

# Abstracts of the 46th Annual Conference of the Veterinary Orthopedic Society

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## Podium Abstracts

### A3746. Evaluation of the Process and Materials of 3D Printed Bone Models for Use in Education and Presurgical Planning Purposes

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**Introduction:** Three-D printed bone models have become more popular in veterinary surgical training and pre-surgical planning in place of cadaver bones. The purpose of this study was comparing technical and physical features of 3D printed bone models built using different materials to commercially available models.

**Materials and Methods:** A canine tibia was imaged using a CT scanner and imported into Slicer3D software. Three tibia models were printed using resin (Verowhite plus photopolymer), polylactide (PLA), and acrylonitrile butadiene styrene (ABS). These were compared with two commercial tibia models (SAWBONES models 2117 and 2108). Each model was drilled in three locations, and subsequently cut transversely. Subjective quality and performance of models, time, and cost of production were compared.

**Results:** Print times for resin and PLA/ABS models were ~3 and 4 hours, respectively. Unlike the resin and SAWBONES, the PLA and ABS had higher heat generation with construct deformation at cut surfaces. Characteristics of resin, PLA, ABS, followed by 2117 best resembled real bone during drilling and sawing. Production costs were \$14.6 (resin), \$0.48 (PLA/ABS) \$23.50 and \$17.50 for SAWBONES 2117 and 2108 models, respectively.

**Discussion/Conclusion:** The resin performed best and had the closest feel and properties to real bone. Not including the printer costs, the production cost for resin model, although higher than PLA and ABS, was less than SAWBONES. Resin produces higher quality model that withstands the basic orthopaedic procedure simulations and therefore, may justify the production costs.

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

### A3716. Limb Sparing in Dogs using Individualized 3D-Printed Endoprostheses and Cutting Guides for Distal Radial Osteosarcoma: A Pilot Study

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**Introduction:** Using 3D-printed “personalized” implants may reduce the risk of complications for limb sparing in dogs. A disadvantage is the time required to manufacture the implant. The goals were to assess the feasibility and outcome of using 3D-printed implants and cutting-guides in the clinical setting for dogs with distal radial osteosarcoma.

**Materials and Methods:** Data from a CT scan of both thoracic limbs were used to manufacture a cutting-guide and endoprosthesis. Intra-arterial carboplatin was administered after the CT starting with the second dog. A second CT was repeated before surgery where limb sparing was performed. Dogs were monitored postoperatively with physical examinations and chest and limb radiographs.

**Results:** Five dogs participated and 4 received intra-arterial carboplatin. For all dogs that received intra-arterial chemotherapy, no tumor substantially increased in dimension between initial CT and surgery. All specimens had complete margins. Four dogs had a complication: 4 had an infection and one each had a skin laceration, skin necrosis, fracture of the radius, implant pulling out of the radius, and local recurrence. Two dogs required an amputation. One dog had a survival time of 192 days. The other 4 dogs were alive with a follow-up period of 293 to 377 days.

**Discussion/Conclusion:** 3D-printed personalized implants were successfully manufactured in the clinical setting. To allow more time between CT and surgery without the tumor getting significantly larger, intra-arterial carboplatin was administered. Intra-arterial carboplatin appears to

be an effective strategy to prevent the tumor to grow excessively during the design and manufacturing periods. Complications remained common.

*Acknowledgment:* VOI Inc.

### **A3789. Use of Patient-Specific 3D Printed Drill Guides for the Placement of a Coxofemoral Toggle Pin**

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*Introduction:* The toggle pin technique has produced high rates of long-term success in the repair of coxofemoral luxation but typically involves an extensive open approach. The hypothesis of this study was that a patient-specific drill guide that conforms to the femur is feasible for accurate, closed placement of a toggle pin.

*Materials and Methods:* CT-based 3D-printed drill guides were designed and constructed to conform to the proximolateral femur of 16 legs of eight cadavers. Guides were applied via a minimally-invasive closed approach. Following drilling and toggle placement, postoperative gross dissection was performed to evaluate the placement, articular damage, and bone debris within the joint capsule. Drill holes were classified as ideal (no articular cartilage penetration), adequate (partial articular cartilage penetration), or inadequate (full cartilage penetration) at both the femoral head and acetabular fossa.

*Results:* Average skin incisions were 5.1 cm. The average gross (fovea) center-to-(drill) center error at the fovea capitus was 3.43 mm (1.0–6.3). The direction of error was 5 o'clock (2/16), 6 o'clock (9/16), 7 o'clock (1/16), and 11 o'clock (2/16). Placement of the bone tunnel through the fovea capitus was ideal (2/16), adequate (10/16), and inadequate (4/16). Acetabular placement was ideal (10/16), adequate (2/16), and inadequate (4/16).

*Discussion/Conclusion:* The hypothesis was confirmed that 3D-printed guides are feasible for placement of coxofemoral toggle pins. This is the first report evaluating the feasibility and accuracy of patient-specific 3D-printed drill guides.

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

### **A3770. Use of an Amikacin-Infused Collagen Sponge Concurrent with Implant Removal for Treatment of TPLO Surgical Site Infection in 30 Cases**

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*Introduction:* Surgical site infection (SSI) is a complication following TPLO. Medical management of TPLO SSIs with antibiotics has a high failure rate (88.9%). The objective of this study was to report the use and long-term outcome of an amikacin-infused collagen sponge surgically implanted concurrent to TPLO implant removal as a definitive treatment of TPLO SSI.

*Materials and Methods:* Medical records were reviewed for dogs with surgical site infections after a TPLO procedure that were treated with surgical plate removal and implantation of an amikacin-infused collagen sponge. Relevant clinical and surgical data were recorded. The TPLO implants were routinely removed, and the surgical site was swabbed for culture. The collagen sponge was cut to approximate size of the removed implants, and amikacin was asepti-

cally deposited onto the sponge before being placed at the surgical site prior to routine closure.

*Results:* Thirty dogs met all inclusion criteria. Median follow-up time was 684 days. Short-term examination revealed uneventful incisional healing in 24 dogs. Six dogs (20%) exhibited inflamed incision sites a median of 4 days (range, 3–9 days) postoperatively that resolved without additional treatment. Long-term follow-up examination revealed no clinical evidence of SSI recurrence and no lameness in any case.

*Discussion/Conclusion:* Surgical implant removal and implantation of an absorbable collagen sponge infused with amikacin alone was an effective treatment option for postoperative TPLO SSI. This procedure had a 100% long-term resolution of SSI; it should be considered as a treatment for TPLO SSI.

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

### **A3769. Comparison of Activity Levels Derived from Two Accelerometers in Dogs with Osteoarthritis-Associated Pain: Implications for Clinical Trials**

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*Introduction:* Accelerometer data are frequently reported as total weekly activity counts (AC); however, methods of further utilizing the activity data to allow differentiation of activity intensities have been established. While this information offers significant clinical value for researchers, only a few investigators have utilized this methodology, likely due to the labor involved in deriving this data. Novel devices offer methods of collecting this data in efficient manners, however, have not been currently. The objectives of this study were to (a) validate a novel accelerometer (Heyrex), (b) compare automatically generated categories quantifying activity intensity to established manually derived cut-points (Actical), and (c) describe variability of AC in dogs with osteoarthritis-associated pain (Actical & Heyrex).

