dogs (811 TPLO) were included. Two cohorts were established, with 255 dogs ($n = 282$ TPLO)

that underwent an established TPLO procedure and 448 dogs ($n = 529$ TPLO) that underwent a revised TPLO procedure. Data were analysed to determine the rate of IAI and risks associated with these rates.

Results: Implant removal was performed in 31 dogs ($n = 24$ pre-change, $n = 7$ post-change). IAI was confirmed with a positive bacterial culture in 26 dogs ($n = 21$, pre-change, $n = 5$ post-change). The pre-change group had nearly eight times the risk of infection in comparison to the post-change group when sex, if intact, and laterality were controlled. All culture-positive implants removed from the post-change group produced a *Staphylococcus* spp., 80% of which exhibited methicillin-resistance.

Discussion/Conclusion: A significant reduction in post-operative TPLO IAI rate was achieved by implementing evidence-based changes during and after TPLO surgery. Methicillin-resistant bacterial strains are becoming more prevalent over time, increasing the urgency for reduction of surgical site infections (SSIs) and therefore, IAI.

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

A3532. Stabilization with a Ventral Screw and Polymethylmethacrylate Construct as a Method of Surgical Fixation for Transverse Vertebral Body Fractures of C2 in Three Dogs

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Introduction: Canine spinal column fractures have been variably described in veterinary medicine, with limited characterization of cervical fractures. This report details the mechanism of injury of a transverse vertebral body fracture of the axis (C2) not previously described in veterinary literature, as well as a surgical fixation technique applied to three cases of the aforementioned fracture type.

Materials and Methods: Diagnostic imaging was used to describe C2 fractures and plan fixation in three dogs. The injury to C2 in all patients was characterized by a transverse fracture of the vertebral body with a dorsally displaced and caudodorsally angulated cranial fragment and an over-riding, craniodorsally angulated caudal fragment. Surgical reduction and stabilization of the cervical spine was performed through a ventral approach at the fracture site and adjacent vertebrae using Kirschner wires for anatomic reduction and a screw and polymethylmethacrylate (PMMA) construct was placed in a monocortical fashion.

Results: All three dogs had a good functional outcome. One dog experienced implant failure within 24 hours of surgery, which was immediately surgically corrected. At long-term follow-up (15 months postoperatively), all patients were clinically normal with no pain or difficulty ambulating.

Discussion/Conclusion: A transverse fracture of the vertebral body of C2 occurs as a result of a high energy, head-on impact that causes an axial loading injury. A ventral screw and PMMA construct is a useful method to stabilize this type of fracture with a successful clinical outcome.

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

A3590. Infection Rate following TPLO Procedure with and without a Course of Postoperative Antibiotics: A Retrospective Study of 308 Dogs

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Introduction: Minimizing implant-associated infections and antimicrobial resistance would improve patient outcome and client satisfaction. We aimed to compare infection and antimicrobial-resistance rates in dogs treated with oral antimicrobials following TPLO versus dogs not given oral antibiotics. We hypothesized postoperative antimicrobials would not protect against infection and would result in higher incidence of multidrug-resistance.

Materials and Methods: Medical records from unilateral TPLO procedures and TPLO implant removals between January 2013 and December 2015 were retrospectively analysed.

Results: Body weight correlated inversely to age but had a linear relationship with surgical and anaesthesia times. The study had a 16.2% SSI, 9.4% positive culture, and 6.5% antibiotic-resistant infection rates. Higher weight correlated with positive culture and resistant infections. Longer surgical and anaesthesia times predisposed to SSI, positive culture, and antibiotic resistance. The surgeon directly influenced infection rate. Postoperative antibiotic usage was not protective against infection and did not predispose to antibiotic resistance.

Discussion/Conclusion: Results prove no advantage to routinely use prophylactic oral antibiotics in postoperative TPLO patients. Contrary to common belief, no increased antibiotic-resistance occurred in patients treated with postoperative antibiotics. The study supports well-known risk factors for infection including weight, surgical time, and anaesthesia time. Results raise concern for increased infection risk related to specific individuals, with potential factors including intraoperative contamination, poor tissue handling, differences in surgical implants, and nasopharyngeal carriers of multidrug-resistant organisms.

Acknowledgement: There was no proprietary interest or funding.

