



Veterinary Orthopedic Society 43rd Annual Conference Abstracts

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Part II

PODIUM ABSTRACTS (continued)

52 COMPARISON OF ULTRASOUND AND MRI TO ARTHROSCOPY FOR ASSESSMENT OF MEDIAL MENISCAL PATHOLOGY IN DOGS WITH CRANIAL CRUCIATE LIGAMENT DISEASE

Samuel Patrick Franklin¹; James L. Cook²; Cristi R. Cook²; Layla Shaikh¹; Shannon P Holmes¹

¹University of Georgia, Athens, GA, ²University of Missouri, Columbia, MO

Introduction: No studies have directly compared the accuracy of ultrasound and MRI for diagnosing medial meniscal pathology in dogs with CCL disease. Further, no assessment of ultrasound has been made when ultrasound is performed by a veterinary surgeon.

Materials and Methods: A prospective clinical trial was performed in which 31 stifles in 26 dogs diagnosed with CCL disease had ultrasound, MRI, and arthroscopic evaluation of the medial meniscus of the affected stifles. Stifles were evaluated by one surgeon using physical examination, ultrasound, and arthroscopy for the presence of clinically relevant medial meniscal damage. Video recordings of the arthroscopy were saved and subsequently reviewed by a second arthroscopist that was blinded to all other assessments. A radiologist blinded to all other assessments evaluated MRI images acquired using a 1.5T scanner. The correct classification rate (CCR), sensitivity, and specificity of ultrasound and MRI were calculated twice using each of the two arthroscopists' assessment as the standard.

Results: The CCR of ultrasound was 84 and 90%, sensitivity was 86 and 95%, and specificity was 78 and 82% respectively. These same values for MRI were 77 and 84% CCR, 68 and 75% sensitivity, and 100 and 100% specificity.

Discussion/Conclusion: These data are consistent with previous studies performed independently to assess ultrasound or MRI and suggest imperfect but clinically useful applicability of both ultrasound and MRI. These data also provide the first assessment of the accuracy of ultrasound when performed by a surgeon with limited ultrasound experience.

Acknowledgement: Supported by Hitachi-Aloka and SCiL Animal Care.

53 CORRELATION OF DISTRACTION INDEX WITH ARTHROSCOPIC FINDINGS IN JUVENILE DOGS WITH HIP DYSPLASIA

Emily H. Ulfelder; Caleb C. Hudson; Brian S. Beale
Gulf Coast Veterinary Specialists, Houston, TX

Introduction: Hip dysplasia is a common developmental disease of dogs. Distraction index (DI) has been recommended as a selection tool in candidates for double pelvic osteotomy (DPO). Arthroscopic evaluation of the hip joint has been reported to be more accurate at identifying pathologic lesions in young dogs with hip dysplasia compared to traditional radiographs. The

purpose of this study was to compare DI measurements with hip arthroscopy findings in dogs undergoing DPO.

Materials and Methods: Medical records, arthroscopic images, and radiographs from 14 patients (26 hips) undergoing unilateral or bilateral DPO were reviewed. DI was measured using distraction view radiographs. Arthroscopic images were analyzed and findings graded using the Modified Outerbridge Scale. ANOVA was used to compare DI between grade groups.

Results: The highest grades of cartilage wear were noted cranially on the femoral head, mid-acetabulum, and caudally on the DAR. No significant differences in DI were identified between groups of cartilage wear grade on the femoral head, acetabulum, or DAR, nor were any significant differences in DI identified between grade groups for the round ligament, labrum, or degree of synovitis.

Discussion/Conclusion: This study found no significant differences in DI with different grades of cartilage, DAR, round ligament, or labral wear, or degree of synovitis. No trend was noted for DI to increase as wear grade increased in any region of the joints evaluated. Arthroscopic evaluation should be considered prior to DPO as part of appropriate candidate selection.

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

54 CORRELATION BETWEEN MRI, MACROSCOPIC AND HISTOLOGIC MEASURES IN A CANINE MODEL OF OSTEOARTHRITIS

Frederic H David¹; Mark B Hurtig²; Michael G Conzemius³

¹Veterinary Clinical Sciences, College of Veterinary Medicine, University of Minnesota, St Paul, MN, ²University of Guelph, Guelph, ON, Canada, ³Veterinary Clinical Sciences, College of Veterinary Medicine, University of Minnesota, Saint Paul, MN

Introduction: Histology is the gold standard for studies on osteoarthritis (OA), but non-invasive T2 mapping MRI, thanks to correlations with biochemical properties of the cartilage, allows longitudinal studies in other species. The objective of this study was to determine if T2 mapping measures correlated with macroscopic and histological data in a canine model of OA.

Materials and Methods: Ten adult male bloodhound dogs underwent right medial meniscal release at the caudal menisco-tibial ligament. Five months later, MRI was performed, followed by euthanasia and macroscopic and microscopic evaluations. Correlation coefficients were calculated between MRI measures and percentage of abnormal cartilage on India Ink stain, OARSI score and the individual scores pertaining to the cartilage.

Results: Correlation coefficients (r^2) between MRI, gross pathology, and histologic score were improved when the MFC and MTC were considered together. For the medial compartment, MRI to gross pathology had an $r^2=0.81$; MRI to histologic pathology had an $r^2=0.17$ and gross to histologic pathology had an $r^2=0.28$.

Discussion/Conclusion: Strong positive correlations between MRI and abnormal cartilage percentage are explained by higher T2 relaxation time of synovial fluid than normal articular cartilage. The limited number of histologic samples likely explains poor correlations between MRI and gross pathology to histologic correlations. T2 mapping in experimental and clinical studies of canine stifle OA could prove to be a valuable method to diagnose cartilage pathology and evaluate response to treatments.

Acknowledgement: There is no proprietary interest. This project was funded in part by Elanco Animal Health.

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55 SAFETY AND ACCURACY OF MINIMAL INVASIVE LONG BONE FRACTURE REPAIR USING A NOVEL INTERLOCKING NAIL: A CADAVERIC FELINE STUDY

Katrin Nabholz¹; Antonio Pozzi²; Philipp A. Schmierer¹; Sebastian C. Knell¹

¹Clinic for Small Animal Surgery, Vetsuisse Faculty University of Zurich, Zurich, Switzerland, ²Vetsuisse Faculty University of Zurich, Zurich, Switzerland

Introduction: The Targon Vet System (TVS) is a novel interlocking nail designed for feline long bone fracture fixation. The purpose of this study was to compare safety and efficacy of the TVS applied to different long bones percutaneously with and without the use of fluoroscopy.

Materials and Methods: A 10 mm mid-diaphyseal gap was created in 16 humeri, tibiae and femora from 8 feline cadavers. Paired bones were randomly assigned to two treatment groups: 1) TVS inserted percutaneously under fluoroscopy guidance; 2) TVS inserted percutaneously without fluoroscopy. Fracture alignment measured with radiographs, complications and damage of neurovascular structures evaluated with dissection were statistically compared between treatment groups.

Results: Twelve intraoperative complications occurred in 48 fractures repaired with or without fluoroscopy. These complications were more common in the humerus (44% complications). Neurovascular structures were only damaged repairing humeral fractures (42%). There was no difference in any variable between treatment groups.

Discussion/Conclusion: We conclude that the TVS cannot be considered safe for humeral fractures in cats. In contrast, TVS can be safely applied with minimally invasive technique to the femur and tibia of the cat with or without fluoroscopy. Even though a learning curve has to be expected and guidelines need to be respected to decrease complications.

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56 EVALUATION OF FLUOROSCOPIC-GUIDED CLOSED REDUCTION VERSUS OPEN REDUCTION OF SACROILIAC FRACTURE-LUXATIONS IN LAG FASHION

Amanda Rollins Haque; Raviv J. Balfour; David Szabo; Christina M. Chesvick

Animal Specialty and Emergency Center, Los Angeles, CA

Introduction: This retrospective study compares the outcomes of fluoroscopic-guided closed reduction (FGCR) versus open reduction of sacroiliac fracture-luxations (SIFLs) in lag fashion. We hypothesized FGCR would lead to consistently more optimal and accurate screw placement, less incidence of screw loosening on first follow-up radiographs, and fewer perioperative and postoperative complications.

Materials and Methods: Medical records, immediate post-operative radiographs and first follow-up radiographs of 35 dogs and 6 cats (50 SIFLs) that underwent open reduction or FGCR of SIFLs were retrospectively reviewed to assess SIFL reduction and lag screw placement.

Results: Optimal screw depth/sacral body width ratio (>60%) and accurate screw placement in the sacral body was achieved in a higher percentage of FGCR cases than openly reduced cases. Fewer instances of lag screw loosening were reported for FGCR cases. Few perioperative and postoperative complications were noted across all groups, but 4/18 FGCR cases required conversion to an open approach; the SIFLs in these cases were an average of 7.66 days old compared to 2.50 days for all cases successfully reduced in closed fashion.

Discussion/Conclusion: We recommend using FGCR of SIFLs as this leads to consistently more optimal and accurate screw placement, as well as a lower incidence of lag screw loosening on first follow-up radiographs compared to open reduction. However, for significantly chronic cases, one should be prepared to convert to an open approach if a closed approach is not amenable to adequate reduction and lag screw placement.

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

57 DISPOSITION AND ULTIMATE FATE OF A PLA-PEG SUSTAINED RELEASE POLYMER AFTER INTRA-ARTICULAR INJECTION

Mark B Hurtig¹; Felipe Garcia¹; Matthew Shive²; Wayne Marshall²

¹University of Guelph, Guelph, ON, Canada, ²Arthritis Innovation Corporation, Toronto, ON, Canada

Introduction: There is an unmet need to manage pain and inflammation associated with joint disease without the complications associated with oral NSAIDs. The purpose of this work was to study to distribution of a sustained release polymer carrier within the synovial space.

Materials and Methods: Eighteen female adult sheep received an injection of 0.6 mL of a biodegradable polylactic acid-polyethylene glycol polymer (BEPO™, Medincell, Montpellier, France) combined with a generic NSAID into the stifle joint. Plasma and synovial fluid were collected at time 0 to 90 days post injection. The sheep were sacrificed and tissues were collected at time points up to 90 days.

Results: Negligible plasma levels of NSAID resulted although synovial fluid concentrations were detectable at 28 days. Synovial tissue drug levels remained high throughout the study. Polymer was found only within the synovial membrane where there was a typical foreign body reaction resulting degradation to microscopic particles, many of which resided within cells. These reactions were focal and localized to polymer; areas of synovial membrane lacking polymer displayed normal morphology.

Discussion/Conclusion: This study shows that the primary target of this sustained release drug formulation is likely to be the synovial membrane where the polymer matrix undergoes cellular degradation and hydrolysis whilst releasing the active ingredient.

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58 BIOMECHANICAL EVALUATION OF POLYMETHYL METHACRYLATE WITH THE ADDITION OF CEFZOLIN, VANCOMYCIN, GENTAMICIN, AND SILVER

Michael G. Ficklin¹; Kevin A.R. Kunkel¹; Patrick D. Gerard²; Jonathan T. Suber¹; Michael P. Kowaleski³

¹VCA Animal Specialty Center of South Carolina, Columbia, SC, ²Department of Mathematical Sciences, Clemson University, Clemson, SC, ³Department of Veterinary Clinical Sciences, Cummings School of Veterinary Medicine at Tufts University, North Grafton, MA

Introduction: Numerous studies have examined the biomechanics of polymethyl methacrylate (PMMA). Procedural differences between studies make direct comparisons difficult. Our purpose was to evaluate the effects of the addition of antibiotics and silver on compression and bending strength of PMMA. Our null hypothesis was that there would be no significant difference in the compressive or bending strength of PMMA with added antibiotics and/or silver.

Materials and Methods: PMMA was combined with cefazolin, gentamicin, or vancomycin; the control was PMMA alone. Each group contained 20g PMMA and 0.5g, 1g, 2g, or 3g of antibiotic. Silver groups had 0.25g silver powder added. Samples underwent 4-point bending and compression testing; pairwise comparisons between groups and to the ISO minimum standard were performed.

