

## Veterinary Orthopedic Society 42<sup>nd</sup> Annual Conference Abstracts

February 28 - March 7, 2015  
Sun Valley, Idaho, USA

### Part I

#### PODIUM ABSTRACTS

### 1 Pathologic Changes Identified during Second Look Stifle Arthroscopy and TPLO Implant Removal in Clinically Asymptomatic Limbs

**Phipps WE; Hudson CC; Beale BS**

Gulf Coast Veterinary Specialists, Houston, TX.

**Introduction:** Previously, intra-articular pathologic changes and implant infections have been reported in post-operative cases with clinical evidence of disease. The purpose of this retrospective study is to document the incidence of pathology found during second look stifle arthroscopy and tibial plateau levelling osteotomy (TPLO) implant removal in patients that are clinically asymptomatic in that leg.

**Materials and Methods:** The medical records and arthroscopy images from 74 patients undergoing second look stifle arthroscopy and implant removal were reviewed. All surgical procedures were performed at the same practice by a single surgeon. Prophylactic second look stifle arthroscopy and TPLO plate removal was performed concurrently with another procedure.

**Results:** Of the 74 arthroscopies performed, 22 (29.7%) showed tears in the medial meniscus and twenty-five (33.7%) showed tears in the lateral meniscus. Culture and sensitivity was performed on 43 plates, and eight (18.6%) were culture positive. One (1.4%) major arthroscopic complication occurred. Thirteen (17.6%) minor implant removal complications occurred. All complications resolved with appropriate therapy.

**Discussion/Conclusion:** The data presented here show that treatable meniscal injury and implant infection can go undetected. The post-operative complication rate was low, and all complications resolved with appropriate medical management.

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

### 2 Clinical Outcome of Antebrachial Growth Deformity Treated Using True Spherical Osteotomy and Internal Fixation in 47 Canine Limbs

**Fitzpatrick N; Egan P**

Fitzpatrick Referrals, Surrey, United Kingdom

**Introduction:** True spherical osteotomy (TSO) allows concurrent correction of rotational and angular limb deformity. We applied single level TSO to treat complex antebrachial growth deformity (ABGD) using internal fixation with orthogonal plates.

**Materials and Methods:** Radiographs of dogs presented with ABGD were assessed using CORA methodology. CT scan was obtained for all multi-apical deformities. Distal ulnar osteotomy was followed by distal radial osteotomy with a DOMESAW™. Limb realignment was achieved by palpation of the humeral epicondyles and radial-ulnar styloid processes whilst the joints were manipulated. K-wires maintained alignment during plate application. Reassessment was performed at 2, 6, 12 and 26 weeks.

**Results:** 35 dogs (47 forelimbs) had a mean body weight of 13kg, mean age 658 days, mean radiographic follow up 210 days. All were affected by ro-

tational deformity and 34/47 were multi-apical. All patients exhibited complete healing of the radial osteotomy by 12 weeks. Limb function was graded as excellent in 15/47 limbs, good 27/47 and fair 5/47. Those patients with a fair outcome exhibited persistent elbow pain (2), radial head sub-luxation (1) and persistent carpal pain (2). Post-operative complications included implant removal (5/47) and one patient exhibited delayed union at 6 weeks.

**Discussion/Conclusion:** Intraoperative alignment of the elbow and carpus has been reported reliable for restoration of functional limb axis where significant rotation is present. TSO may maximise bone contact, expedite healing, and minimise translation. Two orthogonal plates facilitated rapid healing, avoiding management challenges associated with external skeletal fixation.

**Acknowledgements:** There was no proprietary interest or funding provided

### 3 Results of a Dynamic Oblique Proximal Ulnar Osteotomy for Joint Incongruity with and without Placement of an Intramedullary Pin

**Norvet JS; Balfour R**

Surgery, Animal Specialty and Emergency Center, Los Angeles, CA

**Introduction:** Elbow joint incongruity is seen in juvenile dogs secondary to early cessation of ulnar growth. A surgical technique used to restore congruity is the dynamic oblique proximal ulnar osteotomy (DOPUO). Placement of an intramedullary (IM) pin is recommended for stability of the osteotomy. Complications associated with IM pin use can include pin migration, pin breakage and irritation to the surrounding soft tissues. We hypothesized that a DOPUO without an IM pin is a safe procedure and can achieve good healing and stabilization of the osteotomy.

**Materials and Methods:** Medical records of 15 dogs with elbow incongruity that underwent unilateral or bilateral DOPUO were retrospectively reviewed. Information obtained from the medical record included elbow stability, radiographic osteotomy healing, and post-operative complications.

**Results:** Eighteen DOPUOs were performed. Three dogs had bilateral procedures. Four DOPUOs included an IM pin. Complications included pin breakage with subsequent pin removal (n=2) and premature osteotomy site healing (n=2). All DOPUOs without an IM pin had appropriate healing of the osteotomy on orthogonal radiographs and clinical stability.

**Discussion/Conclusion:** In this case series, the use of an IM pin was not necessary for stabilization of the osteotomy. Dogs that underwent DOPUO without IM pin placement healed well without instability, caudal tilting, or carpal varus.

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

### 4 A Novel Model for Canine Cranial Cruciate Ligament Disease

**Cook JL<sup>1</sup>; Bozynski CC<sup>1</sup>; Kuroki K<sup>1</sup>; Stannard JP<sup>2</sup>; Smith PA<sup>3</sup>; Stoker A<sup>1</sup>; Cook CR<sup>1</sup>**

(1)Comparative Orthopaedic Laboratory University of Missouri, Columbia, MO, (2)University of Missouri, Columbia, MO, (3)Columbia Orthopaedic Group, Columbia, MO.

**Introduction:** The objective of this study was to characterize the effects of partial transection versus synovial debridement of the cranial cruciate ligament (CCL) in dogs.

**Materials and Methods:** With IACUC approval, adult purpose-bred research hounds underwent surgery and were assessed over the following 8 weeks. Dogs were randomized into 3 CCL status groups: sham control (n=9), intact CCL with synovial debridement (exposed CCL) (n=9) and partial transection of the CCL (partial tear CCL) (n=9).

**Results:** Dogs in the exposed CCL group and partial tear CCL group had significantly (p<0.05) more severe lameness, pain, effusion, reduced function

and reduced comfortable range of motion (CROM) compared to controls, with the partial tear CCL group being most severely affected. More severe CCL and whole-joint pathology, and radiographic scores for osteoarthritis were present in the partial tear CCL group compared to exposed and/or sham control group.

**Discussion/Conclusion:** Based on these findings, biologic components of CCL injury (exposed CCL) played a role in whole-joint inflammation, but clinical and pathological effects were more severe when both biologic and biomechanical components were present (i.e., partial tear CCL). These novel canine models were successfully developed to evaluate partial transection versus synovial debridement of the CCL, and will be used to evaluate etiopathogenesis and optimizing diagnosis and treatment options for CCL disease in dogs.

**Acknowledgements:** Funded by the Comparative Orthopaedic Laboratory

## 5 CASE REPORT: Repair of Calcanean Tendon Rupture Using Calcanean Tendon Component Allografts in Dogs: A Case Series

**Spall BF**

Washington State University, Pullman, WA

Calcanean tendons are one of the most common musculotendinous units that sustain injuries in dogs. Allogenic tendon grafts are currently used in human medicine and provide a useful application in canine calcanean tendon repair. Commercially available canine calcanean tendon allografts or calcanean tendon component allografts were used in the following case series of dogs requiring calcanean tendon repair.

**Case 1:** A two year old, 19kg, intact male, Border collie was presented for chronic left hind limb lameness. Ultrasound examination indicated calcanean tendon disruption. Calcanean tendon allograft and omental free-graft were used to repair the calcanean tendon. Four week ultrasound follow-up examination indicated healing calcanean tendon.

**Case 2:** A four-month-old, intact male, 18.6kg, Siberian husky mix was presented for evaluation of a chronic left hind limb lameness. Ultrasound examination revealed complete disruption of all components of the calcanean tendon. Superficial digital flexor allograft was used to repair the calcanean tendon. Follow-up-examinations indicated healing calcanean tendon with placement of significant weight on his left limb.

**Case 3:** A nine-year-old, 27kg, spayed female, Australian shepherd presented for a 3.5 month left hind limb lameness. Ultrasound examination indicated complete disruption of the left common calcanean tendon. Superficial digital flexor tendon allografts were used to repair the calcanean tendon. Two weeks following surgery the dog was placed in a custom orthotic. Four week ultrasound indicated healing calcanean tendon.

**Discussion/Conclusion:** The use of common calcanean or calcanean tendon component allografts may be a viable option for calcanean tendon repair in dogs.

## 6 Comparison of Open Reduction Versus Minimally Invasive Surgical Approaches on Screw Position in Canine Sacroiliac Lag-Screw Fixation

**Marturello DM<sup>1</sup>; Déjardin LM<sup>2</sup>; Guiot LP<sup>3</sup>; Guillou RP<sup>4</sup>; DeCamp CE<sup>5</sup>**

(1)Michigan State University, East Lansing, MI, (2)Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI, (3)Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, Dublin, OH, (4)Ohio State University, Dublin, OH, (5) College of Veterinary Medicine, Michigan State University, East Lansing, MI

**Introduction:** Sacroiliac luxations (SIL) are routinely treated with lag screw(s) using open reduction and internal fixation (ORIF). While minimally invasive osteosynthesis (MIO) techniques have been devised to optimize

screw fixation and reduce surgical morbidity, objective comparison of these approaches has yet to be performed.