A3602. Biomechanical Comparison of Knotted and Knotless Stabilization Techniques of the Medial Collateral Ligament in Cats: A Cadaveric Study

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Introduction: Distal extremity injuries often lead to medial instability in cats. Current surgical techniques rely on coaptation to protect healing in the postoperative period. A new knotless reconstruction technique has recently shown promising clinical results, but biomechanical data are lacking. The purpose of our study was to compare a new knotless stabilization technique and the standard reconstruction technique utilizing bone tunnels.

Materials and Methods: Samples consisted of 24 tarsi harvested from euthanized cats. A previously described technique using bone tunnels and polypropylene suture and the knotless anchor technique utilizing FibreWire (Arthrex Inc.) were used. The two parts of the medial collateral ligament were tested separately requiring four treatment

groups. A cyclic tensile test (600 cycles) was performed sequentially for the intact ligament and the reconstruction techniques. The prosthetic reconstruction was finally tested in load to failure. Total elongation, peak-to-peak elongation, stiffness and load to failure were compared with the intact condition. Significance was set at $p < 0.05$.

Results: No difference in stiffness, total and peak-to-peak elongation was found between knotless anchor technique and intact condition, whereas the tunnel technique showed a significantly less strong reconstruction ($p < 0.02$). Load to failure was not different between techniques ($p > 0.09$). Mode of failure for the tunnel groups was suture breakage. Anchor groups predominantly failed through suture slippage.

Discussion/Conclusion: The results showed that knotless anchor technique is more similar to the intact ligament than bone tunnel technique. These characteristics support its use as a coaptationless repair technique.

Acknowledgement: The implants were donated by Arthrex Inc. The authors work as part time consultants for Arthrex.

A3564. Retrospective Evaluation of Intraarticular Proximal Jig Pin Placement with Tibial Plateau Levelling Osteotomy

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Introduction: During tibial plateau levelling osteotomy (TPLO), erroneous pin placement of the proximal jig pin may lead to intraarticular damage. The purpose of this study was to determine the rate of the intraarticular placement of the proximal jig pin in dogs undergoing TPLO and identify any possible risk factors for poor pin placement. We hypothesized that tibial plateau angle higher than 30° and the experience level of the primary surgeon would be associated with erroneous jig pin placement.

Materials and Methods: Medical records (2007–2017) were reviewed identifying 696 dogs with TPLO using a jig. Primary surgeon and tibial plateau angles (TPA) were recorded. Postoperative radiographs were evaluated and scored according to intraarticular jig pin placement: Score I–jig pinhole at the osteochondral junction of the medial plateau. Score II–jig pinhole within 1 mm of the subchondral bone surface, pin trajectory encroaching on the osteochondral junction of the lateral plateau. Score III–jig pinhole greater than 1 mm away from the subchondral bone surface, pin trajectory encroaching on the osteochondral junction of the lateral tibial plateau.

Results: Thirty-seven (5.32%) dogs had erroneous placement of the proximal jig pin. There was no statistical association between the TPA or surgeon experience and inadvertent placement of pin.

Discussion/Conclusion: Dangerous placement of the jig pins was uncommon but identified in over 5% of cases. Our findings serve as a reminder to take precaution when placing the proximal jig pin and provide guidelines for evaluating proximal jig pin placement on postoperative radiographs.

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

A3605. Biomechanical Rationale and Rational Planning for TPLO

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Introduction: TPLO has been a main driver behind the progress of modern veterinary orthopedics. However, the rationale for TPLO planning has seen little scrutiny. In Slocum's TPLO force diagram, muscle forces on the tibia are omitted. With muscle forces considered, the stifle joint force on the tibia is approximately parallel to the patellar tendon and in most cases, due to co-contraction, inclined even more cranially. The inherent error in TPLO planning due to the 'mechanical axis' concept is ~10 degrees, but outcomes have proved satisfactory. Introduction of the 5-degree optimal tibial plateau angle (TPA) has partially compensated for this error, but there is a geometrical cause that—when understood—can provide an objective foundation for planning.

Materials and Methods: Radiographs of 20 stifle joints in extension were used to determine and compare angles by the conventional method and by the rational method that accounts for convexity of both tibial and femoral condyles.

Results: TPLO correction conventionally measured resulted in 2.9 degrees average over correction. Standard deviation of the difference was 3.9; the maximum over-correction was 8.4 and the maximum under-correction was 5.5 degrees.

Discussion/Conclusion: Two errors in the conventional TPLO planning—one in the presumed direction of the joint force and the other in treating the tibial condyles as a planar surface instead as convex—cancel each other—accidentally and partially. While the average error of conventional planning is relatively modest, individual over or under corrections could have significant clinical consequences.