Results: Compression: All antibiotic and silver groups were weaker than the control. Samples with cefazolin tended to be stronger than other antibiotic groups. The silver+PMMA group was weaker than the control. All groups were above the ISO standard, except 3g vancomycin. 4-point Bending: The addition of antibiotics did not significantly affect bending strength in some



groups. The silver+PMMA group was weaker than the control. No groups were significantly below the ISO standard except 3g vancomycin.

Discussion/Conclusion: Addition of antibiotic or silver decreased the bending and compressive strength but not below the ISO standard for most groups. Addition of cefazolin appears to affect biomechanics the least. High doses of vancomycin significantly alter strength. This study is limited because it did not evaluate the effect of elution on biomechanics.

Acknowledgement: PMMA/silver were donated from BioMedtrix; of which MPK is a course instructor/consultant.

59 COMPUTED TOMOGRAPHY STUDY OF SAFE IMPLANTATION CORRIDORS IN RABBIT VERTEBRAE

Clara E. Moran; Tisha Adele Maria Harper; Julia K. Whittington; Steve Joslyn; Mark A. Mitchell; Devon W. Hague
University of Illinois Veterinary Teaching Hospital, Urbana, IL

Introduction: A study was performed at the University of Illinois Veterinary Teaching Hospital to evaluate the lumbar vertebrae of domestic rabbits using computed tomography in order to identify safe corridors for implant insertion.

Materials and Methods: 20 adult New Zealand White (NZW) rabbits were imaged using a GE Lightspeed 16 slice CT scanner. Measurements of the vertebral bodies and determination of the implantation corridors with the minimum and maximum safe angles were performed using 3-D multiplanar reconstruction.

Results: The cranial and caudal endplates contained the majority of the vertebral bone stock, and were an average of 3.14 and 3.30 mm in length, respectively. The mean safe corridor angle was 62.9 degrees (range 58.8–66.7), and the mean width of the corridor was 2.03 mm (1.60–2.35). Minimum and maximum safe angles were recorded for each vertebra, with an average maximum angle of 75.9 degrees (71.1–79.8), and minimum angle of 47.9 degrees (43.9–51.7).

Discussion/Conclusion: The results of the corridor evaluation indicate that an insertion angle of approximately 60 degrees relative to the sagittal midline is appropriate for implant insertion in the lumbar vertebrae of NZW rabbits. Due to the hourglass shape of rabbit vertebrae, the endplates provide maximal bone stock for implant purchase, so insertion should be attempted in these regions. Moderate variation was noted in the caudal lumbar vertebrae (varying numbers of vertebrae; sacralization) highlighting the need for individual patient assessment preoperatively.

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

60 FRAMELESS STEREOTAXY FOR VERTEBRAL IMPLANT GUIDANCE IN DOGS

Fred Alan Wininger¹; Nick Archambault²; Stephen Frey³

¹Veterinary Specialty Services, St. Louis, MO, ²Animal Specialty Hospital of Florida, Naples, FL, ³Rogue Research, Montreal, QC, Canada

Introduction: There are many clinical indications for placement of vertebral implants in the dog. Accuracy is paramount because of proximity to critical neurovascular structures. The purpose of this study was to investigate the clinical application of a computed tomography (CT) guided stereotactic technique for implant placement in the thoracolumbar spine.

Materials and Methods: 6 cadaveric specimens were used. CT studies were performed from the T12 to L3 vertebral segments. A bilateral dorsal approach of the thoracolumbar spine was made. Image-patient fusion was achieved through a novel subject tracker and the Brainsight neuronavigation program. Bicortical vertebral body implants were placed under real-time guidance. Stereotactic guided trajectories were stored and compared with post-operative CT implant placement. Vertebral bodies were disarticulated and removed for qualitative analysis of canal violation and bone purchase.

Quantitative comparison of calculated and actual trajectories included angle, depth and entry point of the implant.

Results: A total of 59 trajectories were drilled with no vertebral canal violations (partial or full). Fifty-three of 59 (90%) trajectories involved the vertebral midline or contralateral vertebral body. Mean difference between stereotactic guided trajectory and postoperative CT trajectory angle was 3.8 ± 2.2 degrees. Mean difference between stereotactic guided trajectory and postoperative CT trajectory depth was 1.5 ± 1.1 mm. There was no significant difference between stereotactic guided and postoperative CT trajectory angle and depth measurements.

Discussion/Conclusion: CT guided stereotaxy provides an accurate means of implant placement into the canine thoracolumbar spine. The technique minimizes risk to vital structures and spinal cord trauma and affords excellent bone purchase.

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

61 BIOMECHANICAL EVALUATION OF DIFFERENT PLATING TECHNIQUES FOR FELINE ILIAL FRACTURE GAP STABILIZATION: AN EX VIVO CADAVERIC STUDY

Philipp A. Schmierer¹; Lucas A. Smolders²; Ivan Zderic³; Boyko Gueorguiev³; Antonio Pozzi²; Sebastian C. Knell¹

¹Clinic for Small Animal Surgery, Vetsuisse Faculty University of Zurich, Zurich, Switzerland, ²Vetsuisse Faculty University of Zurich, Zurich, Switzerland, ³AO Research Institute Davos, Davos, Switzerland

Introduction: Fractures of the ilium are a common problem in cats. Currently, it is unclear how different types of plating of ilial fractures compare biomechanically. The purpose of this study was to biomechanically compare different plating techniques for feline ilial fractures.

Materials and Methods: Forty paired feline hemipelvises were used. A transverse 3 mm gap was created in each ileum. Each hemipelvis was fixed with one of the following methods (n=10 per group): 1) a dorsal plate using non-locking screws; 2) a lateral plate using non-locking screws; 3) a lateral plate using locking screws; 4) a lateral and dorsal LCP using non-locking screws. Each specimen was subjected to incremental, sinusoidal cyclic compression loading until failure, defined as 10 mm displacement. Initial stiffness and number of cycles needed to reach 1, 2, 5, and 10mm axial displacement were statistically analyzed.

Results: Initial stiffness and number of cycles to failure were significantly higher in the group with double non-locking plates compared with all other groups ($p < 0.05$), except for the group fixed with a lateral locking plate, which was not different from the double plate group for 5mm and 10mm displacement. Most non-locking groups showed screw loosening as a mode of failure (94% of all screws).

Discussion/Conclusion: Double plating results in a significantly higher stiffness and resistance to failure than the other fixation groups. Using a locking implant does not influence initial stiffness, but increases resistance to fatigue compared to non-locking implants.

Acknowledgement: This study was funded by the AOVET-ARI grant.

62 INVESTIGATION AND GRADING OF INTERVERTEBRAL DISC DEGENERATION IN THE CAT BY WAY OF MAGNETIC RESONANCE IMAGING AND MACROSCOPIC EVALUATION

Thomas Bitterli; Ladina Ettinger; Antonio Pozzi; Frank Steffen; Lucas A. Smolders

Vetsuisse Faculty University of Zurich, Zurich, Switzerland

Introduction: Intervertebral disc degeneration (IVDD) and consequent disease are well-recognized problems in humans and dogs. Standardized grading schemes using magnetic resonance imaging (Pfirrmann) and macroscopic evaluation (Thompson), allowing standardized assessment of IVDD



and aiding in clinical decision-making, have been developed for these species. In contrast, IVDD in cats has remained largely unexplored, and currently its clinical significance may be underestimated. Standardized grading schemes for IVDD in cats have not been reported. Therefore, the aim of this study was to investigate the characteristics of IVDD in cats using MRI and macroscopic evaluation, and to evaluate the applicability of Pfirrmann and Thompson grading in cats.

Materials and Methods: Forty-six thoracic IVDs, collected from 21 cats, were scored twice by two observers using Pfirrmann and Thompson grading. Degenerative changes of the individual disc components were recorded, and inter- and intra-observer agreement was calculated using a Cohen's weighted κ analysis.

Results: IVDD in cats involved similar degenerative changes as observed in humans/dogs. However, some characteristic differences were also observed. Inter-observer and intra-observer agreement for Pfirrmann grading were 0.71 and 0.72, respectively, indicating substantial agreement. Inter-observer and intra-observer agreement for Thompson grading were 0.8 and 0.9, indicating substantial and almost perfect agreement, respectively.

Discussion/Conclusion: IVDD in cats involves similar degenerative changes as observed in humans and dogs. Pfirrmann and Thompson grading can be successfully applied to IVDD in cats. These grading schemes may help to elucidate the pathogenesis and clinical importance of IVDD in cats.

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63 COMPARISON OF THREE TOGGLE SUTURE CONSTRUCTS (TSCS) FOR CRANIODORSAL HIP LUXATION IN DOGS: AN EX-VIVO CYCLICAL BIOMECHANICAL STUDY

Steve Zambrano¹; Marcelo W. Teixeira¹; Jodie L Lamb¹; Kevin J Cummings¹; Sharon C. Kerwin¹; Michael P. Kowaleski²; Michael R. Moreno¹; W. Brian Saunders¹

¹Texas A&M University, College Station, TX, ²Tufts Cummings School of Veterinary Medicine, North Grafton, MA

Introduction: The objective of this study was to compare the function of three commonly utilized toggle-suture constructs (TSCs) in a cyclical, ex-vivo setting.

Materials and Methods: Twenty-four canine hips from 50–80 kg cadavers were randomly assigned to one of three treatment groups: polyethylene (Ethibond) with hand-turned Knowles toggle (EB), monofilament nylon with toggle-rod (MN), and Tightrope™ (TR). A canine hip ambulation simulator was fabricated to perform dual-axis cyclical testing. A three-phase ramp-up cyclical loading protocol was developed. Simulated loads ranged from 0–65% body weight. Loading was performed in runs of 1000 flexion/extension (FE) cycles and 100 abduction/adduction (A/A) cycles. A complete testing protocol consisted of 38,006 F/E cycles and 3,806 A/A cycles.

Results: Mean \pm SD cumulative F/E and A/A cycle counts for TSCs were as follows: EB (32,901 \pm 9,417), MN (29,095 \pm 11,779), and TR (41,296 \pm 1,461). Both EB ($P=0.0259$) and MN ($P=0.0115$) underwent significantly fewer cumulative cycles at ultimate failure when compared to TR. Mean \pm SD femoral head displacement was: EB (13.95 \pm 6.38 mm), MN (7.24 \pm 4.78 mm), and TR (12.10 \pm 1.62 mm). While MN TSCs tended to experience the fewest cumulative gait cycles to failure, they experienced lower displacement values as compared to EB ($P=0.0321$) or TR ($P=0.0166$).

Discussion/Conclusion: In this study, TR consistently outperformed both EB and MN systems. EB TSCs performed on an intermediate level, whereas MN performance was markedly unpredictable, with failure occurring most often due to suture breakage.

Acknowledgement: Funded by the Ginn Fund, Texas A&M University. Tightrope™ implants were provided by ArthrexVet (Naples, FL).

64 FLEXIBLE EGRESS CANNULA USE FOR CANINE STIFLE ARTHROSCOPY

Jennifer Warnock; Miranda de la Vega; Gerd Bobe
Oregon State University, Corvallis, OR

Introduction: The objective of this study was to compare the volume of retained egress fluids and incidence of iatrogenic cartilage injury in the stifle joint with use of a 2.7mm diameter flexible fenestrated egress cannula versus use of a rigid steel cannula.

Materials and Methods: Nine donated canine cadavers humanely euthanatized for reasons unrelated to the study received bilateral stifle arthroscopy with 10% iopamidol enhanced ingress fluids, using either a steel egress cannula, or a ClearVu 2.7mm cannula (Cannuflo Inc., San Jose, CA). Postoperative egress fluid retention was determined via computed tomography. Fourteen donated humanely euthanized cadavers were used to assess iatrogenic cartilage injury via the India ink assay. Data were analyzed with a paired t-test assuming poisson distribution and significance was set at $P\leq 0.05$.