**Materials and Methods:** Canine cadaver SILs were stabilized using an ilio-sacral screw applied via either ORIF or MIO techniques (n=10/group). Sacral screw angles in the dorsal and transverse planes and pilot screw hole length to sacral width ratio were measured on CT scan MPRs, then statistically compared (p<0.05).

**Results:** Screw angles were greater in ORIF than MIO specimens (p<0.001) in both dorsal and transverse planes reflecting their consistent cranioventral orientation. Pilot hole length to sacral width ratio was smaller (p<0.001) in the ORIF than MIO group. While pilot holes exited through S1 end-plate in 3/10 ORIF specimens, spinal or sacral foramina were not violated in either group.

**Discussion/Conclusion:** This study demonstrates that compared to ORIF, MIO provides more accurate and consistent sacral screw placement. Importantly, with proper techniques, iatrogenic neurological damage can be avoided with both ORIF and MIO. The pilot hole to sacral width ratio, which relates to safe screw fixation, also demonstrates that screw penetration of at least 60% of the sacral width can be achieved regardless of surgical approach. These findings suggest that MIO of SIL is a valid alternative to ORIF.

**Acknowledgements:** Supported by MSU Endowed Research Fund

## 7 Evaluation of Early Effects of a Novel Lumbosacral Distraction-Fusion Stabilization System for the Treatment of Degenerative Lumbosacral Stenosis over Six Months Using Computed Tomography

**Fitzpatrick N; Jovanovik E**

Fitzpatrick Referrals, Godalming, United Kingdom

**Introduction:** Degenerative lumbosacral stenosis (DLSS) is the most common cause of compression of the cauda equina and L7 nerve roots in dogs and abaxial neuroforaminal impingement is a significant contributor to pain. Our aim was to apply the FITS device (Fitz Intervertebral Traction Screw) in association with dorsal stabilization using an internal vertebral screw-rod system (Fitzateur) and to compare measurement of L7 neuroforaminal and end-plate distance dimensions pre-operatively with six months post-operatively.

**Materials and Methods:** All CT scans were performed using 0.63mm slice thickness, pitch of 1, 130kV, 100mAs. Dorsal and mid-sagittal end-plate distance measurements respectively were obtained where the transverse and spinous processes of L7 were clearly visible. Left and right neuroforaminae were observed at entry, mid and exit zones. Statistical analysis was performed using ANOVA with repeated measures (generalized linear model).

**Results:** 21 dogs met inclusion criteria. The average age was 6.4 ± 1.9 years and weight 27.1 ± 9.1kg. All measurements taken were significantly different from pre-operatively. In the dorsal plane end-plate distance measurements were 87.5% immediate, 53% 6 weeks and 31.8% 6 months. In the sagittal plane 132.2% immediate, 114.2% 6 weeks and 122.8% 6 months. The right neuroforaminal measurements increased 79.1% at entry, 114.2% At mid and 161.9% at exit zones immediately post-operative; and 79.1%, 100% and 86.7% respectively at 6 months.

**Discussion/Conclusion:** CT documentation of distraction of the neuroforaminae may support application of this technique for the management of DLSS in dogs. Further studies to determine long-term outcome are warranted.

**Acknowledgements:** The primary author is the inventor of the devices.

## 8 Clinical Safety and Efficacy of a Novel Dextran Polymer Hydrogel Local Antimicrobial Therapy Applied for Suspected Orthopedic Implant Infection in Dogs

Reed TP<sup>1</sup>; Thomas LA<sup>2</sup>; Weeren R<sup>1</sup>; Ruth JD<sup>3</sup>; Anders BB<sup>1</sup>

(1)Chesapeake Veterinary Surgical Specialists, Towson, MD, (2)Veterinary Surgical Specialists, Tampa, FL, (3)Small Animal Clinical Sciences, Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, VA

**Introduction:** A novel, fully bioabsorbable dextran polymer local antimicrobial therapy may increase the spectrum of activity and decrease side effects compared to systemic therapy following orthopedic implant infection. We hypothesize no physical or clinicopathologic abnormalities would be identified after application and signs of infection would resolve without systemic antimicrobials.

**Materials and Methods:** Patients with suspected tibial plateau leveling osteotomy (TPLO) implant-associated infection were selected; owners provided informed consent. Routine TPLO explantation and bacterial culture were performed. Polymer hydrogel containing 100mg amikacin and 50mg clindamycin was applied. No systemic antimicrobials were used postoperatively. Clinicopathologic data were collected preoperatively and 2 weeks post-operatively. Physical examinations were performed at 2, 6, and 12 weeks post-operatively.

**Results:** Positive bacterial cultures in 16/20 dogs (80%); 44% of which were methicillin resistant. No significant alterations in clinicopathologic data identified. No signs of inflammation/infection in any patient at the 6 and 12 week rechecks.

**Discussion/Conclusion:** No adverse events were identified. All signs of infection resolved after implant removal and application of the local antimicrobial. This local antimicrobial therapy vehicle appears safe and efficacious; additional controlled, blinded studies are needed.

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

## 9 Biomechanical Evaluation of the SpeedWhip™ Suture Pattern Versus a Three-Loop Pulley Suture Pattern in a Canine Calcaneus Tendon Avulsion Model

Dunlap AE<sup>1</sup>; Kim SE<sup>1</sup>; McNicholas WT<sup>2</sup>

(1)Small Animal Clinical Sciences, University of Florida College of Veterinary Medicine, Gainesville, FL, (2)Affiliated Veterinary Specialists, Jacksonville, FL

**Introduction:** The purpose of this study was to compare the SpeedWhip™ (SW) suture pattern with the three-loop pulley (TLP) suture pattern for the surgical repair of canine calcaneal tendon avulsion injuries.

**Materials and Methods:** In vitro biomechanical study using 12 paired tendons collected from 6 canine cadavers. Paired tendons were repaired with either a SW suture pattern using Fiberloop® suture or a TLP suture pattern using polypropylene suture. Tensile loads required to create a 1-mm and a 3-mm gap were measured.

**Results:** The mean loads to achieve a 1-mm and 3-mm gap were 41.53 +/- 6.59 Newton (N) and 68.28 +/- 21.49 N for the TLP, and 17.55 +/- 6.08 and 38.38 +/- 14.71 for the SW. These differences were significantly significant ( $P < 0.001$  and  $P = 0.007$ , respectively).

**Discussion/Conclusion:** The TLP with polypropylene suture is superior to the SW using Fiberloop® at resistance to 3-mm gap formation.

**Acknowledgement:** The authors of the study thank Arthrex® for donating Fiberloop®.

## 10 The Effect of Valgus Femoral Osteotomies on Measures of Anteversion

Franklin SP<sup>1</sup>; Gilleland B<sup>2</sup>; Adams R<sup>3</sup>; Monibi F<sup>3</sup>

(1)Department of Small Animal Medicine and Surgery, University of Georgia, Athens, GA, (2)Department of Educational Resources, University of Georgia, Athens, GA, (3)College of Veterinary Medicine, University of Georgia, Athens, GA

**Introduction:** Femoral anteversion has been considered synonymous with femoral torsion. However, with human femurs anteversion changes when an osteotomy is performed that only affects the varus/valgus conformation of the bone. The purpose of this study was to determine whether anteversion changes when distal femoral osteotomies are performed on canine femurs that correct a varus malangulation but which do not change femoral torsion.

**Materials and Methods:** Five normal canine femurs were scanned using a 3-D laser scanner to create 3-dimensional reconstructions. A virtual Steinman pin was placed from the femoral head through the proximal-lateral femur along the femoral neck axis to facilitate repeated identification of the neck axis. Three images of the unaltered femurs ('Normal') were acquired corresponding to the axial, sagittal, and frontal planes. A virtual osteotomy of the distal femur was performed and 18° of varus was induced ('Varus') without affecting torsion of the bone. Images were re-acquired. Anteversion was measured from the axial images under both conditions. The differences in anteversion between the 'Normal' and 'Varus' conditions were compared using a paired T-test.

**Results:** The mean anteversion with distal femoral varus was 16.8°. Anteversion increased to a mean of 22.8° in the 'Normal' condition. This change was statistically significant ( $p < 0.0001$ ).

**Discussion/Conclusion:** The hypothesis was accepted. Correction of distal femoral varus without change in torsion to the femur results in a statistically significant increase in femoral anteversion.

**Acknowledgements:** None

## 11 Response to Repeated Intra-Articular Injection of Stem Cells after 2 Cell Preparation Techniques

Joswig AJ<sup>1</sup>; Watts AE<sup>2</sup>; Cummings K<sup>3</sup>; Marsh C<sup>1</sup>; Dabareiner R<sup>1</sup>; Levine G<sup>4</sup>; Gregory C<sup>5</sup>; Smith R<sup>4</sup>

(1)TAMU, College Station, TX, (2)Clinical Sciences, Texas A&M University, College Station, TX, (3)Department of Veterinary Integrative Biosciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX, (4)Texas A&M, College Station, TX, (5)Department of Molecular and Cellular Medicine, Institute for Regenerative Medicine at Scott and White, Texas A&M Health Sciences Center, Temple, TX

**Introduction:** Marked post injection synovitis has been reported in the horse following intra-articular injection of mesenchymal stem cells (MSCs). Routine MSC culture media contains xenogeneic proteins (fetal bovine serum; FBS). We hypothesized that intra-articular injection of MSCs prepared with FBS throughout culture would result in worsened negative clinical reaction compared to the injection of MSCs prepared in a xenogen-free manner for the final 48 hours.