Acknowledgement: There was no proprietary interest or funding provided.

A3548. Comparison of Three Crural Fascia Repair Techniques for Tibial Tuberosity Advancement Surgery

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Introduction: This study compares the strength of repair of the crural fascia following tibial tuberosity advancement surgery, using three described techniques, to the strength of paired intact limbs. We hypothesize there would be a biomechanical advantage to one of the repairs and all repairs would be weaker than intact controls.

Materials and Methods: Twenty-two canine cadavers were randomly assorted into three groups. Group A: a continuous suture pattern. Group B: five equally spaced simple interrupted cruciate sutures combined with a simple continuous suture pattern. Group C: an interrupted modified

locking loop suture pattern. The mid-portion of the crural fascia was incised in Groups A and C while Group B used a cranial incision. Contralateral limbs were utilized as paired control. Tibiae were mounted to an Instron 4206 and loaded at 10 mm/min.

Results: Mean peak load to failure was: Group A: 20.5 kgf. Group B: 26.6 kgf. and Group C: 30.6 kgf. Intact limbs: 81.5 kgf. No significant difference between peak load to failure was identified between individual repair groups ($p > 0.05$). Significant differences were identified between all repair groups and intact limbs ($p < 0.05$). All repair groups approached a mean of 33.5% of intact muscle strength.

Discussion/Conclusion: Based on the results of this study, it is hypothesized that the best repair technique would be a combination of the crural fascia incision used in Group B and the repair used in Group C (modified locking-loop) in conjunction with a simple continuous suture pattern.

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

A3617. Biomechanical Comparison of ALPS, FIXIN, LCP And DCP Plates in a Feline Iliac Fracture Model

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Introduction: Iliac fractures are a common encountered problem in cats after trauma. Complications after fixation are frequent. Biomechanical evaluation of different plate systems, including locking versus non-locking constructs are limited in the current literature. Therefore, our purpose was to biomechanically compare different locking-plate systems to a standard DCP for feline iliac fractures.

Materials and Methods: Fresh-frozen feline hemipelvis ($n = 24$) were randomly assigned to one of the four lateral plating groups: (1) Advanced Locking Plate System (ALPS) (2), Locking Compression Plate (LCP), (3) FIXIN Plate (FIXIN) and (4) a standard Dynamic Compression Plate. A standardized long oblique osteotomy was performed before applying the plates according to group. Each specimen was subjected to sinusoidal cyclic axial loading until the test stop criterion of 10 mm axial displacement was reached. Statistical analysis was performed with parametric tests.

Results: Significant differences were detected for the LCP and FIXIN groups, withstanding significantly more cycles to 1 mm, 2 mm and 5 mm displacement compared with the DCP. No significant differences were found between the ALPS and DCP groups. No significant differences were found for construct stiffness. In the DCP group, screw loosening was the predominant mode of failure, which was not found in the locking plate groups.

Discussion/Conclusion: A significantly increased fatigue life was found for LCP and FIXIN when compared with DCP. Screw loosening as mode of failure was exclusively found in the DCP group resembling the findings in clinical patients and emphasizing the role of locking implants in feline iliac fractures.

Acknowledgement: Fixin Intrauma and Kyon donated the implants for this study.

A3607. Combined Fatigue and Wear Testing of Anchored Sutures

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Introduction: Abrasion of the suture at the anchor/bone interface is detrimental to the clinical function of anchored sutures. The relative movement of the suture at the anchor point causes windshield wiper effect and leads to early failure. Testing the cyclic wear and fatigue of anchored sutures was performed with a specially developed test frame.

Materials and Methods: The test evaluates the effect of combining a cyclic perpendicular pull, at 1000 cycles/minute, on the suture while the angular position of the anchor varies from -15 to $+15$ degrees. In each cycle, the load varies from -40 to $+40$ N about the average. Two anchor systems have been tested at average loads of 80, 130, 180 and 230 N: a 5.5 mm PEEK SwiveLock anchor (Arthrex) with 2 mm FiberTape (Arthrex), and a 4.5 mm Ruby Ti6Al7Nb anchor with a 16 mm Dyneema Purity loop (Kyon). Failure mode and time to failure were recorded.

Results: All sutures failed at the anchorage point. Depending on the load level, the number of cycles to failure for the Ruby system was 500 to 1000 times higher than for the SwiveLock/FiberTape system.

