Veterinary Orthopaedic Society 40th Annual Conference Abstracts

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Part I

1 Autologous and allogeneic stem cells as adjuvant therapy for osteoarthritis caused by spontaneous fragmented coronoid process in dogs

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Introduction: Osteoarthritis (OA) can cause lifelong lameness regardless of treatment. Autologous adipose-derived stem cell (ASC) therapy shows promise in treating OA. Clinical use of allogeneic ASC therapy has not been investigated. The purpose of this study was to objectively assess safety and therapeutic effects of autologous and allogeneic canine ASCs on treatment of OA. We hypothesized that ASC therapy is safe and results in measurable clinical improvement.
Materials and Methods: This prospective, randomized controlled trial utilized dogs diagnosed with fragmented coronoid process (FCP) and OA. All dogs had arthroscopic fragment removal and were randomized into four groups (n=10/group): 1) control group with no further treatment, 2) Proximal ulnar osteotomy (PUO), 3) PUO + autologous ASCs and 4) PUO+ allogeneic ASCs. Each dog had force platform gait analysis, Canine Brief Pain Inventory questionnaires, and delayed gadolinium enhanced magnetic resonance imaging (DGEMRIC) scores prior to therapeutic intervention, and six months after intervention.
Results: 34/40 of participants have completed the study. Successful outcomes were found in 30% of cases in the control group, 20% of the PUO group, 60% of autologous ASCs, and 75% of allogeneic ASCs, with no deleterious side effects.
Discussion/Conclusion: Preliminary data indicates ASC therapy is safe as an autologous or allogeneic intra-articular injection with improved outcome in OA caused by fragmented coronoid process.
Acknowledgments: Hohn-Johnson Research Award

2 The effect of rotational positioning of the canine tibia on radiographic measurement of proximal and distal mechanical joint angles

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Introduction: We hypothesized that internal rotational deviation of canine tibiae from a caudo-cranial (Cd-Cr) position alters proximal and distal mechanical joint angles measured on radiographs.
Materials and Methods: Cadaveric limbs (n=8) of large breed dogs were secured for standard and tangential view radiography in a custom apparatus with tibae in precise Cd-Cr orientation followed by quantifiable internal tibial rotational deviation (iARD) of 0°, 5°, 10°, 15°, 20°, 25°, 30°, 35°, and 40°. Three observers, blinded to the iARD, measured mechanical medial proximal tibial angle (mMPTA) and mechanical medial distal tibial angle (mMDTA) on each radiograph. An ANOVA for repeated measurements evaluated the effect of increasing iARD on mMPTA and mMDTA. In addition, we evaluated the influence of investigator upon the effect of iARD on mMPTA and mMDTA. Significance was set at $p<0.05$.
Results: The effect of each sequential iARD increase was a significant increase in mMPTA for both standard ($p<0.01$) and tangential views ($p<0.01$). In contrast, the effect of increasing iARD was a significant increase in mMDTA ($p<0.01$) for standard and a significant decrease in mMDTA for tangential view ($p<0.01$) radiographs. The effect of iARD on mMPTA and mMDTA was not statistically different between investigators for standard or tangential views.
Discussion/Conclusion: Tibial rotational deviation from a Cd-Cr image altered measured frontal plane angles. These findings demonstrate the importance of close scrutiny to insure that true frontal plane (Cd-Cr) radiographs are used to measure frontal plane tibial angulation.
Acknowledgments: Funding was provided by the Colorado State University College of Veterinary Medicine and Biomedical Sciences Research Council. Tibial positioning apparatus kindly loaned by Dr. Mike Kowaleski and the Ohio State University Small Animal Orthopedic Fellowship.

3 Biomechanical evaluation of medial femoral condylar subchondral cystic lesions and the effects of treatment with internal fixation

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Introduction: Subchondral bone cysts (SBCs) of the medial femoral condyle (MFC) are a source of lameness in the horse. We have successfully treated horses (20/22) by internal fixation of the cyst. The reason for this success is unknown. The purpose of this study was to measure the strain on the MFC and medial meniscus (MM) before and after the creation of a cyst-like defect, and following placement of a screw across the MFC defect. We hypothesized that with creation of the defect, strain will decrease on the MFC and increase on the MM. Following screw placement, strain will return to pre-defect levels, lending experimental justification for the treatment.
Materials and Methods: Stifles were collected and strain gages were placed on the MFC and MM. Axial compression was applied from 100–900lbs, and strain was measured. A defect was created in the MFC and the limb was re-tested. A 4.5mm cortical bone screw was placed across the defect, and the limb was again tested.
Results: Strain on the MFC decreased following creation of the defect at loads >100 lbs and increased on the MM. Following insertion of the transcondylar screw, strain returned to pre-defect levels on the MFC and MM.
Discussion/Conclusion: The data presented suggests that subchondral cystic lesions can be addressed by restoring the biomechanics towards a more physiologic condition, and offers experimental data for the clinical use of internal fixation for the treatment of SBC's.
Acknowledgments: There was no proprietary interest or funding provided for this project.

4 Stromal cell-derived factor-1 (SDF-1) response to exercise and joint injury in horses

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Introduction: The purpose of this study was to evaluate whether the inflammatory biomarker, stromal cell derived factor-1 (SDF-1), could be used in equine serum and synovial fluid (SF) to discriminate the effects of rest, exercise, and osteochondral (OC) joint injury.

Materials and Methods: Serum and fetlock SF were collected from 3 groups of Thoroughbred (TB) racehorses. Group 1 (untrained) consisted of 22 racehorses (<2 years old). Group 2 (trained) consisted of group 1 racehorses after 5 to 6 months of race training. Group 3 (OC injured) consisted of 19 mature (3 to 6 years old) horses undergoing arthroscopic surgery for removal of OC fragments from the fetlock joint. Samples were analyzed by SDF-1 ELISA (QuantikineÔ Human SDF-1a Immunoassay, R&D Systems). ANOVA with Tukey's test for multiple comparisons was used to determine differences between groups. P<0.05 was considered significant.
Results: Mean serum SDF-1 concentrations were lower in horses with fetlock OC injury (1129 ± 205 pg/mL) than in untrained (1366 ± 169 pg/mL; P<0.001) and trained horses (1495 ± 136 pg/mL; P<0.001). SF SDF-1 was higher in horses with OC injury (965 ± 278 pg/mL) compared to untrained (753 ± 179 pg/mL; P<0.01) and trained horses (759 ± 162 pg/mL; P<0.01). SF:serum SDF-1 ratio was higher in OC injured horses compared to untrained and trained horses (P<0.001).
Discussion/Conclusion: Serum SDF-1 decreased with OC injury while SF SDF-1 increased. Serum SDF-1 was most sensitive in discriminating horses with OC injury from uninjured trained horses.
Acknowledgments: ACVS Foundation Surgeon-in-Training Grant 2011 recipient.