Results: The mean volume of retained fluids was 74mL for the steel cannula and 28.5mL for the ClearVu ($P=0.04$, Figs 4,5). Steel cannulas had an average of 1.2 cartilage scratches (range 0–2) per joint, with an area of 3.2mm (range 0–10mm) versus ClearVu ($P=0.006$). ClearVu stifles had no iatrogenic cartilage scratches, but 60% had synovial reflection tears of the medial gutter.

Discussion/Conclusion: The ClearVu cannula's flexibility, softness, and fenestrations resulted in less iatrogenic cartilage injury and less fluid retention postoperatively. However the multiple fenestrations caught on femoral synovial reflection, creating tears in some cases. Further study in a clinical trial is warranted.

Acknowledgement: This study was funded by Oregon State University and there are no conflicts of interest to report.

65 CLINICAL EVALUATION OF A NOVEL EXTRACAPSULAR ARTICULATING IMPLANT FOR THE SURGICAL TREATMENT OF CANINE STIFLE INSTABILITY AND LAMENESS CAUSED BY CRANIAL CRUCIATE LIGAMENT DISEASE

Neil Andrew Embleton; Veronica Jean Barkowski
Helivet Mobile Surgical Services, Embark Enterprises Inc., Sundre, AB, Canada

Introduction: Deficiency of the cranial cruciate ligament (CrCL) results in translational and rotational stifle instability and subsequent lameness. There is currently no procedure that is considered the optimal surgical treatment for the CrCL deficient canine stifle. Our objective was to evaluate the clinical efficacy of a novel extracapsular articulating implant (EAI).

Materials and Methods: 60 client owned dogs (66 stifles) with CrCL disease (mean 38.0 \pm 13.7 kg) that met the initial inclusion criteria were treated with the EAI and were monitored for complications. 34 stifles met inclusion criteria for analysis of outcome measures which were performed preoperatively and up to 16.0 months postoperatively and included lameness score, and bilateral assessment of stifle stability, range of motion (ROM), and thigh circumference (TC).

Results: Seven dogs were lost to follow up prior to 6 months. Major complications occurred in 15.3% of stifles (9/59) and minor complications in 10.2%. Complications were significantly lower in the second half of the study and in dogs < 40 kg ($p=0.03$). There was significant improvement in lameness scores and ROM ($p<0.0001$) compared to preoperative values in the EAI treated limbs. Lameness resolved in 85.3% (29/34) of treated stifles and postoperative ROM was within the normal range. Thigh circumference returned to preoperative mean in the operated limb, but decreased significantly in the control limb ($p=0.0071$).

Discussion/Conclusion: The EAI effectively stabilized CrCL deficient stifles with subsequent improvement in lameness and ROM in dogs < 40 kg.

Acknowledgement: The authors are the inventors of the implant.



66 ALTERNATIVE EGRESS TECHNIQUE FOR REDUCTION OF IATROGENIC CARTILAGE INJURY IN CANINE STIFLE ARTHROSCOPY

Miranda de la Vega; Jennifer Warnock; Gerd Bobe
Oregon State University, Corvallis, OR

Introduction: The purpose of our study was to establish a technique for egress cannula placement, parallel to the femur in the dog, with the intent of reducing or eliminating iatrogenic cartilage injury during fluid egress portal placement.

Materials and Methods: Ten donated canine cadavers were used to compare the transarticular and parallel egress cannula placement. Following dissection, iatrogenic cartilage lesions were visualized and quantified using India ink. The parallel technique was then applied in 31 dogs receiving unilateral stifle arthroscopy for naturally occurring cranial cruciate ligament disease and placement was characterized as: easy, difficult, or technique abandoned. Data were analyzed with a paired t-test assuming poisson distribution, significance set at $P \leq 0.05$.

Results: Number and area of cartilage lesions were greater in stifles receiving transarticular egress portal placement versus parallel portal placement. For clinical cases, parallel egress portal placement was rated easy in 24/31 joints, difficult in 4/31 cases, and in 3/31 cases egress placement was abandoned. In contrast to the cadavers, no cartilage or synovial injury was visualized in the joints.

Discussion/Conclusion: Both the transarticular and parallel egress placement techniques inflict some damage to the joint. Parallel placement puts the synovial reflection at risk while the transarticular technique causes more lesions to articular cartilage. As synovium heals rapidly and cartilage does not heal, the parallel technique is preferential to use for canine stifle arthroscopy.

Acknowledgement: Funded by the Morris Animal Foundation and the Oregon State College of Veterinary Medicine Grant. There were no conflicts of interest to report.

POSTER ABSTRACTS

67 A2M AND TARGETED DESIGNED VARIANTS INHIBITS CATABOLIC PROTEASES IN AN ACLT RAT MODEL BY FLUORESCENCE MOLECULAR TOMOGRAPHY IN VIVO

Lei Wei¹; Lewis Hanna²; Shawn Browning²

¹Department of Orthopaedics, Brown University, Providence, RI, ²Cytomics Corporation, West Palm Beach, FL

Introduction: This study evaluates whether molecular variants of A2M have a similar or potentially enhanced function as wt-A2M to inhibit catabolic enzymes by dynamically quantifying catabolic proteases changes during OA development in rat ACLT-OA model.

Materials and Methods: Wistar rats underwent ACLT and sham surgery on the left knee, the right knee served as an internal control. 77 rats were randomly divided into 7 groups and treated with different doses of A2M and its variants. The animals were injected with A2M at 24 hours and day 14 after surgery by intra-articular knee injection. A mix of fluorescent imaging probes were injected intra-articularly after A2M injection at 24 hours, week 2, week 4, and week 6 after surgery on both knees. FMT was used to monitor the levels of inflammation in vivo 24h after injection. The picomolar concentrations of probes in the knee joint were determined using region of interest analysis. Data is reported as means \pm SE. $n = 11$ /per group.

Results: A2M variants potently inhibited cartilage catabolism in the BCE model by up to 200% of wt-A2M. The levels of ProSense and MMPsense increased in all groups after ACLT or sham surgery. Supplemental A2M reduced the level of ProSense and MMPsense compared with the saline-treated group and the sham group.

Discussion/Conclusion: In this study, we found that A2M and its variants are able to specifically inhibit proteases either in ex vivo cartilage or in vivo ACLT-T models immediately after injury compared to saline treated animals.

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

68 PHARMACOKINETIC ANALYSIS OF AN ORAL MULTICOMPONENT JOINT NUTRACEUTICAL (PHYCOX®) IN DOGS – A PILOT STUDY

Stephanie E Martinez¹; Ryan Lillico¹; Ted M Lakowski¹; Steven A. Martinez²; Neal M. Davies¹

¹College of Pharmacy, University of Manitoba, Winnipeg, MB, Canada,

²Comparative Orthopedic Research Laboratory, Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Washington State University, Pullman, WA

Introduction: Phycos® is a multicomponent joint support supplement used for the clinical management of osteoarthritis in dogs. Many of the active constituents are recognized anti-inflammatory and antioxidant agents. Due to a lack of pharmacokinetic (PK) data available in the literature for the product, a pilot PK study of select constituents in Phycos® was undertaken in dogs.

Materials and Methods: Two novel methods of analyses were developed and validated for quantification of glucose and select polyphenols in dog serum using LC-MS/MS. After a single PO administration of Phycos®, a series of blood samples from 4 naive healthy female beagle dogs were collected for 24 h post-dose and analyzed for concentrations of glucosamine HCl, \pm hesperetin, trans-resveratrol and \pm naringenin. A non-compartmental PK analysis was carried out using Phoenix® WinNonlin® software.

Results: Glucosamine was detected for up to 8 h post-dose with a T_{max} of 2 h and a C_{max} of $9.69 \pm 1.14 \mu\text{g/mL}$. The half-life of glucosamine was determined to be approximately 35 min. None of the polyphenols were found at detectable concentrations in the samples as aglycones or glucuronide metabolites.

Discussion/Conclusion: Co-administration of glucosamine with other compounds in Phycos® may enhance the absorption of glucosamine. Future multiple-dose PK studies are needed to better characterize the dispositions of Phycos® constituents after steady state dosing and the PK of additional bioactives in Phycos® should also be undertaken given the complexity of this multicomponent nutraceutical.

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69 RANDOMIZED, DOUBLE-BLINDED, CONTROLLED CLINICAL TRIAL EVALUATING THE EFFICACY OF A DIET SUPPLEMENTED WITH CURCUMINOIDS EXTRACT, HYDROLYSED COLLAGEN AND GREEN TEA EXTRACT IN DOGS WITH OSTEOARTHRITIS

N. P. Barthélémy¹; Fanny Comblain¹; Michael Lefebvre¹; Isabelle Lespoune²; Alexandre Feugier²; Yves Henrotin¹; M. Balligand¹

¹University of Liège, Liège, Belgium, ²Royal Canin Research Center, Aimargues, France

Introduction: To evaluate the effects of a food supplemented with curcuminoids extract, hydrolysed collagen and green tea extract in dogs with osteoarthritis.

Materials and Methods: Randomized, double-blinded, controlled clinical trial. Animals were 42 client-owned dogs with osteoarthritis. Dogs were randomly assigned to receive a typical commercial food ($n=21$) or a diet ($n=21$) containing curcuminoids extract, hydrolysed collagen and green tea extract. At day 0 (T0) and at 3 months (T3), investigators conducted orthopedic



evaluations and force-plate analysis of the most severely affected limb of each dog and owners assessed the chronic pain of their dog via a Canine Brief Pain Inventory. Generalized linear model or mixed model were used for statistical analysis.

Results: In the diet group there was an effect of time for pain at manipulation ($p=0.04$) and this effect was different from the control group ($p=0.04$). The delta T3-T0 for pain severity (PS) was different between diet and control groups ($p=0.01$). There was no significant difference for peak vertical force (PVF) between control and diet groups ($p=0.15$). For younger dogs (60th percentile, 5.8 ± 0.4 years, $n=11+15$), delta T3-T0 for PVF was different between diet and control groups ($p=0.05$). The effect of time was different between diet and control groups for PS ($p=0.01$).

Discussion/Conclusion: Dogs receiving supplemented diet were less painful after 3 months. The difference of evolution between groups suggests that a longer treatment may be necessary to reach a stronger effect on other evaluation parameters. Improvement of lameness may be better or quicker in younger dogs.

Acknowledgement: Royal Canin SAS

70 EFFICACY OF AN ORAL HERBAL FORMULATION IN DOGS ON THE GROUND REACTION FORCES IN A SODIUM URATE-INDUCED SYNOVITIS MODEL

Ruth Scott; Richard B. Evans; Michael G. Conzemius
University of Minnesota, St. Paul, MN

Introduction: Studies infer the possibility herbal formulations may be a valuable alternative in managing the clinical signs of osteoarthritis 1. The purpose of this study was to examine the efficacy of an oral herbal formulation on ground reaction forces in a canine sodium urate-induced synovitis model as compared to placebo and an NSAID.

Materials and Methods: Eight healthy purpose-bred mixed-breed dogs were enrolled. An oral herbal formulation was administered once daily for three days preceding and 1-hour prior to intra-articular stifle injection of sodium urate suspension. Force platform gait analysis and lameness scores were completed before synovitis induction and hours 2.5, 5, 7.5, 10 and 24 after induction.

Results: There was no significant difference in peak vertical force, vertical impulse, or average rising slope in dogs treated with oral herbal formulation and placebo-treated dogs. However, in dogs treated with carprofen, ground reaction forces were significantly increased at 2.5 and 5.0 hours after stifle injection of urate crystal synovitis.

Discussion/Conclusion: Results of the present study revealed no difference in the ground reaction forces in dogs receiving the herbal formulation as compared to the placebo treated dogs. While NSAIDs are consistently effective in this model a less punitive model may be necessary to evaluate the benefits of the herbal supplements used in this study.