Discussion/Conclusion: The Kyon system with the ruby eyelet at the anchor exit provides a low abrasion contact for the suture. The bone edge at the suture exit with interference screws creates a highly abrasive interface leading to early failure.

Acknowledgement: Funding has been provided by Kyon AG.

A3584. Measuring Distance Traveled with an Activity Monitor in Normal Dogs Participating in a 5K Race

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Introduction: Improved outcome measures for dogs with disease that affects activity in their natural environment. The objective of this study was to test the accuracy of a mathematical model to predict distance traveled from AM data in a variety of dog breeds in a natural setting.

Materials and Methods: Client-owned dogs free of disease and participating in a 5K dog walk fundraiser were recruited. Patient morphometrics were documented and a synchronized AM and collar was randomly assigned. Race times, activity counts and steps taken were documented. A mathematical model was used to estimate distance travelled.

Results: Forty-four dogs completed the race. Median dog weight was 20.5 kg; 2.7–36.4, BCS was 5; 4–7, shoulder height was 41 cm; 19–66, race time was 48:48 minutes; 25:07–59:30, steps taken was 4367; 2689–7827 and activity counts were 169958; 61883–256440. Dog shoulder height had the greatest influence on stride length, step count could estimate distance travelled, activity counts could not. Estimated median distance travelled was 4809 m (range: 2339–12423) and mean 4954.4 ± 1652.5 m for the 5000 m event.

Discussion/Conclusion: The data suggest, that while some dogs may generate outlier data (> 2 SD from mean), distance travelled can be reasonably estimated using step counts from the AM tested. Understanding if distance

travelled in normal versus dogs with OA is necessary to best utilize AM as an outcome tool. In addition, it is important to understand the effect size approved interventions have using this diagnostic tool so prudent clinical trials can be designed.

Acknowledgement: There was no proprietary interest.

A3652. Assessment of Canine Cranial Radial Cortex Torsion Profile using Computed Tomography

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Introduction: The purpose of this study was to use computed tomography (CT) multiplanar reconstructions (MPRs) of canine thoracic limbs to evaluate and provide baseline data regarding the degree and variation in torsion along the length of the cranial radial cortex in a population of normal dogs.

Materials and Methods: CT images of paired thoracic limbs from canine cadavers free of orthopedic disorders were evaluated. Specimens were separated into two groups based on total body weight (toy breed dogs versus large breed dogs). Using CT-MPR images, the torsion profile of the cranial radial surface was measured. Canine cadavers of two different weight groups were evaluated and compared. Measurement landmarks were normalized to radial length to allow inter-group comparisons.

Results: The overall mean (\pm SD) degree of torsion was 5.82 ± 6.92 degrees of external rotation. A significant difference in torsion profile was not identified between right and left limbs of the same dog. Comparison of the overall mean degree of torsion was significant between toy and large breed dogs.

Discussion/Conclusion: This study is an endeavour to provide baseline data with reference to the torsion profile of the cranial surface of the canine radius. These quantitative measurements could serve as a general guideline for the magnitude and location of torsional contouring to apply to bone plates utilized on radius fractures. These results may also lend themselves to the development of a pre-contoured radius plate that would help streamline minimally invasive plate osteosynthesis for radius fractures.

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

A3596. Combination Therapy is Superior to Conventional or Laser Therapy Alone for Equine Tendon and Ligament Injuries: A Comparison of 61 Clinical Cases

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Introduction: Laser therapy is often combined with conventional therapies but there are no studies to justify this. The aim was to compare laser therapy, with or without conventional treatment, to conventional treatment alone.

Materials and Methods: All clinical cases receiving high-power, multiple-frequency laser therapy in a referral center were divided into groups that received laser therapy only (Laser) or conventional treatments in addition (Combination); these were compared with cases receiving conventional therapies without laser treatment (Conventional). Horses were hospitalized for treatment with a Class IV laser (15W, 4 frequencies: 630–1064 nm) (FP4; TLX International) twice daily for 10 to 14 days. Return to previous level of exercise was assessed, with a minimum follow-up of 1 year.

Results: There were 61 cases, including all SDFT and suspensory cases treated with laser 2014–2016. All were

mature sport horses. There were no statistical significances between groups in structures affected or chronicity. Conventional treatments included soft-tissue optimized hyaluronic acid, autologous conditioned serum, platelet-rich plasma, mesenchymal stem cells, therapeutic ultrasound, shockwave therapy and surgery.