*Materials and Methods:* Twelve client-owned dogs with osteoarthritis were fitted with a collar with two accelerometers (Heyrex and Actical), data were recorded for 28 days in 1-minute intervals. Gait analysis was performed once weekly. Automatically generated categories of activity intensity by the Actical were compared with established manually derived cut-points. Variability was determined for activity and gait data.

*Results:* There was a high correlation between the AC reported by Heyrex and Actical devices, and the amount of time spent in the automatically generated category "moderate" by the Actical and the validated cut-point-derived categories "walking" and "trotting." Weekly AC displayed the least variability.

*Discussion/Conclusion:* Total AC from the Heyrex accelerometer correlate well with AC from the Actical. Automatically generated categories by the Actical provide a simplified method of analyzing canine activity intensity data.

*Acknowledgment:* There was no proprietary funding provided for this project.

### A3745. In Vitro Comparison of a Novel Plateless Tibial Plateau Leveling Osteotomy Implant to a Locking Plate for Maintenance of Osteotomy Position and Biomechanical Stability

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**Introduction:** The purpose of this study was to compare the stability provided by a novel plateless tibial plateau leveling osteotomy (TPLO) implant to that of a locking plate for osteotomy maintenance. We hypothesized that both the novel implant and locking plate constructs would be similarly effective at maintaining tibial plateau position.

**Materials and Methods:** Twelve paired canine cadaver tibia were collected and randomly assigned to have a TPLO performed with either a locking plate (group 1) or novel implant (group 2). The contralateral limb was assigned to other group. Computed tomography (CT) imaging was performed after TPLO and implant application before testing. The limbs were then tested in compression for 30,000 cycles at 4 Hz with a peak load of 1,000 N. After testing, CT imaging was again performed on all limbs. Imaging data and biomechanical data were compared between the 2 groups.

**Results:** There were no significant differences in the maintenance of tibial plateau position or construct stiffness between groups. Additionally, CT imaging did not reveal any significant differences in implant or osseous complications.

**Discussion/Conclusion:** Both testing groups maintained rotated tibial plateau positions equally well. The novel TPLO implant evaluated in this study may be a reasonable alternative to plating systems currently in use.

**Acknowledgment:** Implants and funding were provided by Everost.

### A3793. Effects of Marker Cluster Combinations on the Calculated Three-Dimensional Kinematics of the Canine Stifle Joint

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**Introduction:** Skin marker-based motion analysis has been widely used for quantitative evaluation of functional performance of the canine gait and posture. However, the interference of soft tissues between markers and the underlying bones, the soft tissue artifacts (STA) may lead errors on the skeletal kinematics measurement. Different kinematic models were demonstrated to result in discrepant estimation of human joint kinematics. Currently, no recommended cluster combinations for canine gait analysis were proposed. Therefore, the study aims to evaluate the effects of different cluster combinations on the computed kinematic variables of canine stifle joint.

**Materials and Methods:** Ten adult mixed-breed healthy dogs were enrolled in the IACUC approved study. During isolated stifle passive extension, the marker trajectories were acquired with a motion capture system; the skeletal poses were determined by integrating fluoroscopic images and volumetric CT bone data.

**Results:** Limited cluster candidates were collected when examining with the cluster design principles. Four combinations of clusters selected satisfying the criteria

were used to calculate stifle kinematics. The stifle joint angle discrepancies obtained from SM in comparison to the reference joint angle were quantified.

**Discussion/Conclusion:** A selection of cluster compositions was useful for deriving accurate sagittal and frontal plane stifle kinematics with the flexion angle lower than 50% of range of motion. The findings contributed to improve knowledge of canine STA and its impact on the motion measurements. The marker composition with smallest error in the description of joint kinematics might be recommended in future canine gait analysis.

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

### A3762. Ex vivo Mechanical Properties of the 2.5-mm MiniPushLock

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**Introduction:** Numerous extracapsular stabilization methods for cranial cruciate ligament (CrCL) disease have been described. Numerous problems and failures with these techniques have also been well-documented and include suture and other implant failures, material creep, bone tunnel widening, and loss of stability. These problems have led many surgeons to abandon extracapsular stabilization techniques in favor of osteotomy techniques, such as TPLO. However, for smaller patients, these techniques have remained popular despite the high failure rates. The purpose of this study is to investigate the ex vivo mechanical properties of the 2.5 mm MiniPushLock in the cadaveric femurs of small dogs for potential suitability in clinical use for dogs 7 kg and under.

**Materials and Methods:** Eight paired cadaveric femurs of small dogs (< 7 kg) were implanted with 2.5 mm MiniPushLock in either knotted or knotless configurations or subjected to mechanical testing.

**Results:** There was no significant difference between knotted and knotless groups in all parameters tested, including yield load, load at 3 mm displacement, ultimate load, and stiffness. Mean load at 3 mm displacement was ~43N for the knotless group and 47 N for the knotted group. The configuration in which the knots are tied is an important factor.

**Discussion/Conclusion:** This study suggests that the 2.5 mm MiniPushLock may be indicated for use in small dogs under 7 kg. A clinical trial to evaluate the in vivo performance of this device in small dogs is planned.

**Acknowledgment:** This study was funded by Arthrex Vet Systems and performed at the Arthrex mechanical testing laboratory in Naples, Florida. Two of the investigators are Arthrex consultants. Two of the investigators are employees of Arthrex.



**A3817. Comparing the Functional Recovery of Dogs Undergoing TPLO Surgery with Stifle Arthroscopy or Arthrotomy: A Pilot Study**

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**Introduction:** We hypothesize that canine stifle arthroscopy and tibial plateau leveling osteotomy (TPLO) patients will have less morbidity after surgery compared with arthrotomy and TPLO patients. Our study objectives were to evaluate and compare recoveries in dogs with CrCL ruptures following TPLO with arthroscopy or arthrotomy over an 8-week-study period.

**Materials and Methods:** 20 dogs presenting for unilateral CrCL rupture were to be enrolled into the study and then randomly assigned to one of two study groups; Group 1: arthroscopy, Group 2: arthrotomy. Patients underwent surgery at time 0. At baseline (2 weeks prior) and times 1, 7, 14, 28, and 56 days after surgery, force plate analysis and accelerometer data were obtained while blinded veterinary assessors performed goniometry and MGPS assessments. The Canine Brief Pain Index (CBPI) was completed in every 2 weeks. Statistical significance was  $p < 0.05$ .

**Results:** 18 dogs qualified for the study. There were no significant differences between treatment groups evaluated with any objective measurements or the MGPS. There was a significant difference reported for a single time point between Group 1 (arthroscopy) and Group 2 (arthrotomy) for CBPI evaluated pain and activity. Objective data trends were noted between Group 1 and Group 2 for pain and function.

**Discussion/Conclusion:** Based on the results of this study we conclude that patients undergoing stifle arthroscopy or arthrotomy with a TPLO surgery would be expected to have equivalent recoveries related to function and pain during the first 8 weeks after surgery.

**Acknowledgment:** The investigators declare no conflicts of interest. Funding provided by Canine Health Foundation-AKC.