5 Inflammatory and immune effects of autologous, allogeneic, xenogeneic, and genetically modified autologous mesenchymal stem cells after intra-articular injection in horses

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Introduction: The equine inflammatory response to an intra-articular bone marrow derived mesenchymal stem cell (BMDMSC) injection has not been well characterized. Our hypothesis was that injection of BMDMSC from an autologous (auto), allogeneic (allo), xenogeneic (xeno), or autologous cell transduced with the BMP2 gene (auto-BMP2) will yield no inflammatory difference.
Materials and Methods: Six healthy, 5 year old mares had each of 4 fetlock joints injected with 15 million BMDMSC from the auto, allo, xeno, or auto-BMP2 source. Clinical and synovial inflammatory parameters were assessed for 1 month. On Day 60, arthroscopic evaluation of selected joints was performed and synovial biopsies obtained for histochemistry. On Day 120, PBMC were co-cultured with monolayers of each MSC group.
Results: All injected MSC groups had greater inflammation than controls. The auto and auto-BMP2 groups were not significantly different. Xeno and allo groups produced greater peak inflammation (Days 1,2) than either autologous group. The auto-BMP2 injected joints produced significantly increased synovial fluid BMP2 concentration at Days 1 and 2. Synovial histology demonstrated a significant increase in capillary thrombi and perivascular lymphocyte cuffing in MSC treated joints compared to normal fetlock synovium. Adaptive immunity was demonstrated after 4 months upon re-exposure to xeno cells in co-culture.
Discussion/Conclusion: Intra-articular MSC injection resulted in a marked, transient clinical inflammatory response in horses that was significantly greater in allogeneic and xenogeneic MSC injected joints than in autologous MSC injected joints.
Acknowledgments: There was no proprietary interest and funding was provided by the Trueman Endowment and Development Funds.

6 Retrospective case series evaluating the incidence and risk factors affecting development of osteosarcoma following consecutive tibial plateau leveling osteotomies performed at a single institution between 1999–2009

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Introduction: An unpublished study on the incidence of neoplasia with the tibial plateau leveling osteotomy (TPLO) surgery revealed an incidence of 0.075%. The purpose of this study was to evaluate the incidence and risk factors for the development of osteosarcoma (OSA) following TPLO. Our hypothesis was that there would be a low incidence of OSA following TPLO surgery.
Materials and Methods: Medical records from Colorado State University (CSU) were searched for all dogs undergoing TPLO surgery. Information on signalment, weight, TPLO plate type, bilateral procedures, presence of complications, development of OSA, and last follow-up was collected. Referring veterinarians and owners were contacted for follow-up. The incidence of OSA following TPLO surgery and risk estimates for risk factors were calculated.
Results: 437 dogs with 747 TPLO surgeries were evaluated; 84 dogs had bilateral staged TPLO procedures and 353 were unilateral. 521 TPLO cases had over 1 year of follow-up. Thirteen dogs developed osteosarcoma; 6 dogs at the TPLO site. Cumulative incidence of TPLO-site osteosarcoma over the 12-year period was 1 per 100 dogs. Dogs that had received bilateral TPLO procedures were 8.4 times more likely to develop TPLO-site osteosarcoma than dogs with unilateral procedures.
Discussion/Conclusion: Our results support the hypothesis that there is a low incidence of OSA following TPLO surgery. Dogs receiving bilateral TPLO procedures were significantly more likely to develop osteosarcoma. A prospective cohort study following a large canine population would be beneficial to better understand this disease.
Acknowledgments: Funding provided through charitable giving office of Jeffrey Neu

7 Effect of monocortical versus mixed monocortical-bicortical fixation on the torsional stability of 3.5mm string of pearls locking plate constructs

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Introduction: Limited data is available on the torsional properties of locking constructs using monocortical (M) versus bicortical (B) screw fixation. Our *objectives* were to evaluate the effect of screw type, number and position on the torsional stability of String of Pearls (SOP) plate constructs. We *hypothesized* that torsional compliance (TC) and angular deformation (AD) would decrease with 1) increasing number of bicortical screws per fragment and 2) bicortical screws positioned closer to the fracture gap.
Materials and Methods: Thirty-two SOP plates were assigned to eight groups (n=4/group), named according to screw type and position relative to the fracture gap. Specimens were tested in torsion; data (TC and AD) was statistically compared (p<0.05).
Results: The MMM (negative control) group was the most compliant (p<0.001). Compliance decreased in groups with a single bicortical screw (p<0.001). Compared to a centrally positioned bicortical screw, constructs with a bicortical screw in either the outer or inner most position were 15 % and 23 % less compliant, respectively (p<0.001). Addition of a second bicortical screw per fragment further decreased compliance (p<0.001). The positive

control, BBB, was the least compliant construct ($p<0.001$). Maximum AD followed an identical pattern of significance to that of TC.
Discussion/Conclusion: Our results suggest that a minimum of one bicortical screw per fragment should be used to provide adequate torsional stability of 3.5 mm SOP constructs. Should further stability be desired, using two bicortical screws in the "far-near" positions or three bicortical screws per segment is recommended.
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8 Specialisation of tendon mechanical properties results from inter-fascicular differences and alter in ageing in the equine superficial digital flexor tendon

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Introduction: Tendon injuries are common in horses and occur more frequently as horses age. We investigated the microstructural mechanical properties in the injury prone equine superficial digital flexor tendon (SDFT) to determine if these alter with increasing age, and how these properties differed from the rarely injured common digital extensor tendon (CDET).
Materials and Methods: Fascicles were dissected from the CDET and SDFT of young, middle-aged and elderly horses. Tendons, their fascicles and the interfascicular matrix (IFM) were subject to mechanical testing.
Results: Fascicles failed at lower stresses and strains than tendons. The SDFT was more extensible than the CDET, but SDFT fascicles failed at lower strains than CDET fascicles, resulting in large differences between tendon and fascicle failure strain in the SDFT. Fascicle sliding in the IFM was greater in SDFT which accounts for differences in tendon and fascicle failure strain. With ageing there was significantly less sliding of the IFM. There was no relationship between fascicle sliding and age in the CDET.
Discussion/Conclusion: Sliding between fascicles prior to fascicle extension in the SDFT allows the large extensions required for energy storage while protecting fascicles from damage. The increase in stiffness of the IFM in older SDFT may result in the fascicles being loaded at an earlier point in the stress-strain curve, increasing the risk of damage potentially predisposing aged tendons to tendinopathy. Manipulation of the IFM is a relevant therapeutic target in treatment of tendon injury and its prevention.
Acknowledgments: Funded by Horserace Betting Levy Board