No significant complications were noted with laser treatment. On censored analysis, 12/23 (52%) of the Conventional group returned to full function, compared with 10/16 (63%) of the Laser group and 12/13 (92%) of the Combination group. Success was increased with Laser compared with Conventional treatment, but not significantly. Combination treatment was significantly superior to Conventional treatment ($p = 0.025$).

Discussion/Conclusion: This study supports the use of combination therapy in a clinical setting. These results may not be applicable to other types of lasers.

Acknowledgement: No proprietary interest or funding was provided for this project.

Poster Abstracts

A3537. Development of a Biologically Immortalized Equine Stem Cell Line

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Introduction: Cell based treatment continues to be an expanding area for regenerative medical therapy in veterinary medicine including the field of bone healing. Stem cell lines that have a perpetual lifespan and maintain appropriate features may be useful as cell-based therapy 'off the shelf'. The purpose of the study was to generate and evaluate in vitro a biologically immortalized stem cell line for potential use in promoting equine bone healing.

Materials and Methods: All animal study protocols were approved by the Animal Care Committee. Equine bone marrow-derived mesenchymal stem cells (BMMSCs) were immortalized by transfection with the pBABE-neo-hTERT retroviral vector plasmid. Immortalized cells in passages 2, 10, 20, 30, 40 and 50 were evaluated for stem cell characteristics including the ability to differentiate into osteoblasts.

Results: PCR analysis revealed the hTERT gene was successfully integrated into the genome DNA of BMMSCs. Immortalized cells maintained a spindle shaped morphology, and positively expressed surface markers CD90 and CD44 while lacking expression of CD45 and CD34, representative of MSCs. Bone nodules were produced in vitro by cells from all passages. RT PCR revealed that gene expression of bone-related genes RUNX2, Osterix and Osteocalcin was not significantly different from that of primary equine stem cells that were considered the gold standard.

Discussion/Conclusion: Immortalized equine BMMSCs maintained properties of stem cells and readily differentiated into osteoblasts. An equine immortalized stem cell line may be beneficial as a readily available source of MSCs for cell-based therapy for bone lesions.

Acknowledgement: Funding source: Atlantic Canada Opportunity Agency.

A3549. Morphometric Investigation of the Canine Caudal Cervical Intervertebral Space: An Ex-Vivo Computed Tomography Study

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Introduction: Implantation of an intervertebral disc (IVD) prosthesis is a novel treatment strategy for caudal cervical spondylomyelopathy in dogs. However, current prosthesis designs are suboptimal because of a mismatch between the prosthesis and the dimensions of the canine IVD space. The purpose of this study was to determine for C4-C5, C5-C6 and C6-C7 (1) the size and shape of the cranial and caudal endplates and (2) the IVD space dimensions and angles in neutral position and in motion extremes.

Materials and Methods: CT images were obtained from five canine spinal specimens, which were positioned in neutral position and thereafter loaded in flexion, extension and lateral bendings. Images were used to determine and compare for C4-C5, C5-C6, and C6-C7 (1) height, width and shape of the cranial and caudal endplates, and (2) angle and dimensions of the IVD space in the different positions.

Results: Endplate size and shape, and IVD angle and dimensions were similar between the three tested segments. Endplate shape and size were significantly different between cranial and caudal endplates. Flexion induced a significant reduction in disc height in the ventral 36% of the IVD, whereas extension induced a significant decrease in the dorsal 20% of the IVD. The dimensions of the central 44% remained unchanged during all positions.

Discussion/Conclusion: The canine caudal cervical IVD space has unique dimensions and dynamic characteristics. These findings should be respected when designing IVD prostheses for canine cervical spondylomyelopathy.

Acknowledgement: The project was supported by the Small Animal Foundation, University of Zurich.

A3567. Biomechanical Comparison of 3.5 mm String of Pearl and Cortical Pearl Systems in a Simulated Fracture GAP Model and the Effect Plate Bending on Screw Push Out

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Introduction: Multiple locking systems are commercially available on the market; knowing their biomechanical characteristics may help the surgeon in decreasing the risk of implant failure. The aim of the study was to compare biomechanical properties of the string of pearl (SOP) and cortical pearl plate system (CPPS) systems in a simulated fracture gap model and evaluate the effect of plate contouring on the screw push out force.

Materials and Methods: Twenty specimens were created for the SOP and CPPS groups. Each group consisted of eight plate-synthetic bone model constructs to evaluate

stiffness(N/mm), yield load (N) and load to failure (N) in axial compression; six uncountoured 3-holes plates to evaluate screw push out; and six countoured 3-holes plates to evaluate the effect of uniplanar plate bending on screw push out.