**Materials and Methods:** We injected 10 million bone marrow derived autologous MSCs to a randomly selected forelimb fetlock of 12 horses (n=6 xenogen-free preparation; n=6 routine preparation). Four weeks later, the injection was repeated. In the week following each injection, serial clinical and synovial cytology evaluations were performed and compared to baseline values. FITC-conjugated FBS was used to characterize depletion of xenogeneic proteins.

**Results:** The increase in TNCC after the first injection was not different, but after the second injection the change in TNCC was significantly worse for the FBS group ( $p < 0.0001$ ) but not the xenogen-free group. Horses from the FBS group had increased lameness ( $p = 0.04$ ) and xenogen-free treated horses did not. Flow cytometry revealed >95% reduction in the amount of intra-cytoplasmic FBS in the xenogen-free group.

**Discussion/Conclusion:** Stem cells should be prepared in a xenogen-free manner to minimize negative joint reaction, especially if a second injection is planned.

**Acknowledgements:** We have no conflicts to disclose. This work was funded by the Link Fund for Equine Research at Texas A&M University and a Faculty Grant from the Department of Large Animal Clinical Sciences at Texas A&M University

## 12 Repeated Intra-Articular Injection of Autologous Vs. Allogeneic Bone Marrow Derived Stem Cells in the Normal Equine Metacarpophalangeal Joint

**Watts AE<sup>1</sup>; Joswig AJ<sup>2</sup>; Dabareiner R<sup>2</sup>; Marsh C<sup>2</sup>; Cummings K<sup>3</sup>; Levine G<sup>4</sup>**

(1)Clinical Sciences, Texas A&M University, College Station, TX, (2)TAMU, College Station, TX, (3)Department of Veterinary Integrative Biosciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX, (4)Texas A&M, College Station, TX

**Introduction:** Intra-articular injections of mesenchymal stem cells (MSCs) are used in the treatment of injury. Allogeneic MSCs would allow point-of-care treatment. We hypothesized that intra-articular injection of allogeneic MSCs would result in worse negative clinical reaction compared to the injection of autologous MSCs.

**Materials and Methods:** In 12 horses, we injected 10 million bone marrow derived, culture expanded MSCs to a randomly selected forelimb fetlock (6 autologous; 6 allogeneic). Four weeks later, the injection was repeated. Serial clinical and synovial cytology evaluations were performed and compared to baseline values.

**Results:** Following the first injection, the change in total nucleated cell count (TNCC) over time varied significantly for allogeneic ( $p < 0.0001$ ), but not for autologous ( $p = 0.2$ ). Following the second injection, both groups TNCC varied significantly (allogeneic,  $p < 0.0001$ ; autologous,  $p = 0.05$ ) over time. Other cytology parameters did not vary over time for either group. Changes in post-injection lameness, joint effusion and joint range of motion were minimal and there were no differences between groups.

**Discussion/Conclusion:** Although the negative joint reaction was mild, there was significantly worse reaction (increased TNCC) in the allogeneic MSC injected joints compared to autologous MSC injected joints. Although mild, there was an increased negative joint reaction to autologous MSC injection after a second, injection. The cause of the negative joint reaction should be investigated.

**Acknowledgements:** No conflicts. Funded by the Link Fund for Equine Research at Texas A&M and a Faculty Grant from the Department of Large Animal Clinical Sciences at Texas A&M

## 13 Isolation and Characterization of Canine Multipotent Stromal Cells from Bone Marrow, Adipose Tissue, and Synovium

**Bearden RN<sup>1</sup>; Huggins SS<sup>1</sup>; Saunders WB<sup>1</sup>; Smith R<sup>1</sup>; Gregory C<sup>2</sup>**

(1)Department of Small Animal Clinical Sciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX, (2)Department of Molecular and Cellular Medicine, Institute for Regenerative Medicine at Scott and White, Texas A&M Health Sciences Center, Temple, TX

**Introduction:** It has been proposed that Multipotent Stromal Cells (MSCs) improve tissue repair through differentiation into specialized mesenchymal cells, production of anabolic growth factors and anti-inflammatory cytokines, modulation of the immune system, and anti-apoptotic effects. For these reasons, MSCs may prove useful as therapeutic agents for debilitating orthopedic conditions. We hypothesized that canine MSCs (cMSCs) could successfully be isolated from various canine tissues and that important differences would exist in isolation parameters, growth kinetics, Colony Forming Unit (CFU) potential, and tri-lineage differentiation.

**Materials and Methods:** Canine synovium, bone marrow, and adipose tissue were harvested from five dogs and cMSCs were isolated via Ficoll separation or enzymatic digestion. Flow cytometry profiles and proliferation rates of each cell line were determined. Tri-lineage differentiation assays were performed on all cell lines.

**Results:** cMSCs from synovium, bone marrow, and adipose were successfully isolated. Cells were negative for CD 34, 45, Stro-1 and positive for CD 9, 44, 90. CD105 staining was variable across cell lines. There were significant differences in growth parameters, CFU potential, and differentiation across cell lines.

**Discussion/Conclusion:** The cMSCs evaluated in this study meet established in vitro characteristics for MSCs. In general, synovial and adipose MSCs proliferate more rapidly and exhibit greater CFU capacity, while synovial and marrow MSCs respond more favorably to osteogenic differentiation cues.

**Acknowledgements:** American Kennel Club-Canine Health Foundation.

## 14 Serum Concentrations of Canine Interleukin-1 Receptor Antagonist Protein (IRAP) in Healthy Dogs in Response to an Autologous Serum Processing System

**Saunders WB; Huggins SS; Bearden RN; Steiner J; Suchodolski J**

Department of Small Animal Clinical Sciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX

**Introduction:** Assessing the effect of autologous serum processing systems on IL-1RA levels in canine blood is currently limited by the inability to detect the canine IL-1RA isoform. The objective of this study was to develop a canine IL-1RA ELISA and to report the effect of the IRAP II system on canine blood.

**Materials and Methods:** Whole blood samples from 8 healthy dogs were obtained and transferred to IRAP II chambers or 50 ml polypropylene control tubes. Samples were incubated at 37°C for 24 hours before serum was separated, filtered, and stored at -80°C. Additional blood was collected during the same venipuncture and allowed to clot for one hour and processed for pre-treatment controls. A Canine IL-1RA ELISA was developed using commercially available reagents. The ELISA was validated by determining intra-assay variability, inter-assay variability, dilutional parallelism, spiking recovery, and detection limit. Results: Assay linearity, accuracy, and reliability were well within acceptable limits as determined by O:E ratios and variance. There was a significant increase in IL-1 RA after 24 hours in both polypropylene ( $P < 0.001$ ) and IRAP II treatment groups ( $P < 0.001$ ).

**Discussion/Conclusion:** This study demonstrates the successful generation and validation of a canine IL-1RA ELISA. IL-1RA serum levels increase after incubation of whole blood in an autologous processing system.

**Acknowledgements:** ArthrexVet, Naples, FL.

## 15 PDGF-BB Mediated Invasion of 3D Collagen Gels By Canine MSCs Requires MT-MMPs

**Saunders WB<sup>1</sup>; Bearden RN<sup>1</sup>; Huggins SS<sup>1</sup>; Reeve L<sup>1</sup>; Gregory C<sup>2</sup>**

(1)Department of Small Animal Clinical Sciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX, (2)Department of Molecular and Cellular Medicine, Institute for Regenerative Medicine at Scott and White, Texas A&M Health Sciences Center, Temple, TX

**Introduction:** Cellular invasion requires an invasion stimulus, integrins, matrix metalloproteinases (MMPs), and cytoskeletal rearrangement. Determining the molecular events regulating invasion of Mesenchymal Stem Cells (MSCs) is likely important in order to improve cMSC homing. We hypothesized that PDGF-BB would induce canine MSCs to invade 3D collagen matrices in an MT-MMP dependent manner and soluble MMPs would be less relevant to this process.

**Materials and Methods:** cMSCs were isolated from bone marrow using Ficoll centrifugation, characterized, and seeded on 3.75 mg/ml Collagen I gels

in a serum-free environment. Cells were allowed to invade for 24–72 hours and invasion was determined by direct quantification of invading cells. MMP expression and activation were determined via Western blot and gelatin zymography.

**Results:** PDGF-BB induced dose- and time-dependent invasion of cMSCs into 3D collagen matrices. PDGF-BB resulted in increased expression of MT1-MMP, MMP-1, and MMP-2. The MMP inhibitors GM6001, TAPI-O, and TIMP-3, which broadly inhibit both soluble and membrane-type MMPs, significantly inhibited invasion. Addition of TIMP-1, which inhibits soluble MMPs, or the serine proteinase inhibitor aprotinin, had a markedly reduced effect. Lastly, the addition of the PDGF receptor tyrosine kinase inhibitor AG1296 resulted in a significant reduction in cMSC invasion.

**Discussion/Conclusion:** This work demonstrates that PDGF-BB is an important growth factor in canine MSC invasion of 3D matrices and that MT-MMPs are required for this process.

**Acknowledgements:** None.

## 16 Equine Bone Marrow-Derived MSC Osteogenesis Requires Intrinsic BMP Activity

**Stewart M; Martychenko M; Durgam S**

Veterinary Clinical Medicine, University of Illinois at Urbana Champaign, Urbana, IL

**Introduction:** Bone marrow-derived MSCs (BM-MSC) show strong osteogenic capacity and are a valuable resource for augmenting bone repair. BM-MSCs undergo osteogenesis without needing exogenous stimulation by bone morphogenetic proteins (BMP). This study was conducted to test the hypothesis that endogenous BMP activity is necessary for BM-MSC osteogenesis.