**A3791. Use of an Intraoperative Distraction Device as an Aid for the Open Reduction and Fixation of Chronic Lateral Humeral Condylar Fractures in Dogs**

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**Introduction:** Lateral humeral condylar (LHC) nascent malunion fractures are challenging to treat because of extensive callus formation, scar tissue, and contracture of surrounding tissues. We hypothesized that an intraoperative distraction device would facilitate anatomic reduction and fixation resulting in acceptable outcome in nascent malunion LHC fractures.

**Materials and Methods:** Medical records from 5 dogs with 7 nascent malunion LHC fractures that were treated with the aid of an intraoperative distraction device were reviewed. Relevant clinical data, radiographic data, forelimb circumference, elbow goniometry, and clinical outcome were evaluated.

**Results:** Anatomic reduction and fixation was achieved in all 7 cases, and all cases healed uneventfully. Implants were removed from 4 cases in attempt to resolve persistent lameness. Three dogs (4 cases) were available for long-term follow-up. Long-term mean circumference and range of motion was decreased in the operated limbs as compared with the unoperated limbs. One dog (2 cases)

was euthanized due to poor outcome. Outcome was acceptable in the other 5 cases.

**Discussion/Conclusion:** Based on the results of this study, use of an intraoperative distraction device to aid in anatomical reduction and fixation of nascent malunion LHC fractures should be considered.

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

**A3705. The Relationship between Sagittal Hoof Balance and Hindlimb Lameness in the Horse**

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**Introduction:** The identification of factors associated with lameness could be one method to decrease lameness incidence and prolong the competitive life of the equine athlete. The objective of this study was to determine if there was an association between sagittal plane hoof balance and hindlimb lameness. We hypothesized that horses with hindlimb lameness would have a higher prevalence of negative/neutral plantar angle of the distal phalanx (PADP).

**Materials and Methods:** Eighty client-owned horses with hindlimb lameness localized with regional anesthesia (cases) and eighty horses with no detectable hindlimb lameness (controls) were prospectively enrolled. Lameness cases were categorized by location (stifle, tarsus, proximal metatarsus, and other sites). Lateromedial radiographs were performed of hind hooves and PADP determined. Mean PADPs were calculated and analyzed with linear regression. Logistic regression was performed and used to calculate odds ratios. Significance set at  $p < 0.05$ .

**Results:** Mean PADP was 1.76° less in cases than controls, with a significantly lower PADP in horses with lameness localized to tarsus and proximal metatarsus. Lameness cases were 3.8 times more likely to have a negative/neutral PADP; horses with lameness localized to the tarsus and proximal metatarsus were 5.2 and 5.5 times more likely to have negative/neutral PADP, respectively.

**Discussion/Conclusion:** It is unknown whether negative/neutral PADP contributes to lameness or lameness resulted in lower PADP. Corrective Farriery to improve PADP may be one component to investigate in prevention or treatment of hindlimb lameness localized to regions proximal to the foot.

**Acknowledgment:** The authors acknowledge the American Quarter Horse Association for financial support of this study.

**A3740. Corticocancellous Bone Autograft in the Treatment of a Third Metacarpal Bone Nonunion in a Foal**

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**Introduction:** An open, comminuted mid-diaphyseal third metacarpal fracture was repaired with a 10-hole 4.5 mm LCP in a 1-day-old foal with complete failure of passive transfer. On day 36, osteomyelitis was diagnosed at the fracture site with a large cortical sequestrum. Osteomyelitis was managed over the course of 3 months with surgical debridement and cancellous bone grafting, intravenous

antimicrobial therapy, intravenous regional limb perfusion, local antimicrobial beads, plate removal followed by transfixation pin casting, standard full limb casts, bandages with splints, and physical therapy. Serial microbial cultures revealed 5 species of multidrug resistant bacteria.

**Materials and Methods:** On day 127, an atrophic nonunion with a mid-diaphyseal cortical defect were diagnosed. The fracture was debrided and three 4 cm corticocancellous grafts harvested from the 9th rib were aligned within the cortical defect. Cancellous bone graft was placed around the fracture site and an 8-hole, 4.5-mm LCP was applied.

**Results:** By day 278, the metacarpal fracture healed with integration of the corticocancellous bone graft.

**Discussion/Conclusion:** A successful outcome was achieved in this case of multidrug resistant osteomyelitis with a cortical defect through the persistent use of advanced techniques in osteomyelitis management and a novel approach to fill the cortical defect with corticocancellous bone graft. The use of an autogenous corticocancellous bone graft in the treatment of a nonunion has not been previously reported in the horse. This may be a viable option for other patients with similar challenges in the future.

**Acknowledgment:** We acknowledge the owner's commitment to this foal and the other clinicians who assisted in medical care.

#### **A3747. Clinical and Radiographic Features of Septic Physisitis in Foals**

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**Introduction:** Septic physisitis is a less common sequela to blood-borne sepsis in foals. However, clinical and radiographic features in the literature are lacking. The objective of this investigation is to report clinical and radiographic features of septic physisitis in foals.

**Materials and Methods:** Medical records (2008–2018) from cases that had radiographic diagnosis of septic physisitis were included. Clinical parameters of case presentation, management, and outcome were recorded. Radiographic features recorded included physeal location, limb affected, and description of the size, shape, margination, and opacity of radiographic abnormalities present in the physis.

**Results:** Eight foals were identified with septic physisitis. In 6/8 foals, presence of a discrete, focal, irregular radiolucency centered on the physis, and extending into the epiphysis and metaphysis was present. In the remaining two foals, subtle irregularity and diffuse radiolucency along the length of the physis was present. When evaluating the extent of radiolucency relative to the width of the physis, in the sagittal (dorsal to palmar/plantar) plane, the mean radiolucent area was 58.4% of the physeal distance. In the frontal (lateral to medial) plane, the mean radiolucent area was 42.5% of the physeal width. When measuring the maximal diameter of the radiolucent area in a proximal to distal orientation, the mean diameter was 18.5 mm (3mm to 55 mm). Clinically, 4/8 foals were discharged following treatment. Of these four, 3/4 were able to perform athletic function.

**Discussion/Conclusion:** Overall, a distinguishing radiographic feature of septic physisitis in foals is the presence of a focal radiolucency centered on the physis consistent with osteolysis.

**Acknowledgment:** There was no proprietary interest or funding provided.

#### **A3754. Second Harmonic Generation (SHG) Imaging of Equine Flexor Tendon Fascicular Structure during Healing**

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**Introduction:** Most experimental and clinical studies of equine tendon healing have focused on evaluating longitudinal collagen alignment. The elastic property of energy-storing flexor tendons is largely attributed to higher order structures than fascicular collagen orientation alone. The objective of this study was to evaluate the utility of second harmonic generation (SHG) imaging to assess cross-sectional fascicle architecture of normal and healing equine flexor tendons.

**Materials and Methods:** Collagenase-induced tendinitis was created in the superficial digital flexor tendons (SDFT) of eight horses. Horses were euthanized at 6 ( $n = 4$ ) and 16 weeks ( $n = 4$ ) after collagenase injections and the injured and normal SDFTs were harvested for histological evaluation. Tendon specimens were cross-sectioned and imaged through a confocal microscope with a 2-photon laser source, to generate SHG images. Fascicle bundle sizes were measured from representative cross-sectional images (normal, 6- and 16-week postinjury) and analyzed by one-way ANOVA for repeated measures.