9 Ultrasonographic findings of canine supraspinatus tendonopathies following intralesional platelet-rich plasma injection

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Introduction: Canine supraspinatus tendonopathy (ST) is an emerging condition that is becoming more widely recognized. The diagnosis has been based on radiographic evidence of mineralization of the tendon near the greater tubercle of the humerus. However, non-mineralized forms of ST have been missed due to soft tissue resolution limitations of radiography. Tendon ultrasonography is a more sensitive and accurate modality for tendon evaluation. This study provides a descriptive analysis of changes in ST lesions based on ultrasonography pre- and post-intralesional injection of platelet-rich plasma (PRP) and the short term outcome of these patients.
Materials and Methods: 8 dogs diagnosed with ST based on ultrasonographic diagnosis and clinical findings were included. Dogs were treated with a single ultrasound guided intralesional injection of autologous PRP. Objective data (gait kinetics, ultrasonographic appearance) and subjective data (clinical assessment) were recorded.
Results: PRP was injected into 10 supraspinatus and 6 biceps lesions. 7/8 dogs had a concurrent lesion of the biceps tendon. Mineralization of the supraspinatus tendon was seen in 2/10 dogs, mineralization of the bicipital tendon was not detected. Lesions were described as hyperechoic (4/10) hypoechoic (3/10), heterogeneous (2/10). Lameness assessed at follow-up was improved (5), resolved (2) or worsened (1).
Discussion/Conclusion: Ultrasonographic findings of ST lesions in our study corresponded similarly to a previous report. Ultrasonographic measurement of lesion size, bicipital involvement or mineralization did not correspond with clinical evaluation of lameness. Resolution of lameness in 2 dogs corresponded with ultrasonographic resolution of the ST lesion. Preliminary findings support the hypothesis that single intralesional PRP does not affect ultrasonographic and clinical outcome in dogs with ST. The short follow-up period did not evaluate the possibility of relapse or recurrence of the ST lesions, and whether repeat injections may be of benefit.
Acknowledgments: There was no proprietary interest or funding provided for this project.

10 MR assessment of meniscal motion during stifle flexion: a cadaveric study in intact and CrCL deficient stifles using stress MRI

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Introduction: Menisci are recognized to play a key role in knee biomechanics. In dogs meniscal motion in intact and cranial cruciate ligament (CrCL) stifles has not been described. The aim of our study is to describe medial and lateral meniscal motion in the intact and CrCL deficient stifle in cadavers using a validated technique of stress MRI.
Materials and Methods: 10 cadavers were used for the study. The limbs were positioned in a custom made loading device and scanned in a 1.5 T MRI unit with intact CrCl first, and then following CrCL transection. Static poses of the cranial and caudal poles of the medial and lateral menisci were calculated at different flexion angles (85°-110°-135°-160°). Motion of the cranial and caudal poles of the medial and lateral meniscus were compared in the intact and CrCL deficient stifles using a two-way repeated measures ANOVA ($p<0.05$).
Results: No significant difference in motion was found between the medial and lateral caudal poles in the intact and CrCL deficient stifles. Mean±SD meniscal motion of the medial and lateral caudal poles in the intact stifle were 3.01 ± 0.85 and 3.20 ± 1.40, respectively. Mean±SD meniscal motion of the medial and lateral caudal poles in the CrCL deficient stifle were 2.90 ± 2.06 and 2.86 ± 1.54, respectively.
Discussion/Conclusion: Our results suggest that both medial and lateral menisci are mobile during flexion and extension. We suspect that meniscal deformation, rather than motion, may have contributed to our results.
Acknowledgments: The study was funded by UF Opportunity Fund.

11 Molecular characterization of WNT/-catenin signaling in early equine osteochondrosis

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Introduction: The objective of this study was to elucidate the expression of signalling molecules associated with the canonical Wnt signalling pathway in cartilage of prepubescent foals and determine its association with chondrocytes located at the osteochondral junction and cartilage canals. Our hypothesis was that increased expression of the components of the canonical Wnt pathway in chondrocytes of the osteochondral junction and cartilage canals would be found in early OC lesions compared to normal controls.
Materials and Methods: Cartilage was harvested from femoropatellar joints of 15 foals 1–6 months of age. Equine-specific β-catenin, Wnt-4, Wnt-5b, Wnt-11, DKK-1, LRP4, LRP6, Axin1, Wif-1, Sfrp1, Sfrp3, Sfrp5, RAR, RAR inducible serine carboxypeptidase and 18S mRNA expression levels were evaluated by two-step real-time quantitative PCR. Spatial tissue protein expression was determined by immunohistochemistry, using rabbit a-human polyclonal (β-catenin and Wnt-11). Statistical analysis was performed using the Wilcoxon rank sum test ($p < 0.05$).
Results: There was significantly increased β catenin, DKK1, LRP6, Wif-1, Axin 1, RAR, and RAR inducible serine carboxypeptidase gene expression in early OC cartilage compared to age-matched controls. No difference was found in Wnt-4, Wnt-5b, Wnt-11,Sfrp1, Sfrp3, Sfrp5, and LRP4 gene expression between OC and normal cartilage. Protein expression of β catenin, Wnt-4, and DKK-1did not show significant difference between OC and controls.
Discussion/Conclusion: The statistically significant increased gene expression of β catenin, Wif-1, RAR, RAR inducible serine carboxypeptidase, Axin 1, DKK1, and LRP6 of this study provides evidence that the canonical Wnt signalling pathway is involved in early osteochondrosis of the femoropatellar joint of horses.
Acknowledgments: Funding provided by OSU-CVM.

12 Correlation between histopathology, arthroscopic and MRI findings in medial coronoid disease in dogs

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Introduction: Despite recent advances in our understanding of medial coronoid disease (MCD), detailed descriptions of magnetic resonance imaging (MRI) findings in MCD are scarce, The long-term goal of our research is to develop an objective scoring scheme for diagnosing and staging MCD using MRI. As a first step towards this goal, we undertook a systematic comparison of the MRI, arthroscopic and histopathologic findings in dogs with MCD of differing severities.
Materials and Methods: Osteochondral specimens from 25 affected dogs and 5 unaffected controls were evaluated by MRI (using a novel grading scheme), arthroscopy (using a modified Outerbridge scheme) and histopathology.
Results: Modified Outerbridge scores of II and III were observed most commonly. MRI findings and Outerbridge scoring were consistent. On MRI, bone marrow lesions were described as focal in 68% of the cases, with 3 different patterns observed. The most common histopathologic findings were subchondral microfractures, subchondral microfractures continuous with cartilaginous fissures, moderate to severe hypercellularity of the marrow space, trabecular bone necrosis and degenerate articular cartilage. When compared to the controls, there was a reduction in subchondral bone density in affected dogs.
Discussion/Conclusion: Although qualitative at this stage, the findings from this study highlight the potential divergence between cartilage lesion score, MRI findings and histopathology. Objective quantitative assessment of subchondral bone quality and quantity may be needed to more completely describe the extent and severity of MCD disease in dogs.
Acknowledgments: There was no proprietary interest or funding provided for this project.

