



## Veterinary Orthopedic Society 39<sup>th</sup> Annual Conference Abstracts

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### Part II

#### 41 Mechanical properties of the canine patella-ligament-tibia segment

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**Introduction:** None of the surgical procedures currently performed for canine cranial cruciate ligament (CCL) rupture reproduce the anatomy or mechanical duties of the normal CCL and therefore can lead to secondary arthritis. Comparatively, common surgical repairs for people involve arthroscopic placement of intra-articular auto- or allografts at the origin and insertion of the original ligament. The objective of this study was to test the *ex vivo* mechanical properties of canine patella-ligament-tibia (PLT) segment and establish the relationship between donor size and PLT dimensions to the mechanical properties of PLT grafts, to determine their suitability as grafts.

**Materials and Methods:** Forty-two canine PLT had morphometric measurements (width, thickness, length) taken from computed tomography (CT). These measurements were compared to results obtained using calipers. The PLT were tested to failure at a rate of 100% length/second.

**Results:** Measurements taken via calipers significantly underestimated the width and thickness of the PLT ( $p=2.47E-8$ ,  $2.69E-4$ , respectively) when compared to measurements taken from CT. Eighty-three percent of specimens failed by the tendon pulling off its patella attachment. The weight of the donor animal and the length of the PLT had the strongest Pearson's  $r$  value when correlated with load at failure ( $r=0.84$ ,  $0.82$ , respectively). Failure loads from dogs weighing greater than 25-kg were generally greater than 1750N.

**Discussion/Conclusion:** The loads at failure were similar to those previously reported for the CCL suggesting the whole PLT may be a suitable graft for CCL replacement.

**Acknowledgments:** Supported by the VMC Small Companion Animal grant, University of Minnesota

#### 42 Long-term radiographic assessment of 25 stifles after tibial tuberosity advancement for cranial cruciate ligament rupture

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**Introduction:** Our purpose was to record the presence and progression of radiographic changes 1–2 years after TTA and to establish risk factors for OA progression.

**Materials and Methods:** 19 dogs contributed 25 stifles that were retrospectively evaluated. Using preoperative and long-term radiographs, 32 features of OA were graded from 0–3 and total OA scores recorded. OA scores and progression of OA were correlated with clinical variables.

**Results:** OA progressed in 19 joints, remained unchanged in 5 joints and improved in 1 joint. Dogs with meniscal lesions had significantly higher preoperative and long-term OA scores. Dogs with higher OA score differences were 6.75 times more likely to have had a meniscal lesion and 2.75 times more likely to have had bilateral TTA. Parameters were not significantly different between dogs with

bilateral and unilateral TTA and between first and second TTA in bilateral dogs. Clinical variables were not significant predictors of progression of OA.

**Discussion/Conclusion:** Dogs with greater progression of OA are more likely to have had a meniscal lesion and bilateral TTA procedures. Additional prospective, long-term clinical trials with a standardized OA scoring system for comparison are needed to further evaluate the clinical importance of these findings.

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

#### 43 Canine osteoarthritis: validation of the owner-administered clinical outcomes measurement tools load, CBPI and HCPI

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**Introduction:** Owner-based questionnaires are frequently used in clinical studies to assess pain and function. This study tests further, and compares, psychometric properties of three promising instruments: Liverpool Osteoarthritis in Dogs (LOAD), the Helsinki Chronic Pain Index (HCPI) and the Canine Brief Pain Inventory (CBPI).

**Materials and Methods:** Dogs with OA were recruited. Owners completed LOAD, HCPI and CBPI, force-platform analysis was performed and activity data were recorded using an accelerometer-based activity monitor. Amongst other analyses, tool scores were correlated against each other using Spearman's Rank Correlation ( $r_s$ ), as a test of construct validity, and against force and activity data as tests of criterion validity. Analyses were performed for the data "en-bloc", and for data grouped by "index joint".

**Results:** Significant ( $p<0.05$ ) correlations existed between all tools in all analyses. Significant correlation with Asymmetry Indices for Peak Vertical Force (AIPVF) and Vertical Impulse (AIVI) existed for LOAD, and both factors of CBPI, but not for HCPI, in the "en-bloc" ( $n=183$ ) and "elbow" group analyses ( $n=85$ ).

**Discussion/Conclusion:** Significant correlation between all tools suggests construct validity. The significant correlation with AIPVF and AIVI for LOAD and CBPI reported here is the first reported evidence of criterion validity. Work exploring these tools and activity data continues.

**Acknowledgments:** MBW and EC were funded by Pfizer Animal Health.

#### 44 Does radiographic arthrosis correlate with cartilage disease in Labrador retrievers affected by medial compartment disease of the elbow joint?

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**Introduction:** Fragmented medial coronoid process (MCP) is the commonest component of the canine elbow dysplasia complex. This study was designed to compare radiographically evident osteophytosis with arthroscopic cartilage pathology in a population of client-owned Labrador retrievers affected by medial compartment disease (MCD) of the elbow joint.

**Materials and Methods:** Data was collected retrospectively (June 2007-June 2011) to identify Labrador retrievers presenting with thoracic limb lameness and elbow pain, with a complete set of elbow radiographs and a comprehensive arthroscopic surgery report. Each radiograph was scored for osteophytosis using the International Elbow Working Group (IEWG) scoring system. Elbows affected by traumatic MCP fracture, humeral condylar osteochondrosis, or ununited anconeal process were excluded. A global arthroscopic cartilage score (1=mild, 2=moderate, 3=severe) was assigned to each elbow by a panel of three investigators (MF, NE, MPK). Statistical comparisons were made to investigate potential correlations between radiographic arthrosis score and global cartilage score.



**Results:** Data was available for 594 elbow joints (317 dogs). Mean age was 31 months (range 5–120m). There was a significant correlation between radiographic elbow arthrosis score and arthroscopic global cartilage score (Spearman correlation <0.001).

**Discussion/Conclusion:** Radiographic arthrosis can be used to predict arthroscopic cartilage pathology in Labrador retrievers affected by MCD.

**Acknowledgments:** No funding was provided for this project.

#### 45 The use of hinged trans-articular hybrid external skeletal fixation for temporary limiting of tarsal range of motion

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**Introduction:** Tarsal immobilization with application of a hinged trans-articular hybrid external skeletal fixator (THESF) over the tarsus has not been described in dogs to the authors' knowledge. Potential advantages of using a THESF include gradual remobilization of the affected joint, increased mobility of adjacent joints, decreased iatrogenic trauma, and eventual removal of all implants. This series reports four cases of tarsal immobilization using a THESF in three common calcaneal tendon (CCT) repairs and one tibiotarsal luxation.

**Materials and Methods:** Immobilization following two CCT revisions, one acute CCT repair, and one tibiotarsal luxation are described. The THESF combines a circular fixator at the metatarsus with a linear type 1 fixator on the tibia, joined by an IMEX SK ROM hinge. Small diameter (0.062") K-wires engaged metatarsals 4 and 5 with one K-wire and engaged metatarsals 2 and 3 with an opposing K-wire. In three of four cases, a femoral component was included, preventing weight bearing, to further protect a CCT tenorrhaphy.

**Results:** The tarsal THESF remained intact, without complication for 23 to 42 (mean 34) days in four cases. Complications associated with the additional femoral component necessitated early removal in all cases. The complications included pin tract infection, pin loosening, and femoral fracture. Owners reported 80–90% return to normal in follow-up interviews.

**Discussion/Conclusion:** THESF provides a consistent, low-morbidity means of metatarsal fixation at the tarsus. Immobilization of both the tarsus and stifle should be done cautiously as this appears to be associated with a high rate of implant-related complications.