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

71 TENOGENIC DIFFERENTIATION OF CANINE ADIPOSE DERIVED STEM CELLS EXPOSED TO CANINE TENDON DERIVED CELLS IN CO-CULTURE ENVIRONMENTS

Isaac Cortes III¹; Caleb C. Hudson¹; Brian S. Beale¹; Rudy F. Martinez²; Michael Coleman²

¹Gulf Coast Veterinary Specialists, Houston, TX, ²InGeneron Inc., Houston, TX

Introduction: Inducing stem cell differentiation is a prominent area of research. The purpose of this study was to evaluate the effect of various co-culture conditions on gene expression of adipose derived stem cells (ADSC) compared to independently cultured ADSC and tendon derived cells (TDC). We hypothesized that ADSC co-cultured with TDC or TDC growth factors would demonstrate increased expression of Tenascin-C.

Materials and Methods: Adipose and tendon were collected from a fresh canine cadaver and processed separately for culture. 6-well co-culture plates with test environments were incubated 1 week prior to harvest. RNA isolation was performed using TRIzol/precipitation protocol. Primers were engineered for canine tenascin-C (TNC) and cDNA synthesis was performed. PCR was used to evaluate gene expression. qPCR data quantified gene expression using crossing threshold (C_t) value, normalized to β -actin C_t , and relative expression of the target gene was calculated using $2^{-\Delta\Delta C_t}$.

Results: $2^{-\Delta\Delta C_t}$ values represent fold changes of Tenascin-C expression relative to control β -actin. ADSC/TDC co-culture in 1:1/2 ratio produced the largest fold increase (3.76), followed by ADSC/growth factors in 1:1 ratio (3.25), ADSC/TDC 1:1 (1.46), ADSC/growth factors 1:2 (1.00), ADSC 1st passage (0.24), and adipose SVF (0).

Discussion/Conclusion: This data supports the hypothesis that culturing ADSC in the presence of either TDC or TDC conditioned media will induce expression of Tenascin-C and suggests a biologic basis for the clinical use of ADSC to aid tendon healing.

Acknowledgement: Equipment and facilities for this project were provided by InGeneron Inc. Houston, TX.

72 ONCOGENE EXPRESSION IN CULTURED SYNOVIOCYTES TOWARDS SAFE TISSUE ENGINEERING

Jennifer Warnock; Maureen Larson; Virginia Cook; Patrick Chappell; Shay Bracha
Oregon State University, Corvallis, OR

Introduction: The objective of this study is to identify similarities in oncogene expression in synovioocyte tissue engineered constructs as compared to a positive control canine synovial cell sarcoma, towards determining the safety of tissue engineering neotissues.

Materials and Methods: Synovial fragments were arthroscopically harvested and cultured as cell pellets exposed to either fetal bovine serum or growth factors. Real Time RT-PCR analysed gene expression of MUC-1, IGF-2, and BCL-2. Pellet Viability was measured with ethidium homodimer/ calcein AM live- dead assay and laser microscopy. Western Blot was used to measure pAKT.

Results: Cell pellets contained a mixture of live and dead cells. Relative oncogene expression in the patient's cell pellets were low; IGF-2 was down regulated by growth factor treatment ($P=0.008$). With exposure to growth factors, MUC-1 expression increased by 50% as compared to FBS treated cell pellets ($P=0.06$). Expression of bcl-2 was not detectably different between FBS and growth factor treated cell pellets; ($P=0.7$). When compared to average gene expression of the growth factor or FBS treated cell pellets, the positive control canine synovial cell sarcoma showed 109%, 990%, and 172% increase in relative expression of bcl-2, IGF-2, and MUC-1 expression, respectively. Phosphorylated AKT expression did not differ between groups.

Discussion/Conclusion: Based on the low expression of the few oncogenes tested here, in combination with the low cell viability of the cultured pellets, the oncogenic potential of FBS and growth factor treated cell pellets is likely low.

Acknowledgement: This study was funded by Oregon State University and there are no conflicts of interest to report.

73 EFFECTS OF CALCIUM CHLORIDE AND THROMBIN ACTIVATION ON CANINE PLATELET ACTIVATION, AD GROWTH FACTORS AND CYTOKINE CONCENTRATIONS

Samuel Patrick Franklin; Alena Strelchik; Kate Elizabeth Birdwhistell; Benjamin M Brainard
University of Georgia, Athens, GA

Introduction: Platelet-rich plasma (PRP) is used to deliver high concentrations of anabolic growth factors. Although platelet concentration affects



growth factor concentration in the plasma the activation state of platelets may have a greater effect on growth factor content. The purpose of this study was to assess the effects of activation protocols on canine platelet activation and growth factor and cytokine concentrations.

Materials and Methods: PRP was made from twelve dogs and aliquots from each dog were divided into three groups activated with calcium chloride (CaCl), human gamma thrombin (HGT), and an unactivated group. Validated ELISAs were used to quantify TGF- β 1, PDGF-BB, VEGF, and TNF- α concentrations. Likewise, P-selectin (CD62P) and platelet bound fibrinogen (CAP1 antibody) were quantified using flow cytometry. P-selectin and CAP1 expression, and growth factor concentrations were compared among the different activation protocols using repeated measures ANOVAs.

Results: PRP activated with HGT had significantly greater PDGF-BB, P-selectin, and CAP1 expression than all other groups and also had a higher concentration of TGF- β 1 than the CaCl activated group. PRP activated with CaCl had greater P-selectin expression than the unactivated group but without increases in growth factor concentrations.

Discussion/Conclusion: Activation with HGT significantly increased platelet activation based upon cell surface marker expression and TGF- β and PDGF-BB concentrations. Conversely, CaCl did not provide as robust an activation of canine platelets. In addition, these data show that platelets in PRP prepared using this device are not activated during PRP preparation.

Acknowledgement: Supported by a Faculty Research Grant, Merial, and equipment donation by Arthrex. Thanks to M. Boudreaux for CAP1 antibody.

74 FOCUSED ASSESSMENT OF ELISAS FOR QUANTIFYING TGF- β 1, PDGF-BB, TNF- α , IL-1 β , AND VEGF IN CANINE PLATELET-RICH PLASMA SAMPLES

Kate Elizabeth Birdwhistell; Robert William Basinger; Brian Richard Hayes; Natalie A Norton; David John Hurley; Samuel Patrick Franklin
University of Georgia, Athens, GA

Introduction: Validations of enzyme-linked immunosorbent assays (ELISA) for quantifying several relevant growth factors and cytokines in canine PRPs prepared with citrate-based anti-coagulants are limited or not available. The purpose of this study was to perform a focused validation of five commercially available ELISAs for use with canine plasma prepared with acid citrate dextrose-A (ACD-A).

Materials and Methods: Whole blood was collected from 8 beagles and plasma prepared using ACD-A. Samples were pooled and ELISAs were used to quantify TGF- β 1, PDGF-BB, TNF- α , IL-1 β , and VEGF in the pooled plasma sample and in aliquots that were spiked with the protein of interest. Three assays were performed with each ELISA to quantify the efficiency of spike-recovery and intra assay and inter-assay precisions.

Results: The TGF- β 1, VEGF, and PDGF-BB assays provided efficiencies within 21.2% of the expected and also had intra and inter-assay coefficients of variation (CV) less than 20%. The TNF- α assay had CVs less than 10% but the efficiency was only 65%. The IL-1 β assay had an efficiency of 144% and CV of 144%.

Discussion/Conclusion: Industry guidelines suggest that efficiency should be 80–120% of expected and that intra-assay and inter-assay CVs should be less than 20%. Based upon these data the TGF- β 1, VEGF, and PDGF-BB assays meet or are close to meeting these standards. The TNF- α did not provide adequate efficiency but had a low CV, suggesting the relative amount of TNF- α could be compared among different PRP samples. The IL-1 β assay needs further optimization as both the precision and efficiency were suboptimal.

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

75 CASE REPORT – SURGICAL MANAGEMENT OF DORSAL SCAPULAR LUXATION IN THREE DOGS

Selena Tinga; Stephen Christopher Jones; Erin L. Porter; Daniel D. Lewis
University of Florida, Gainesville, FL

Introduction: This report describes 3 dogs with dorsal luxation of the scapula, treated using a variation on described surgical techniques.

Materials and Methods: Unilateral forelimb lameness was characterized by dorsal protrusion of the scapula during weight-bearing. One dog had a scapular fracture; other concurrent injuries were minor. Rhomboideus and trapezius muscles were intact and were transected. Supraspinatus and infraspinatus muscles were elevated along the scapular spine. The majority of the serratus ventralis muscle was torn. Monofilament nylon leader material was passed around the base of a rib and through bone tunnels at the base of the scapular spine. Muscles were reapposed using a locking loop pattern, through bone tunnels in the dorsal scapula where necessary. All sutures were pre-placed then tied sequentially, then the leader material was tied.

Results: All 3 dogs had good functional outcomes at 16 weeks to 6 months post-operatively. Shoulder flexion and extension angles, and brachial circumference, remained mildly decreased. The dog with the scapular fracture had intermittent exercise related lameness, but was non-painful during orthopedic examination.

Discussion/Conclusion: Damage to the serratus ventralis was present in all 3 dogs without disruption of the rhomboideus or trapezius muscles, suggesting that isolated injury to the serratus ventralis is sufficient to allow dorsal scapular displacement. We used two monofilament nylon leader material prostheses to tether the mid-body of the scapula to a rib. This technique provided sufficient support to allow the serratus ventralis to heal without complications in all 3 dogs.

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

76 PULLOUT STRENGTH OF MONOCORTICAL AND BICORTICAL SCREWS IN METAPHYSEAL AND DIAPHYSEAL REGIONS OF THE CANINE HUMERUS

Denty Paul Vaughn Jr.¹; Jason A. Syrcle¹; John E. Ball¹; Steven H. Elder¹; Jennifer M Gambino¹; Russell L. Griffin²; Ronald M. McLaughlin¹

¹Mississippi State University, Mississippi State, MS, ²University of Alabama Birmingham, Birmingham, AL

Introduction: Monocortical screws are commonly employed in locking plate fixation, but specific recommendations for placement are lacking. Several studies report placement of monocortical screws in metaphyseal bone may be contraindicated. Our objectives were to evaluate axial pullout strength of two different lengths of monocortical screws placed in various regions of the canine humerus compared to bicortical screws and to develop methodology for deriving cortical thickness and bone density measurements using Quantitative CT analysis (QCT).

Materials and Methods: Thirty-six cadaveric humeri were collected and QCT was performed to determine average cortical thickness and bone density for six regions of interest (ROI). A 3.5 mm screw was implanted in each ROI. Screw length groups included bicortical, short monocortical, or screws that measured 50% of the transcortical distance in each ROI. Axial pullout testing was performed.

Results: Bicortical screws were stronger than monocortical screws in all ROI except the epicondylar ridge. 50% transcortical screws were stronger than monocortical screws in the condyle. A linear relationship between screw length and pullout strength was observed.

Discussion/Conclusion: Cortical thickness and bone density measurements were obtained from multiple regions of the canine humerus using methodology novel to the veterinary field. Use of short monocortical screws may contribute to failure of locking plate fixation of distal humeral fractures, especially when placed in metaphyseal bone. When bicortical screw placement



is not possible, maximizing length of monocortical screws may optimize fixation stability for difficult fractures such as those of the distal humerus.

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77 TRAUMATIC FRAGMENTED MEDIAL CORONOID PROCESS (JUMP DOWN SYNDROME) IN 24 DOGS

Desmond K S Tan¹; Sherman O. Canapp Jr.¹; David L Dycus¹; Christopher S. Leasure¹; Erica O'Donnell²

¹Veterinary Orthopedic & Sports Medicine Group, Annapolis Junction, MD,

²Fitzpatrick Referrals, Surrey, United Kingdom

Introduction: The etiopathogenesis for the development of a fragmented medial coronoid process (FCP) due to elbow dysplasia is multifactorial. FCP has been theorized to lie within the spectrum of elbow dysplasia. We hypothesized that development of FCP may occur in non-dysplastic elbows. This paper aims to describe a traumatic cause of fragmentation of the medial coronoid process (Jump Down Syndrome) in dogs and present it as a clinically distinct disease unrelated to congenital elbow dysplasia.