**Results:** SHG imaging was very useful to evaluate cross-sectional higher order structure. Tendon fascicle structure was not restored at 16 weeks postinjury. Fascicle bundle size was significantly increased at 6 (2-fold) and 16 weeks (3.5-fold) following collagenase injection compared with normal tendon ( $0.22 \pm 0.01 \text{ mm}^2$ ).

**Discussion/Conclusion:** The increase in fascicle bundle size between 6 and 16 weeks indicates that normal fascicular dimensions are not restored in the early or intermediate stages of tendon repair and may contribute to the high rates of reinjury. Restricting assessment of tendon histology during healing to longitudinal collagen alignment and crimp restoration alone ignores the considerable importance of higher order reorganization.

**Acknowledgment:** AQHA, OSU intramural funded this study.

#### **A3772. Evidence of Subchondral Lesions Preceding Proximal Sesamoid Bone Fracture in Thoroughbred Racehorses**

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**Introduction:** Proximal sesamoid bone (PSB) fractures are the leading cause of racehorse death. Our objective was to determine if PSB abnormalities precede fracture.

**Materials and Methods:** Fractured (FX) and intact contralateral (CIL) medial PSBs from 10 thoroughbred racehorses that died because of a unilateral biaxial PSB fracture and a medial PSB (CTRL) from 10 TB racehorses that died for an unrelated reason were initially studied. Color abnormalities and focal radiolucencies (lesions) were quantified using articular surface, parasagittal serial sections, or radiographs. Focal bone porosity was determined from microcomputed

tomography ( $\mu$ CT) images of a second sample of PSBs (9 FX, 9 CIL, 18 CTRL).

**Results:** Focal subchondral discoloration was observed in 10% of CTRL, 70% of CIL, and 80% of FX PSBs; and on the fractured face of 90% of FX-PSBs. Subchondral lesions were observed in 0% of CTRL, 50% of CIL-PSBs, and 60% of FX-PSBs. Subchondral discoloration and subchondral lesions were highly correlated ( $r = 0.711$ ); 69% of discolored samples had a subchondral lesion. Bone porosity was 12% higher at the subchondral lesion site in FX-PSBs and 2% higher in CIL-PSBs than in CTRLs.

**Discussion/Conclusion:** Focal subchondral lesions of high porosity were present in fractured PSBs and to a lesser extent in contralateral intact PSBs and were rare in control PSBs; these lesions likely predispose to PSB fracture.

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### **A3786. Standing Trans Cyst-Like Lesion Screw Application in the Proximomedial Radius of a Horse**

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**Introduction:** Screw placement has been advocated as a treatment to expedite return to use among horses with proximomedial radial cyst-like lesions. The objective of this report is to describe a standing lateral surgical approach for transcyst cortical bone screw placement and short-term follow-up for a subchondral cyst-like lesion of the proximomedial radius in a mare.

**Materials and Methods:** A 10-year-old American Paint mare was presented for evaluation of an intermittent, severe, left forelimb lameness of 6 months duration. Nuclear scintigraphy revealed increased radiopharmaceutical uptake of the proximomedial radius. Radiographs confirmed a subchondral cyst-like lesion. Using local anesthetics and  $\alpha$ -agonist sedation, a 100 mm long, 5.5 mm diameter cortex screw was placed from a lateral approach.

**Results:** Mild discomfort was present as the drill entered the cyst-like lesion, which was resolved following instillation of local anesthetic into the cyst. Serous incisional drainage was present for 1 week following surgery. Although the subchondral cyst-like lesion remained radiographically apparent, the mare was sound at 6 weeks and returned to full exercise 3 months following surgery.

**Discussion/Conclusion:** Lateral to medial placement of a screw in the proximal radius for treatment of subchondral cyst-like lesions provides an alternative to a medial approach in dorsal recumbency. Advantages include avoiding general anesthesia and the medial neurovascular structures of the cubital region with improved ability to maintain surgical orientation in a standing horse. Limitations include available screw lengths and lack of direct access for cyst debridement.

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

### **A3719. Scientific Principles for Post-CCL Repair Rehabilitation: An Evidence-Based Approach**

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**Introduction:** The Orthopedic and Rehabilitation Integrated Outcomes Network of Veterinarians (ORION Vets) aims to collect outcome data that will guide clinical decision making for veterinary patients. To identify predictors of successful outcome following CCL surgery, a standardized approach to postoperative rehabilitation in dogs should be adopted.

**Materials and Methods:** ORION Vets is working toward creation of guidelines for physical rehabilitation post-CCL surgery. As part of development of these guidelines, review of the fundamental physiologic principles and goals of rehabilitation was conducted.

**Results:** Postoperative rehabilitation programs should be designed such that patients' progress based on individual assessment according to the degree of tissue healing, strength, and achievement of functional goals. Therapists must fully understand phases of tissue healing, reassess the patient frequently, and use clinical reasoning skills to progress treatment appropriately for the individual patient. Therapists must be trained in manual therapy, therapeutic modalities, and therapeutic exercise progression. Goals of rehabilitation include: decrease pain, swelling and joint effusion; facilitate tissue healing; restore normal arthrokinematic and osteokinematic motion; promote weight bearing to initiate muscle contractions for dynamic stabilization of the stifle joint; normalize proprioception; restore normal neuromuscular patterning (functional movements); normalize muscle function, strength, endurance, and mass; improve joint health; weight loss, if indicated; address and resolve compensatory issues in other limbs that may be causing pain and gait dysfunction; decrease probability of further injury; hasten return to normal activity/full function.

**Discussion/Conclusion:** Based on these fundamental principles, we will develop and test several post-CCL surgery rehabilitation protocols prior to establishing the first set of guidelines.

**Acknowledgment:** None.

### **A3743. Survey of 156 Police Dogs in New Zealand: Functional Assessment and Canine Orthopaedic Index**

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**Introduction:** The objective was to determine the functional fitness (FA) and canine orthopaedic index (COI) of 156 New Zealand Police Dogs. Our hypothesis was that these dogs would have excellent fitness and no evidence of orthopedic disease as reported by the dogs' handlers.



**Materials and Methods:** COI and FA questionnaires were completed by handlers. Descriptive statistics and 1-way ANOVA were used to determine the dog's fitness.

**Results:** The average age was  $3.2 \pm 2.4$  (mean  $\pm$  SD) years and 96% were German Shepherds. 109 dogs were male, 9 neutered, 13 female, 15 spayed, and rest unknown. COI stiffness score was abnormal in 37% ( $3.3 \pm 2.2$ ), function score was abnormal in 22% ( $2.9 \pm 2.1$ ), and gait score was abnormal in 41% ( $5.4 \pm 4.0$ ). Quality of life was excellent in 108 (69%) dogs who were younger ( $3.2 \pm 1.8$ ,  $p < 0.05$ ) than the others ( $6.2 \pm 2.2$ , score =  $3.5 \pm 2.5$ ). Overall function was impaired in 20%, abnormal in 15%, and fitness inadequate in 36%. Only 29% had normal function (score = 0) and these were younger ( $2.8 \pm 1.7$  years,  $p < 0.05$ ) than impaired ( $6.6 \pm 2.2$ ) but similar in age to reduced fitness dogs ( $3.7 \pm 1.8$ ).