13 Randomized, controlled, clinical trial comparing two techniques for cranial cruciate ligament repair

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Introduction: There is controversy surrounding which surgical procedure is most beneficial. Many board certified surgeons believe that TPLO's provide a better outcome without scientific evidence.
Materials and Methods: This study is a randomized, blinded, controlled, clinical trial comparing the LFS technique and the TPLO. Eighty dogs were randomized and stratified based on size. To be included, dogs had unilateral surgically confirmed cruciate disease with no clinical signs of other orthopedic or medical disease at the time of entrance. The Canine Brief Pain Inventory owner survey, thigh circumference, goniometry, client satisfaction rating, and pressure platform gait analysis were completed prior to surgery, at 6 weeks, 12 weeks, 6 months and 1 year after surgery.
Results: Potential confounders including, age, breed, size, weight, body condition, sex, surgeon, meniscal tear rate, duration of lameness, postoperative contralateral cruciate tear, and complications were not statistically different ($p > 0.05$). The thigh circumference, range of motion, and owner evaluation improved over time ($p < 0.05$), but there was no difference in improvement between groups ($p > 0.05$). At 1 year, dogs in the TPLO group showed better limb function ($p < 0.05$) and client satisfaction ($p < 0.05$).
Discussion/Conclusion: Dogs treated with a TPLO have a superior outcome based on gait analysis and owner satisfaction compared with LFS.
Acknowledgements: Funding provided by Morris Animal Foundation

14 Relationship between mechanical thresholds and limb use in dogs with coxofemoral joint OA-associated pain, and the modulating effects of pain alleviation from total hip replacement

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Introduction: In addition to peripheral pain, osteoarthritis (OA) pain is associated with central sensitization (CS) at the level of the spinal cord. Quantitative Sensory Testing (QST) measures somatosensory abnormalities indicative of CS. We evaluated the effects of unilateral total hip replacement (THR) on distal hind limb mechanical von Frey thresholds ($mQST_{vF}$). We hypothesized that unilateral THR would decrease CS as measured by distal hind limb $mQST_{vF}$.
Materials and Methods: The $mQST_{vF}$ and GRF (measured using a pressure sensitive walkway) were evaluated before and at 3, 6, and 12 months after unilateral THR in client-owned dogs (n = 44). Measurements were recorded from the affected (operated) pelvic limb (APL) and the non-operated pelvic limb (NPL). Random effects analysis and forwards stepwise linear regression models were used to evaluate the influence of time since surgery and patient factors on $mQST_{vF}$ thresholds.

Results: Preoperative $mQST_{vF}$ measured at the APL and NPL did not differ ($P = 0.909$). $mQST_{vF}$ thresholds increased significantly after 12 months in NPL ($P = 0.047$), and the APL ($P = 0.001$). Additionally, APL $mQST_{vF}$ values were significantly affected by sex (higher in males, $P = 0.010$) and body condition score (higher in leaner dogs, $P = 0.035$).
Discussion/Conclusion: Remote mechanical thresholds increased with time following THR in APL and NPL suggesting decreased CS following pain-alleviating THR. Persistence of CS in patients with chronically painful disease could be a factor in less optimal outcomes seen clinically following surgical procedures.
Acknowledgments: There was no external funding for this study.

15 Use of a custom designed collared cementless titanium femoral stem to prevent subsidence

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Introduction: A custom collared titanium cementless femoral stem was implanted to distribute implant-bone interface forces to the calcar. The hypothesis was that a collar would prevent subsidence.
Materials and Methods: The stems used were the same basic design as the BFX beaded porous surface cementless stem. The porous surface and collar had a 300µ diameter diamond cubic cell structure of interconnecting pores with 65% ingrowth space and 35% metal. Load-to-failure at the stem-collar junction was 88 kg. The surface coefficient of friction was greater than the beaded stem. Mean radiographic follow up was 4.2 months.
Results: The collared stem was implanted in 18 hips with osteoarthritis secondary to hip dysplasia in 16 dogs with a median body weight of 36kg. Patient selection was preferentially those with a canal flare index (CFI) <1.8 including German Shepherd Dogs. The collar was resting on bone at 6 weeks in 16 hips and remained ≤1mm away from bone in 2 hips. No subsidence occurred.
Discussion/Conclusion: The prosthesis can be used regardless of the CFI. The increased friction coefficient noticeably increased resistance to implant drive. The short term usefulness of the collar is to provide stability during osteointegration. The usefulness of the collar following osteointegration is likely negligible. Long term consequences need additional study.The collar stopped subsidence when it contacted bone without creating other short term complications.
Acknowledgments: None

16 Effects of implant malpositioning on load transfer following total knee replacement in dogs

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Introduction: In humans malalignment of TKR (Total Knee Replacement) implants is associated with an increased risk of early implant failure. We hypothesized that alterations in varus-valgus alignment would be associated with qualitative changes in the pattern of femorotibial contact and statistically significant changes in load transfer within the canine medial and lateral joint compartments.
Materials and Methods: Custom tibial inserts with zero, three or five degrees of varus or valgus angulation were used to create clinically relevant degrees of implant malalignment. Limbs were loaded axially and the distribution and magnitude of femorotibial load transfer was measured using thin-film pressure sensors. The distribution of contact pressures within the medial and lateral compartments of the TKR were determined using pressure-sensitive film that was placed between the femoral and tibial components. Data were analyzed using repeated measures analysis of variance and a significance level of $p<0.05$ was considered statistically significant.
Results: Valgus angulation resulted in preferential loading of the medial compartment (8 of 8 limbs) and reduced loading of the lateral compartment (5 of 8 limbs). In contrast, varus angulation increased lateral compartment load transfer (6 of 8 limbs) while decreasing medial compartment loading (7 of 8 limbs).
Discussion/Conclusion: Data from these experiments support the hypothesis that implant malalignment alters load distribution in canine TKR. The clinical significance of these data remains to be determined and we plan to use the findings from this study to develop a retrieval analysis program.
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17 Initial clinical experience of the advanced locking plate system (ALPS) in dogs and cats: 282 cases