**Acknowledgments:** None.

#### 46 Arterial thromboembolism after humeral fracture repair in a dog

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A 3 year old, 19kg, spayed female, mixed breed dog was presented to the emergency service after being hit by a car. Injuries included pneumothorax, hemothorax, pulmonary contusions, a right axillary wound, and a grade I open fracture of the right humerus. Following initial patient stabilization, the fracture was repaired and the axillary wound closed. The dog was weight-bearing lame at the time of hospital discharge; postoperative instructions included physical therapy and strict exercise restriction. Seven days following fracture repair the dog represented for an acute onset of pain and non weight-bearing lameness in the right forelimb. Repeat radiographs of the humerus were unchanged compared to postoperative views. Based on physical examination findings of coolness in the limb and lack of palpable digital pulses, a thrombus was suspected and unfractionated heparin was administered by continuous intravenous infusion. Ultrasound of the limb confirmed a right brachial artery thrombus with minimal flow to the affected limb. Clinical improvement was noted over the next 48 hours: the dog was subsequently discharged with Dalteparin and Clopidogrel.

Repeat physical examination and ultrasound 5 wks later revealed complete resolution of the thrombus and normal blood flow to the limb. Follow-up radiographs showed no change in the implants and early bone healing. Anticoagulant therapy was discontinued. Further short-term follow-up revealed the dog continuing to do well with no signs of lameness or discomfort. Although not reported in the dog, arterial thrombosis should be considered a potential complication in dogs following humeral fracture repair.

#### 47 Effects of serum and IRAP II on equine articular chondrocytes treated with interleukin-1

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**Introduction:** To compare the effects of autologous horse serum (HS) and autologous conditioned serum (ACS) on equine chondrocyte metabolism stimulated with IL-1.

**Materials and Methods:** Cells were obtained from 6 young adult horses. Autogenous articular cartilage, HS, and ACS were collected. Cartilage was digested and chondrocytes were isolated and formed into pellets. Treatment groups consisted of 10% HS only, 10% HS with IL-1, 20% HS with IL-1, 10% ACS with IL-1, and 20% ACS with IL-1. GAG synthesis and release, total GAG concentration, total DNA content, media MMP3, and IL-1ra content, and mRNA (collagen II, aggrecan, Cox 2, and MMP-3) expression were evaluated.

**Results:** IL-1 treatment decreased pellet GAG synthesis and collagen II mRNA expression. In addition, IL-1 treatment increased media MMP-3 content and COX-2 mRNA expression. When comparing ACS and HS treatment groups, there was no difference in GAG release, total GAG concentration, total DNA content, and media MMP-3 content. There was a significant increase in pellet GAG synthesis with 20% HS compared to 10% ACS. Media from ACS treatment groups had higher concentrations of IL-1ra compared to HS treatment groups. There was no difference in mRNA gene expression between the ACS and HS treatment groups.

**Discussion/Conclusion:** While treatment with ACS increased levels IL-1ra there were minimal beneficial changes on chondrocyte matrix metabolism when compared to using HS.

**Acknowledgments:** Funding from the VOS residency grant

#### 48 Assessment of the cranio-caudal stability of four extracapsular stabilization techniques during two cyclic loading protocols: a cadaveric study

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**Introduction:** The objectives of this study were to compare the effect of cyclic loading on cranio-caudal tibial translation in cranial cruciate ligament (CrCL)-deficient stifles after extracapsular stabilization, and to evaluate the effect of peak force during cyclic loading on the rate of construct laxity and cranio-caudal translation development.

**Materials and Methods:** Twenty-four pairs of cadaveric stifles were randomly assigned to four treatment groups: nylon leader lateral circumfabellar-tibial suture (NLS), FiberTape lateral circumfabellar-tibial suture (FTLS), TightRope (TR), or bone anchor (BA). Cranio-caudal displacement was measured with a mechanical testing machine during cyclic loading with the CrCL intact, CrCL transected, and after extracapsular stabilization. Cyclic loading after stabilization was performed at peak forces of 80 or 160 N. The number of cycles each construct underwent before reaching 200% and 300% of the mean cranio-caudal displacement present during cyclic loading of the CrCL-intact stifles was calculated.



Number of cycles among treatment groups was compared with a Kruskal-Wallis test.  $P < 0.05$  was considered significant.

**Results:** Mean translation of the CrCL-intact stifles was 3.9 mm. The TR constructs resisted significantly more cycles than NLS constructs before reaching 7.8 mm (200%) and 11.7 mm (300%) of translation when loaded to 80 N. All constructs reached 7.8 and 11.7 mm of translation in fewer cycles when loaded to 160N than at 80 N.

**Discussion/Conclusion:** The TR constructs were most resistant to elongation during cyclic loading. Doubling the peak force during cyclic loading significantly decreased the number of cycles constructs withstood, supporting the importance of post-operative exercise restriction.

**Acknowledgments:** Implant materials for this study were provided free of charge by Arthrex Vet Systems and Securos. One of the coauthors of this study is a paid consultant for Arthrex Vet Systems

#### 49 Biomechanical evaluation of the helica femoral implant system using the traditional and a new modified technique

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**Introduction:** Helica is a screw-in femoral neck prosthesis; a previous study revealed stress shielding and micromotion using the traditional implantation technique. A new modified technique anchors the prostheses in the lateral cortex; this is hypothesized to reduce stress shielding and micromotion.

**Materials and Methods:** In vitro mechanical study cyclically loading femora (intact, traditional, and modified) comparing proximal axial strains, head deflection, and failure properties.

**Results:** Significant difference exists for medial strain between intact (-570  $\mu$ strain) and modified femora (-790); a statistical trend exists between intact and traditional femora (-700). A significant difference exists in neck angle between intact and modified femora (5%), and between implant techniques (5.7%). Significant differences and trends exist for vertical head displacement between implant techniques.

**Discussion/Conclusion:** Proximal medial strain became more compressive with both techniques. This finding indicates less stress shielding, a mechanism indicated in aseptic loosening. Increased vertical head displacement noted during cyclic and failure testing supports micromotion and subsidence in both groups. Further research with longer implants will allow a more medial osteotomy, preserving more normal anatomy, and may eliminate micromotion.

**Acknowledgments:** Funding provided by Chesapeake Veterinary Surgical Specialists.

#### 50 Extracorporeal shockwave therapy for treatment of delayed TPLO healing in dogs

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**Introduction:** Delayed union of TPLO osteotomies is a relatively uncommon complication. Most TPLO osteotomies heal with time, but pain and lameness may be associated with delayed union TPLO osteotomies. Extracorporeal Shockwave Therapy (ESWT) to treat delayed union TPLO osteotomy sites has not been reported, and may serve a dual purpose in decreasing pain and improving healing time of the TPLO osteotomy site.

**Methods:** Three middle-aged adult dogs that were diagnosed with delayed union TPLO osteotomies at 15 weeks or greater post-TPLO were treated with a single ESWT treatment (750 shocks total at 0.15 J/mm<sup>2</sup>). Each dog had pain over the osteotomy site on palpation and a visible lameness prior to ESWT. Follow up radiographs were obtained 4 weeks post-ESWT treatment.

**Results:** All three dogs had obvious progression radiographic healing after ESWT treatment. All three dogs had an improvement of at least one lameness

grade at the walk and stance, and had no pain on palpation of the TPLO osteotomy site.

**Discussion:** In cases where delayed union TPLO sites contribute to pain and lameness, a single ESWT treatment may be a valid treatment option to address both pain and delayed healing.

**Acknowledgments:** No funding was provided for this work.

#### 51 In-vitro comparison of three knotting techniques for lateral fabellotibial suture stabilization

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**Introduction:** Cranial cruciate ligament rupture is one of the most common orthopedic conditions encountered in the canine. The objective was to evaluate the biomechanical characteristics of 2 types of the self-locking knot (SLK): a single self-locking knot (sSLK) and a double self-locking knot (dSLK) compared to the square knot (SQ) for stabilization of cranial cruciate ligament rupture.