**Discussion/Conclusion:** Most police dogs have good-to-excellent function; however, as age increases (> 3 years), function may decline. Dogs with impaired fitness and excellent function were similar in age. Further study is warranted to determine if improvement in fitness could improve function and COI.

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

#### **A3806. Gait and Electromyographic Alterations due to Early Onset of Injury and Eventual Rupture of the Cranial Cruciate Ligament in Dogs: A Pilot Study**

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**Introduction:** New perspectives on the etiopathogenesis of stifle disease include recognizing the role of dynamic stabilizing components, such as the muscular system, as possible contributors to CCL disease. Muscle activity, or motor control, is integral in the control of movement; however, failure occurring in one or more muscles associated with maintaining stability and normal stifle kinematics, is a speculative contributing factor to CCL disease. The objective of this study was to identify relevant electromyography (EMG), kinematic and kinetic changes resulting from monopolar radiofrequency energy (MRFE)-induced cranial cruciate ligament (CCL) injury, and eventual rupture in dogs.

**Materials and Methods:** Five female dogs were used to assess surface EMG, joint kinematics and kinetics at a trot in the pelvic limbs at baseline, 2 and 4 weeks after unilateral MRFE-induced CCL injury, and 4, 8, and 16 weeks following CCL rupture (CCLR).

**Results:** Average hip joint range of motion during stance decreased within the untreated pelvic limb post MRFE-induced injury. Post CCLR, kinematics in the stifle and tarsus were altered bilaterally. Qualitative alterations of many EMG parameters were noted following MRFE-induced injury and CCLR, though no statistical significance difference was found.

**Discussion/Conclusion:** MRFE-induced injury produced altered contralateral hip kinematics, suggesting early

compensatory gait alterations. Additional compensatory gait patterns occurred in both pelvic limbs post CCLR. Qualitative analysis of trial averaged EMG data support a relationship between neuromuscular function and CCL injury and subsequent rupture.

**Acknowledgment:** The authors would like to acknowledge a foundation grant from Mrs. Jaynn Emory.

#### **A3767. Horizontal Shear Forces of Dirt and Synthetic Arena Surfaces**

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**Introduction:** Shear forces at the surface-hoof interface affect hoof slide, surface grip, forces transferred to the limb, and injury risk. Relationships between shear properties and arena surface type and techniques to manage shear properties were determined.

**Materials and Methods:** Shear force and horizontal and vertical displacement were measured at 6 sites on 12 arena surfaces (5 dirt;7 synthetic) with 5 increasing normal loads (50–225 pounds). Angle of internal friction and cohesion were calculated. Surface temperature, cushion depth and moisture content were also measured. The effects of surface on shear properties were assessed using ANOVA ( $p < 0.05$ ). Surface and shear properties were correlated.

**Results:** Angle of internal friction and shear force were significantly larger (7%; 12%) for synthetic surfaces than dirt surfaces ( $p = 0.027$ ;  $p < 0.001$ ). Average vertical displacement during the shear test was significantly larger (68%) for dirt surfaces ( $p < 0.001$ ). Cushion depth was significantly correlated with shear parameters of dirt ( $r = -0.63, 0.57, 0.63$ ) and synthetic surfaces ( $r = -0.44, 0.33$ ). Temperature and moisture content also contributed to shear properties of dirt ( $r = -0.46, 0.58$ ) and synthetic ( $r = -0.49, 0.43, 0.60$ ) surfaces, respectively.

**Discussion/Conclusion:** Synthetic surfaces had higher resistance to horizontal motion and vertical displacement than dirt surfaces. Cushion depth and temperature or moisture content contributed to dirt and synthetic shear measurements. The range of surface parameters was larger for synthetic surfaces than dirt surfaces, indicating that synthetic surfaces may have more design latitude to reduce injury risk.

**Acknowledgment:** Supported in part by the Center for Equine Health with funds provided by the State of California satellite wagering fund and contributions by private donors.

#### **A3780. The Incidence of Musculoskeletal Injuries in Avalanche Search and Rescue Dogs in North America**

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**Introduction:** The objectives of this study were to (1) determine the incidence of musculoskeletal (MS) injuries in trained avalanche rescue dogs, (2) identify potential risk factors for MS injuries, and (3) determine any long-term morbidity that negatively impacted continued avalanche

rescue activities. Data from an in-depth online survey would be collected and used to achieve the study objectives.

**Materials and Methods:** An online survey was developed and distributed to ski patrollers/handlers in the United States and Canada. In-depth questions included information pertaining to the dog's signalment, history of avalanche training and activities, working altitude, diet, previous and current medical and orthopedic history, body condition scores, and avalanche work-based MS injury. Pearson's Chi-square analysis was performed to identify potential risk factors associated with the incidence of MS injuries. Significance was  $p < 0.05$ .

**Results:** 59% (36/61) respondents completed the entire survey. 25% (9/36) of the dogs were reported to have MS injuries associated with avalanche rescue work that involved either a thoracic limb, pelvic limb, or both. MS injuries ranged from muscle strains to fractures. 9% (1/11) was forced to retire due to injuries. Statistically significant risk factors for MS injury could not be identified.

**Discussion/Conclusion:** Although the incidence of MS injury in the study cohort was low, these injuries may have a negative impact in achieving successful human avalanche rescues. A future survey is currently being developed in attempt to elucidate potential MS injury risk factors in this population of specialized working dogs.

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

#### **A3712. Carpal Hyperextension in Agility Dogs**

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**Introduction:** Carpal injuries are commonly seen in agility dogs. The study objective was to measure the extension of the carpus in dogs coming off the A-frame before and after carpal brace application. We hypothesized that a carpal brace would reduce the degree of carpal extension when completing this obstacle.

**Materials and Methods:** 10 healthy agility dogs were enrolled in the current study. Markers were placed over the radial head, lateral malleolus, and lateral and distal aspect of the fifth metacarpal bone. Each dog was filmed transitioning from the A-frame. Five trials were collected. A carpal brace was then placed and the dogs navigated obstacles for 10 minutes. An additional five trials were collected with the brace in place. Carpal extension was measured from the videos. The speed and angles for each limb were averaged for each dog. Means, standard deviations, and a matched paired *t*-test were performed to determine if speed or carpal angle changed after brace placement ( $p < 0.05$ ).

**Results:** There was no statistically significant difference in pre- and postbrace measurements from the A-frame videos. The mean difference in carpal extension for the right and left limbs were 4.76 degrees and 4.94 degrees, respectively.

**Discussion/Conclusion:** The brace used in this study did not show a statistically significant decrease in carpal extension. However, multiple avenues for future research have been developed using this data.

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

#### **A3796. Effect of Increasing Fracture Site Stiffness on Bone-Pin Interface Stress in the Equine Distal Limb Transfixation Cast: A Finite Element Analysis**

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**Introduction:** Transfixation pin casts are used to treat phalangeal fractures in the horse. An understanding of how changing fracture site stiffness within a transfixation cast affect the stresses distal to the transcortical pins, at the fracture site, and at the BPI, is required. We hypothesized that increasing tissue stiffness at the fracture site would increase stress in bone distal to the pins and decrease the BPI stress.

**Materials and Methods:** An FE model of the equine transfixation cast with transcortical pins positioned in the distal third metacarpal bone was generated. The stiffness of the tissues was represented by a composite tissue block within the cast. The composite stiffness was altered to approximate various time points during fracture healing.