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Introduction: The purpose of this clinical retrospective study was to evaluate the experience of working with the Advanced Locking Plate System, the rate of bone union, and postoperative complications in an effort to create recommendations for the clinical use of the system in small animal orthopedics.
Materials and Methods: Dogs and cats with fractures, arthrodeses or corrective osteotomies stabilized using the ALPS bone plating system were included.
Results: Two hundred and eighty-two fixations were performed on 266 patients, including 240 fractures, 26 corrective osteotomies, 14 arthrodeses and 2 additional procedures. Double or triple plating was applied in 78 of the fixations. Intraoperative complications were reported in 10 cases, each involving screw failure, and all 10 cases were reported within the first year of the study. Postoperative complications were reported in 9 of the 282 procedures (3.2%), of which 7 cases were major complications (2.5%) and 2 cases were minor complications (0.7%). With the exception of 2 amputations, all treated cases achieved bone union or a tendency towards bone union (99.3%).
Discussion/Conclusion: This study demonstrated a high rate of bone union (99.3%), accompanied by a low rate of postoperative complications (3.2%), when using the ALPS system in small animal orthopedics.
Acknowledgments: None of the authors received any reimbursement or have any financial interest in the companies from which products were obtained for this study.

18 Battlefield injuries in the military working dog; treatment at a US army veterinary referral hospital

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Military Working Dogs (MWDs), now more than ever, play a crucial role in the war on terror. Their keen sense of smell enables them to outperform any man made device used to detect explosives on the battlefield. Their deployments over the past 10 years, alongside their human handlers, have led them into danger every step of the way. From improvised explosive devices and direct sniper fire to mortars and indirect shrapnel, MWDs are suffering traumatic injuries rarely seen before by veterinarians… and surviving. MWDs are considered four legged Soldiers and are afforded similar medical care as their two legged counterparts. When an MWD is injured on the battlefield, immediate care is rendered by the handler or medic imbedded within the combat unit, who is often trained in the basics of emergency medical care for dogs. The injured MWD is then transported, most often via military helicopter, to the closest veterinarian or human forward surgical team. There are numerous veterinary teams with one veterinarian and one or two veterinary technicians stationed at strategic locations throughout Afghanistan. Here, the MWDs will receive stabilization or definitive care, depending on the severity of their injuries. When injured MWDs require advanced care, they are

evacuated to Dog Center Europe (DCE), the US Army's veterinary referral hospital in Kaiserslautern, Germany where they undergo numerous orthopedic and soft tissue surgeries to recover from their devastating battle injuries. This presentation provides an insight and lessons learned on a case series of severe MWD battlefield injuries from Afghanistan.

19 Dual axis gene-therapy using stem cells overexpressing TGF-β3 in combination with IL-1β and TNF-α RNA silencing for osteoarthritis control in a large animal osteochondral chip fracture model

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Introduction: Dual axis gene therapy using a combination of anti-cytokine therapy and an anabolic growth factor may provide synergistic effects not apparent in single target manipulation. The purpose of this study was to investigate the in vivo potential of intra-articular injection of MSCs overexpressing the anabolic TGF-β3 gene concurrent with an RNA interference motif to suppress the catabolic IL-1β and TNF-α cytokines, in an equine model for treatment of osteoarthritis (OA).
Materials and Methods: Early OA was induced in one middle carpal joint by osteochondral fragmentation in 13 skeletally mature Thoroughbreds. The contralateral joint was sham operated. Second passage autologous bone marrow derived mesenchymal stem cells (MSCs; 10e6) were transfected with long hairpin silencing construct against IL-1β and TNF-α and transduced with AdTGF-β3. Treatments with either MSCs (n=6) or placebo (n=7) were injected to OA joints 14 days after OA induction. Sham joints were injected with placebo.
Results: No adverse treatment effects were observed. When comparing MSC versus placebo injected OA joints, there were significant improvements in range of motion and effusion in the week following injection, higher GAG content of opposing third carpal bone cartilage, significantly improved gene expression of cartilage MMP13 and synovial membrane IL-1β, and reduced synovial fibrosis histologically otherwise, there no differences due to treatment.
Discussion/Conclusion: Intra-articular injection of MSCs co-expressing a growth factor and cytokine suppressing genes in dual axis gene therapy approach was effective in reducing osteoarthritis progression in this OA model. This may be through modulation of synovial fluid constituents, inflammation, cytokine profile, or direct cartilage repair.
Acknowledgments: Study funded Harry M Zweig Foundation; NIH 5R01-AR055373–04

20 Assessment of meniscal-osteochondral allografts in dogs

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Introduction: We reported successful clinical tansplantation of frozen meniscal allografts (MAT) in dogs. However, graft extrusion and shrinkage, degeneration, and failure of fixation are potential complications based on the human experience. These issues may be associated to at least some degree with the use of a non-viable tissue and/or lack of anatomical placement and fixation of the graft. Therefore, use of a viable MAT that allows for anatomical placement of the graft on the tibial plateau could significantly reduce complications and improve long-term success.
Materials and Methods: With IACUC approval, viable meniscal-tibial plateau allogfrats (MTPAs) from purpose-bred research dogs were aseptically harvested and stored for 30 days using our tissue preservation system. After disease testing and assessment for viability during storage, the grafts were implanted into the knees of two size-matched purpose-bred research dogs. The dogs were assessed at weeks 5, 8, and 12 after surgery using measures of knee function, second look arthroscopy and radiographs. Three months after implantation, the dogs were humanely euthanatized and assessed grossly and histologically for evidence of graft location and stability, graft incorporation, tissue architecture, and articular cartilage health.
Results: Surgical implantation of the MTPAs was accomplished in both dogs without complications. Dogs ambulated on the operated limbs immediately after surgery and were using the limbs with no apparent lameness and normal knee range of motion (105° and 107°) 3 months after surgery. Five and twelve weeks after implantation, arthroscopic assessment revealed maintenance of meniscal positioning with evidence for synovial attachment to the periphery of the transplanted menisci. Articular cartilage in the medial compartment showed no evidence of softening, fibrillation, or erosions. Radiographic assessments at 8 and 12 weeks after surgery showed mild joint effusion and evidence for progressive healing of donor to recipient bone with maintenance of graft and implant positioning. Gross and histologic assessments at the time of sacrifice were consistent with clinical findings. Meniscal positioning was maintained such that subluxation or extrusion was not noted. Evidence for bone union between donor bone and recipient bone was noted.
Discussion/Conclusion: These data provide initial evidence for the feasibility of performing complete replacement of the medial tibial plateau and meniscus using viable meniscal-osteochondral grafts stored using our preservation system for at least 30 days. Clinical, arthroscopic, radiographic, gross and histologic assessments provided evidence for graft integration and healing, maintenance of function, and lack of associated morbidity.
Acknowledgments: none