**Materials and Methods:** 3 different knot groups were evaluated (SQ, sSLK, dSLK) under monotonic tensile and cyclical loading. Starting tension, elongation, stiffness, and load to failure were all evaluated. A value of  $p < 0.05$  was considered significant.

**Results:** Starting tension, overall stiffness, and load to failure were all significantly ( $p < 0.001$ ) greater for both types of SLK compared to the SQ under monotonic testing. Cyclic testing revealed overall stiffness, load to failure, and number of cycles were significantly ( $p < 0.001$ ) greater for both types of the SLK compared to the SQ. Elongation wasn't different among any of the knots with a mean of  $10.1 \pm 0.26$  mm. There were no significant changes in terms of starting tension, elongation, stiffness, and load to failure between the sSLK and the dSLK.

**Discussion/Conclusion:** Biomechanically the self-locking knot provides adequate in vitro properties consistent with those used in vivo to stabilize the cranial cruciate ligament, and is superior to the SQ. There is no biomechanical advantage in using the dSLK compared to the sSLK. The sSLK should be compared to other knotting types (ie crimping) and suture material (ie fiberwire).

**Acknowledgments:** Funding provided by the Department of Clinical Sciences Internal grant, Mississippi State University.

#### 52 Comparative kinetic analysis of tibial tuberosity advancement (TTA) and leveling tibial plateau osteotomy (TPLO) for the treatment of cranial cruciate ligament deficiency in dogs – preliminary results

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**Introduction:** Cranial cruciate ligament rupture is the major cause of lameness in dogs. Dynamic stability is achieved by changing the bone geometry by techniques like the TPLO and the TTA. Kinetic analysis on the pressure platform is the most objective measurement of the gait. The objective of this study is to compare TTA and TPLO.

**Materials and Methods:** The animals will be separated into groups with 15 dogs each. All animals of groups will be evaluated in the preoperative period, at 15, 30, 60, 90 days and one year postoperatively, through veterinarian assessment, visual analogue scale and on the pressure platform.

**Results:** Until now 15 dogs were evaluated (six from the TPLO and nine from the TTA). At 14, 30 and 60 days PO, PVF and VI were better for TTA compared with TPLO, but at 90 days they presented similar results when compared with each other.



**Discussion/Conclusion:** The results reported here must be interpreted with caution because the number of dogs between groups are uneven and the comparison of both groups can be misleading, but until now both types of treatment showed improvement on weight-bearing in the limb with CCLR when we compared PVF and VI 14 days post-operation (PO) and 90 days PO.

**Acknowledgments:** none

### 53 Shoulder hemiarthroplasty for treatment of severe osteochondrosis dissecans lesion located on the humeral head in a dog

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**Introduction:** Osteochondritis dissecans (OCD) of the humerus occurs in young medium to large breed dogs. Conventional treatment includes arthroscopic debridement and osteochondral autograft mosaic plasty. Partial resurfacing of the humeral head has been reported in humans to treat humeral OCD lesions. The aim is to describe a novel spherical humeral resurfacing prosthesis for treatment of severe OCD of the caudo-central humeral head.

**Materials and Methods:** A seven-month female entire Saint Bernard presented with a ten-week history of marked left thoracic limb lameness. Radiography, arthroscopy and MRI confirmed an extensive OCD lesion covering the entire caudo-medial, caudocentral humeral head. The prosthesis was designed from CT scans and manufactured in polished cobalt-chromium-alloy with finned central humeral stem and base coated in hydroxyapatite. The prosthesis was inserted using a standard lateral approach to the shoulder and following reaming of the caudal humeral head.

**Results:** Radiography and CT revealed caudal-ventral implant placement on the humerus. Force plate analysis demonstrated initial reduction in ground reaction force (GRF) at seven weeks, followed by gradual improvement at three months. No radiographic evidence of implant loosening was present at three months and range of motion was normal and comfortable. Owner satisfaction is excellent with good activity levels and no requirement for analgesia.

**Discussion/Conclusion:** Placement of a humeral head resurfacing prosthesis was an effective technique for the management of severe OCD related shoulder lameness. The technique alleviated pain, provided satisfactory limb function and permitted muscle regrowth.

**Acknowledgments:** This implant is manufactured by OrthoFitz UK, primary author is a director.

### 54 Application of a novel osteointegration screw for treatment of incomplete ossification of the humeral condyle in six elbows (four dogs) and humeral unicondylar fracture in addition to a locking plate in four elbows (four dogs)

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**Introduction:** Incomplete ossification of the humeral condyle (IOHC) results in an intercondylar fissure. Affected dogs are predisposed to humeral condyle fracture. Our objective was to report clinical experience with a new device, The Fitz Fenestrated Tubular Transcondylar (F<sup>2</sup>T<sup>2</sup>), for lameness attributed to IOHC and humeral condylar fractures in addition of one SOP locking plate.

**Materials and Methods:** The F<sup>2</sup>T<sup>2</sup> Screw is a threaded titanium cylinder the inside of which is hollowed and has a series of radial slots for bone in-growth. It is filled with cancellous bone harvested from the drill hole swarf and is coated with hydroxyapatite. Dogs (n=7;10 elbows), affected by thoracic limb lameness with four unicondylar fractures and six elbows with IOHC. For cases with unicondylar humeral fracture, an additional SOP locking plate was applied caudolaterally. **Results:** n=5 Springer Spaniels, n=1 Cocker Spaniel and n=1 Slumber Spaniel. Mean  $\pm$ SD age at surgery was 48.00 $\pm$ 32.36 months and mean weight was 20.55 $\pm$ 3.74Kg. Post-operative complications were recorded in n=3, n=2 cases

with infection, which resolved after oral antibiotic therapy and n=1 with seroma. Bone bridging was documented by CT scan in 10/11 elbows at 6 weeks and 11/11 by 12 weeks post-operatively.

**Discussion/Conclusion:** Salient advantages of the F<sup>2</sup>T<sup>2</sup> screw are immediate stability coupled with rapid bridging of the humeral fissure which should provide resilient repair and its versatility for surgical revision of previously failed repair of humeral condylar fractures with positional or lag screws. Short-term outcome measures are favourable and evidence of bone bridging of the IOHC fissure has been established.

**Acknowledgments:** All implants were designed and manufactured by OrthoFitz, UK, of which the author is a director.

### 55 Total shoulder arthroplasty in a canine for treatment of severe glenohumeral arthrosis

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**Introduction:** Total shoulder arthroplasty is well established in humans but is unreported in veterinary literature. Three human studies describe canine shoulder arthroplasty models for testing prosthetics. The purpose is to describe a novel ball and socket prosthesis for treatment of severe glenohumeral instability in a canine.

**Materials and Methods:** A ten month old, female German Short-haired Pointer presented with severe non-weight bearing left shoulder lameness unresponsive to conservative management. Radiography revealed severe joint deformity, osteophytosis and caudodistal displacement of the humeral head. The implants were designed from CT scans and manufactured in 316L stainless steel. The proximal glenoid was anchored obliquely with two hydroxyapatite coated plates to the spine of the scapula. A polyethylene meniscus liner was cemented into the glenoid socket. The distal component was cemented into the proximal humerus with a curved stem, a collared neck and spherical head. A standard lateral approach to the shoulder was used.

**Results:** Force plate analysis demonstrated initial reduction of ground reaction forces at six weeks and increased at six months. No radiographic evidence of implant loosening at three and six months. The joint was non-painful in all phases of motion. Activity is currently unrestricted and owner satisfaction is excellent. Analgesia is not required.

**Discussion/Conclusion:** This semi-constrained shoulder prosthesis was effective for the management of severe shoulder arthrosis. The technique allowed return to satisfactory levels of activity. The procedure is an alternative to conventional shoulder arthrodesis in selected cases.