Results: There was no statistical difference in stiffness between groups. There was statistical difference in yield point and maximum load between groups. No difference in screw push out was noted before and after plate contouring in the SOP or CPPS group, but a statistically significant difference was noted between groups.

Discussion/Conclusion: SOP plates have higher yield point and load to failure compared with CPPS plates. A possible explanation would be a difference in how the 316 L stainless steel is worked in each system. The CPPS plates showed a significant higher push out force in the unmodified and bent group. The clinical importance of this finding is unknown, as the minimum safe push out resistance has not been determined.

Acknowledgement: VOI donated the implants.

A3600. Articulated Joint Distraction in a Cadaveric Model of the Canine Elbow

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Introduction: Elbow osteoarthritis is the most common cause of forelimb lameness but lacks a definitive treatment. Joint distraction has steadily gained popularity for the treatment of human ankle and knee arthritis and shows promise as a treatment modality in the canine elbow. The purpose of this study was to determine if articulated joint distraction of the canine elbow can effectively maintain a minimum distraction gap necessary to prevent contact of the articular surfaces under a weight-bearing load.

Materials and Methods: Articulated external skeletal fixators with turnbuckles were applied to seven canine cadaver elbow specimens. Specimens were potted, loads of 0, 90, and 180 N were applied and joint contact pressure was recorded. Distraction was sequentially performed, loads were reapplied and pressure was recorded until no load at each of the three joints was recorded at 180 N.

Results: The average amount of distraction necessary to achieve no joint loading at 180 N of pressure was 2.3 mm (range: 1.8–3.6 mm) for the medial and lateral turnbuckles and 1.67 mm (range: 0–3.6 mm) for the caudo-lateral and caudo-medial turnbuckles.

Discussion/Conclusion: Results suggest that joint distraction can be effectively performed in the canine elbow. A minimum of 3.6 mm of distraction is necessary. Further study is necessary for a more practical determination of the feasibility and efficacy of its application in the canine patient with elbow osteoarthritis.

Acknowledgement: This study was funded by the Tata Group Endowment. There are no conflicts of interest or propriety interests to disclose.

A3619. A Comparison of New Repair Techniques for Tarsal Medial Collateral Ligaments in Cats: A Cadaveric Feasibility Study

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Introduction: Injuries to the distal extremities commonly involve the medial collateral ligament in cats. Current surgical prosthetic ligament techniques rely on additional stabilization such as transarticular external fixator or external coaptation. The purpose of this study was to evaluate the safety, feasibility and initial clinical results of new, potentially coaptationless, surgical techniques using two types of suture anchors.

Materials and Methods: Paired tibiae from 10 cats were harvested and the medial collateral ligament transected. Either the right or the left tibia was assigned to group 'knotless' or 'knotted' using PushLock or FASTak suture anchors, respectively. Complications and duration of surgery were recorded. Computed tomography (CT) scans were performed to measure insertion angles and bone stock surrounding the anchors for the calcaneus and talus, respectively. Finally, the specimens were dissected to evaluate joint penetration, fractures and distance of suture anchor to footprint of the ligament. Data were compared between techniques and bones using chi square and paired *t*-test. A *p*-value < 0.05 was considered significant.

Results: Surgical time was significantly shorter using PushLock anchors (9.9 ± 2.7 min vs. 12.3 ± 2.2 min; *p* = 0.006). Insertion of FASTak anchors was frequently associated with fractures (4/10). Insertion angles and distances to the footprint were similar between groups.

Discussion/Conclusion: According to the results of this study, surgical repair using PushLock anchors can be considered safe and accurate. Initial clinical experience is promising.

Acknowledgement: Implants used in this study were donated from Arthrex GmbH.

A3622. Assessing Clinical Relevance of Weight Distribution as Measured on a Stance Analyzer through Comparison with Lameness Determined on a Pressure Sensitive Walkway and Clinical Diagnosis

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Introduction: Objective analysis of lameness is an important component in the work-up of orthopedic disease and monitoring recovery. Weight distribution, and off-loading, at the stance is a commonly used subjective assessment during the orthopedic examination. The clinical relevance of limb off-loading has not yet been established. The study aim was to assess off-loading on a stance analyzer (SA) and correlation with lameness, measured on a pressure sensitive walkway (PSW), and clinical diagnosis as determined at surgery.