**Materials and Methods:** Bone marrow aspirates were passaged twice to enrich for MSCs. The cells were then maintained in basal medium or transferred to osteogenic medium for up to 10 days. The effect of osteogenic medium on BMP mRNA levels was determined by QPCR. Endogenous BMP activity was inhibited by co-administering the BMP antagonists Noggin, K0288 or DMH-1. Osteogenesis was monitored by aggregate formation, alizarin red staining, calcium deposition, alkaline phosphatase (ALP) activity, and up-regulation of the critical osteogenic transcription factors.

**Results:** BMP-4 transcript levels were significantly increased over the first 7 days. All three BMP inhibitors inhibited osteogenesis, as demonstrated by multiple phenotypic assays. Runx2 expression was not affected by BMP inhibition; however, OSX expression was significantly suppressed by the inhibitors.

**Discussion/Conclusion:** The significant inhibition of osteogenesis by BMP inhibitors Noggin, K0288 and DMH-1 indicates that endogenous BMP activity is necessary for BM-MSC osteogenesis. The results suggest that BMP-4 is the ligand primarily responsible for driving osteogenesis, although this requires further investigation. The results indicate that OSX up-regulation, a transcription factor required for appendicular skeletal formation, is a primary target of endogenous BMP signaling during osteogenesis.

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

## 17 Technique and Outcome of Treatment of Concurrent Medial Patellar Luxation and Cranial Cruciate Ligament Rupture Using a Modified Tibial Plateau Leveling Osteotomy in 40 Stifles

**Flesher KJ; Hudson CC; Beale BS**

Gulf Coast Veterinary Specialists, Houston, TX

**Introduction:** The purpose of this study was to describe the surgical technique for a modified TPLO to simultaneously level the tibial plateau and realign the quadriceps mechanism through lateral translation of the distal tibial segment as reported in 40 stifles.

**Materials and Methods:** Thirty-five dogs with concurrent CCLR and MPL were treated by modified TPLO where the distal tibial segment was lateralized until the quadriceps mechanism was appropriately aligned. Arthroscopy was performed in addition to preoperative, postoperative and recheck radiographs. Tibial plateau angle, magnitude of distal tibial segment lateralization, mechanical medial proximal tibial angle, mechanical medial distal tibial angle, and osteotomy healing time were analyzed.

**Results:** Dogs with complete and partial CCLR were almost evenly split and grades I-III of MPL were represented. Overall complication rate was 20% with the majority being minor complications that resolved with no treatment or medical management. Reluxation occurred in two dogs but in both cases revision surgery was not pursued due to owner satisfaction with limb function.

**Discussion/Conclusion:** A modified TPLO should be considered for concurrent MPL and CCLR correction. Complication rates are comparable to those previously reported for medial patellar luxation. Further studies evaluating effects of this technique on stifle contact mechanics are indicated.

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

## 18 CASE REPORT: Treatment of Canine Stifle Disruptions Using a Novel Transarticular Implant

**Embleton NA; Barkowski VJ**

Helivet Mobile Surgical Services, Embark Enterprises Inc., Sundre, AB, Canada

Canine stifle disruption is characterized by damage to two or more of the primary or secondary stifle stabilizing structures. The goal of treatment should be to immediately stabilize the joint while restoring normal anatomical alignment and stifle kinematics. Early return to mobility after surgery results in better outcomes for stifle function. Treatment of stifle disruption with a novel articulated implant combined with primary repair of collateral ligament damage is described in two patients. The patients included a 33.6 kg Siberian Husky and a 46 kg Labrador Retriever cross. Pre-operative and post-operative stifle stability, lameness scores, range of motion and thigh circumference were assessed in both patients. Both patients had complete rupture of the cranial cruciate ligament combined with injuries to the caudal cruciate and collateral ligaments. One patient also had an avulsed medial meniscus. Both patients were weight bearing and began rehabilitation exercises 24 hours post-operatively. Each patient showed marked improvement compared to preoperative assessment with follow up times of 10 and 7 months respectively. Both patients returned to full activity. Osteoarthritis and reduced joint function are common after surgical repair of stifle disruption in large dogs and may be due to the prolonged immobilization of the joint required following primary repair. This implant provides an alternative treatment for this potentially devastating injury by providing immediate stability allowing for early post-operative use of the affected limb. **Acknowledgements:** The authors hold the patent to this implant.

## 19 Custom Built Rotating Hinge Total Knee Replacement in Six Dogs: Indications, Design Principles, Surgical Technique and Clinical Outcome

**Fitzpatrick N; Egan P**

Fitzpatrick Referrals, Godalming, United Kingdom

**Introduction:** The rotating hinge total knee replacement (RHTKR) represents an evolution of design principles based on experience of limitations with uniaxial constrained and unconstrained TKR in the face of end-stage stifle disease with profound periarticular disruption.

**Materials and methods:** The implants used for all cases were custom-made based upon CT scan measurements using computer assisted design (CAD). The components were constructed from a cobalt chromium alloy using direct metal laser sintering (DMLS) and were secured via tapered beveled stems ce-

mented with polymethylmethacrylate (PMMA). A molded ultra-high-molecular-weight-polyethylene (UHMWPE) bushing mounted on a peg on the tibial component provided axial stability and allowed 7 degrees of internal and external rotation.

**Results:** RHTKR was performed unilaterally in 6 dogs. Indications for application were multi-ligamentous disruption of the stifle joint, end-stage degenerative joint disease and previous infection. Limb function at 12 weeks and to a mean of 248 days was graded as 'excellent' (5) and 'fair' (1). Radiographic follow-up has not shown implant loosening. One femur fissured intraoperatively and one patient suffered a femoro-tibial luxation 4 weeks post-operatively which was addressed by replacing the UHMWPE bushing.

**Discussion/Conclusion:** Alternatives to arthroplasty in the face of end-stage stifle disease or injury are arthrodesis and amputation. The RHTKR is designed to decrease bone-cement-implant interface stress. Luxation in one case prompted redesign of the UHMWPE bushing. RHTKR is a valid treatment option for profound stifle disruption and end-stage stifle degenerative joint disease in dogs, even after infection.

**Acknowledgements:** The primary author is the inventor of the implant system.

## 20 Tibial Tuberosity Advancement Performed with a Bioabsorbable Polymer Cage: A Series of 14 Cases

**Schwartz SH; Maritato KC**

MedVet Medical and Cancer Center, Cincinnati, OH

**Introduction:** Tibial Tuberosity Advancement (TTA) has an overall infection rate of 2.6–7.6% and infection often requires implant removal. Cage removal is time-consuming and challenging. We investigated a novel bioabsorbable 70% Poly-L/D-lactide (PLDLA) TTA cage. Our objective was that a PLDLA cage is a viable alternative to metal TTA cages and can result in excellent clinical outcomes with minimal complications.

**Materials and Methods:** Medical records were reviewed in 14 dogs with a PLDLA TTA cage (Group 1) between February and April 2014. Fixation method, complications, and radiographic evaluation were recorded. Group 2 consisted of 14 dogs with a metal TTA cage. Bone healing was compared at 6-week recheck using 2 scoring systems.

**Results:** All dogs in Group 1 were available for follow-up and radiographs at 6 and 27 weeks and achieved clinical union with improved weight bearing and no major complications. Few minor intra-operative complications occurred involving the screws. Bone healing between groups was similar using both scoring systems. Using scoring system A, the mean healing in Group 1 was 2.6 and Group 2 was 2.53. Using scoring system B, the mean healing in Group 1 was 1 and in Group 2 was 1.15.

**Discussion/Conclusion:** This case series supports our hypothesis that a PLDLA TTA cage is a viable alternative to a metal cage with similar 6-week radiographic healing. Bone healing was complete in all PLDLA cases. Future studies are indicated to assess infection rate using PLDLA cages and determine if cage removal is necessary in cases of infection.

## 21 Is the Ninety-Degrees Patellar Tendon Angle a Valid End-Point for Tibial Tuberosity Advancement Surgery in Dogs?

**Ness M**

Croft Veterinary Hospital, Cramlington, United Kingdom

**Introduction:** The ninety-degrees patellar tendon angle (PTA) is a key datum in the pre surgical planning and a surrogate endpoint of tibial tuberosity advancement (TTA) surgery. The use of surrogate endpoints is problematic; specifically, the risk over interpretation and misinterpretation. A good surrogate end point is readily available, easily measured, reliable, reproducible, biologically plausible and correlate with primary outcome measures.

The purpose of this work was to evaluate the validity of the ninety-degrees patellar tendon angle (PTA) as a surrogate endpoint for TTA surgery.

**Materials and Methods:** A systematic search of the literature identified relevant publications, which were reviewed systematically against the criteria that define the quality of a surrogate endpoint. Additionally, the effects of varying angles of stifle extension and tibio-femoral subluxation on measured PTA was investigated using digitally constructed radiographic images.

**Results:** Measured PTA varied widely with small stifle subluxations or radiographic positioning imprecision. 37 papers identified: ten reported data relevant to this study: nine about reliability, six about reproducibility; three about correlation with primary surgical outcome and six about biological plausibility.