**Acknowledgments:** This implant is manufactured by OrthoFitz UK, primary author is a director.

### 56 Evaluation of contralateral stifle radiographic abnormalities and bilateral tibial mechanical joint angles as risk factors for subsequent contralateral cranial cruciate ligament rupture in dogs

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**Introduction:** The objective of this study was to investigate the tibial mechanical joint angles and contralateral radiographic stifle effusion (ConEF) or osteoarthritis (ConOA) as risk factors for subsequent contralateral CrCL rupture.

**Materials and Methods:** Medical records of dogs with confirmed CrCL rupture undergoing stifle arthroscopy for initial treatment of CrCL disease, between July 2006 – June 2007 were reviewed, and the tibial mechanical joint angles were calculated, bilaterally.



**Results:** 118 dogs were included in this study, 22 were classified as bilateral rupture (BR), and 96 were classified as unilateral (UR). Of the UR group, 12 dogs were identified with subtle contralateral stifle abnormalities on palpation (AbC) and 84 were classified as palpably normal (NC). Twenty-nine (35%) of the NC dogs had ConEF. Univariate analysis identified AbC, ConEF and ConOA to be significant risk factors for subsequent contralateral rupture ( $P < 0.001$ ,  $P < 0.001$ ,  $P < 0.001$ ). Multivariate analysis found only ConEF to be a significant risk factor ( $P < 0.001$ ). Sex, breed, age, weight, BCS, duration of lameness, arthroscopic findings, concurrent coxofemoral or tarsal OA, and all four tibial mechanical joint angles were not found to be significant risk factors. When excluding the AbC group, median survival time of remaining free from subsequent contralateral rupture was 1715 days for dogs without ConEF, and 275 days for dogs with ConEF.

**Discussion/Conclusion:** ConEF is a significant risk factor for subsequent contralateral CrCL rupture, in dogs presenting with unilateral CrCL disease, and may be used as a guide when considering treatment options and early preventative measures.

**Acknowledgments:** None

## 57 Comparison of the axial stiffness of carbon composite and aluminum alloy circular external skeletal fixator rings

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**Introduction:** Differences in the individual components of circular external skeletal fixators can greatly affect the clinical performance of the construct. The purpose of this study was to compare the axial stiffness of aluminum alloy and carbon composite ring fixators.

**Materials and Methods:** Single-ring constructs were made with rings of different material composition (carbon-composite and aluminum alloy), diameter (55 mm, 85 mm, and 115 mm), and thickness (6 mm and 12 mm) with all other components remaining constant. Stiffness of each construct was determined under loading in axial compression with a materials testing machine. The axial stiffness of aluminum alloy and carbon composite rings were compared within each combination of ring diameter and ring thickness using a 3-factor factorial analysis of variance;  $p < 0.05$  was considered significant.

**Results:** Carbon composite constructs were 16–55% as stiff as corresponding aluminum alloy constructs. Within each combination of ring material composition and ring diameter, stiffness did not significantly increase when the ring thickness was doubled. Within each combination of ring material composition and ring thickness, stiffness significantly decreased with increased ring diameter.

**Discussion/Conclusion:** Aluminum alloy rings were found to be significantly stiffer than carbon composite rings. Though the carbon composite rings were considerably less stiff, clinical recommendations cannot be made from a single-ring, in vitro analysis. Further studies are needed to evaluate how these rings would behave in vivo.

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

## 58 Computed tomography arthrography of the equine carpus

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**Introduction:** The intra-articular ligaments of the carpus are implicated as a source of lameness in the horse however antemortem diagnosis of intercarpal ligament pathology remains difficult. Carpal arthroscopy, though limited to

evaluation of the mid-body currently provides the most accurate assessment. Computed tomography (CT) arthrography has been utilized in canine and equine stifles and human knees for the identification of intra-articular soft tissue damage. We hypothesize that CT arthrography will accurately delineate the intercarpal ligaments of the carpus.

**Materials and Methods:** CT images were obtained prior to and after injection of iodinated contrast media into the antebrachio-carpal and middle carpal joints and carpal canal in 8 cadaveric limbs. Spin echo sequences were obtained in 3 planes using a 1.5 Tesla MRI scanner in 3 limbs. Following MRI, colored resin was injected into the synovial structures and cross sections were obtained in 3 planes. CT arthrograms were compared to pre-contrast, MRI and anatomic specimens.

**Results:** The medial (MPICL) and lateral (LPICL) palmar intercarpal, radiocarpal and transverse intercarpal ligaments were visible in all limbs. The proximal and distal entheses were also readily identifiable. CT arthrograms represented the anatomy well when compared to the corresponding MRI and the specimens.

**Discussion/Conclusion:** CT arthrography allowed for accurate identification and description of intercarpal ligaments including their proximal and distal entheses. The study supported the hypothesis that CT arthrography provides representative images of the regional anatomy. This technique may be useful in the antemortem diagnosis of clinical cases with carpal region lameness.

**Acknowledgments:** This study was funded by the Center for Equine Health with funds provided by the State of California parimutuel fund and contributions by private donors.

## 59 Minimally invasive nail osteosynthesis for the treatment of femoral and tibial fractures in dogs

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**Introduction:** Minimally invasive nail osteosynthesis (MINO) is the standard of care for diaphyseal femoral and tibial fractures in people. Current veterinary nail designs applied using conventional osteosynthesis techniques may be associated with acute postoperative instability and local blood supply impairment leading to suboptimal outcomes. This study describes MINO of canine femoral and tibial fractures using an angle stable interlocking nail (AS-ILN).

**Materials and Methods:** Thirteen dogs (5–60 months; BW: 16–76 kg) with traumatic femoral and tibial fractures underwent MINO with an AS-ILN. Postoperative alignment was compared to the normal contralateral limb (paired t-test,  $p < 0.05$ ). Bone healing was assessed radiographically every 3 weeks. Results: Postoperative alignment was not significantly different from contralateral bones in any cases. Mean ( $\pm$ SD) time to clinical union was  $37.8 \pm 13.1$  days (21–65 days) in the 10 cases that completed scheduled follow up. Long-term radiographic evaluation showed absence of complication and continuous bone remodeling in the 12 cases completing the study.

**Discussion/Conclusion:** The short healing time and absence of complications reported in this series compare favorably with healing times (90–120 days) and complications rates (17% requiring revision surgery) reported with open reduction and internal fixation using conventional nails. The MINO application of an AS-ILN allowed atraumatic reduction with immediate postoperative stability and likely explains our findings. These agree with studies reporting the benefits of biological osteosynthesis and strongly suggest that MINO using an AS-ILN is an effective alternative to standard ILNs.

**Acknowledgments:** One author is the AS-ILN inventor. Implants were provided by BioMedtrix.



## 60 Development of the Sirius® canine total elbow prosthesis

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**Introduction:** Total elbow replacement (TER) was first reported in clinical canine cases in 2003. Our experience with that first system revealed issues with complications such as luxation and ulnar fracture. Consequently, we embarked upon a project to design a novel canine total elbow system, 'Sirius' and here we report the design features.

**Materials and Methods:** Analyses of CT scans provided morphometrics to guide computer-aided design of the new components. Model and cadaveric surgery trials provided an iterative refinement of design. Ex vivo kinematic analyses have been performed and phase I clinical trials are underway.

**Results:** Key aspects of the resulting system include: instrumentation to accurately identify elbow flexion-extension axis (locates on axis of humeral shaft and articular surface of trochlea); gap between humeral forks for passage of radio-ulnar implant, to optimise ROM; conservative bone cuts to maintain the loading environment on the distal humerus and enhance long-term fixation (by minimising stress shielding); all cuts are instrumented and reference from one flexion-extension axis marker; radio-ulnar cutter is a 'TPLO' reciprocating saw; radio-ulnar bearing is snap-fitted to stemless, screw-fixed titanium plate with HA coating providing an internal plate fixation to the semilunar notch of the ulna to guard against fracture; a small radial difference between TER articular surfaces to enable some joint laxity; universal (non-handed) implants existing in small, medium and large to cover wide range of patient size.