21 Effects of local anesthetics and steroids on articular tissues

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Introduction: Local anesthetics and corticosteroids are often used alone or in combination for intra-articular and peri-articular therapies. A comprehensive study assessing and comparing the effects of all of the commonly-used products with respect to their toxicity on cartilage and peri-articular tendon has not been performed to the authors' knowledge.
Materials and Methods: Full-thickness explants of articular cartilage and supraspinatus tendon were harvest from canine cadavers (n=7) and processed for explant culture. Explants were exposed to lidocaine, bupivacaine, betamethasone acetate, methylprednisolone acetate and triamcinalone acetonide at multiple concentrations (n=7 per group) in the culture media for 24 hours. Explants were collected on days 1 and 7 of culture and assessed for cell viability and histologic characteristics of tissue health.
Results: 1% lidocaine, betamethasone and methylprednisolone were associated with significantly ($p<0.05$) greater loss of cell viability in both tissues compared to all other groups at both time points. 0.5% lidocaine and 0.25% and 0.125% bupivacaine were also signficantly more chondrotoxic than all other groups on day 1. Histologic assessments of tissue health corresponded well with loss of cell viability in cartilage and tendon.
Discussion/Conclusion: Significant loss of cell viability in articular cartilage and peri-articular tendon can occur after short term exposure to lidocaine, betamethasone, bupivacaine and methylprednisolone. Only triamcinalone and 0.0625% bupivacaine were considered safe as assessed in this in vitro study. Ongoing work in our laboratory is validating this work in vivo and initial analyses show nearly identical results.
Acknowledgments: Funded by the Comparative Orthopaedic Laboratory and a gift from Dr. David Flood

22 Evaluating the presence of increased radial torsion in patient with confirmed elbow dysplasia

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Introduction: Elbow dysplasia is a developmental disease affecting primarily large breed dogs. Our previous research presented at the VOS 2012 meeting suggests possible connection between radial torsion and elbow dysplasia. The goal of this study is to evaluate radial torsion in cases diagnosed with elbow dysplasia via CT.
Materials and Methods: *Group one:* 22 CT scan sets of one year old clinically normal Labrador Retrievers (16) and Golden Retrievers (6) assessed by a boarded radiologist. *Group two*: 41 imaging sets from patients diagnosed with elbow dysplasia via full antebrachial CT scans from two independent practices. Multi Planar Reconstruction imaging software was used to identify the landmarks previously described by Meola et.al. and the authors in studies of canine cadavers and normal dogs. The data of the two sets was evaluated for statistical significance via paired t-test ($p \leq 0.005$).
Results: *Group one*: radial torsion angle Mean 3.45, Median 3.25, Range 0.16 to 7.43. *Group two*: radial torsion angle Mean 10.24, Median 10.28, Range 1 to 26.55 The paired t-test showed statistical significance $p<0.0001$. 95% confidence interval of this difference: from 5.0947 to 8.9348. The mean of Group One minus Group Two equals 7.0147
Discussion/Conclusion: The data presented strongly suggests that there is relationship between elbow dysplasia and radial torsion. The measurement of radial torsion could possibly be used as a tool for early detection of dysplasia.
Acknowledgments: Financial support from American Veterinary Orthopedic Research and Education Foundation, Canine Companions for Independence international Foundation and New York Veterinary Specialty Center.

23 Canine intra-articular multipotent stromal cells (msc) from adipose have the highest in vitro expansion rates, multipotentiality, and MSC immunophenotypes

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Introduction: Intra-articular multipotent stromal (stem) cells (MSC) have significant potential to restore stifle function. This study was designed to compare *in vitro* expansion rates, multipotentiality, and immunophenotypes of adult MSCs derived from three sources, infrapatellar (IFP) adipose (ASC), synovium lining the joint capsule (SSC) and synovium surrounding the cranial cruciate ligament (LSC). We hypothesized that IFP is the best source for tissue regeneration among the three sources.
Materials and Methods: Tissues were collected from normal stifles of six dogs. Cells were characterized by cell doubling (CD), colony-forming unit (CFU) frequencies, tissue specific mRNA levels and cell surface marker expression. Adipogenic, osteogenic, and chondrogenic differentiation was confirmed with light microscopy.
Results: Adipose had the highest yield of MSCs. The CD, CFU frequencies and MSC immunophenotypes decreased with increasing passages for all cell types. ASC had highest CD values. Tissue specific target gene expression was higher in induced versus uninduced cells, and ASCs had the highest tissue specific target gene upregulation. The majority of cells were $CD29^+$, $CD34^+$, $CD44^+$, $CD45^+$ and $CD90^+$, and ASCs had more $CD29^+$ cells in early passages and more $CD44^+$ and $CD90^+$ cells in later passages than other cell types.
Discussion/Conclusion: ASC had the highest *in vitro* expansion rates, CFU frequencies, tissue-specific target gene expression and percentages of MSC immunophenotypes. The IFP may be the best source of adult MSCs in the canine stifle.
Acknowledgments: This study was supported by the American Kennel Club Canine Health Foundation and laboratory funds.

24 Differential osteogenic capacities of equine progenitor cells from bone marrow, synovium and fat

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Introduction: Bone repair in horses is a major challenge. Therapies that increase the speed of fracture repair will benefit these cases. Stem cell therapy offers promise to improve the rate and quality of fracture repair. This study compared the osteogenic capacities of MSCs from equine bone marrow (BM), synovium (SYN) and adipose tissue (FAT).
Materials and Methods: Bone marrow, adipose tissue and synovium were collected from six adult horses. Primary cells were expanded through two passages. Third passage cells remained in basal medium or were transferred to osteogenic medium. Osteogenesis was assessed after 7 and 14 day, by Alizarin Red (AR) staining, alkaline phosphatase (ALP) localization, ALP activity and osteogenic mRNA up-regulation. Osteogenic responses were assessed by two-way repeated measures ANOVA and Holms-Sidak post hoc tests.
Results: Under basal conditions, only Osterix mRNA was elevated, in BM cells. BM monolayers developed aggregates that stained strongly with AR by day 7. Staining was delayed and less intense in SYN and FAT cultures. BM cells increased ALP activity, along with ALP, Runx2 and Osterix mRNAs. ALP activity was increased in FAT cultures, but no other osteogenic marker was increased in FAT or SYN cultures.
Discussion/Conclusion: BM cells are superior to SYN or FAT cells for osteogenic applications. Elevated 'basal' Osterix expression seems to 'prime' BM-MSCs for osteogenesis, while the inability of SYN and FAT cells to up-regulate Runx2 and Osterix mRNA expression under osteogenic conditions signifies a molecular constraint to osteogenesis in these populations.
Acknowledgments: USDA Animal Health and Diseases Research Fund