Materials and Methods: Clinical records of dogs with unilateral lameness attributable to medial coronoid process disease were reviewed retrospectively. Clinical interpretation included findings on physical examination, orthopedic examination and subjective gait analysis. Radiographs of affected and contralateral elbows were obtained and reviewed for pathology. Arthroscopy of the elbow joints was performed by one of three surgeons and findings were compared to pre-operative diagnostics. Post-operative follow-up was continued for 16 weeks.

Results: Twenty-four dogs were included in this study. All dogs in this study were free of radiographic evidence of medial coronoid pathology; furthermore, there was no arthroscopic evidence of humeral pathology or joint incongruence. Dogs generally had an excellent short-term outcome following arthroscopic treatment of the traumatic fragmented medial coronoid process.

Discussion/Conclusion: Traumatic fragmentation of the medial coronoid process or Jump Down Syndrome should be considered a clinical disease distinct from dysplasia-related fragmentation and should be considered as a differential diagnosis in dogs presenting for acute unilateral elbow discomfort or lameness, especially after concussive activities involving the forelimb.

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

78 CASE REPORT - ATROPHIC DISTAL RADIAL NONUNION TREATED WITH RHBMP-2

Randy J. Boudrieau

Clinical Sciences, Tufts University Cummings School of Veterinary Medicine, North Grafton, MA

A 2.1 yr old, 1.8 kg, MC Pomeranian was presented for treatment of an atrophic nonunion of the right distal radius/ulna ~9 mo after sustaining a left distal radius/ulna fracture that was repaired. The right radius/ulna fracture was operated 4 times over 8+ mo without success. The dog was unable to ambulate on either front leg. Radiographs revealed an angular deformity of the left distal radius with carpal valgus and absent olecranon. The right distal radius had an ~1.5-cm gap and severe osteopenia of the entire distal limb. A left elbow arthrodesis was performed (12-hole 2.0 mm LC-DCP with 0.6 mg rhBMP-2/CRM graft). The right distal radius was bridged after gap debridement (4-ring mini [35 mm] transarticular CESF/1.0 mm olive wires with 0.4 mg rhBMP-2/CRM graft). At 4 mo PO the elbow arthrodesis had healed; however, the carpal valgus had worsened. The right radius had healed, but with a tenuous bone bridge proximally. Additional 0.2 mg rhBMP-2 graft was applied percutaneously using a calcium phosphate bone cement carrier. At 7 mo PO the left forelimb had increased carpal valgus/plantigrade paw placement. The right radius demonstrated increased bone deposition and further

remodeling, and the CESF was removed. A left carpal arthrodesis was planned; however, the owners were happy with the dog's function (full weight bearing despite the valgus/plantigrade stance). The dog died recently (12 yr old, Feb., 2015) due to progressive problems associated with tracheal collapse, but the owners reported he had continued to do well and had no issues ambulating.

Acknowledgement: Pfizer and Zoetis.

79 APPENDICULAR FRACTURE REPAIR IN CATS USING THE FIXIN® LOCKING PLATE SYSTEM

Francesca C Ferrero¹; Alessandro Boero Baroncelli¹; Bruno Peirone¹; Lisa A. Piras¹; Ullrich Reif²; Caleb C. Hudson³

¹University of Turin, Grugliasco, Italy, ²Tierklinik Dr. Reif, Böbingen, Germany, ³Gulf Coast Veterinary Specialists, Houston, TX

Introduction: The purpose of this study was to retrospectively evaluate the clinical application of the Fixin® 1.9–2.5 mm system for treatment of appendicular fractures in cats.

Materials and Methods: Feline patients with appendicular fractures from 2008–2015 treated with the Fixin® 1.9–2.5 mm system for which complete clinical and radiographic follow-up were available were included in the study. Follow up radiographs were reviewed on each patient to determine healing time.

Results: Fifty-four cats were included in this study. Five humeral, 5 radius-ulna, 26 femoral, 18 tibial fractures were included. The surgical approach was ORIF in 43 cases and MIPO in 11 cases. Complete healing was recorded in 50 patients and mean healing time was 51.4 days. Minor complications were observed in 3 (6%) cases. Major complications occurred in 4 (7%) cases, consisting of 2 non-unions and 2 cases of plate bending.

Discussion/Conclusion: The Fixin® 1.9–2.5 mm locking plate system was subjectively well designed for the stabilization of appendicular fractures in cats. No plates broke in this study but plate bending occurred in 2 patients. Observed complication rate and type were comparable to what is reported for other locking systems and final clinical outcome was good in all cats.

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

80 TREATMENT OF DISTAL RADIUS AND ULNA FRACTURES IN TOY BREED DOGS WITH MINI LOCKING PLATES: IMPLANT SELECTION AND PLATE REMOVAL

Alessandro Boero Baroncelli; Lisa A. Piras; Carla Ricevuto; Bruno Peirone
University of Turin, Grugliasco, Italy

Introduction: The purpose of this retrospective study was to provide guidelines for treatment of radius-ulna fractures in toy breed dogs with the LCP.

Materials and Methods: The medical records of toy breed dogs (≤6kg) affected by fractures of radius and ulna stabilized with LCP were reviewed. The Working Length (WL), Plate Screw Density (PSD) and Plate Bone Ratio (PBR) were calculated. After fracture healing, if stress protection was present, staged destabilization or implant removal were performed and WL and PSD recalculated.

Results: Twenty-two fractures were included in the study. The 1.5 mm LCP was used in dogs less than 1.7 Kg (4 cases), the 2.0 mm LCP in dogs between 1.7 and 5 Kg (12 cases) and the 2.4 mm LCP for dogs between 5 and 6 Kg (6 cases). In 21 out of 22 cases the treatment was successful and no ulna resorption was noted. One plate breakage occurred after 30 days. Staged destabilization was performed in 9 cases. Plate removal was performed in 10 cases and in 2 cases refracture occurred.

Discussion/Conclusion: Internal fixation with the Synthes LCP is an effective method for treatment of distal radius and ulna fractures in toy breed dogs. We suggest the use of 1.5 mm LCP only in dogs weighting less than 1.7



kg. When stress protection is present, we recommend performing staged desabilization by reducing the PSD of 50% and increasing the WL of 60%.

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

81 INFLUENCE OF LOCKING SCREW NUMBER ON MECHANICAL PROPERTIES OF FOUR DIFFERENT ANGULAR STABLE SYSTEMS UNDER STATIC AXIAL LOAD

Alessandro Boero Baroncelli¹; Angelo Abitante²; Bruno Peirone¹; Cristina Bignardi²; Ullrich Reif³

¹University of Turin, Grugliasco, Italy, ²Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Torino, Italy, ³Tierklinik Dr. Reif, Böblingen, Germany

Introduction: The purpose of this study was to evaluate mechanical properties of two constructs vs. three screw constructs in four different 3.5 mm locking plate systems on a fracture gap model under static axial load.

Materials and Methods: Four different locking systems were tested in our study: 3.5 mm PAX System (Securos, Neuhausen, DE); 3.5 mm LCP (Synthes, Solothurn, CH); 3.5 mm Fixin Internal Fixator (InTrauma, Rivoli, IT); 3.5 mm Stacked Locking Hole Plates (Veterinary Instrumentation, Sheffield, UK). Plate-bone models (n. 24) were tested; 6 of each plate type, respectively 3 two screws constructs and 3 three screws constructs. Static stiffness was determined as defined in ASTM-F38217. ANOVA test was used to assess the difference between two screws and three screws constructs.

Results: The insertion of the third screw did not influence axial stiffness for Veterinary Instrumentation (p: 0.79), Intrauma (p: 0.70) and Synthes (p: 0.78). A significant difference between the two and three screws constructs was found in the Securos system (p: 0.03).

Discussion/Conclusion: In the 3.5 mm PAX Locking System the two screws construct is 30% less stiff than the three screws construct. The stiffness of the Securos three screws construct is comparable to the Synthes and Intrauma two screws constructs. The Veterinary Instrumentation is 20% stiffer than the other locking systems because the thickness of this plate (4 mm) is more than a broad 3.5 mm DCP plate.

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

82 GUIDELINES AND ANATOMICAL DIFFERENCES IN SURGICAL APPROACHES FOR MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS IN CATS

Philipp A. Schmierer¹; Antonio Pozzi²

¹Clinic for Small Animal Surgery, Vetsuisse Faculty University of Zurich, Zurich, Switzerland, ²Vetsuisse Faculty University of Zurich, Zurich, Switzerland

Introduction: Minimally invasive plate osteosynthesis (MIPO) is one of the most recent fixation techniques that embody the concept of biological osteosynthesis. Several studies evaluating MIPO in dogs have been published in the recent years. However, there are few clinical reports of MIPO in cats and no description of the surgical approaches. The purpose of our study was to describe the safe corridors for plate and screw insertion in cats using MIPO technique, with attention to the anatomical differences between cats and dogs.

Materials and Methods: Forty-four limbs of cadaveric cats were used in this study. The surgical approaches for humerus, radius-ulna, femur and tibia were developed after reviewing the described techniques and surgical approaches for MIPO in dogs, while considering any relevant anatomical difference between dogs and cats. Following MIPO approaches the limbs were anatomically dissected and the relationship between proximal and distal positions of the plate and neurovascular structures was noted.

Results: The surgical approaches developed for humerus and radius-ulna differed from what previously reported, because relevant anatomical differences

were found between dogs and cats. Anatomical landmarks for safe plate application were described for all long bones in cats. No damage to vital structures following plate insertion was detected in the dissection.

Discussion/Conclusion: Based on our clinical experience MIPO is a valuable technique in cats. In this cadaveric study, we evaluated the safety of the surgical approaches for MIPO in cats. By respecting the anatomical landmarks described in this report, damage to the neurovascular structures can be avoided performing MIPO technique in cats.

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

83 EVALUATION OF TWO EXTERNAL FIXATOR SYSTEMS FOR FACILITATING ALIGNMENT AND REDUCTION WHEN PERFORMING MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS IN SIMULATED ANTEBRACHIAL FRACTURES

Erika M. Davies¹; Daniel D. Lewis¹; Sarah Townsend¹; Stanley E. Kim²

¹Small Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL, ²University of Florida, Gainesville, FL

Introduction: The study objective was to compare the efficacy of a two ring circular external fixator construct with a new unilateral linear fixator system (Minimally Invasive Reduction Instrumentation System, MIRIS) for performing MIPO in a comminuted radius and ulna fracture model. We hypothesized both systems would provide acceptable fracture alignment, but that use of MIRIS would be simpler and faster.

Materials and Methods: Simulated bilateral comminuted antebachial fractures in 10 cadaver dogs were reduced and stabilized using either a two ring circular construct or MIRIS prior to placement of a Locking Compression Plate. Time to achieve satisfactory reduction and implant placement were recorded. A subjective score was assigned for the efficacy of reduction and plate application for each limb. Pre-fracture and post-operative antebachial radiographs were used to assess radial length, and sagittal and frontal plane alignment. A paired t-test (p<0.05) was used to compare parameters.

Results: Reduction was faster (p=0.0191) and plate application efficacy scores were higher (p = 0.0298) when using MIRIS compared to the circular construct. There was no difference in ease of reduction or time of plate application. Measurements of post-operative radial length and procurvatum were less than pre-fracture measurements, regardless of reduction method. Pre-fracture and post-reduction frontal plane alignment were not different within either group.

Discussion/Conclusion: While both constructs were useful in performing MIPO, MIRIS was simpler to apply and interfered less with plate placement.

Acknowledgement: Our Comparative Orthopaedics and Biomechanics Laboratory provided discretionary funds. DePuy Synthes Vet, West Chester, PA provided implants and instrumentation.