**Discussion/Conclusion:** Cadaveric trials confirm that Sirius® TER allows accurate alignment, a relatively large ROM, and should avoid ulnar fracture through reinforcement of this weakened area.

**Acknowledgments:** None

## 61 Mechanical analysis of twelve toggle suture constructs

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**Introduction:** Toggle pin stabilization most commonly fails due to breakage of the suture at the toggle pin eyelet. Our goal was to compare the mechanical performance of 12 commonly used toggle-suture-constructs (TSC) to determine the best combination of the TSC to maximize sustained load and cycles to failure in toggle-pin stabilization.

**Materials and Methods:** TSC evaluated included #5 Fiberwire, #5 Orthofiber, 80-lb Nylon leader, or a double strand of #5 Ethibond, combined with Piermattei toggle (0.045" K wire), Modified Knowles (MK) toggle (3/32" Steinmann pin) and Securos toggle rod for a total of 12 test groups. Acute and cyclic testing were performed and load at failure and cycles to failure were determined.

**Results:** In acute testing, Piermattei TSCs failed by toggle deformation and MK and Securos TSCs failed by suture breakage. The mean failure load of MK-Orthofiber TSC (1416 +/- 74N) was significantly greater than that of MK-Ethibond (883 +/- 38N); both were significantly greater than all others. Only the MK toggle constructs with Ethibond, Orthofiber and Nylon did not fail during cyclic testing.

**Discussion/Conclusion:** The combination of the MK toggle and Orthofiber or Ethibond achieved a higher load at failure than all other groups, and resisted the greatest number of cycles to failure. Long term mechanical testing of these TSC is warranted to further define their durability.

**Acknowledgments:** Financial support provided by the CAHF, Cummings School of Veterinary Medicine at Tufts University, and materials donated by Securos Veterinary Orthopedics, Inc., Fiskdale, MA and Arthrex Vet Systems Inc., Naples, FL.

## 62 A descriptive study of the equine proximal interphalangeal joint using magnetic resonance imaging, contrast arthrography, and arthroscopy

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**Introduction:** This study describes areas of the proximal interphalangeal (PIP) joint that are arthroscopically accessible, defines the soft tissue structures that must be avoided during arthroscope and instrument placement, and investigates the differences between the fore and hind PIP joint.

**Materials and Methods:** Twenty-four cadaver limbs were used to perform anatomic modeling, magnetic resonance imaging (MRI) with MRI-compatible needles, computed tomography (CT) with contrast arthrography, and arthroscopy of the PIP joint. Two arthroscopic approaches to the dorsal joint pouch were compared.

**Results:** Imaging revealed that in order to prevent penetration of the axial palmar/plantar ligaments, abaxial palmar/plantar ligaments, straight sesamoidean ligament, and the branches of the superficial digital flexor tendon palmar/plantar pouch instrument and arthroscope portals should be placed dorsal to the neurovascular bundle. There was no significant difference in the amount of joint visualized when using the more proximal or distal approach to the dorsal joint pouch ( $p=0.586$ ).

**Discussion/Conclusion:** The dorsal and palmar/plantar joint pouches allowed for adequate arthroscopic visibility of the axial portions of the articular surface of the proximal and middle phalanx (P1 and P2). The abaxial portions of the articular surface were difficult to view due to the narrowing of the joint pouches abaxially. When comparing the proximal and distal approach to the dorsal joint pouch, placement of the arthroscope 1.5cm proximal to the joint allowed the easiest manipulation of the arthroscope. Palmar/plantar portals were placed dorsal to the neurovascular bundle to prevent injury of tendons and ligaments.

**Acknowledgments:** Funding for this study was provided by the John H Venable Grant at the College of Veterinary Medicine and Biomedical Sciences at Colorado State University.

## 63 Quantification of proximal ulnar displacement following ulnar osteotomy to address canine medial coronoid disease

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**Introduction:** Radioulnar incongruity is considered a component of the aetiopathogenesis of canine medial coronoid disease. Ulna osteotomies are commonly performed to 'free' the proximal ulna, and unload the medial compartment of the cubital joint.

**Materials and Methods:** Thirteen forelimbs with arthroscopic evidence of medial coronoid disease and joint incongruity were prospectively evaluated. Following arthroscopic management of the intra-articular structures the cases were then randomly assigned to either receive an ulna osteotomy at the level of the proximal one third of the ulna (7) or at fifty percent of the ulna length (6). The proximal third osteotomies were performed proximo-lateral to disto-medial and caudo-proximal to cranio-distal. On either side of the planed osteotomy, radiopaque biocompatible markers were inserted into the ulna. Craino-caudal and flexed mediolateral views of the antbrachii were taken immediately post-operatively and at two, four, six and eight to twelve weeks thereafter.

**Results:** Statistically greater movement of the proximal ulna was appreciated in the cases with the more proximal osteotomy (mean 3.14mm) relative to those cases with the mid-ulna osteotomy (1.25mm). In the cases of the proximal third osteotomy the proximal segment on radiographs had visibly moved proximally as well as caudally.



**Discussion/Conclusion:** Performing an osteotomy further distally dampens segmental movement likely due to constraint of the interosseous ligament. The more proximal osteotomy is more favorable as greater unloading of the medial compartment is expected. Further studies would include joint kinematic studies in addition to clinical follow-up.

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

#### 64 Force plate evaluation of a model of canine lameness

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**Introduction:** A humane, simple, repeatable, non-invasive/ topical, and reversible pain model in normal dogs would be ideal to objectively assess the analgesic properties of non-proven or developing analgesic formulations in dogs for the treatment of lameness due to "superficial" pain (e.g. osteoarthritis).

**Materials and Methods:** 12 healthy dogs were used for the study. A 14 mm marble was placed into the paw pad recesses of the thoracic and pelvic limbs. Dogs were trotted at a controlled velocity and acceleration over an imbedded force plate. Peak vertical force (PVF), vertical impulse (VI), and stance time were recorded before and following treatment with carprofen (4.4 mg/kg, PO).

**Results:** Compared to baseline, marble placement on the thoracic limb paws resulted in greater mean reduction of PVF compared to placement on the pelvic limb paw ( $P=0.001$ ). VI reductions were greater with the thoracic limb paws compared to the pelvic limb paw ( $P=0.0034$ ). There was no difference in stance time between thoracic or pelvic limb paws with marble placement ( $P>0.05$ ). There was no improvement in PVF, VI or changes in stance times following carprofen dosing in either thoracic or pelvic limb paws ( $P>0.05$ ).

**Discussion/Conclusion:** The marble did not act as true noxious stimulus since treatment with carprofen did not significantly improve the variables measured with marble placement. Although a marble may not induce a nociceptive-based lameness it may have useful applications during select physical therapy sessions.

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

#### 65 The modified maquet procedure (mmp) for tibial tuberosity advancement in dogs: preliminary report of 131 cases

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**Introduction:** Tibial tuberosity advancement (TTA) to treat human knee OA was first described by Maquet more than 30 years ago. TTA is now very popular for treating CCL failure in dogs but the surgery is complex, time-consuming and costly. MMP is a technique for TTA using a wedge shaped implant of Titanium foam. This paper is a preliminary report of the first 131 MMP cases – the first clinical application of Ti foam.

**Materials & Methods:** 131 dogs with CCL failure were treated using MMP. Outcome was "good" or "poor" when re-examined clinically and radiographically four weeks after surgery. Complications were "minor"; "major" or "catastrophic".  
**Results:** Age:  $4.95 \pm 2.67$  years. Weight  $35.5 \pm 9.1$ kg. TT advancement  $7.5 - 13.5$ mm ( $9.9 \pm 1.5$ mm). 83/131 were double-wired: 48/131 were single-wired (26 proximal; 22 distal). Outcome: 4 weeks 94.7% "good"; 5.3% "poor". Complications: Minor: 33/131 (25.2%). Major: 4/131 (3.1%) – 4 similar traumatic diaphyseal fractures of the tibia and fibula. Surgical time was  $27.2 \pm 4.2$ ; (Range: 22–45 minutes).