25 Canine adipose derived stem cell viability following exposure to synovial fluid from osteoarthritic joints

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Introduction: Canine adipose derived stem cells (ASCs), generally delivered by intra-articular injections, are a treatment for osteoarthritis. The milieu of osteoarthritic joints causes local tissue destruction, but its effect on the viability of canine ASCs has not been reported. We hypothesized that exposure to osteoarthritic synovial fluid (SF) will reduce canine ASC viability, while dilution of osteoarthritic SF will decrease this effect.
Materials and Methods: ASCs were incubated for 12 hours under the following conditions: culture medium, normal or osteoarthritic SF collected from clinical patients, or serial dilutions of 1:1 to 1:10 of osteoarthritic SF with medium. Cells were then harvested and assessed for viability using trypan blue dye exclusion. Data was analyzed using a Wilcoxon signed-rank test where $P<0.05$ was significant.
Results: There were no significant differences in the viability of cells in medium or normal SF. Significant differences were found among cells exposed to osteoarthritic SF regardless of dilution and normal SF, and among cells exposed to undiluted osteoarthritic SF and all serial dilutions. Greater dilution correlated with reduced cytotoxicity.
Discussion/Conclusion: We accept our hypothesis that exposure to osteoarthritic SF reduces canine ASC viability and dilution of osteoarthritic SF diminishes this effect. Current practice should be reassessed as flushing joints prior to ASC treatment may provide a better outcome.
Acknowledgments: Research supported by the Tata Foundation Endowment.

26 Equine adipose-derived cells induce chemotaxis in a dose-dependent manner

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Introduction: Adult stem cells show great potential in musculoskeletal applications. The mechanism remains elusive; however, production of soluble proteins may play a critical role. The purpose of this study was to evaluate the production of soluble factors by equine adipose-derived cells (ADC) in vitro. We hypothesized that ADC would be capable of stimulating an anabolic response in tendon fibroblasts (TF) and inducing cell migration via the release of soluble factors.
Materials and Methods: TF and ADC were isolated from superficial digital flexor tendons and gluteal adipose tissue of 8 young adult horses. Microchemotaxis assays were performed using conditioned media from TF and ADC grown in monolayer for 72 hours. TF and ADC were grown in co-culture and TF were harvested for biochemistry and gene expression for extracellular matrix molecules. Data were compared using mixed model ANOVA with significance set at $P<0.05$.
Results: Conditioned media from ADC and TF stimulated cell migration in a dose-dependent manner ($p<0.0001$) without significant differences between cell types. There were no significant differences in DNA and GAG content or expression for extracellular matrix molecules compared to controls following co-culture of TF and ADC.
Discussion/Conclusion: ADC are capable of inducing cell migration via release of soluble factors. Lack of an anabolic response in TF may be a consequence of phenotypic changes in ADC during culture in vitro. Further investigations using fresh ADC are indicated to help define the effects of culture expansion on cell phenotype.
Acknowledgments: Funding for this study was provided by VOS and the USEF.

27 Distribution and homing of stem cells after intra-articular injection to normal and arthritic joints

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Introduction: Clinical evidence suggests that intra-articular injection of mesenchymal stem (stromal) cells (MSCs) is effective. We hypothesized that autologous bone marrow derived MSCs would engraft to cartilage in OA joints but not in normal joints following injection.
Materials and Methods: Twenty-nine joints from 10 horses were characterized as normal or OA through lameness and radiographic examination. Second passage autologous MSCs (3e6 for fetlocks and 5e6 for femoropatellar joints) were labeled with fluorescent nanoparticles (Quantum® dots; Qdot®) or remained unlabeled (7 joints). Seventeen normal and 12 OA joints were injected and examined after 1 week by necropsy, microscopy and synovial fluid (SF) cytology. Twelve joints in 6 horses were injected with MEM only.
Results: Clinical findings included lameness (2), and severe effusion (11), moderate (3), or slight effusion (4). SF abnormalities included elevated nucleated cell counts (median 2,800/ul; interquartile range 1,750–4,450/ul), consisting of large mononuclear cells and small lymphocytes. Synovial fluid from MEM only injections had a nucleated cell count of 850/ul; 300–1,700/ul. There were no statistically significant differences in synovial parameters between Qdot® labeled and unlabeled MSC injected joints. QDot® labeled MSCs were found predominantly in the synovial membrane compared to cartilage ($p<0.0001$). Adherence of labeled MSCs to cartilage was minimal and found in 17/97 cartilage sections. The proportion of positive sections from synovium and cartilage was not different between OA and normal joints ($P=0.79$).
Discussion/Conclusion: MSCs did not reliably home to cartilage injury in OA joints. Although mild, joint flares were common after intra-articular MSC injection. SF was indicative of non-septic inflammation and antigenic stimulation.
Acknowledgments: Study funded by private gifts to the laboratory

28 Kinetic and kinematic analysis of hind limb joints following immobilization of the tarsus – a pilot study

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Introduction: The aim of this study was to determine pelvic limb kinetic and kinematic characteristics after partial tarsal immobilization. We hypothesized that stifle and hip flexion would increase and peak vertical force (PVF) would decrease.
Materials and Methods: This randomized prospective study evaluated five clinically sound, orthopedically normal dogs. Kinetic and kinematic gait analyses were performed on splinted and contralateral pelvic limbs of each dog at a walk and trot before and after placing a commercially available tarsal splint. Statistical analysis was performed using paired t-Test.
Results: Tarsal flexion (FLX) and range of motion (ROM) of the splinted limb were significantly decreased at both the walk and trot ($P< 0.05$). Significantly greater tarsal ROM of the contralateral limb occurred at a walk and trot compared to the splinted limb (ROM $P=0.01$ and 0.003, respectively). Splinted limb stifle FLX and ROM increased while walking and trotting ($P=0.05$). Splinted limbs demonstrated significantly more stifle FLX at a trot when compared to contralateral limbs ($P=0.0004$). Coxofemoral EXT, FLX and ROM were not affected after splinting, but ROM of the splinted limb was greater than the contralateral limb at a walk. There were NSD in PVF at a trot before and after splint application.
Discussion/Conclusion: Splinting reduced tarsal FLX and ROM. Limiting tarsal motion resulted in compensatory changes in stifle motion and contralateral tarsal ROM.
Acknowledgments: Funding provided by the University of Tennessee Veterinary Orthopedics Laboratory (UTVOL).