**Results:** FE analysis showed that increasing the composite tissue stiffness resulted in a decrease in the maximum von Mises stress at the BPI, a decrease in the maximum and minimum principal stress at the BPI and an increase in von Mises stress distal to the transcortical pins.

**Discussion/Conclusion:** Healing at the fracture site is expected to alter BPI stresses and fracture site stresses over time. These changes support the approach of not reducing the number of pins present in a distal limb transfixation cast during healing as a method to dynamize the fracture site since this is expected to occur as a direct result of the altered stress environment due to healing and local changes in tissue stiffness.

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#### **A3795. Tearing of the Palmar Aspect of the Intersesamoidean Ligament as Primary Pathology of the Digital Tendon Sheath: An Endoscopic Diagnosis in Two Horses**

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**Introduction:** Imaging techniques frequently fail to diagnose digital tendon sheath (DTS) pathology, thus diagnostic endoscopy is often employed. Ultrasonographic detection of proximal scutum pathology has been reported, but there are no published reports of endoscopic abnormalities. The aim of this case report is to describe palmar intersesamoidean ligament (IL) pathology, to raise awareness of this as a differential diagnosis.

**Case 1:** 11 yo TB eventer gelding with RF lameness localized to foot and DTS, which failed to respond to medical management. Ultrasound and standing MRI showed only mild PAL thickening. DTS endoscopic examination revealed horizontal tearing of palmar aspect of the IL, distal-to-distal margin of manica flexoria. This was debrided using synovial resectors. No other pathology was evident. The PAL was transected. After 8 months, field rest the horse resumed



work and has competed successfully for two seasons with no lameness.

**Case 2:** A 13yo TBX eventer gelding with RF lameness, localized to foot and DTS, which failed to respond to medical management. Ultrasound showed mild PAL desmitis. There were negative findings on a positive contrast DTS study. Endoscopic examination, findings, and treatment were as in Case 1. The horse is in early stages of rehabilitation.

**Discussion:** The two cases are remarkably similar with concurrent foot pathology and mild PAL findings. Foot problems are common, so may be coincidence. There is possibly an association between PAL and IL pathology. The long-term soundness of Case 1 is prognostically encouraging for this condition.

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

### **A3807. Case Series: Scapulohumeral Arthrodesis in Four Shetland Ponies**

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**Introduction:** Osteoarthritis of the scapulohumeral joint in horses is uncommon, but when it does occur, it is usually secondary to a primary musculoskeletal disorder or trauma. Miniature horses, however, are predisposed to osteoarthritis secondary to dysplasia of the scapulohumeral joint. The objective of this study is to describe the latest surgical technique used in four Shetland ponies diagnosed with severe joint dysplasia, along with the complications and outcome of this new approach.

**Materials and Methods:** Four Shetland ponies with severe osteoarthritis were presented in a period of four years at the University of Ghent. A lameness and radiographic exam was performed prior and postsurgery. All ponies were treated with an internal fixation using 4.5 mm locking compression plates (LCP) cranially across the scapulohumeral joint. Telephone questionnaires from owners were assessed postsurgery.

**Results:** The clinical outcome was considered good in all four cases. Two ponies developed a subcutaneous seroma. The first case was not infected and resolved two weeks after surgery. Culture of the second case showed an infection with *Streptococcus spp.* and *Staphylococcus spp.* that resolved with the appropriate antibiotic treatment during hospitalization. Implants were never affected by the seromas. One pony was diagnosed with an unsatisfactory ankyloses of the shoulder joint two years post-op but improved in lameness.

**Discussion/Conclusion:** Shoulder arthrodesis in ponies < 100 kg with severe osteoarthritis of the scapulohumeral joint should be considered to restore both the comfort and use of the affected limb in ambulation.

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

### **A3823. Successful Closed Reduction and Conservative Management with Traumatic Elbow Luxation and Medial Collateral Ligament Rupture in an Equid**

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Elbow joint luxation in equids has been rarely described and has primarily occurred in equids less than 10 months old with concomitant fracture. Elbow luxation has predominantly been treated with surgical repair and is described as having a guarded prognosis. In this case, a 9-year-old donkey jenny (212 kg) presented with an acute, nonweight bearing left forelimb lameness of 24 to 36hours duration. The limb was held in flexion and abduction, with the toe above the ground, and was unable to be manually straightened. There was significant palpable swelling along the medial aspect of the elbow joint and proximal radius, with no lateral swelling or discomfort on palpation. Radiographic evaluation revealed a medial luxation of the elbow joint with avulsion and rupture of the medial collateral ligament. Closed reduction was accomplished under injectable anesthesia without complication. The patient was weight bearing and comfortable on the limb immediately upon recovery from anesthesia. Full limb bandages, splints (extending proximal to the scapula), hobbles, NSAIDs, and cold laser therapy were utilized, decreased, and discontinued as the jenny was generally kept tied standing for 60 days. At 74 days, a rehab program was initiated. At 8 months post injury, the patient was not lame and was back to her previous level of exercise. Closed reduction without surgical intervention in adult animals with elbow luxation can be successful, likely dependent on the level of associated injury.

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

### **A3814. Description of the Anatomical Landmarks for Measuring Intravertebral and Intervertebral Sagittal Diameter Ratios on Equine Cervical Radiographs**

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**Introduction:** The objective of this study is to describe the anatomical landmarks for the floor of the vertebral canal to be used when measuring the intravertebral and intervertebral minimum sagittal diameter ratios on cervical spinal radiographs of horses. Our hypothesis is that on lateral cervical radiographs, the most ventrally located, cranio-caudally oriented mineral opaque line seen on the craniodorsal aspect of the vertebral bodies (floor of the vertebral canal) represents the mid sagittal aspect of the vertebral canal.

**Materials and Methods:** The cervical spine of an adult horse was obtained postmortem. A radiographic marker was sequentially placed at three discreet locations along the craniodorsal aspect of the C4 vertebral body including the left and right osseous ridges abaxial to midline, and on sagittal midline. The cervical vertebrae were then manually realigned and lateral radiographs of the C3–C5 vertebrae were subsequently made. Computed tomographic images of

the cervical spine were obtained to depict the anatomy of the vertebral canal.

**Results:** When the marker was placed on the abaxial osseous ridges and midsagittal aspect of the C4 vertebral body, it demarcated the more dorsally located and more ventrally located, craniocaudally oriented mineral opaque lines at the craniodorsal aspect of the vertebral body, respectively.

**Discussion/Conclusion:** This study describes the radiographic appearance of the anatomical landmark for the floor of the vertebral used to measure the intravertebral and intervertebral minimum sagittal diameter ratios for evaluation of equine cervical vertebra malformation.

**Acknowledgment:** There was no proprietary interest or funding provided for this project. The authors thank Bobbie Davis for helping with radiographs.

### **A3826. Distal Tibial Osseous Cyst-like Lesions in Association with OCD Lesions of the Distal Intermediate Ridge in Three Horses**

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**Introduction:** Distal tibial cysts are uncommon in horses. They can be a manifestation of osteochondrosis. We describe three cases of distal tibial cysts in association with distal intermediate ridge of the tibia (DIRT) OCD lesions seen at two referral practices in 2018, to raise awareness that these two conditions may occur concurrently.