**Discussion/Conclusion:** These results compare favorably in terms of outcome and complication rates with published accounts of other similar surgeries. Although outcome analysis was binary, subjective, uncontrolled and therefore sub-optimal, it seems that MMP is worthy of consideration as a treatment for CCL failure in dogs. Complication rates are already low and all the recorded major

complications were attributable to owner non-compliance. Surgical time is short compared with other similar procedures.

**Acknowledgment:** The presenting author is a member of IVOA LLP which receives royalty payments on the sale of the instruments and Ti foam implants which are the subject of this paper.

#### 66 Use of computed tomography to compare technical outcome for femoral head and neck excision osteotomy performed by novice surgeons

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**Introduction:** Excision of the femoral head and neck (FHNE) is a salvage procedure commonly performed to treat arthritis or trauma of the coxofemoral joint. The purpose of this study was to compare the use of osteotome and sagittal saw for FHNE by novice veterinarians to identify an accurate technique that may be utilized by new graduates in a general practice setting.

**Materials and Methods:** FHNE as performed on 6 canine cadavers with a 12.7mm osteotome and mallet using a pre-scoring technique ("OM") or Micro 100 sagittal saw, 14mm x 25.5mm coarse blade ("MSS"). Osteotomy times were recorded for each limb. A 64 slice helical computed tomography scanner measured volume of the femur proximal to the lesser trochanter on 3-dimensional reconstructions. A blinded board certified radiologist blinded to the osteotomy technique measured volume of remaining femoral neck and presence/number of fissures and bone fragments in the surrounding soft tissues.

**Results:** OM residual neck volume was 0.13cc, versus 0.0083cc in MSS ( $P=0.0688$ ). Only OM osteotomies were noted to have caudal cortex fissures and chips. Bone transection time was 60s for OM and 48s for MSS ( $P=0.4717$ ). When the population was restricted to dogs with a body weight  $>17$ kg, sagittal saw bone transection time was significantly shorter ( $p=0.0292$ ).

**Discussion/Conclusion:** We cannot reject the null hypothesis regarding incomplete femoral neck excision using osteotome versus saw in novice veterinarians, however presence of fissures and bone chips in OM femurs may indicate superiority of using a sagittal saw versus osteotome for FHNE.

**Acknowledgments:** There was no proprietary interest for this project; this study was funded internally by Oregon State University College of Veterinary Medicine.

#### 67 Internal fixation of incomplete sagittal fractures of the first phalanx – outcome in 126 cases (1994–2010)

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**Introduction:** Incomplete sagittal proximal first phalangeal (ISFPF) fractures are common in racehorses. The majority of studies examining post-fracture prognosis have focused on American Standardbreds and include both surgical and conservative treatment. There are few recent data from the UK reporting on post-operative racing performance in Thoroughbreds.

**Materials and Methods:** Inclusion criteria were racing Thoroughbreds that had a simple lag screw repair of an ISFPF fracture under general anaesthesia and survived to discharge. Racing performance data were retrieved from the Racing Post website.

**Results:** 126 horses had either a short ( $<30$  mm;  $n=17$ ) or long ( $>30$  mm;  $n=109$ ) ISFPF fracture. Fractures occurred significantly more frequently in forelimbs (66%) than hindlimbs (34%;  $P=0.005$ ); and most often in the right forelimb (42%;  $P=0.005$ ). Post-operative racing records were available for 108 horses; 83% (95% confidence interval 76.3–90.4%) returned to racing. 88% of horses with short and 68% with long sagittal fractures raced following surgery, with mean post-operative time until racing 270 and 337 days, respectively. 82% that raced post-operatively were placed, 63% won a race.



**Discussion/Conclusion:** These results demonstrate the prognosis for horses returning to racing is excellent following surgical repair of long and short ISPPF fractures. These findings provide a similar or better prognosis than described in previous literature, suggesting an improved ability to treat these fractures in the perioperative period. The data offer a prognostic guide for trainers, owners and clinicians that evaluates the benefits of surgical correction of these fractures in the racing Thoroughbred.

**Acknowledgments:** Polly Compston is supported by the Margaret Giffen Trust

### 68 Diagnosis of an incomplete third carpal bone slab fracture using magnetic resonance imaging

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A 10 year-old thoroughbred gelding used for three-day eventing was evaluated for chronic lameness of one-year duration of the left carpus that resolved with intra-articular anesthesia, and partially resolved with regional anesthesia of the proximal suspensory. Previous radiographic, scintigraphic, and ultrasonographic exams revealed abnormalities that were not related to the carpus. Intra-articular treatment of the carpus concurrent with rest improved the lameness, but the lameness progressed when returned to exercise. Magnetic resonance imaging (MRI) was used to more completely evaluate the carpus because it eliminates summation artifacts and detects articular cartilage and subchondral bone damage more readily than radiography. In addition, MRI provides superior soft tissue imaging than ultrasonography. The results of the MRI were third carpal bone sclerosis with articular cartilage irregularities and subchondral bone damage consistent with an incomplete slab fracture. Arthroscopic exploration confirmed the MRI findings. The lesion was debrided and the horse was placed on appropriate post-operative rest and controlled exercise regime. Four months following surgery the horse was sound and had full-range of motion of the joint. Magnetic resonance imaging should be considered as a valuable imaging modality to detect occult sources of lameness not found with conventional imaging.

### 69 Implant removal – complication or inconvenience?

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**Introduction:** Orthopedic surgeries have a particular risk of infection in that an implant is often used. The goal of this study was to determine the prevalence of implant removal following TPLO and the cost associated with removal.

**Materials and Methods:** The number of TPLO procedures and TPLO implant removals was determined from 01/01/2006 until 05/30/2010. Age, breed, sex, hind limb, cost of removal, time from surgery to removal and reason for removal was identified from the medical record.

**Results:** During the time period there were 1,117 TPLOs performed with 102 TPLO implant removals (9.1%). For the TPLO cases a variety of breeds were represented. There were 52 left hind limbs and 40 right hind limbs affected and there were 4 intact male, 0 intact female, 45 neutered males and 53 neutered females. The reasons for removal were: implant failure (2%), infection (60.8%), irritation (1%), persistent lameness (28.4%), neoplasia (1%) and not provided (6.8%). 33% of removals occurred 1–6 months after surgery. The average cost of implant removal was \$1,1156.60 regardless of reason for removal.

**Discussion/Conclusion:** In recent years implant-associated infections have become more common in veterinary medicine. Our TPLO implant removal rate of 9.1% was higher than the overall re-operation rate reported in the literature (1.6–8.4%), yet our infection rate (5.5%) was lower. As surgeons we hope that our complication rate will be low and that re-operation will be something encountered infrequently. Nonetheless, the cost associated with implant removal must be considered, especially since our clients often bear the burden of this cost.

**Acknowledgments:** None.

### 70 Inter- and intra- observer variability in a novel radiographic technique for the measurement of the magnitude of the advancement necessary for the Modified Maquet procedure

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**Introduction:** The Modified Maquet Procedure (MMP) is a variation of the tibial tuberosity advancement (TTA) for treatment of the cranial cruciate ligament deficient stifle. Development of the MMP procedure included a review and modification of the TTA templating procedure, as it is not perfect. This study compared the intra- and inter-observer variability of the new radiographic measuring technique.

**Materials and Methods:** Twenty MMP radiographs were selected and anonymously copied in triplicate. Three observers were asked to measure the required tibial tuberosity advancement, using the DICOM image processing tools and choose a wedge size for the resulting sixty images, following the new technique. To compare the intra- and inter-observer variability, intraclass correlation coefficients (ICCs) were calculated. The intra-observer ICCs were calculated using the triplicate measurements for each of the twenty radiographs. The inter-observer ICCs were calculated by comparing the mean advancement of the three measurements between each observer.