**Discussion/Conclusion:** The poor reliability/reproducibility found here is consistent with previous reports. The datum has not been compared directly with any primary outcome measures and correlates poorly with other surrogate endpoints. The datum is biologically implausible deriving from a human model, features of which prevent sensible extrapolation to dogs. The ninety degrees PTA datum is not a useful surrogate endpoint for TTA surgery.

**Acknowledgements:** None

## 22 Ultrasonographic Findings in 121 Cases of Equine Carpal Sheath Effusion

**Stewart M<sup>1</sup>; Jorgensen JS<sup>2</sup>; Genovese R<sup>3</sup>; Dopfer D<sup>4</sup>**

(1)Veterinary Clinical Medicine, University of Illinois at Urbana Champaign, Urbana, IL, (2)Comparative Biosciences, University of Wisconsin, Madison, WI,

(3)Cleveland Equine Clinic, Ravenna, OH, (4)Medical Sciences, University of Wisconsin, Madison, WI

**Introduction:** This retrospective study was conducted to identify pathology associated with carpal sheath effusion (CSE) in horses.

**Materials and Methods:** Records from 121 horses with ultrasonographic diagnosis of CSE were evaluated. Horses were categorized as young (<9 years), middle-aged (9–10 years) or older (>18 years). Odds ratios were calculated to assess risk for lameness and specific injuries.

**Results:** Most horses (89/121) were lame at presentation. Eight cases were idiopathic. Osseous abnormalities were diagnosed in only 10 cases. Most soft tissue injuries (93/111) were complex; involving two or more structures and extending from the antebrachium into the metacarpus. The SDF/T (98 cases) was the most commonly injured structure. The SDFT accessory ligament (ALSDFT) was also frequently injured (64 cases). DDF/T lesions were present in 21 cases. ALDDFT lesions were recognized in 25 horses. Forty-two horses had carpal sheath and/or retinacular damage. Forty horses had medial SDF musculotendinous junction fibrosis. Middle-aged and older horses were significantly more prone to lameness at presentation, SDF and SDFT injuries and medial SDF fibrosis than young horses.

**Discussion/Conclusion:** Osseous pathology was uncommon. SDF/T lesions were identified in almost 90% of cases, but most horses had other injuries, particularly the ALSDFT. The significant associations of SDF/T injuries with age strongly suggests that cumulative strain injury at and around the flexor MTJs occurs in horses. Comprehensive assessment of all soft tissue structures in the distal antebrachium and proximal metacarpus is indicated in all horses with CSE.

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

### 23 A Retrospective Study of Surgical Treatment of 28 Cases of Primary Palmar/Plantar Annular Ligament Desmopathy

**Bladon BM; Nieuwenhuis G**

Donnington Grove Veterinary Surgery, Newbury, United Kingdom

**Introduction:** The outcome of tenoscopically-guided desmotomy of the palmar/plantar annular ligament (PAL) for primary PAL desmopathy is not clearly reported. Our objectives were to report the return to exercise in horses treated with tenoscopically-guided transection of the PAL, where PAL injury was the primary condition.

**Materials and Methods:** Surgical records from Donnington Grove Veterinary Surgery between 2005 and 2013 were reviewed retrospectively. The inclusion criteria were cases that had undergone surgical transection of the PAL under tenoscopic guidance. The exclusion criteria were horses with other abnormalities within the tendon sheath, considered the primary cause of lameness. Follow-up information was obtained by a telephone questionnaire. Results: 28 horses were included in the study. 25 horses were considered to have clinically relevant restriction to passage of the arthroscope through the fetlock canal at the time of surgery. Following a 3 month post-operative period 27 horses were sound. Three horses did not return to previous level of activity due to unrelated lameness issues and 3 returned to a lower level due to owner preference. Two horses had recurrent or persistent lameness associated with the tendon sheath.

**Discussion/Conclusion:** Surgical treatment of primary PAL desmopathy carried a good prognosis (89%) in contrast to a previously studies (<50%). We suggest the better results in this study are due to tenoscopic examination identifying horses with other abnormalities of the tendon sheath, which may be included in previous studies.

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

### 24 Hoof Position during Limb Loading Affects Dorsoproximal Bone Strains on the Equine Proximal Phalanx

**Singer ER<sup>1</sup>; Stover SM<sup>2</sup>; Garcia TC<sup>2</sup>**

(1)Department of Musculoskeletal Biology/School of Veterinary Science, University of Liverpool, Neston, United Kingdom (2)J.D. Wheat Veterinary Orthopedic Research Laboratory, University of California, Davis, Davis, CA

**Introduction:** Risk for proximal phalangeal (P1) sagittal fracture is higher on turf compared to all-weather or dirt racing surfaces. Foot slip was shorter for Thoroughbreds galloping on turf than an all-weather wax surfaces. We hypothesized that restricting forward foot slip would result in higher P1 bone strains during metacarpophalangeal joint (MCPJ) hyperextension.

**Materials and Methods:** Unilateral limbs from 6 cadavers were instrumented with strain gauges and bone reference markers to measure dorsoproximal P1 bone strains, and MCPJ extension, collateromotion and axial rotation during in vitro limb loading to 10500N, for each of three different foot conditions (Forward, Free, Restricted) in a randomised block design. Rosette strain data were reduced to principal and shear strain magnitudes and directions. The effect of foot position on P1 bone strains and MCPJ angles were assessed using a mixed model ANOVA.

**Results:** The Restricted condition resulted in higher P1 axial compressive ( $p=0.015$ ), maximum shear ( $p=0.043$ ) and engineering shear ( $p=0.046$ ) strains compared to the Forward condition. The Restricted condition had higher compressive ( $p=0.025$ ) and lower tensile ( $p=0.043$ ) principal strains compared to the Free condition. At equal strains, axial rotation and collateromotion MCPJ angles were greatest for the Restricted condition.

**Discussion/Conclusion:** Restricting forward foot slip resulted in higher principal and shear bone strains on dorsoproximal P1 at gallop load. Racing surfaces or horseshoe additions that restrict foot slip may alter MCPJ biomechanics and potentiate sagittal P1 fracture.

**Acknowledgements:** No proprietary interest or funding provided.

### 25 Caudal Lumbar Vertebral Fractures in California Quarter Horse and Thoroughbred Racehorses

**Collar EM<sup>1,2</sup>; Zavodovskaya R<sup>2</sup>; Spriet M<sup>3</sup>; Hitchens PL<sup>2</sup>; Wisner T<sup>2</sup>; Ural FA<sup>4</sup>; Stover SM<sup>2</sup>**

(1)Oregon State University, Corvallis, OR, (2)J.D. Wheat Veterinary Orthopedic Research Laboratory, School of Veterinary Medicine, University of California-Davis, Davis, CA, (3)Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California-Davis, Davis, CA, (4)California Animal Health and Food Safety Laboratory, University of California Davis, School of Veterinary Medicine, San Bernardino, CA

**Introduction:** Vertebral fractures occur in racehorses, most commonly in the lumbar region. Our objectives were to characterize lumbar vertebral fractures in California racehorses, associated jockey injuries, and evidence of pathologic changes in fractured lumbar vertebrae.

**Materials and Methods:** Racehorse postmortem reports and jockey injury reports were retrospectively reviewed. Vertebral specimens from 6 racehorses affected with lumbar vertebral fractures and 4 control racehorses were assessed using visual, radiographic, computed tomography, and histologic examinations.

**Results:** Lumbar vertebral fractures occurred in 38 Quarter Horse (QH) and 29 Thoroughbred racehorses over a 22-year period, primarily involving the 5<sup>th</sup> and/or 6<sup>th</sup> lumbar vertebrae (L5-L6)(87% of QHs, 48% of Thoroughbreds). Lumbar vertebral fractures were the third most common musculoskeletal cause of death in QHs and frequently involved a jockey injury. Lumbar vertebral specimens contained anatomic variations in the number of vertebrae, dorsal spinous processes, and intertransverse articulations. Lumbar vertebral fractures examined in 6 racehorse specimens (5 QHs, 1 Thoroughbred) coursed obliquely in a cranioventral to caudodorsal direction across the adjacent L5-L6 vertebral endplates and intervertebral disk, although one case involved only one endplate. All cases had evidence of abnormalities on the ventral aspect of the vertebral bodies consistent with pre-existing, maladaptive pathology.

**Discussion/Conclusion:** Fractures occur in racehorses with pre-existing pathology at the L5-L6 vertebral junction that likely predisposes horses to catastrophic fracture. Knowledge of these findings should increase detection of vertebral injuries, preventing catastrophic racehorse and associated jockey injuries.

**Acknowledgements:** California Horse Racing Board's Racing Safety Program.

### 26 Assessment of Biocartilage + PRP in Horses

**Fortier LA<sup>1</sup>; Cook JL<sup>2</sup>; Cole BJ<sup>3</sup>; Roller B<sup>4</sup>**

(1)Cornell University, Ithaca, NY, (2)Comparative Orthopaedic Laboratory University of Missouri, Columbia, MO, (3)Rush University Medical Center, Chicago, IL, (4)Arthrex, Naples, FL

**Introduction:** The objective was to evaluate safety and efficacy of BioCartilage + platelet rich plasma (PRP) for cartilage repair in an equine model of full thickness cartilage loss.

**Materials and Methods:** With IACUC approval, horses (2-5 years old) underwent arthroscopic surgery to create two 10mm full thickness cartilage defects on the lateral trochlear ridge of each stifle. Both defects in one stifle received BioCartilage + PRP and both defects in the contralateral stifle underwent microfracture. Outcome measures included clinical assessments, arthroscopic grading, and synovial fluid analysis at 2, 6 and 13 months, and quantitative MRI, gross, microCT and histologic assessments at 13 months after surgery.