**Case 1:** A yearling Warmblood filly had bilateral DIRT OCD lesions, marked left tarsocrural joint effusion and lameness. A large cyst was present in the left distal tibia, lateral to the DIRT lesion. These were clearly identified on CT. Arthroscopically the left DIRT lesion was fragmented. The cyst was injected with corticosteroids through a 2 mm drill tract. The filly is on pasture rest.

**Case 2:** 9 yo Warmblood mare with hindlimb lameness had a small DIRT lesion and adjacent small subchondral cystic lesion. There was minimal tarsocrural joint effusion and lameness blocked elsewhere. The cyst was not treated, and the horse is rehabilitating.

**Case 3:** A 4 yo Warmblood gelding underwent OCD surgery of the hocks and stifles. Radiographically the right hock had irregularity of the DIRT and a small cyst in the medial malleolus. Arthroscopically there was a small DIRT lesion on the right. The cyst was not evident and thus not treated. The horse is sound and returned to competition.

**Discussion/Conclusion:** The significance of these lesions is uncertain in these cases, but horses identified with DIRT lesions should also be critically evaluated for distal tibial cysts.

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

### **A3700. Mechanical Comparison of Small Interlocking Nail Systems in Torsion Using A Feline Bone Model Surrogate**

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**Introduction:** Traditionally, plate osteosynthesis was the preferred fixation method of for feline long-bone frac-

tures. Recently, two angle-stable interlocking nails suitable for cats were introduced, but objective comparison of these nails has yet to be performed. Our null hypotheses were that for both phases, there would be no significant difference in outcome measures among groups.

**Materials and Methods:** Phase I: Mid-diaphyseal gap models were created using a feline femoral surrogate. Constructs ( $n = 4/\text{group}$ ) were stabilized with one of six implants and tested nondestructively. Phase II: intact models with implant specific holes ( $n = 4/\text{group}$ ) were loaded to failure. Outcome measures for Phase I (torsional compliance [TC, °/Nm], maximum angular deformation [AD, °]), and Phase II (failure torque [ $F_T$ , Nm]) were statistically compared ( $p < 0.05$ ).

**Results:** Phase I: the I-Loc-4 had the smallest ( $p < 0.05$ ) TC and AD overall. The Targon-2.5 had the largest AD ( $p < 0.05$ ) with locking interface slippage resulting in torsional instability. This was not noted with the Targon-3.0. Phase II:  $F_T$  of both Targon specimens was lower ( $p < 0.05$ ) than all other groups. Conversely, I-Loc and LCP  $F_T$  was not different ( $p = 0.12$ ) from the intact feline femoral bone surrogate.

**Discussion/Conclusion:** Our results suggest that the I-Loc-3 and I-Loc-4 provide greater torsional stability and may be valid alternatives to plate osteosynthesis. Furthermore, I-Loc and LCP pilot holes do not affect the torsional strength of the bone surrogate, and may not increase the risk of iatrogenic fracture following explantation. Given our positive results, a prospective clinical evaluation of the I-Loc-3 and -4 is underway.

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### **A3720. The Effect of Short- and Long-Term NSAID Administration on Osteotomy Healing in Dogs**

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**Introduction:** Nonsteroidal anti-inflammatory drugs (NSAIDs) have been shown to delay fracture healing in experimental models and received scrutiny in human medicine due to NSAIDs being identified as a risk factor of delayed and nonunions. The effects of NSAIDs on fracture healing in veterinary medicine using FDA approved drugs are limited. The study objective was to determine if short-term NSAIDs use would delay bone healing. We hypothesized no difference would be seen between dogs given no NSAIDs and 2 weeks of NSAIDs, but 8 weeks of NSAIDs would delay bone healing.

**Materials and Methods:** An 8-week study was performed following tibial osteotomy in 18 dogs. Fracture healing was evaluated using radiographs, biomechanical strength, histological cartilage: callus ratio, and bone mineral density with quantitative CT.

**Results:** Some, but not all biomechanical measures (stiffness, maximum stress) showed 0- and 8-week NSAID groups were different, but no further differences could be demonstrated between any groups. Radiographic healing score both 4 weeks and 8 weeks postop was the not different (i.e., equivalently healed) for the 0- and 2-week NSAIDs group,

but less healed for the 8-week group. There was no effect of treatment on cartilage, callus ratio, or bone mineral density.

**Discussion/Conclusion:** Limitations include small sample size, superficial infection rate (58%), and simplicity of fracture model. Biomechanical strength, radiographic union, histopathology, and bone mineral density demonstrated short-term NSAID usage did not affect healing in this study. Caution should be exercised when using NSAIDs in postoperative fracture patients at risk for delayed healing.

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#### **A3749. Evaluation of Threaded External Skeletal Fixation Pin Insertion with and without Predrilling in Avian Bone** Lam G.<sup>1</sup>, Kim S.K.<sup>1</sup>, Wei F.<sup>1</sup>

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**Introduction:** External skeletal fixation (ESF) is frequently used to treat fractures in mammalian and avian species. Pin loosening secondary to heat generation during pin insertion and subsequent thermal osteonecrosis is a common complication. Previous research has demonstrated the significant benefits of predrilling pin insertion sites in reducing heat generation and morphological damage in canine bone. However, pin placement without predrilling has been anecdotally recommended in avian species. The purpose of this study was to document the effects of ESF pin insertion with and without predrilling on heat generation and structural bone damage in avian bone.

**Materials and Methods:** Twenty paired tibiotarsi and twenty paired humeri from ten Mallard duck cadavers were harvested. Specimens were randomized to have positive-profile threaded ESF pins placed with or without predrilling insertion sites. Heat generation (maximum–resting temperature) was measured during drilling and pin insertion with infrared thermography. Structural damage (gross transcortical damage and microcracks) was evaluated with environmental scanning electron microscopy and scored using a visual analog scale (VAS).

**Results:** VAS scores for transcortical surfaces were significantly higher than for ciscortical surfaces; however, no difference was noted between predrilled and non-predrilled specimens. No significant difference in heat generation was noted between predrilling and pin placement without predrilling.

**Discussion/Conclusion:** Pin insertion without predrilling in avian bone does not cause significantly more structural damage or heat generation compared with predrilling. Overall, our results indicate that there is no obvious advantage to predrilling prior to ESF pin insertion in avian species.

**Acknowledgment:** Funded by the Michael E. Scott Endowment Fund, Michigan State University.

#### **A3808. Role of Cartilage and Bone Matrix Regulation in Early Equine Osteochondrosis** Grissom S.K.<sup>1</sup>, Semevolos S.A.<sup>1</sup>

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**Introduction:** The aim of the study was to gain understanding of the role of cellular regulatory mechanisms in the pathogenesis of early equine osteochondrosis by evaluating differences in protein and gene expression of specific regions in both normal and diseased cartilage. The hypothesis of this study was that it would be expected to find upregulation of matrix metalloproteinases and a decrease in extracellular

matrix gene expression within the osteochondral junction and in chondrocytes lining the cartilage canals of osteochondrosis affected samples.

**Materials and Methods:** Previously archived samples from the femoropatellar joints of adolescent foals were obtained using laser capture microdissection to isolate cDNA from cells located within the osteochondral junction and surrounding cartilage canals. Samples included 7 early osteochondrosis affected and 8 normal controls. Quantitative real-time PCR was performed on 20 target genes. Based on statistically significant gene expression as determined by a Wilcoxon rank-sum test, genes were chosen for further evaluation using immunohistochemistry.