84 VACCINATING WITH DONOR BONE PROTEINS IMPROVES BONE FORMATION IN A MURINE CORTICAL ALLOGRAFT LIMB RECONSTRUCTION MODEL

Ruth Rose¹; Daniel Regan¹; Kaitlyn Louise McNamara¹; Laura Chubb¹; Steven Dow¹; Nicole P. Ehrhart¹

Colorado State University, Fort Collins, CO

Introduction: Poor host-cortical allograft union leads to complications requiring revision surgery in 40–60% of cases and are a result of host-donor MHC mismatch. With complication rates being high and chronic systemic immunosuppression not recommended, novel approaches are needed to improve healing between the host and the cortical allograft. The objective of this study was to evaluate the use of an allogeneic bone vaccine to improve allograft healing in a murine femoral allograft model.

Materials and Methods: 20 C57Bl/6 mice had a 4mm mid-femoral defect created and reconstructed with one of the following: Autograft, allograft, al-



lograft + allogeneic bone protein vaccine, and allograft + allogeneic bone protein vaccine + syngeneic MSCs (1×10^6). Micro Computed Tomography calculations of mean bone volume/total volume, mean histologic apposition score, and mean histologic bone maturation score were compared between groups ($p < 0.05$).

Results: Mice that received the allogeneic bone vaccine had significantly more bone volume/total volume than mice that had allograft alone ($p = 0.0138$) and more bone volume/total volume than those mice that had the allograft + vaccine + MSCs ($p = 0.0107$) (Figure 1). There was no difference in bone volume/total volume between the mice that received allograft + vaccine and autograft.

Discussion/Conclusion: Allogeneic bone protein vaccination prior to and during the early healing period following surgery improved host-allograft healing and in at least one outcome measure and was equivalent to autograft, the gold standard of graft healing.

Acknowledgement: Project funding by The Shipley Foundation and the Laboratory of Comparative Musculoskeletal Oncology and Traumatology.

85 EVALUATION OF BONE GRAFT PERFORMANCE IN A RABBIT FEMUR DEFECT MODEL

Nelson L. Scarborough¹; Daniel D. Lewis²; Stanley E. Kim³; Andy Carter¹; Brad Patt¹; William R. Walsh⁴; Chris Christou⁴; Rema A. Oliver⁴

¹TheraCell-VET, Inc., Lowell, MA, ²Small Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL, ³University of Florida, Gainesville, FL, ⁴Surgical and Orthopaedic Research Laboratories, University of New South Wales, Sydney, Australia

Introduction: This study evaluated the performance of 3 bone grafts in a validated rabbit femoral critical sized defect. Bone grafts were selected to represent three categories namely autograft, demineralized bone allograft and synthetic bone graft substitute materials.

Materials and Methods: Bilateral defects (6mm diameter x 10mm deep) were created in skeletally mature rabbits. Defects were filled with: autograft (iliac crest); allograft (VET Fiber Matrix™ made with Demineralized Bone Fibers, DBF™); or Vitoss Foam Strip (collagen/TCP) hydrated with bone marrow aspirate. Unfilled defects served as negative controls. Animals were evaluated at 2, 4 and 6 weeks using microCT, radiography and histology.

Results: Postoperative radiographs demonstrated autograft and Vitoss Foam Strip. DBF is radiolucent. Histological evaluation at 2 weeks demonstrated new bone formation along the margins and into the defects filled with autograft and DBF. At 4 weeks bone formation had progressed with significant remodelling of DBF. Autograft had a slower rate of remodelling. At 6 weeks the DBF demonstrated cortical window regeneration. The autograft defects remodelled but the cortical wall was not reformed. Vitoss Foam Strip had some new bone at defect margins at 6 weeks with an inflammatory response at all time points. Unfilled defects remained empty.

Discussion/Conclusion: Autograft and DBF treatment supported new bone formation and remodelling. Reformation of the cortical window at 6 weeks by DBF was an unexpected positive finding. The ability of DBF to remodel more rapidly than autograft is consistent with previous findings. DBF without addition of autograft or BMA demonstrated excellent bone healing characteristics.

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86 CASE REPORT - THREE DIMENSIONAL CORRECTIVE OSTEOTOMY FOR AN ANTEBRACHIAL DEFORMITY IN A DOG USING A SUBJECT SPECIFIC SURGICAL GUIDE

Alexandra Penelas; Andreas Gutbrod; Antonio Pozzi
Vetsuisse Faculty University of Zurich, Zurich, Switzerland

Introduction: A 7-year-old, 19.1 kg, castrated crossbreed dog was presented for an angular limb deformity of the right front limb.

Materials and Methods: Orthogonal radiographs and a CT scan revealed a multiplanar deformity of the distal antebrachium with valgus, procurvatum and external rotation of the paw. The magnitudes of the CORAs were determined in both planes (frontal 27°, sagittal plane 15°) using the contralateral limb as reference. A three-dimensional bone model of the antebrachium was created digitally from CT-data and a subject specific surgical guide was manufactured based on this bone model. The guide included four holes for Kirschner wires for temporary fixation and two osteotomy slits with an angle of intersection equivalent to the magnitude of the CORAs. The underside of the guide was matched to the anatomy of the dorsal surface of the radial bone. During surgery it closely fitted the bone and was temporarily fixed with pins. The radial closing wedge osteotomy was carried out using an oscillating saw aligned with the osteotomy slits. An additional osteotomy of the distal ulna was conducted. Torsion was corrected by aligning the carpus and the elbow joint orientation angle. After achieving anatomic reduction internal fixation was performed with two preoperatively contoured locking plates.

Results: Postoperative x-rays showed accurate correction of the deformity.

Discussion/Conclusion: We believe establishing a subject specific surgical guide helped execute the corrective osteotomy more easily and accurately compared to standard technique. A further advantage was reduction of surgical time and making fluoroscopy unnecessary.

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

87 COMPARISON OF ARTHROSCOPIC ABNORMALITIES, RADIOGRAPHY, AND DISTRACTION INDEX IN THE HIP JOINTS OF JUVENILE DOGS WITH HIP DYSPLASIA UNDERGOING PELVIC OSTEOTOMY WITH LONG TERM CLINICAL OUTCOME

Teresa Michelle Linder¹; Jason A. Bleedorn¹; Milan Milovancev²; Paul Manley¹

¹School of Veterinary Medicine, University of Wisconsin, Madison, WI, ²College of Veterinary Medicine, Oregon State University, Corvallis, OR

Introduction: The absence of pre-existing degenerative changes in the hip joints of juvenile dogs with hip dysplasia is thought to be crucial to ensure a good clinical outcome for patients undergoing corrective pelvic osteotomy. Current assessment methods include static and distraction radiography; however, correlation with joint health and long term outcomes are lacking. Arthroscopy is the gold standard of overall joint health assessment.

Materials and Methods: Hip joints from 15 juvenile dogs were evaluated using clinical assessment, standard radiographic projections, PennHIP distraction radiography, and hip arthroscopy as selection criteria prior to pelvic osteotomy. 4–8 years post-operatively dogs were reassessed using orthopedic examination, the Canine Brief Pain Inventory (CBPI) questionnaire, and standard orthogonal radiographic projections.

Results: Arthroscopic evidence of osteoarthritis was seen in all hip joints evaluated. No correlation was found between any clinical or radiographic outcome measure, and arthroscopic findings in this cohort. Excellent long-term clinical outcome with correlation to initial arthroscopic findings was demonstrated in all dogs that returned for follow up assessment.

Discussion/Conclusion: Radiographic assessment of arthritis is insensitive for cartilage damage and joint inflammation in young dogs with hip laxity. Arthroscopic observations are important to fully characterize hip joint health; however early outcome measures predictive of long-term clinical success with corrective pelvic osteotomy remain unclear.

Acknowledgement: University of Wisconsin-Madison, School of Veterinary Medicine, Department of Small Animal Surgery.



88 MORPHOMETRIC ANALYSIS OF FEMORAL AND TIBIAL ALIGNMENT IN DOGS WITH MEDIAL PATELLAR LUXATION

Amy E Thibault; Stanley E. Kim; Selena Tinga; Scott A. Banks
University of Florida, Gainesville, FL

Introduction: Hindlimb abnormalities of the femur and tibia have been associated with the presence of medial patellar luxation (MPL) in dogs. Cause and effect relationships between these deformities and the presence of MPL have not been well investigated. We utilized morphometric analysis through 3D reconstructions of the femur and tibia to quantify 3D alignment of the femur and tibia in each plane for dogs with and without MPL.

Materials and Methods: Ten small breed dogs with MPL and 8 small breed dogs unaffected with MPL were recruited. All dogs underwent orthopedic examinations and hindlimb CT scans. Volumetric 3D reconstructions of the femurs and tibias were created from CT scans. Coordinate systems were assigned to the proximal and distal regions of the femur and tibia based on local anatomical landmarks. Degrees of torsion, varus/valgus, and angulation were measured by calculating the angle formed between the coordinate systems created.

Results: Dogs with MPL had a mean of 4 degrees more external rotation of the distal tibia (or internal rotation of the proximal tibia), 3 degrees more valgus angulation of the tibia, 6 degrees more external rotation of the intertrochanteric axis, and 6 degrees less femoral procurvatum.

Discussion/Conclusion: Subtle morphometric differences in femoral and tibial alignment were identified between normal dogs and dogs with MPL.

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

89 EVALUATION OF NOVICE STIFLE ULTRASONOGRAPHY FOR DETECTING MENISCAL PATHOLOGY IN DOGS WITH NATURALLY OCCURRING CRANIAL CRUCIATE LIGAMENT PATHOLOGY

Lauren Michelle Retallack; R. Mark Daye; Dustine D. Spencer

Ohio Veterinary Surgery and Neurology, Metropolitan Veterinary Hospital, Akron, OH

Introduction: Diagnosis of meniscal injuries following cranial cruciate ligament stabilization is challenging, and commonly requires arthroscopy or arthrotomy for conclusive evidence. This study was conducted to determine the clinical usefulness, accuracy, and ease of novice ultrasonography for the diagnosis of meniscal pathology in dogs with naturally occurring cranial cruciate ligament disease undergoing arthroscopy and surgical repair.

Materials and Methods: Ultrasonographic evaluation of the stifle was performed by two novice ultrasonographers with a basic ultrasound machine and conical probe. The ultrasound examinations were performed under general anesthesia. Medial and lateral menisci were evaluated for displacement, echogenicity, shape, and fluid in cranial, middle, and caudal segments. Arthroscopy was then performed by a board certified surgeon. Finally, surgery for cranial cruciate ligament injury was performed. All participants were blinded to results until conclusion of the study.

Results: Lateral and medial menisci were evaluated in 46 dogs. Medial meniscal tears were diagnosed arthroscopically in 22 cases (47.8%), and lateral meniscal tears in 5 cases (10.9%). Novice ultrasonographers were inaccurate in diagnosing meniscal pathology.

Discussion/Conclusion: Novice ultrasonographers, while confident in their ability to locate the menisci, were inaccurate at diagnosing meniscal pathology. Comfort with ultrasonographic anatomy and landmarks is required in order to make this a useful technique. Proper training under the supervision of an experienced radiologist, feedback while learning, and/or different equipment than what was used may be necessary to increase the accuracy of this technique in novice hands.

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

90 CENTER OF ROTATION OF ANGULATION (CORA) BASED TIBIAL PLATEAU LEVELLING OSTEOTOMY (TPLO) IN DOGS: 10 CASES

Sebastian Mejia; Kenneth A. Bruecker

Veterinary Medical and Surgical Group, Ventura, CA

Introduction: The objective of this study was to document initial experience and short-term follow-up with the use of CORA based TPLO (cb-TPLO) for repair of rupture of cranial cruciate ligament in dogs between the years 2011–2014.

Materials and Methods: Medical records (2011–2014) of dogs that had rupture of the cranial cruciate ligament and had repair using cb-TPLO were reviewed. Signalment, preoperative assessment/rationale for cranial cruciate ligament repair, postoperative assessment of the repair, and complications were recorded.