**Results:** There was no evidence for infection, implant migration, or synovial inflammation. BioCartilage + PRP had significantly better arthroscopic repair scores at 13 months for both sites compared to microfracture. MRI showed both treatments to have abnormalities, however, only one defect (microfracture) had poor cartilage fill while all others had good fill. There

were no significant differences in T1 $\rho$  and T2 mapping data for BioCartilage + PRP versus microfracture. There were no significant differences between BioCartilage + PRP and microfracture for any micro-CT parameters. Treatments were not significantly different based on synovial histology. BioCartilage + PRP proximal defects had significantly better histologic scores for repair-host integration, base integration, and formed more collagen type II than microfracture.

**Discussion/Conclusion:** BioCartilage + PRP treatment of full thickness articular cartilage defects in the equine stifle is safe and effective with advantages over microfracture.

**Acknowledgements:** Funded by Arthrex

## 27 Correlation of Clinical Imaging with Structural Alterations in Equine Palmar Osteochondral Disease

**Clegg PD<sup>1</sup>; Powell S<sup>2</sup>**

(1)Musculoskeletal Biology, University of Liverpool, Neston, United Kingdom

(2)Diagnostic Centre, Rossdale and Partners, Newmarket, United Kingdom

**Introduction:** Palmar osteochondral disease is an extremely common disease of the palmar condyle of the third metacarpus and metatarsus of racing Thoroughbreds and is a cause of both poor performance and wastage in racehorses. The condition, at its earliest stages, can be difficult to definitively diagnose using conventional diagnostic imaging. Recently, MRI has shown to have potential as a sensitive and specific diagnostic modality for this condition. However it remains unclear how specific imaging changes relate to structural alterations in this disease.

**Materials and Methods:** 20 limbs from flat racing Thoroughbred racehorses in recent race training were collected post-mortem after euthanasia for a variety of clinical conditions. The limbs were dis-articulated at the carpus, and the metacarpophalangeal/metatarsophalangeal joints were imaged by low field clinical MRI (Hallmarq), clinical CT and digital radiography. The joint was graded for macroscopic pathology, and the metacarpal/metatarsal condyles imaged using research microCT. Selected condyles were sectioned parasagittally and underwent scanning electron microscopy (SEM). Findings were correlated between differing imaging modalities.

**Results:** A range of pathologies were identified associated with palmar osteochondral disease, with the earliest changes being observed as bone resorption in the subchondral bone, which could be identified using low-field MRI.

**Discussion/Conclusion:** Low-field MRI was able to sensitively identify early changes of bone resorption defined by both microCT and SEM prior to there being significant structural alterations to joint architecture.

**Acknowledgements:** Rob Van't Hoff (University of Liverpool) for assistance with microCT

## 28 In-Vivo Three-Dimensional Kinematics of Cranial Cruciate Ligament-Deficient Stifles Treated with Tibial Plateau Leveling Osteotomy

**Tinga S<sup>1</sup>; Kim SE<sup>1</sup>; Banks SA<sup>2</sup>; Jones SC<sup>1</sup>; Park BH<sup>2</sup>; Lewis DD<sup>3</sup>; Pozzi A<sup>1</sup>**

(1)Small Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL, (2)Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, FL, (3)University of Florida, Comparative Orthopaedic and Biomechanics Laboratory, Gainesville, FL

**Introduction:** Cranial cruciate ligament rupture produces abnormal femorotibial kinematics that contribute to osteoarthritis; therefore, surgical therapies should strive to restore normal kinematics. Our purpose was to evaluate the effect of TPLO on 3-dimensional kinematics in clinical canine subjects. We hypothesized that TPLO would restore normal femorotibial kinematics during walking.

**Materials and Methods:** Dogs had unilateral complete CrCL rupture of less than 6-months duration. Three-dimensional models of the femur and tibia were superimposed over 2-dimensional lateral fluoroscopic images taken

during treadmill walking. At 6-month follow-up, flexion angle, axial rotation, abduction-adduction angle, and cranial-caudal translation were compared between the TPLO-treated and unaffected contralateral stifle using ANOVA and post-hoc Tukey ( $p \leq 0.05$ ).

**Results:** Ten dogs were included. There was no significant difference in flexion angle, axial rotation, and abduction-adduction angle. There was a mean of 3 mm of caudal tibial displacement in the TPLO-treated limb throughout the gait cycle. Two of 10 dogs continued to experience cranial tibial translation and internal tibial rotation during stance phase.

**Discussion/Conclusion:** This is the first study to objectively quantify 3-dimensional in-vivo kinematics after TPLO treatment. TPLO returns most kinematics to normal values in most dogs, but the tibia becomes caudally displaced by a mean of 3 mm. The long-term effects are unknown. Limitations include small sample size and the use of single-plane rather than bi-plane fluoroscopy.

**Acknowledgements:** This research is supported by the Hohn Johnson Research Award (Veterinary Orthopedic Society).

## 29 The Effects of Low Intensity Pulsed Ultrasound on Radiographic Healing of Tibial Plateau Leveling Osteotomy Sites in Dogs: A Prospective, Double Blinded Study

**Kieves NR<sup>1</sup>; Canapp SO<sup>2</sup>; Christopher SA<sup>3</sup>; Lotsikas PJ<sup>4</sup>; Leasure CS<sup>2</sup>; Canapp DA<sup>2</sup>; Gavin P<sup>5</sup>**

(1)Department of Clinical Sciences, Colorado State University, Fort Collins, CO (2) Veterinary Orthopedic & Sports Medicine Group (VOSM), Annapolis Junction, MD(3)Iowa State University, Ames, IA, (4) Skylos Sports Medicine, Ellicott City, (5)MR Vets, Inc., Sagle, ID

**Introduction:** Fracture healing involves many biological processes to restore adequate mechanical strength and full return to function. Previous studies have shown that low intensity pulsed ultrasound (LIPUS) can accelerate the rate of fracture healing. The aim of this study was to evaluate the effect of LIPUS on the healing following tibial plateau leveling osteotomy (TPLO). We hypothesized that treatment with LIPUS would accelerate the rate of bone healing.

**Materials and Methods:** Dogs underwent standard TPLO surgery and were assigned to one of two groups post-operatively. The LIPUS group underwent treatment for 20 minutes daily. The Control group underwent the same protocol with a sham unit. Orthogonal radiographs made at 4, 8, 10, and 12 weeks post-operatively were scored for healing by a blinded board certified radiologist.

**Results:** Twenty-five client owned dogs were enrolled in each group. No significant difference was seen at any time point in radiographic scores between groups.

**Discussion/Conclusion:** No difference in bone healing was seen between groups. Future studies should evaluate the effect of LIPUS on non- or delayed-unions, and with different ultrasound settings to determine the optimal dose for use in stimulating canine bone healing.

**Acknowledgements:** The LIPUS units used were used on loan from the manufacturer for the study.

## 30 The Effect of an Interlocking Bolt on Subsidence, Mechanical Properties and Failure of an Implanted Cementless Hip Prosthesis

**Buks Y<sup>1</sup>; Wendelburg K<sup>2</sup>; Garcia TC<sup>3</sup>; Stover SM<sup>3</sup>**

(1)Animal Specialty Group, Inc., Los Angeles, CA, (3)J.D. Wheat Veterinary Orthopedic Research Laboratory, University of California, Davis, Davis, CA

**Introduction:** Stem subsidence is a potential complication and leading cause for perioperative femoral fracture following cementless total hip arthroplasty. BFX femoral stem was modified to limit subsidence. We hypothesized that



addition of an interlocking bolt will enhance initial construct stability and limit subsidence under physiologic loads.

**Materials and Methods:** Paired canine femora (n=10) implanted with traditional or modified BFX stems were subjected to a staged cyclic loading protocol. Kinematic markers and high speed video were used to measure stem migration. Femora were then dynamically loaded to failure to evaluate failure mechanical properties.

**Results:** Subsidence was greater with traditional implants than modified implants after cyclic gallop loads (4.19mm and 0.78mm, respectively; P= 0.04) and after all cyclic loads (5.20mm, 1.28mm; P= 0.04). Yield and failure loads were greater (P= 0.029 and P= 0.002) for the modified implant (1155N and 2337N) compared to the traditional implant (816N and 1405N).

**Discussion/Conclusion:** Stem modification with an interlocking bolt had lower subsidence under physiologic loads, and greater yield and failure loads compared to traditional stems. Stabilizing bolt addition enhanced construct stability and limited subsidence under physiologic loads. Findings suggest that modified implant use may decrease postoperative femoral fractures resulting from excessive subsidence.

**Acknowledgements:** Implants donated by BioMedtrix. Wendelburg KL may receive financial benefits from BioMedtrix.

### 31 Canine Platelet Rich Plasma Systems: A Multicenter, Prospective Analysis

**Carr BJ<sup>1</sup>; Canapp SO<sup>1</sup>; Mason DR<sup>2</sup>; Cox C<sup>1</sup>; Hess T<sup>2</sup>**

(1)Sports Medicine and Rehabilitation, Veterinary Orthopedic and Sports Medicine Group, Annapolis Junction, MD, (2)Las Vegas Veterinary Speciality Centre, Las Vegas, NV

**Introduction:** The purpose of this study was to analyze key parameters of the PRP product from five commercial canine PRP systems.