**Results:** There was strong intra- and inter-observer agreement with the ICC's all being close to 1. The same wedge  $\pm$  one size was chosen on 97.8% of occasions.

**Discussion/Conclusion:** This study has shown that there is low intra and inter-observer variability of the new MMP radiographic measuring technique. All measurements are based on points on the tibia so exact stifle angle, variable morphology of the femur and spatial alignment of the femur and tibia are irrelevant. MMP wedges come in 1.5mm size increments and in nearly all cases the same wedge plus or minus one size was chosen which is comparable to consistently choosing a 3mm TTA cage.

**Acknowledgments:** None

### 71 A retrospective evaluation of the efficacy of bacterial isolation from synovial fluid in dogs with suspected septic arthritis

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**Introduction:** Early diagnosis and appropriate antimicrobial therapy is essential to prevent irreversible pathology in dogs with septic arthritis. It was our perception that we infrequently obtained positive cultures of synovial fluid from dogs with suspected joint sepsis. The purpose of this study was to evaluate our efficacy in culturing bacteria from synovial fluid from dogs with suspected septic arthritis.

**Materials and Methods:** Synovial fluid cytology and microbiology submissions from dogs from March 2007 to August 2011 were reviewed. Synovial fluid samples from dogs with a clinical history and joint fluid cytology consistent with joint sepsis (leukocytosis  $>10,000/\mu\text{L}$  with  $>50\%$  neutrophils) were included. Cultures of synovial fluid from these dogs were used to evaluate the efficacy of bacterial isolation.

**Results:** Thirty-nine dogs met the inclusion criteria for this study. Initial cultures of joint fluid yielded bacterial growth in 41% of the dogs. Thirty-eight percent had surgery involving the affected joint within 150 days prior to presentation. Twenty-five percent of dogs with positive cultures received antibiotics prior to arthrocentesis, whereas 22% of dogs with negative cultures received antibiotics prior to sample collection. Anaerobic cultures were performed in 25 of the dogs, none of which yielded bacterial growth.





**Discussion/Conclusion:** Obtaining bacterial growth from cultures of synovial fluid in dogs with suspected septic arthritis has a low yield. Prior administration of antibiotics did not appear to influence the efficacy of isolating bacteria. There is a need to establish a more effective means of identifying bacteria from canine joints with suspected sepsis.

**Acknowledgments:** None.

## 72 Assessing the efficacy of shockwave therapy in dogs with hip dysplasia and osteoarthritis using pressure platform gait analysis

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**Introduction:** The extracorporeal shockwave therapy (ESWT) is used recently as alternative treatment to osteoarthritis, but their treatment protocols and effectiveness in improvement the lameness and is still being researched. The objective of this study was to verify the increase of vertical forces in 60 days of follow up after ESWT using pressure platform gait analysis.

**Materials and Methods:** Fifteen dogs with hip dysplasia and osteoarthritis were evaluated and treated with ESWT (Group A). As control group were used 20 healthy dogs (group B) and 18 dogs with osteoarthritis treated conservatively (group C). The dogs were submitted to a walkway system. Each dog had to walk for five valid trials in a speed between 1.3 to 1.6 m/s, and was investigated for peak vertical force and vertical impulse (% of body weight). ANOVA for independent and dependent measures were used when appropriate ( $P < 0.05$ ). Group A received 2000 radial shocks in only one randomized hip joint with a pressure of 3,4 bars and a frequency of 10Hz were applied three times with a between the treatments. Group C received glucosamine and chondroitin sulfate for 60 days. Group C and A were evaluated in time 0, in 30 and 60days after initiation of treatment.

**Results:** Group A had significant increase of vertical forces from 30 days after ESWT comparing to contralateral limb and with Group C. The mean values become closely to the healthy dogs.

**Discussion/Conclusion:** From the results obtained in this study, we suggest that ESWT could improve vertical forces.

**Acknowledgments:** FAPESP.

## 73 Comparison of growth factor treatments on the fibrochondrogenic potential of canine fibroblast-like synoviocytes for meniscal tissue engineering

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**Introduction:** Tissue engineering is an evolving strategy for treating avascular meniscal injury or total meniscal loss. Multiple growth factor protocols used to induce in vitro fibrocartilage formation carry a substantial procedural unwieldiness and financial burden. The objective of this study is to compare the fibrochondrogenic potential and biomechanical properties of a single growth factor protocol (TGF- $\beta$ 3) versus a previously utilized triple growth factor protocol in tensioned synoviocyte bioscaffolds (TSB).

**Materials and Methods:** Arthroscopically harvested synoviocytes were cultured and synthesized into TSB. Bioscaffolds were cultured with TGF- $\beta$ 3 or combined TGF- $\beta$ 1, IGF-I and FGF-2. DMMB and Toluine blue stain assessed GAG content; hydroxyproline assay and collagen I and II immunohistochemistry assessed collagen content. Cell viability was assessed using Ethidium Homodimer and Calcein AM. TSB stiffness and peak load to failure was determined by materials testing/force-deformation curves.

**Results:** Triple growth factor (Tri-GF) treated TSB produced higher total and percent GAG content versus TGF- $\beta$ 3 treated TSB. Total and percent collagen

content was not different between groups. Tri-GF TSB had a higher peak load to failure, but no difference was found for stiffness, resilience or toughness. Cell viability was lower for TGF- $\beta$ 3 TSB. Collagen production was more organized in Tri-GF TSB.

**Discussion/Conclusion:** Cellular viability likely accounted for matrix differences between groups. Cellular viability and organization of the ECM contributed to mechanical differences; however, neither group approached the strength required in normal menisci. The use of TGF- $\beta$ 3 alone cannot be recommended at this time for in vitro formation of autologous fibrocartilage bioscaffolds for meniscal deficiency.

**Acknowledgments:** There was no proprietary interest for this project; this study was funded by an internal resident grant by the Oregon State University College of Veterinary Medicine.

## 74 Evaluation of the effectiveness of bandages on restricting carpus range of mobility in healthy dogs at a walk using electrogoniometry

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**Introduction:** Strapping, process of applying adhesive tape to limit joint motion, is routinely used on humans but not on dogs. Studies investigating the efficacy of bandages procedures on motor performance of carpal joint are lacking in veterinary medicine. Few studies have been designed to evaluate the validation of electrogoniometry in dogs and no accurate standardized protocol for electrogoniometer fixation on the carpus of dogs has been assessed.

**Materials and Methods:** Ten nonlame various breed dogs. A P&GB twin axis electrogoniometer (EG) was used to quantify carpus motion. A standardized fixation procedure was described. In a preliminary study, EG accuracy was evaluated. Angles measurements simultaneously obtained by X-rays and electrogoniometry of the dog's carpal joint in flexion, extension, abduction and adduction were compared. During the main study, dogs were walked on a treadmill with an EG fixed on their right carpus. The range of motion (ROM) of the carpus joint in flexion/extension (Flex/Ext) and abduction/adduction (Abd/Add) were measured in each condition (without bandage, with strapping, with light Robert Jones without and with splint).

**Results:** Compared with X-Ray, EG was shown to be more accurate for ROM measurement (absolute error of 3.1° in Flex/Ext and 1.7° in Abd/Add). All bandages caused a significant decrease of ROM ( $p < 0.05$ ). A significant difference between all the different bandage conditions was identified ( $p < 0.005$ ). Strapping, Robert Jones bandage and Robert Jones bandage with splint restricted respectively flexion/extension of 37, 72 and 88%. The decreased range of motion in abduction/adduction was respectively 31, 64 and 70%.

**Discussion/Conclusion:** Flexible, light weight EG are accurate for measuring static carpus joint angles. Even if the subjects of the study were healthy, the results of the present study are a basis for guiding veterinarians in the choice of bandages in carpal joint injuries.