Materials and Methods: Medium to large breed dogs (*n* = 25) presenting for surgery were included in the study. The total pressure index (TPI) was used to determine lameness on the PSW. Normal weight distribution was considered 30/30/20/20 with a TPI standard deviation (SD) or 2% and a SA SD of 5%. Detection of limb off-loading was statistically compared with objective gait analysis and clinical diagnosis.

Results: The PSW identified 20 (80%) patients as objectively lame (OL). When compared with the OL group,

the SA had an 85% sensitivity (17/20) and 60% specificity (3/5). The positive predictive value (PPV) was 89% (17/19), and the negative predictive value was 50% (3/6). When compared with the entire study population, the SA had a sensitivity of 76%.

Discussion/Conclusion: SA sensitivity reported here is higher than previous reports, which may be due to canine population being primarily large breed dogs with lameness requiring surgical correction. Further investigation is needed to assess if SA is sensitive to changes in lameness.

Acknowledgement: Companion provided the SA; no funding was provided for this study.

A3610. Case Report: Fibular Head Osteosarcoma in a Young Dog

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A 1-year old, male pit bull was presented for a 2-week history of right pelvic limb lameness with marked swelling and pain on the lateral aspect of the right stifle. Radiographs of the right stifle were performed that showed lysis and bony proliferation associated with the fibular head. Histopathology of the fibular head was diagnosed as osteosarcoma.

A lateral approach was made to the right stifle and proximal right fibula along with excision of abnormal soft tissue. The common peroneal nerve was identified, dissected free and then isolated. Soft tissue dissection was continued around the fibular head. An osteotomy was made through the fibula 2 cm distal to the abnormal fibular head, and the attachments between the fibula and the tibia were broken down to remove the fibular head. Grossly abnormal soft tissues along with portions of the surrounding muscles were excised. The remnant of the lateral collateral ligament was identified and sutured to the periosteum of the proximo-lateral aspect of the tibia.

The present case report describes an unusual presentation of canine osteosarcoma which was treated with a novel limb sparing procedure to remove the neoplastic fibular head. The procedure performed was modified from the Malawer types I and II fibular head resections performed in humans with osteosarcoma and had a favorable functional outcome in our patient. Despite returning to normal ambulation and without the development of complications, the dog was eventually euthanized due to pulmonary metastasis.

Acknowledgement: No proprietary interest or funding was provided for this project.

A3660. Comparing Veterinary Diagnosis and a Novel Non-Invasive Device (Paintrace) to Differentiate Location and Quantify Pain in Dogs

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Introduction: Currently, pain is principally measured by self-report in humans or validated pain scales in veterinary medicine. A direct, objective biosignal has yet to be elucidated. Here we compare a novel pain monitor directly to veterinary diagnoses to determine correlation of pain quantitation practices.

Materials and Methods: Dogs were followed, in an observational study, evaluating the entire anatomy, from general examination through rehabilitation. Diagnosis was separated into five categories: pain, discomfort, spasms,

tightness and triggers. Correlation was determined between veterinary and device diagnoses of pain employing unpaired *t*-tests.

Results: Based on veterinarian diagnosis, events were categorized into pain and non-pain groups. Using an unpaired *t*-test, a significant difference between the population means was noted ($p < 0.001$). Delving deeper into pain versus additional pain-related observations, a Kruskal–Wallis test was used to compare pain, spasm, discomfort, tightness and trigger. Pairwise analysis between these categories revealed significant differences in pain/spasm ($p = 0.002$), pain/tightness ($p = 0.001$), pain/trigger ($p = 0.006$), discomfort/tightness ($p = 0.009$) and discomfort/trigger ($p = 0.018$) groupings.

Discussion/Conclusion: Device measurements correlate with veterinary diagnosis with $p < 0.001$. Significant differentiation was observed between degrees of pain. Further studies are in progress based on positive outcomes in completed IRB approved human studies when compared with self-reported pain; $p < 0.001$. This study supports the potential to improve translational studies via significant outcome measures.

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A3662. Articular Cartilage Lesions Associated with Degenerative Lateral Meniscal Tears in the Dog

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Introduction: The incidence of medial meniscal tears and associated articular cartilage (AC) pathology are well described in the veterinary literature. However, little has been reported relative to the occurrence of lateral meniscal tears in the dog. The purpose of this study is to report the occurrence of degenerative lateral meniscal tears and associated AC pathology in dogs.