**Results:** There was significantly decreased expression of Col 2B, Aggrecan, and SOX-9 in chondrocytes near the cartilage canals of early osteochondrosis affected samples. Within the osteochondral junction, there was down-regulation of PRG4 and Col 2B in osteochondrosis samples.

**Discussion/Conclusion:** Limitations of the study include an incomplete evaluation of a comprehensive list of genes expressed in the extracellular matrix. The results of this study will contribute to the overall understanding of the pathogenesis of osteochondrosis and aid in identifying the role of cartilage and bone matrix regulation in early equine osteochondrosis, providing opportunity for early diagnosis prior to apparent clinical signs.

**Acknowledgment:** Internal funding.

#### **A3718. Silicone Cannula Guards for Canine Stifle Arthroscopy Reduce Iatrogenic Cartilage Injury** Ill I.Cortes<sup>1</sup>, Warnock J.<sup>2</sup>, Ranganathan B.<sup>3</sup>, Bobe G.<sup>4</sup>

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**Introduction:** Iatrogenic cartilage injury (IACI) is the most common complication of canine stifle arthroscopy. The objective of this study was to devise a method to decrease IACI during canine stifle arthroscopy using a silicone arthroscopy cannula guard. We hypothesized that there would be fewer and smaller IACI in stifles receiving silicone guarded arthroscopy versus unguarded arthroscopy.

**Materials and Methods:** A 3.0 mm silicone endotracheal tube was trimmed and placed over the 2.7 mm arthroscopy cannula, insuring that 2–3 mm of silicone extended beyond the cannula tip. Stifle arthroscopy was performed by a second-year surgery resident on fourteen canine cadavers alternating left and right stifles for guarded versus unguarded arthroscopy. Following arthroscopy, stifles were dissected and the India ink assay performed to identify IACI. Total IACI number, lesion length, and area were recorded for each stifle.

**Results:** Unguarded arthroscopy resulted in longer IACI ( $p = 0.02$ ), larger IACI area ( $p = 0.02$ ), and total IACI number per joint ( $p = 0.03$ ).

**Discussion/Conclusion:** These data support our alternative hypothesis: silicone guarded arthroscopy cannulas decreased IACI number and size during canine cadaveric stifle arthroscopy. Silicone guarded arthroscopy resulted in significant reduction in cartilage damage. While this may decrease IACI for arthroscopy in general, it may also improve the training process for canine stifle arthroscopy, where there is a steep learning curve, by reducing IACI created by novice arthroscopic surgeons.



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#### **A3771. Determination of Optimal Torque for Cortical Bone Screw Fixation in Equine Third Metacarpal Bone**

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**Introduction:** During fracture repair, bone screws are tightened to a subjective torque value determined by the surgeon. We hypothesized that stress relaxation of bone screws would be a critical factor in determining optimal torque. Our objective was to determine optimal insertion torque and relaxation for 4.5 mm cortical bone screws in mid diaphysis of equine third metacarpal (MCIII) bone.

**Materials and Methods:** Forty pairs of MCIII were collected. Computed tomography was performed to determine each MCIII dimension and density. 20 pairs of MCIII were used to insert 4.5 mm cortical screws unicortically and 20 pairs were used to place 4.5 mm cortical screws in lag fashion. Blocked randomization was used with 4 screws/treatment. Each treatment was assigned an insertional torque and relaxation time in one of five diaphyseal locations. Insertion torque and loosening measurements were used to determine stress relaxation. Repeated-measures analysis of covariance was used for data analysis (significance  $p < 0.05$ ).

**Results:** For unicortical and bicortical screws, relaxation was associated with original torque ( $p = 0.002$  and  $< 0.001$ , respectively). More relaxation occurred with inserting torque 8 Nm compared with 2 Nm and 4 Nm. Relaxation was associated with increased bone density for unicortical ( $p = 0.004$ ) and bicortical screws ( $p = 0.010$ ), consistent with multivariable analysis. Results suggest that insertion torques higher than 4 Nm in unicortical and 6 Nm in bicortical screws increase relaxation. Increased bone density was associated with relaxation in both uni- and bicortical screws.

**Discussion/Conclusion:** This study was limited to static ex vivo model design. We plan to further investigate screw torque optimization under dynamic loading to model in vivo fracture constructs.

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#### **A3784. Efficiency and Accuracy of 3D Printed Patient-specific Guides for Angular Limb Deformity Correction in Dogs**

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**Introduction:** Our objective was to investigate the efficiency and accuracy of the use of 3D printed patient-specific guides (PSGs) for surgical correction of limb deformities in dogs. We hypothesized that use of PSG would result in faster surgical times and improved postoperative limb alignment when compared with performing correction without PSG.

**Materials and Methods:** In this retrospective study, five limb deformity corrections with PSG were matched with a cohort of five similar cases that were corrected using traditional "freehand" techniques, based on deformity characteristics, fixation method, weight, and age. Preoperative alignment (using CORA-based methodology), procedure time, and postoperative alignment were recorded for each case.

**Results:** PSG cases were performed a mean of 110 minutes faster than freehand cases ( $p = 0.027$ ). Fluoroscopy was used for all freehand cases but not used for any of the PSG cases. Differences in postoperative limb alignment and the targeted correction on preoperative planning was not significantly different between groups.

**Discussion/Conclusion:** While the accuracy of correction was good for both groups, the use of PSG for limb deformity correction results in faster operating time and obviates the need for intraoperative fluoroscopy. This was a small retrospective study and further investigation into the value of PSG for deformity corrections in dogs is warranted.

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

#### **A3761. Ex vivo Mechanical Testing of Various Suture Patterns for Use in Plating as a Repair Method for Tendon Rupture**

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**Introduction:** There is some evidence that tendon plating may be a superior method of maintaining tendon apposition during the healing process, but the literature currently describes multiple suture patterns used to attach the plate to the tendon with no evidence of efficacy. The present study seeks to examine the differences between the suture patterns currently described as well as a novel pattern.

**Materials and Methods:** The suspensory ligament and digital flexor tendons were harvested from 16 neonatal foals. Each tendon/ligament was transected midbody and randomly assigned to test groups using either simple interrupted or hybrid suture patterns to secure an 8-hole 2.0 mm veterinary cuttable plate to the tendon. The constructs were distracted at a rate of 1.0 mm/sec to failure, as determined by the formation of a 1 mm gap for initial and 3 mm for ultimate failure. The mode of failure was also recorded.

**Results:** Hybrid (mean = 1 mm: 112 N; 3 mm: 143.6 N) and interrupted (mean = 1 mm: 104.4 N; 3 mm: 140.1 N) patterns sustained significantly higher forces before gap formation than simple interrupted (mean = 1 mm: 47.7 N; 3 mm: 69.3 N) ( $p < 0.01$ ). There was no significant difference between hybrid and interrupted patterns. All patterns failed predominantly by tissue failure with no difference in failure mode between groups.

**Discussion/Conclusion:** Both the interrupted and hybrid patterns described herein offer significantly greater resistance to tendon gap formation when compared with a simple interrupted pattern as described previously.

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

**The second set of Abstracts will follow in VCOT issue 4/2019.**