**Materials and Methods:** Five commercial systems were analyzed using 10 healthy dogs per system: SmartPreP<sup>2</sup> ACP+ (Harvest Technologies, Corp), Arthrex ACP (Arthrex Orthobiologics), CRT Pure PRP (Canine Regenerative Therapies), ProTec PRP (Pulse Veterinary Technologies, LLC), and C-PET Canine Platelet Enhancement Therapy (Pall Corporation). Blood was obtained from each dog according to each system's manufacturer's protocol. The mean baseline platelet, RBC, WBC, neutrophil, monocyte and lymphocyte concentrations were determined for each system. All blood samples were processed according to the manufacturer's protocols. The mean PRP product platelet, RBC, WBC, neutrophil, monocyte and lymphocyte concentrations were determined for each system, which were compared to the mean baseline values.

**Results:** The SmartPreP<sup>2</sup> ACP+ and CRT Pure PRP systems significantly increased platelet concentration (p<0.0001). All systems significantly decreased the RBC concentration (p<0.0001). The CRT Pure PRP, Arthrex ACP, ProTec PRP, and C-PET Canine Platelet Enhancement Therapy systems significantly decreased neutrophil concentration (p<0.0001).

**Discussion/Conclusion:** Only the CRT Pure PRP system increased platelet concentration while significantly reducing the RBC and neutrophil concentrations. Further study is indicated to assess the efficacy of canine PRP systems and PRP therapy in canines.

**Acknowledgement:** Regenerative medicine products were received from the following companies for validation: Harvest, CRT, Arthrex, and PulseVet.

### 32 Tendon Volume Determination in Non-Calcified Supraspinatus Tendinopathy By Magnetic Resonance Imaging

**Spall BF; Fransson BA; Martinez SA; Mattoon J**

Washington State University, Pullman, WA

**Introduction:** Tendon volume determination may represent objective means for diagnosing non-calcifying supraspinatus tendinopathy (NCST). We hy-

pothesized that the normalized supraspinatus tendon volume calculated from magnetic resonance images (MRI) would be larger in cases with confirmed NCST than in dogs of similar signalment but with orthopedic disease other than NCST and in clinically healthy dogs.

**Materials and Methods:** Shoulder MRI from dogs with confirmed NCST, dogs with confirmed other orthopedic disease, and normal dogs were included. Sagittal and transverse MR images were obtained from the midscapula through midhumerus using a synergy spine coil. Tendon and humeral head volumes were calculated using MANGO image analyzing software. A p-value of 0.05/3 (0.017) was considered significant in comparisons between groups.

**Results:** Twenty-two dogs met the inclusion criteria; 9 were diagnosed with NCST, 9 were considered orthopedic controls (OC) and 4 cases were healthy control cases (HC). The supraspinatus tendon volumes in NCST cases, OC and HC were a median of 1323 mm<sup>3</sup>, 630 mm<sup>3</sup>, and 463mm<sup>3</sup>, respectively. The tendon/humeral head volume ratio differed significantly between NCST and OC (p=0.0027), between NCST and HC (p=0.0005), but not between control groups (p=0.21) A volume ratio of 0.3 or higher showed 90% sensitivity and 100% specificity for diagnosis of NCST.

**Discussion/Conclusion:** Dogs diagnosed with NCST showed an increase in normalized supraspinatus tendon volumes compared to dogs with other disorders and to healthy control dogs. Volume ratios may provide objective criteria for diagnosis of NCST.

**Acknowledgements:** None.

### 33 Concentrations of Cytokines, Matrix Metalloproteinases and Tissue Inhibitors of Matrix Metalloproteinases in Serum and Synovial Fluid Following Injection of Autologous Conditioned Serum into Equine Osteoarthritic Distal Inter-Phalangeal Joints

**Tatarniuk DM<sup>1</sup>; Groschen DM<sup>1</sup>; Merritt KA<sup>2</sup>; Maher MC<sup>1</sup>; Ernst NS<sup>1</sup>; Brown MP<sup>2</sup>; Trumble TN<sup>1</sup>**

(1)Department of Veterinary Population Medicine, University of Minnesota College of Veterinary Medicine, St. Paul, MN, (2)University of Florida College of Veterinary Medicine, Gainesville, FL

**Introduction:** Autologous conditioned serum (ACS) is a novel intra-articular treatment for lameness attributable to osteoarthritis. Interleukin-1 receptor antagonist protein (IL-1ra) is upregulated in ACS. It is unknown whether altered levels of other cytokines, matrix metalloproteinases (MMPs), and tissue inhibitors of MMPs (TIMPs) exist in ACS, or how ACS affects osteoarthritis.

**Materials and Methods:** Eleven (11) horses with forelimb distal inter-phalangeal osteoarthritis were treated with ACS for 3 total doses separated by 7 days. Serum and synovial fluid samples were analyzed using ELISA and multiplex assays to evaluate cytokines (IL-1ra, IL-1 $\beta$ , TNF $\alpha$ , IL-4, IL-6, IL-8, IL-10), matrix metalloproteinases (MMP-1, MMP-3, MMP-9, MMP-13) and tissue inhibitor of MMPs (TIMP-1, TIMP-2, TIMP-3, TIMP-4) concentrations.

**Results:** IL-1ra significantly increased in ACS compared to control serum. However, MMP-1 and -9 concentrations also increased while IL-4 and IL-8 decreased. This increase in serum IL-1ra from ACS didn't appear to translate into joints. In synovial fluid, most horses (9/11) decreased or showed mixed change (both increase/decrease) in IL-1ra concentration. In fact, in 2/11 horses that demonstrated consistent increases in IL-1ra concentrations throughout the study, pro-inflammatory biomarkers (IL-1 $\beta$ , TNF $\alpha$  and MMP-9) also increased.

**Discussion/Conclusion:** Based on this study, ACS increases IL-1ra concentrations, but it isn't clear what happens to these high IL-1ra concentrations after injection into joints since most horses had lower IL-1ra concentrations from baseline.

**Acknowledgements:** Funding by UMN Equine Center and ACVS Foundation.

### 34 Robotic Evaluation of the Effects of Total Knee Replacement on Stifle Joint Kinematics

Bertran J<sup>1</sup>; Allen M<sup>2</sup>

(1)The Ohio State University, Columbus, OH; (2)University of Cambridge, Department of Veterinary Medicine, Cambridge, United Kingdom

**Introduction:** Total knee replacement (TKR) has been a valid treatment option for end stage joint OA to alleviate pain and restore function of knees that suffer from disease or trauma. TKR affects the kinetics and kinematics of the operated knee. In-vivo and ex-vivo canine TKR kinematic data is currently lacking. Using a 6-degrees-of-freedom (6-DOF) robotic kinematics system, we tested the hypothesis that TKR would result in statistically significant alterations in stifle kinematics when compared with the intact joint.

**Materials and Methods:** Anterior-posterior translation was significantly greater after TKR ( $p=0.0026$ ) in all flexion angles except for 150° and 100°. Internal-external rotation was significantly greater prior to TKR ( $p < 0.0001$ ) in all flexion angles. Varus-valgus torque was not significantly different before and after TKR procedure ( $p > 0.05$ ).

**Results:** Anterior-posterior translation was significantly greater after TKR ( $p=0.0026$ ) in all flexion angles except for 150° and 100°. Internal-external rotation was significantly greater prior to TKR ( $p < 0.0001$ ) in all flexion angles. Varus-valgus torque was not significantly different before and after TKR procedure ( $p > 0.05$ ).

**Discussion/Conclusion:** Stifle joint kinematics are significantly different after TKR. Commercially available TKR provides a semi-constrained technology of the knee. Kinematic data from this ex vivo study will provide fundamental data to understand and compare in vivo TKR kinematic.

**Acknowledgements:** Extramural financial support was obtained from AOVET foundation.

### 35 Randomized Prospective Evaluation of the Influence of Methadone, Hydromorphone, and Glycopyrrolate Administration on Perioperative Gastroesophageal Reflux and Regurgitation in Anesthetized Dogs

Falender RA; Wetmore LA; Liakouras L; Kowaleski MP

Tufts Cummings School of Veterinary Medicine, North Grafton, MA

**Introduction:** Gastroesophageal reflux (GER) and regurgitation can result in esophagitis, stricture formation, and aspiration pneumonia. Morphine administration results in a dose-dependent increase in the incidence of GER from 27% to 50–60% and regurgitation from 3 to 10%. Our null hypothesis was that opioid selection and glycopyrrolate administration would have no effect on the incidence of GER and regurgitation in anesthetized dogs.

**Materials and Methods:** Fifty dogs undergoing elective stifle surgery were randomly assigned to one of four treatment groups: hydromorphone (0.1 mg/kg IM) or methadone (0.3 mg/kg IM) with or without glycopyrrolate (0.01 mg/kg IM); anesthetic induction and maintenance was otherwise the same. After induction, a catheter monitored esophageal pH to identify GER and the patient was observed for reflux.

**Results:** In total, GER occurred in 14/50 dogs (28%): 10/26 (38.5%) given hydromorphone and 4/24 (16.7%) given methadone, ( $p=0.08$ ). Regurgitation occurred in 7/50 dogs (14%): 6/26 (23.1%) given hydromorphone and 1/24 (4.2%) given methadone ( $p=0.05$ ). There was no significant association between GER/regurgitation and glycopyrrolate administration, age, weight, surgery time, or duration of fast.

**Discussion/Conclusion:** The opioid administered influenced the incidence of GER and reflux, while glycopyrrolate administration did not. Over twice the number of dogs premedicated with hydromorphone refluxed compared to those given methadone demonstrating a clinical advantage to the perioperative use of methadone in dogs.