Materials and Methods: Medical records (2006–2017) of dogs diagnosed with a degenerative lateral meniscal tear were examined. To be included, medical record and arthroscopic images must be available. Data included breed, age, weight, sex and integrity of the cranial cruciate ligament (CrCL), caudal cruciate ligament (CdCL), medial meniscus and lateral meniscus.

Results: Sixteen dogs met the inclusion criteria. There was degeneration of the caudal body of the lateral meniscus leading to multiple, complete radial tears with significant AC lesions of the lateral compartment.

Discussion/Conclusion: In the present study, dogs with degenerative radial tears of the lateral meniscus had significant AC lesions in the lateral compartment. Significant increases in peak contact pressure after loss of the integrity of the meniscus may explain why severe AC lesions occur in the lateral compartment compared with the medial compartment with loss of meniscal function. The majority of dogs had functional CrCL and a stable joint suggesting that degenerative lateral meniscal tears are commonly isolated injuries. Of interest, Boxers are over represented in this population; the reason for this finding is unknown and needs further study.

Acknowledgement: There was no proprietary interest of funding provided.

A3666. Radiographic Healing following Stabilization of Cranial Cruciate Ligament-Deficient Stifles with a Cora-Based Leveling Osteotomy, Bone Plate/Headless Compression Screw, Augmented with a Tension Band Tiffany A. Johnson¹, Donald A. Hulse², Laura E. Peycke³, Elizabeth M. Krier¹

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Introduction: A complication reported after TPLO or CBLO is a shift in TPA during healing, resulting in an increase in the tibial plateau slope and delayed healing. The purpose of this study was to evaluate TPA shift and time to osseous union following stabilization of cranial cruciate ligament (CrCL)-deficient stifles, with a cora-based leveling osteotomy (CBLO) bone plate/headless compression screw (HCS) augmented with a tension band. We hypothesized that augmentation with a tension band will improve osseous healing and prevent TPA shift.

Materials and Methods: Medical records of 21 dogs (22 stifles) with CrCL injury managed with a bone plate/HCS augmented with a tension band were reviewed. Preoperative TPA, postoperative TPA and final TPA at 5 weeks postoperatively were documented. Degree of osseous healing was judged using a previously described scale. Breed, age and weight were recorded for each case as well as arthroscopic evaluation of the integrity of the CrCL, CaCL, medial and lateral menisci, and appearance of articular cartilage.

Results: All dogs (22 stifles) met the inclusion criteria. Both sexes and 10 breeds were represented. Mean age was 6 years; mean weight was 30 kg. All stifles had complete CrCL rupture. Mean preTPA was 29°, mean postTPA was 8.5°, and mean final TPA was 8.5°. Osseous union of the osteotomy at a mean time of 35 days was graded as 4 in 18 stifles (82%) and Grade 3 in 4 stifles (18%).

Discussion/Conclusion: CBLO using a bone plate/HCS combination augmented with a tension band wire fixation maintains the TPA and decreases time to osseous union.

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

A3680. The Effect of Radiographic Femoral Positioning on the Measurement of Postoperative Subsidence in Total Hip Replacements

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Introduction: Femoral stem subsidence is a complication of total hip replacements with potentially catastrophic consequences. Inherent radiographic positional variations of the femur cause measured subsidence to differ significantly from true subsidence. We hypothesize that variations in femoral angle relative to the radiographic cassette in the ventrodorsal projection affect the measured subsidence of an implanted femoral stem. Also, artifactual errors in subsidence measurements where femoral angle varies between radiographs can be corrected using femoral stem length.

Materials and Methods: A biological fixation universal hip (BFX) femoral stem was fitted into a Sawbones femur and placed into a custom Plexiglas frame. Radiographs were obtained with the femur positioned parallel to the radiographic cassette, then at 10° increments of angulation. The femoral stem was then subsided at both 5 mm and 10 mm and

radiographed through the same angles. Subsidence and femoral stem length were measured. Femoral angle was confirmed and artifactual subsidence measurements were corrected using a trigonometric calculation.

Results: Femoral angle caused significant variability in femoral stem length and subsidence measurements. Greater femoral angles were associated with smaller femoral stem and subsidence measurements. Femoral angle and true subsidence was accurately calculated using changes in femoral stem length.

Discussion/Conclusion: Uncontrolled variables between immediate postoperative and follow-up radiographs can cause significant changes to femoral angle. Variations to femoral angle caused artifactual changes to subsidence measurements, and the proposed formula was effective in correcting these changes using femoral stem length, confirming our hypotheses. Limitations are those inherent to an ex vivo study. Further in vivo studies are recommended.

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