**Acknowledgments:** Biometrics France.



## 75 Sensitivity and specificity to determine lameness in dogs with a pressure walkway system

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**Introduction:** Pressure walkway systems have been used in research for several years for gait analysis in dogs to characterize normal gait and assess lameness. The aim of this study was to measure the performance for detection of a lame limb and to provide clinicians a quantitative gait analysis tool.

**Materials and Methods:** A 4.3 m walkway system was used to calculate spatiotemporal and pressure parameters in 115 lame adult dogs suffering from one or several limbs; 32 from a forelimb lameness (shoulder 10, elbow 15, extremities 7), 83 from an hindlimb lameness (hip 36, knee 35, extremities 3). Sensitivity and specificity were first calculated without taking care of the disease. Then, they were detailed for unilateral elbow dysplasia (7 cases), unilateral CCL rupture (22 cases) and unilateral hip dysplasia (25 cases). Orthopaedic conditions were confirmed by explorative surgery or Xray.

**Results:** For all orthopaedic pathologies diagnosed, sensitivity and specificity were respectively 84,6 and 91,1%. (100–97,8 for ED; 93,7–95,7 CCRr; 89,8–90,8 for HD).

**Discussion/Conclusion:** The pressure walkway presented a high sensitivity and specificity to determine a lame limb particularly for ED and CCRr. Because of the high values of sensitivity and specificity, portability, quick results and non invasive procedure, pressure walkway systems could be used in clinics to help diagnosis of orthopaedic diseases.

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## 76 Correlation of canine hip joint laxity from stress radiography with synovial fluid volume from mri analysis

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**Introduction:** This study investigated a possible association between canine coxofemoral laxity measured by the distraction index (DI) from stress radiography and corresponding synovial fluid volume (SFV) quantified from magnetic resonance imaging (MRI). Canine hip DI is definitively predictive of the development of osteoarthritis. Cadaver studies suggest that increased synovial fluid volume is associated with increased hip joint laxity. However, in vivo studies comparing DI to SFV have not been performed.

**Materials and Methods:** The coxofemoral joints of seven Labrador Retrievers were evaluated with stress radiography (DI) and MRI (Fat-saturated 3D fast spoiled gradient and Fat-saturated fast recovery fast spin echo sequences). The MRI images were analyzed using the 3DVIEWNIX software system for SFV quantification. A volumetric index (VI) was developed to normalize for variation in hip dimensions. Appropriate statistical methods were applied. Significance was set at  $P < 0.05$ .

**Results:** DI was positively correlated to VI ( $r=0.85$ ,  $r^2=0.73$ ,  $P < 0.001$ ), indicating a significant moderate linear relationship.

**Discussion/Conclusion:** MRI-determined hip laxity correlated with stress-radiographic hip laxity (DI). Hip laxity from stress radiography in the dog has been strongly correlated with ultimate OA susceptibility of the hip. These pilot results therefore suggest that increased synovial fluid volume may be a principal pathogenic pathway for OA susceptibility of the hip. Expanded studies to support these findings are needed. If confirmed, MRI-determined coxofemoral VI may represent a new phenotype for future hip dysplasia diagnostic and genetic studies.

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## 77 Tensioned synovioyte bioscaffolds versus collagen scaffolds for potential use in meniscal tissue engineering

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**Introduction:** Meniscal injury is a common cause of lameness in the canine secondary to cranial cruciate ligament deficiency. Tissue engineered bioscaffolds may be a treatment option for meniscal incompetency. The objective of this study is to compare meniscal like matrix content and resilience of autologous tensioned synovioyte bioscaffolds to synovioyte- collagen sheet bioscaffolds. **Materials and Methods:** Canine synovioytes were seeded on tensioned porcine intestinal submucosa sheets (SIS bioscaffolds, "SSB") or synthesized into tensioned synovioyte bioscaffolds, ("TSB"). Constructs were cultured with 17.7% FBS or human recombinant chondrogenic growth factors. DMMB and Toluidine blue stain assessed GAG content; the hydroxyproline assay and collagen I and II immunohistochemistry assessed collagen content. Tensile resilience was determined by materials testing/ force-deformation curves.

**Results:** Percent collagen content was higher in all SSB versus all TSB. Percent GAG content was higher in TSB versus SSB. Pre-culture SIS collagen and GAG content were not different than SSB. Tensile resilience was higher in growth factor treated TSB than FBS TSB, and all SSB versus TSB. Growth factor treated constructs had regional GAG deposition and type II collagen immunoreactivity; all constructs had uniform collagen type I immunoreactivity.

**Discussion/Conclusion:** All constructs in this study contained ECM seen in the meniscus. Growth factor treatment in this study affected construct architecture, induced greater type II collagen deposition, and increased tensile biomechanical properties of TSB. TSB cannot be ruled out as a possible scaffold for use in meniscal tissue engineering, and future studies will focus on improving cell viability and mechanical characteristics relative to porcine SIS.

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## 78 Comparison of two fluid ingress/ egress techniques for canine stifle arthroscopy

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**Introduction:** The purpose of this study is to evaluate two stifle arthroscopy fluid ingress/ egress techniques for extra-articular fluid escape and complications. We hypothesize that there will be no difference between the volume of extra-capsular fluid escape and technical complications between a 2 portal/fluid pressure bag system and a 3 portal/ fluid pump system.

**Materials and Methods:** Ten canine cadavers received preoperative computed tomography of the limbs, followed by stifle arthroscopy using a 10% solution of iopamidol as ingress fluid delivered via pressure bag (2PB) or via arthroscopic peristaltic pump (3FP). 3FP limbs received an additional fluid egress portal placed via cannula and trochar. Arthroscopy was limited to 20 minutes per joint. The volume of the contrast medium in the soft tissues was measured via CT post-operatively.

**Results:** Total post operative intra- and extra-articular fluid volume was 72mL in 3FP and 82.1mL in 2PB ( $P= 0.7352$ ). Percentage fluid retention per total ingress fluids given was 7.9% in 3FP and 21.6% in 2PB ( $P= 0.0289$ ). Two 3FP joints had a 3–4mm long trochar track on the distal lateral trochlear ridge. 2PB joints had intermittent visual blurring due to joint fluid mixing or fat pad fragmentation/dissolution, two of which also had joint collapse.



**Discussion/Conclusion:** We cannot reject the null hypothesis regarding superiority of one technique over the other in regard to technical complications, however use of 3FP technique may be useful for stifle arthroscopies that take longer than 20 minutes and may have better visualization due to greater fluid throughput.

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### 79 The effect of oral tramadol on ground reaction forces in dogs with experimentally induced osteoarthritis

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**Introduction:** Osteoarthritis (OA) is a common condition of joints and analgesics, including tramadol, may be used. The aim of the study reported here was to determine the effectiveness of tramadol in reducing lameness associated with OA of a stifle joint. We hypothesized that tramadol would not significantly improve lameness.

**Materials and Methods:** The study was a blinded, sham-controlled, cross-over study using nine hound-type dogs with surgically induced OA of one stifle. Dogs were randomized to treatment or sham groups. Treated dogs received 5 mg/kg tramadol every 12 hours for 2 weeks. After a washout period dogs were crossed over to the other group. Data were collected on days 0, 7, and 14, including measurement of ground reaction forces (peak vertical force and vertical impulse) at a trot, stifle range of motion, and subjective gait analysis. Subjective gait analysis was performed by a blinded investigator using a visual analog scale and a categorical ranking from 0–4. Data were analyzed using Wilcoxin Signed-Rank test or Pearson chi-square.

**Results:** There were no significant differences in any data collected between day 0 and day 14 in the tramadol or sham groups.

**Discussion/Conclusion:** We accept our hypothesis that tramadol alone does not improve lameness associated with OA. Further studies should investigate the efficacy of other doses or dosing frequencies of tramadol, and the efficacy of combination therapy.

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