Results: Four dogs underwent unilateral surgical repair of cranial cruciate ligament ruptures using cb-TPLO and three dogs staged bilateral repair using cb-TPLO for a total of 10 procedures. Static implant with maintained alignment and fixation was observed in all 10 procedures at the time of the final recheck. Satisfactory healing occurred in 10 of 10 procedures. Minor complications occurred in 4 of 10 procedures. There was one major complication that resulted in non-clinical valgus and no further surgical intervention was required.

Discussion/Conclusion: Forty percent of the cases (4/10 cases) had minor complications that were resolved without further surgical intervention. Based on evaluation of the circumstances, it is likely that these complications were a result of concurrent factors, rather than the procedure itself. One major complication was noted but resolved without surgical intervention. There were no surgical failures. The described cb-TPLO technique is appropriate when previous surgical attempts have failed, where anatomy excludes other surgical options, and in juvenile patients with open growth plates.

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

91 EVALUATION OF GAIT RITE LAMENESS SCORES AND MEDIAL MENISCUS INJURY IDENTIFIED VIA CAUDOMEDIAL ARTHROTOMY

Stuart S Sherburne¹; Davyd Pelsue²; Regina Schroeder²; Creacy Box-Bearfield²

¹Surgery, Las Vegas Veterinary Specialty Center, Las Vegas, NV, ²Surgery, Sierra Veterinary Specialists, Reno, NV

Introduction: The objective of this retrospective study was to evaluate the correlation between objective lameness scores and the presence or absence of meniscal injury identified during tibial tuberosity advancement (TTA) or tibial plateau levelling osteotomy (TPLO) surgery. Dogs (n=76) undergoing elective TPLO/TTA for cranial cruciate ligament (CCL) injury were evaluated. Our hypothesis was that dogs with a higher degree of lameness as identified by the (GAIT RITE) walkway system, would be more likely to have meniscal injury identified at the time of surgery.

Materials and Methods: Records review of patients seen between January 1, 2013 and April 1, 2015 undergoing either TTA or TPLO. Pre-operative GAIT RITE lameness scores and total pressure index (TPI%) were compared between dogs with and without medial meniscal injury identified at surgery. Surgery was performed by (2) DACVS boarded surgeons using caudomedial arthrotomies to evaluate meniscal status.

Results: Lameness scores and TPI% were similar between dogs with normal and damaged menisci. No significant difference was found between either lameness scores (P>0.32) or TPI% (P>0.22) and the presence or absence of meniscal injury.

Discussion/Conclusion: GAIT RITE lameness scores were not useful predictors of meniscal damage identified through caudomedial arthrotomy in dogs



undergoing TPLO/TTA surgery for CCL injured stifles. Severity of lameness did not appear to be indicative of increased probability for meniscal injury.

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

92 THE TIBIAL PLATEAU LEVELLING OSTEOTOMY AND THE TIBIAL TUBEROSITY ADVANCEMENT FOR TREATMENT OF CRANIAL CRUCIATE LIGAMENT RUPTURE – A SYSTEMATIC REVIEW

Patricia Beer; Barbara Bockstahler; Eva Schnabl-Feichter

University of Veterinary Medicine Vienna, Vienna, Austria

Introduction: During the last three decades biomechanical surgical techniques have been established that provide joint stability in a cranial cruciate ligament deficient stifle. This review attempts to evaluate whether the Tibial Plateau Levelling Osteotomy (TPLO) displays a better clinical, functional and radiographic outcome and is associated with fewer complications in comparison to the Tibial Tuberosity Advancement (TTA).

Materials and Methods: A systematic literature search was carried out in online databases. Studies published between August 2004 and July 2014, evaluating short- or long-term outcomes as well as complications following TPLO or TTA were selected and classified according to their level of evidence.

Results: 71 studies met the inclusion criterion (TPLO, n=48; TTA, n=21; comparative studies, n=2). Only two studies achieved the third best evidence class out of four. The remaining provide data of the lowest evidence level. Subjective visual gait assessments showed better short-term results for the TTA. TPLO showed slightly better results in movement patterns and weight distributions assessed by objective gait analysis. TPLO was associated with less increase of osteoarthritis and in fewer patients a postoperative joint instability was diagnosed. The average calculated complication rates for the TPLO and TTA were 16.7% and 18.1%, respectively.

Discussion/Conclusion: In conclusion we show that by trend the TPLO was associated with improved clinical outcome parameters and a slightly lower complication rate in comparison to the TTA. In addition, these data clearly highlight the necessity of high quality clinical studies and the application of standardized, validated measurement tools.

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

93 EXAMINATION OF CIGARETTE SMOKE EXPOSURE AS A RISK FACTOR FOR POST-OPERATIVE COMPLICATIONS FOLLOWING AN ELECTIVE ORTHOPEDIC SURGERY IN DOGS

Erin N. Kishi¹; Derek B. Fox²

¹Veterinary Medicine and Surgery, University of Missouri, Columbia, MO,

²University of Missouri, Columbia, MO

Introduction: Dogs of cigarette smoking households undergoing tibial plateau levelling osteotomy (TPLO) will have a higher complication rate than those not exposed.

Materials and Methods: Medical records (2009–2014) of dogs treated with a TPLO were reviewed. Owners were mailed a validated questionnaire to evaluate environmental, socioeconomic factors and post-operative complications. Known intra-operative risk factors for surgical-site infection (SSI) were assessed. A smoke exposure index was calculated for each patient of indoor smoking households. Logistic regression analysis was used to evaluate for significance between independent variables and complication rate.

Results: One-hundred five stifles met the inclusion criteria. Median anesthesia time was 178 min. Median intra-operative patient temperature was 96.8°F. Mean time to follow up was 29.6 months. Twenty dogs (19%) were from smoking households, but only 2 were indoor-only smokers. Overall complications occurred in 42 stifles (40%). Twelve stifles (11%) had SSIs.

Discussion/Conclusion: The number of dogs owned by indoor smokers was unexpectedly low (n=2) which precluded the ability to determine the effect of smoke exposure on complications. Six of the 20 dogs (30%) owned by smokers had complications, which mimicked the overall complication rate (40%). Only anesthesia time was correlated with risk of post-operative complications. Clients whose dogs underwent TPLO and completed the survey exhibited a lower predilection for smoking suggesting this population is problematic for assessing the risk of smoke exposure on post-operative complications in dogs.

Acknowledgement: Phi Zeta Veterinary Honor Society for their financial support and Dr. Richard Madsen for his statistical analysis.

94 A COMPARISON OF POSTOPERATIVE CARE NEEDS AND COMPLICATIONS BETWEEN BILATERAL SIMULTANEOUS AND STAGED TIBIAL PLATEAU LEVELLING OSTEOTOMY (TPLO) IN 192 CASES FROM 2005 TO 2015

Amirreza Vedadi; Kenneth A. Bruecker; Marcos D. Unis

VMSG, Veterinary Medical and Surgical Group, Ventura, CA

Introduction: The objective of this study was to compare postoperative care and complications between simultaneous and staged bilateral TPLO in dogs.

Materials and Methods: For this retrospective study, medical records from one hospital's database were reviewed for postoperative care and complications. 106 dogs underwent bilateral simultaneous TPLO, and 86 dogs underwent bilateral staged TPLO, between May 2005 and June 2015.

Results: Anesthesia and hospitalization duration were shorter in the simultaneous TPLO group than the totals of both surgeries in the staged TPLO group (anesthesia was shorter by 1.6 hours, and hospitalization was shorter by ½ day). Most patients in the simultaneous group required a urinary catheter (69.7%) and recumbent care (70.7%) postoperatively, whereas staged patients didn't require any urinary catheter, and 8.9% needed recumbent care only. The staged group received more injections of opioid analgesics (1.5 more injections per hospital stay). However, patients in the simultaneous group received CRI of combined analgesics more frequently (about 4 times more). Complication rates were higher in the simultaneous group than the staged group (52.0% vs. 39.2%). Both skin and orthopedic complications were higher in the simultaneous group than the staged group (36% vs. 30.4% for skin related complications, and 42% vs. 19.0% for orthopedic-related complications).

Discussion/Conclusion: Due to the higher rate of postoperative complications and the longer post-op recumbent care of our simultaneous group, staged bilateral TPLO may be considered a more manageable and cost efficient approach for dogs sustaining bilateral cranial cruciate injury in our practice.

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

95 CASE REPORT - USE OF FLEXOR DIGITORUM LATERALIS TENDON TRANSPOSITIONS FOR THE REPAIR OF BILATERAL CALCANEAL TENDON RUPTURE IN A CAT WITH SEVERE THERMAL INJURY

Hoong Kien Wong^{1,2}; Alexander Bush²; Daniel Hoffmann²

¹Department of Surgery, Gulf Coast Veterinary Specialists, Houston, TX,

²Department of Surgery, Veterinary Specialists of Rochester, Rochester, NY

Objective: To describe a novel technique utilizing the flexor digitorum lateralis tendon to repair rupture of the common calcaneal tendon (CCT) with gap defect.

Study design: Clinical case report.

Animal: An eight month-old male intact Domestic shorthair with bilateral CCT rupture secondary to severe thermal injury.



Materials and Methods: The bilateral CCT repair was performed in two stages. The first stage involved using the flexor digitorum lateralis tendon to reconstruct the CCT and a semitendinosus muscle flap for improved blood supply. A calcaneotibial (CT) screw was used for immobilization of the tarsocrural joint. The second surgery involved performing a free skin graft for complete wound closure. After eight weeks of bandaging, the CT screws were removed and fiberglass splints were applied. The splints were removed after two weeks.

Results: Full recovery took five months between the surgery and the final follow-up exam. The cat had a functional gait with no lameness and was able to jump to a height of approximately 0.75 meter.

Clinical Significance: Flexor digitorum lateralis tendon transposition is a viable option for repair of a CCT rupture when a gap exists and traditional tendon lengthening techniques are not feasible. This is the first reported use of the flexor digitorum lateralis tendon for repair of CCT in a cat.

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

96 THE USE OF HINGED TRANS-ARTICULAR HYBRID EXTERNAL SKELETAL FIXATION (hTHESF) FOR CONTROLLING TARSAL RANGE OF MOTION FOLLOWING COMMON CALCANEAL TENDON TENORRHAPHY IN TEN CANINE PATIENTS: A RETROSPECTIVE ANALYSIS

Kenneth J Brand¹; Christina L. Boekhout²; Alan R. Cross¹; Robert M. Radasch³

¹BluePearl Georgia Veterinary Specialists, Atlanta, GA, ²Utah Veterinary Center, Midvale, UT, ³Dallas Veterinary Surgical Center, Grapevine, TX

Introduction: Disruption of the common calcaneal tendon (CCT) leaves patients with varying degrees of lameness and tarsal hyperflexion. Current treatment recommendations include tenorrhaphy and some form of post-operative tarsal immobilization. Traditionally, external coaptation, various external skeletal fixator (ESF) devices, and calcaneo-tibial bone screws have been used, however, a superior method has not been identified. In this retrospective study, ten dogs, all with partial or complete rupture of the common calcaneal tendon, had a hinged trans-articular hybrid external skeletal fixator (hTHESF) placed.

Materials and Methods: The hTHESF utilized a tibial type 1 linear fixator and a two-ring construct, utilizing small diameter Kirschner wires, at the level of the metatarsus connected by a hinge. The tarsus was held in rigid fixation at an angle of 160–170 degrees for two to six weeks, after which limited range of motion (10–20 degrees) was granted.

Results: Only 30% of patients encountered major complications associated with the tarsal transarticular component, lower than previously reported complication rates. These were characterized by pin tract infections and completely resolved with systemic antimicrobial therapy. Nine owners were contacted 2 to 39 months post-operatively and subjectively reported a median of 90% return to function.

Discussion/Conclusion: The advantages of the hTHESF include protection of the tenorrhaphy from excessive strain from uncontrolled patient activity or catastrophic overload, low morbidity associated with the use of small K-wires through the metatarsals, and the ability to transition from rigid immobilization to limited range of motion by adjusting the permitted hinge range of motion post-operatively.

Acknowledgement: There were no conflicts of interests or funding provided for this project.