**Acknowledgements:** Funding from the NIH scholars program.

### 36 Osteochondral Allografting of the Femoral Head

Cook JL<sup>1</sup>; Crist B<sup>2</sup>; Stoker A<sup>1</sup>; Pfeiffer FM<sup>1</sup>; Kuroki K<sup>1</sup>; Cook CR<sup>1</sup>; Franklin SP<sup>3</sup>; Stannard JP<sup>4</sup>

(1)Comparative Orthopaedic Laboratory, University of Missouri, Columbia, MO, (2)Orthopaedic Surgery, University of Missouri, Columbia, MO, (3)Department of Small Animal Medicine and Surgery, University of Georgia, Athens, GA, (4)University of Missouri, Columbia, MO

**Introduction:** The objective of this study was to use a canine model to compare femoral head osteochondral autografts and allografts with respect to safety and efficacy for clinical application to veterinary and human patients.

**Materials and Methods:** With IACUC approval, purpose-bred dogs ( $n=6$ ) underwent surgical implantation of osteochondral grafts using a craniolateral approach to the hip, without dislocation. Three graft options were evaluated: Small Auto ( $n=3$ ) – 6 mm diameter autograft from the trochlear ridge of the ipsilateral knee, Small Allo ( $n=3$ ) – 6 mm diameter fresh (21-day storage) allograft from a size-matched canine femoral head, or Large Allo ( $n=3$ ) – 14 mm diameter fresh (21-day storage) allograft from a size-matched canine femoral head. Outcome measures included functional, radiographic and arthroscopic assessments at 8 weeks and functional, chondrocyte viability and histologic assessments at 6 months after surgery.

**Results:** All grafts had greater than 80% chondrocyte viability at the time of implantation. All grafts showed radiographic evidence for integration into host bone. Small Auto and Small Allo hips showed significant ( $p < 0.05$ ) loss in range of motion, chondrocyte viability and articular cartilage integrity 8 weeks after implantation, while Large Allo grafts maintained viability and structural integrity throughout the study period. Large Allo dogs maintained full hip range of motion and hindlimb function.

**Discussion/Conclusion:** These data support clinical studies suggesting that large osteochondral allografts are an appropriate option for functional resurfacing of full-thickness cartilage defects of the femoral head with potential advantages over autografts.

**Acknowledgements:** Funded by Missouri Orthopaedic Institute

### 37 Clinical Outcome of Seven Dogs and Two Cats Treated Using a New Osseointegrated Amputation Prosthesis.

Fitzpatrick N; Murphy S

Fitzpatrick Referrals, Godalming, United Kingdom

**Introduction:** We report use of the PerFiTS prosthesis (Percutaneous Fixation To Skeleton) in nine animals.

**Materials and methods:** Seven dogs and two cats were operated. Mean body weight was 19kg. Four animals had a distal tibial, three had a distal radial and two had talo-calcaneal implant. Mean age was 1655 days, mean follow-up was 210 days. CT scans were acquired for surgical planning. Each endoprosthesis was fabricated from titanium alloy using direct metal laser sintering. The implant has four functional components: an intramedullary peg and extracortical plate, an abutment platform for cortical support and tendon attachment, a dermal integration module (DIM), and an external spigot. Results: All patients were weight-bearing bearing within one week and dermal integration was achieved by three weeks. Bone on-growth was documented for all cases by 12 weeks. Two dogs and one cat developed skin retraction resulting in exposure of the DIM, but retraction has not extended proximal to the periosteum.

**Discussion/Conclusion:** The PerFiTS aims to optimize biological integration with dual mechanical fixation (peg and plate) and a DIM. The abutment provides a mechanical pedestal for the bone cortex, reducing stress on the plate and screws, whilst the intramedullary peg provides for bone on-growth and a stress-riser is avoided by dissipation of load through the extracortical plate. Dermal bonding to the DIM was robust and resilient in six and suboptimal in three cases, all of which had predicating conditions which may constitute contraindications for the technique.

**Acknowledgements:** The primary author is the inventor of the device.

### 38 Mechanical Properties of Four Allograft Reconstruction Techniques for Ruptured Cranial Cruciate Ligament in the Dog

Biskup J<sup>1</sup>; Balogh D<sup>2</sup>; Haynes K<sup>3</sup>; Freeman A<sup>4</sup>; Conzemius MG<sup>3</sup>

(1)University of Tennessee, Knoxville, TN, (2)University of Minnesota, St. Paul, MN, (3)Veterinary Clinical Sciences, College of Veterinary Medicine, University of Minnesota, Saint Paul, MN, (4)Excelen: Center for Bone & Joint Research and Education, Minneapolis, MN.

**Introduction:** We tested four intra-articular graft reconstruction techniques for CCL deficiency and hypothesized that all techniques would have similar mechanical properties of the normal CCL.

**Materials and Methods:** Four CCL-deficient groups (n = 6) had intra-articular repairs. Three techniques using a patella ligament allograft were tested including: fixation with a tibial and femoral interference screw (PPL-2S); fixation using a femoral interference screw and tibial tapering tunnel (PPL-1S); and fixation with a suture and bone anchor on the femoral side and tibial tapering tunnel (PPL-SL). The final technique used a deep digital flexor tendon (DDFT) allograft that was looped around a femoral cross pin and stabilized with a tibial interference screw and spiked washers (DDFT-TF). The tibia was axially loaded at a joint angle of 135°. Cyclic loading was performed at 40% body weight for 100 cycles. Load to induce 3, 5, and 10 mm of femoral-tibia translation, stiffness, and load at ultimate failure with the corresponding displacement were calculated. Group means were compared with a multivariate analysis of variance.

**Results:** Compared to the intact CCL (520 ± 51.3 N), load to induce 3-mm of femoral-tibial translation was not significantly decreased for PPL-SL (422.4N) or DDFT-TF (654.2N). DDFT-TF stiffness was not significantly different from the intact CCL for any tested parameter.

**Discussion/Conclusion:** The DDFT with transverse femoral fixation and locking washers reproduced the mechanical properties of the intact CCL.

**Acknowledgement:** Tata Group Endowment, Arthrex, Inc.

### 39 In Vitro Biomechanical Testing of the Tube Knot

Fahie MA<sup>1</sup>; Chang S<sup>1</sup>; Lagman M<sup>2</sup>; Schmidt P<sup>1</sup>; Irizarry K<sup>1</sup>; Schulz D<sup>3</sup>

(1)College of Veterinary Medicine, Western University of Health Sciences, Pomona, CA, (2)College of Osteopathic Medicine, Western University of Health Sciences, Pomona, CA, (3)Vista Animal Hospital, Boise, ID

**Introduction:** The tube knot is an intraoperatively adjustable slip knot that lies flat within the surgical site and may be desirable for extracapsular stabilization of cranial cruciate ligament-deficient stifles. The objective of this experiment was to compare its biomechanical properties (ultimate tensile strength, elongation, and stiffness) with other common techniques and various suture materials.

**Materials and Methods:** Suture loops created in uniform manner on the monotonic motorized tensile stand equipment with either 2 monofilament nylon, 2 monofilament polypropylene, or 40lb test monofilament leader line.

The suture materials were tied using 3 techniques: tube knot (TB), square knot (SQ), crimp clamp system (CC). In vitro biomechanical testing was performed using monotonic tensile loading at 300mm/min until failure.

**Results:** There was no significant difference in the ultimate tensile strength at failure between TB and CC (p=0.5506). TB had a significantly greater force load than SQ in every suture material (p<0.0001). TB had greater elongation and least stiffness compared to CC and SQ. TB elongation occurred mostly at ultimate tensile strength greater than 70N.

**Discussion/Conclusion:** Both TB and CC broke at similar maximum force loads, making the two knotting techniques equivalent in tensile strength. The elongation of the TB may allow more cyclic force and be less prone to breaking. Further cyclical testing and prospective clinical studies are indicated.

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

### 40 Initial Mechanical Testing of Implants for Fixing the Distal Tibial Tuberosity in TTA Surgery

Ness M

Croft Veterinary Hospital, Cramlington, United Kingdom

**Introduction:** Simplifications to the implant system in TTA surgery have been described. Attempts to omit the distal fixation of the TT have proved problematic unless a longer tibial osteotomy is made as in MMT or TTA2. The short tibial osteotomy of MMP uses a wire tension band or a Titanium staple to fix the distal TT. This work is a preliminary investigation of wires and staples using a synthetic bone model.

**Materials and Methods:** Specimens were polyurethane foam blocks, (Sawbones Inc) joined with wire or staple. Five groups of ten specimens (0.8, 1.0 and 1.2mm wires; 1.6 and 2.0mm staples) were tested, single load to failure, using an Instron. After 20N preload, specimens were distracted at 5 mm/min until failure. Data was collected at 600 points/minute and used to draw load displacement curves. Mode of failure was recorded. Load to failure; stiffness and displacement were estimated or calculated.

**Results:** Staple specimens were significantly stiffer than wires. Wires failed by unravelling and gap formation. Staple specimens failed fracturing the synthetic bone: load to failure with 1.2 wire was highest but associated with substantial gap formation.

**Discussion/Conclusion:** Low loads caused large displacements with thinner wires prompting questions about their use in clinical orthopedics. Staples were considerably stiffer with less gap formation than the thickest wire and this should be clinically advantageous. Material fracture occurred at lower loads with staples apparently due to stress concentration.

**Acknowledgements:** Materials provided by Orthomed UK

Part II to be published in issue 3/2015.