97 APPLICATION OF SPACE PULSE SEQUENCING IN CANINE SPINAL IMAGING

Shannon P Holmes; Layla Shaikh; Kurt Selberg
University of Georgia, Athens, GA

Introduction: New three-dimensional volume imaging fast-spin echo (FSE) sequences produce multiplanar images with a single acquisition, with more preferable image contrast for neuroimaging. We compared 3D FSE images of canine spines to conventional 2D FSE sequences.

Materials and Methods: Sixteen canine patients were included with clinically significant paresis/plegia. All MRI examinations were performed on a 1.5T MRI. Conventional T2w FSE sequences in the sagittal and transverse planes and a sagittal plane T2w SPACE sequence were acquired. The SPACE images were reconstructed with variable thickness/gap ranging between 1–3mm/1–3mm to establish an ideal reconstruction. Signal- and contrast-to-noise ratios were calculated and compared for all sequences using repeated measures. All images were scored (5-point scale) by 3 reviewers for overall image quality and visibility of specific neuromuscular structures.

Results: 3D SPACE scan time was averaged 5.4 minutes; in contrast, the total scan time for sagittal and transverse 2D FSE scans averaged over 10 minutes. SPACE transverse reconstructions SNR and CNR was higher than FSE. The 3mm and 2mm transverse SPACE SNR and CNR values were statistically higher than the 1mm reconstructions. The SNR was higher for the FSE sagittal images. For all anatomic structures except spinal nerves, the FSE images were rated higher than the SPACE images. There was no difference in lesion detection between the SPACE and FSE images.

Discussion/Conclusion: SPACE is a viable alternative for rapid accurate MRI evaluation of the canine spine for intervertebral disc disease. It provides multiplanar, thin-slice, ideal contrast resolution reconstructions in a time frame that rival computed tomography (CT) exams.

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

98 CUSTOM DORSAL STABILISATION OF THE LUMBOSACRAL JOINT IN DOGS USING RAPID PROTOTYPING TECHNOLOGY

Andrew J. Worth

Institute of Veterinary, Animal and Biomedical Sciences, Massey University Veterinary Teaching Hospital, Palmerston North, New Zealand

Introduction: Dorsal stabilisation of the lumbosacral joint is advocated for degenerative lumbosacral stenosis in dogs. Existing methods risk inadvertent nerve root injury during implant placement. A custom designed implant that is its own drill jig would lessen the surgical risk.

Materials and Methods: Three dogs with lumbosacral pain due to dynamic lumbosacral stenosis (1) or OC lesions (2) were CT-scanned with the lumbosacral junction in a neutral position. 3-D volume rendering of the L7 and sacral vertebrae was performed to create a surface structure onto which to apply a bridging implant. Engineering software was then used to design the implant with fixation points in the pedicle of L7, across the L7-S1 articular process joints and into the sacral body without impinging nerve roots. The implant was then printed in titanium and sterilized before being implanted through a dorsal surgical approach.

Results: The surgery was straightforward and the implant directed the drill pathways as designed. All dogs recovered from surgery without additional neurological impediment. At 6-week follow-up screw breakage was noted in all dogs. One dog underwent a second surgery to retrieve a section of broken implant. Bone ingrowth was noted into the porous titanium. Clinically all dogs were doing well and were free of clinical signs at follow-up (11, 12, 18 months).



Discussion/Conclusion: Custom 3D printing offers a solution to the risk of neural damage in vertebral stabilization. Improvements in screw fixation are being sought.

Acknowledgement: This project was funded by the Massey University Working Dog Centre, Palmerston North, New Zealand.

99 EVALUATING THE ACCURACY OF A COMMERCIALY AVAILABLE KINEMATIC GAIT ANALYSIS PROGRAM

Emily Arlene Liles; Joesph P Weigel; Jose Luis Guevara; Darryl L Millis
University of Tennessee – College of Veterinary Medicine, Knoxville, TN

Introduction: The purpose of this study was to compare a home-use movement analysis mobile application to a validated professional motion capture system. We hypothesized that both would give similar values regarding joint motion in trotting dogs.

Materials and Methods: Reflective spheres were attached to anatomic landmarks on ten dogs. Dogs were acclimated before trotting in a testing area where low light cameras captured kinematic data concurrently with an infrared digital camcorder. Five trials were captured on the right and left sides of each dog. Maximum flexion, extension, and range of motion angles were calculated by the programs for the shoulder, elbow, hip, and stifle.

Results: Seven hundred eighty (97.5%) of eight-hundred values obtained on the mobile application deviated less than 5% from the values obtained with the professional gait analysis program. Twenty (2.50%) angles measured with the app differed by greater than 5% from the computed results. Forty-five (11.25%) calculated range of motion from the app had an absolute discrepancy greater than 6° from the values obtained with the professional kinematic program.

Discussion/Conclusion: In 97.5% of the joint angles the mobile application was capable of identifying maximum flexion and extension angles within 5% of values obtained with the professional kinematic gait analysis system. The accuracy and precision of the mobile application decreased when the angles were used to calculate the range of motion in each joint. The authors believe that additional studies are required to determine the most appropriate uses for this technology in a clinical setting.

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

100 EVALUATION OF ACCELEROMETER INTER-DEVICE VARIABILITY AND COLLAR TIGHTNESS IN HEALTHY DOGS

Anastasia M Olsen¹; Richard B Evans²; Felix M Duerr¹

¹Colorado State University, Fort Collins, CO, ²University of Minnesota, St. Paul, MN

Introduction: Accelerometers are frequently used for the objective measurement of activity in animals. However, there is a lack of data evaluating factors that may influence accelerometry such as inter-device variability and collar tightness. The purpose of this study was to compare accelerometer inter-device variability and to evaluate the effect of collar tightness on activity counts. We hypothesized that there would be significant inter-device variability and that a loose collar would result in greater activity counts as compared to a tight collar.

Materials and Methods: Patients were skeletally mature medium or large breed client-owned dogs. A total of 12 Actical devices were used, with the same two devices used for the same four placement patterns in each dog. Acticals were positioned on the ventral cervical region for all placements. Placement patterns included both devices attached to one collar, both devices attached to separate collars concurrently with the same tightness, and both devices attached to separate collars concurrently with a loose and tight fit.

Results: Accelerometer inter-device correlation ranged from 0.92 to 0.95 ($p < 0.0001$). The loose collar was associated with a decrease in correlation ranging from 0.86 to 0.93. ($p < 0.0001$).

Discussion/Conclusion: The tested devices showed significant inter-device variability for all placement patterns. Dog collar tightness affected total activity counts. When using accelerometry as a clinical outcome tool, the same device should be utilized for an individual subject and the same collar tightness should be maintained throughout the study period.

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

101 EVALUATION OF TWO POPULATIONS OF EQUINE STEM CELLS IN PROMOTION OF BONE HEALING IN A NUDE RAT FRACTURE

McDuffee LA¹; Nino-Fong R²; Esparza BP¹; Aburto E¹; Rodriguez-Lecompte JC¹

¹Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, PE, Canada, ²Veterinary Anatomy and Immunology, Ross University School of Veterinary Medicine, Basseterre, St. Kitts, West Indies, St. Kitts and Nevis

Introduction: Bone tissue engineering methods, including mesenchymal stem cell (MSCs) therapy, are being investigated for promotion of bone healing. This study evaluated two populations of equine bone marrow (BM) derived MSCs for promotion of fracture healing.

Materials and Methods: All animal study protocols were approved by the Animal Care Committee. One horse was used for isolation of BM MSCs. A population of 5 million heterogeneous BM MSCs and a population of gravitational field flow fractionated (GrFFF) BM MSCs were combined with fibrin glue (FG), primed with osteogenic media, and implanted at each randomly chosen osteotomy. Twenty four NIH Nude rats were divided into 3 groups (Group 1: FG control; Group 2: fractionated BM MSCs in FG; Group 3: heterogeneous BM MSCs in FG; $n=8$). An osteotomy was created in the tibia of each left hind limb with rats under general anesthesia. A 0.035 inch diameter K-Wire was used to stabilize the fracture. Treatments were implanted at the osteotomy. Soft tissues were routinely closed. Histological and radiographic image analysis and histological scoring were used for comparison of new bone among groups at 4 weeks after implantation. Statistical comparisons were conducted using ANOVA, and post hoc comparisons were conducted using Tukey's method.

Results: Based on histological and radiographic data, the heterogeneous population of MSCs (Group 3) had significantly greater new bone formation.

Discussion/Conclusion: Equine BM MSCs may promote bone healing. A fractionated subpopulation which showed a higher osteogenic capacity in vitro did not improve the cell based therapy.

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102 Abstract withdrawn

103 DEMOGRAPHICS, TRAINING PRACTICES AND INJURIES IN EVENT HORSES IN THE UNITED STATES

Caston SS; Burzette RG

Iowa State University, Ames, IA

Introduction: Eventing, also called three day eventing or horse trials, is a popular riding discipline. Some reports review injuries in event horses – ultrasound abnormalities at the 2000 Olympic games, injuries sustained during cross-country phase falls, and injuries/training programs of upper level British eventing horses. This prospective study investigated eventing horses in the United States.

Materials and Methods: The study primarily investigated lower level event horses – Beginner Novice through Preliminary levels. An electronic survey was sent to all members of the United States Eventing Association (USEA) membership via email newsletter, the association's website, and posting on social media. Respondents received follow up surveys once a month for 6



months. Information collected at initial survey included horse age, breed, previous discipline, training practices, primary footing, turnout and management practices, level and area of competition, and frequency of trailering. At follow up surveys, completion of competitions, occurrence of injuries, time of injury, treatment of injury, and changes in training program were recorded. Analysis includes comparison of incidence of injury with other variables.

Results: A total of 296 responses were initially obtained. At least one follow up response was obtained for 251 cases.

Discussion/Conclusion: This data will be useful to equine practitioners evaluating event horses for lameness or injury. Associations found during data analysis may further benefit owners and trainers by providing evidence of management and training strategies that might best predispose to or prevent lameness and injury in the event horse.

Acknowledgement: The authors would like to acknowledge the assistance of the USEA in disseminating the survey.

104 CHARACTERIZATION AND FUNCTIONAL ASSESSMENT OF EQUINE BMP-2

Herzog K; Chen Y; Stewart M
University of Illinois, Urbana, IL

Introduction: Bone morphogenetic proteins (BMPs) play pivotal roles in cell proliferation, differentiation, organogenesis and homeostasis in many tissues. BMP-2 is particularly important for post-natal skeletal and articular cartilage

maintenance and bone repair. Given the significance of BMP-2 in orthopedic biology, we developed constructs to express equine BMP-2 protein.

Materials and Methods: Equine BMP-2 cDNA was amplified using nested primers and cloned into a pCMV-Sport expression vector and a shuttle vector for adenoviral vector (Ad-eqBMP-2) production. Equine BMP-2 bio-activity was assessed by response of the HepG2 BRA reporter cell line to plasmid and adenoviral transfection, and in an equine synovial MSC chondrogenesis assay.

Results: Equine BMP-2 protein comprises a 23-amino acid signal peptide and a 258 amino acid pro-peptide domain. The mature protein contains 114 amino acids and is completely consistent with human BMP-2 protein. The BMP-2 plasmid and adenoviral vectors stimulated significantly higher luminescence than the 'empty vector' and 'GFP vector' groups in HepG BRA reporter cells. Equine synovial MSCs infected with Ad-eqBMP2 deposited significantly higher sGAG than did control groups, although sGAG content was app. 80% of pellets treated with 100 ng/ml of rhBMP-2 protein. Pellet sizes corroborated the sGAG data.

Discussion/Conclusion: As expected, given the critical functions of BMP-2, equine BMP-2 is highly similar to the human protein. Our equine BMP-2 adenoviral vector stimulated synovial MSC chondrogenesis comparably to BMP-2 protein. In light of these findings, equine BMP-2 could prove valuable for managing equine musculoskeletal disease, though optimal strategies for delivering BMP-2 need to be developed.

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