29 Effects of cold compression therapy in comparison to soft padded bandage on immediate post-operative swelling, range of motion, and degree of weight bearing after tibial plateau leveling osteotomy in dogs

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Introduction: The tibial-plateau leveling osteotomy (TPLO) is commonly performed to stabilize cranial cruciate ligament (CCL) deficient canine stifles. Wound care in the immediate post-operative period may reduce pain, and complications including swelling and bruising, seroma, and incisional dehiscence. The aim of this study was to evaluate the effects of cold compression therapy (CCT) with and without pelvic-limb bandaging compared to pelvic-limb bandaging only, on the degree of weight bearing, limb circumference, and stifle range of motion after TPLO in dogs. We hypothesized that dogs receiving CCT with or without a bandage would have less swelling, increased range of motion, and increased weight bearing post-operatively compared to dogs that did not receive CCT.
Materials and Methods: Twenty-one dogs undergoing TPLO surgery for CCL disease were randomized equally into one of three treatment groups: CCT therapy for 48 hours, a modified Robert-Jones bandage, or CCT in combination with a modified Robert-Jones bandage. Percentage of limb weight bearing when standing, stifle range of motion, and limb circumfer-

ence were measured pre-operatively and at three time points in the immediate post-operative period.
Results: Flexion was significantly different between groups. There was a trend for dogs with CCT to have a greater increase in the percent body weight after surgery compared to dogs without CCT.
Discussion/Conclusion: More data is needed to evaluate the effects of CCT after TPLO surgery in dogs.
Acknowledgments: The PetSafe Stance Analyzer and GameReady Canine unit were used on loan from their manufacturers for this study.

30 Abnormal reflex activation of hamstring muscles in dogs with cranial cruciate ligament rupture

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Introduction: Pathological processes leading to cranial cruciate ligament rupture (CCLR) in dogs are incompletely understood. In this study we investigated whether hamstring muscle activation is abnormal in dogs affected by CCLR since it is a mechanism through which there can be failure of recovery after stifle stabilization in humans; abnormal activity is detectable through changes in the compound muscle action potential (CMAP) in the hamstring muscles.
Materials and Methods: Cranial tibial translation was evoked using a custom-designed device which simultaneously triggered recording of the CMAP in the hamstring muscles. The latencies of the two principle components of this response – the short latency response (SLR) and the medium latency response (MLR) – were measured and compared between affected and unaffected limbs of dogs with CCLR and also between control and CCLR dogs.
Results: In dogs with unilateral CCLR the latency of both the SLR and MLR were similar between affected and unaffected limbs. The MLR latency of both affected and unaffected limbs of unilateral CCLR dogs was significantly prolonged compared to that recorded in control dogs.
Discussion/Conclusion: This study shows that hamstring CMAPs can be recorded in standing conscious dogs and that the latency of the MLR is abnormally prolonged in dogs affected by CCLR. The finding that the MLR is prolonged in the unaffected limb suggests that abnormal hamstring muscle activation may be a causal factor in development of CCLR in dogs.
Acknowledgments: There was no proprietary interest or funding provided for this project.

31 Effect of intramedullary rod diameter on the bending behavior of SOP-rod constructs

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Introduction: While *conventional* plate-rod constructs (PRC) are often used to spare a plate from deleterious bending stresses, the effect of an IMR on PRCs using *locking* plates (e.g. String of Pearls – SOP), is unknown. Our *objective* was to evaluate the effect of IMR diameter on bending compliance (BC) and angular deformation (AD) of SOP-rod constructs. We *hypothesized* BC and AD would decrease with increasing IMR diameter.
Materials and Methods: SOP groups with an IMR 24%, 32%, or 40% the medullary cavity (MC) diameter were compared to an SOP with bicortical fixation and conventional PRC. Specimens were tested in mediolateral bending; BC and AD were statistically compared ($p<0.05$).
Results: Construct BC and AD decreased with increasing IMR diameter ($p<0.001$). The SOP-24 and bicortical SOP control were statistically similar. The SOP-32 was statistically similar to the conventional PRC control. The SOP-40 was the least compliant construct ($p<0.001$). AD followed an identical pattern of significance.
Discussion/Conclusion: Biological osteosynthesis relies on more compliant constructs to promote beneficial micromotion at the fracture site. This study suggests an SOP plate and thinner IMR, 32% the MC diameter, is comparable to a conventional PRC. Should a more compliant construct be desired (e.g. immature patients), a yet thinner IMR with a locking SOP is as compliant, and as stable as an accepted bridging construct with bicortical screws only. Previous studies have shown the SOP to be less compliant than conventional plates. Therefore, SOP constructs augmented with an IMR 40% the MC diameter may be unnecessary.
Acknowledgments: MSU CVM Funds and Orthomed.

32 The effect of the tibial plateau leveling osteotomy on patellar ligament strain: ex vivo study

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Introduction: Patellar tendinopathy is the most commonly reported complication after tibial plateau leveling osteotomy (TPLO). The purpose of this study was to determine the effect of location of the TPLO on the patellar tendon strain (PTS) in cadavers.
Materials and Methods: Paired pelvic limbs of eight canine cadavers were randomly assigned to one of two groups based on TPLO positions: centered at the joint center (TPLO-C); centered more than 5 mm distal to the joint center (TPLO-D). PTS was measured using a differential variable reluctance transducer under an axial load of 30% body weight and standing joint angles; before, and after TPLO. Joint angles and the tension of a gastrocnemus mechanism were standardized by adjusting turnbuckles in series with respective load cells that simulated quadriceps and gastrocnemius muscle functions. PTS was compared before and after TPLO and between the groups. The correlation between change in patellar tendon strain and possible factors were examined.
Results: The TPLO-D decreased patellar tendon strain ($P = 0.014$) while the TPLO-C did not alter PTS ($P = 0.48$). The distance between the center of the osteotomy and the joint center was negatively correlated with change in PTS ($P = 0.028$, $r = -0.63$).
Discussion/Conclusion: TPLO did not increase PTS and patellar tendinopathy is not likely to result from over-stress on the tendon after the TPLO.
Acknowledgments: Funded by Center of Companion Animal Heath, UC Davis, Implant was supported by Synthes Vet

33 Mechanical strength of two patella-ligament-tibia allograft fixation techniques for ruptured cranial cruciate ligament repair

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Introduction: Nearly all procedures currently performed for cranial cruciate (CCL) rupture result in osteoarthritis. The most common repairs for people, who have lower re-operation and osteoarthritis rates, involve arthroscopic placement of allo- and autografts. Previous work showed that patella-ligament-tibia (PLT) allografts from dogs >25kg possessed mechanical properties similar to the intact CCL from similar sized dogs.

Materials and Methods: Canine stifles (n=18) were harvested and PLT allografts were secured by a femoral interference screw and a tibial tapering tunnel (Group 1) or with two interference screws (Group 2). The limbs were axially loaded, at a joint angle of 135 degrees. Load at set points 3, 5 and 10 mm and stiffness were assessed.
Results: Group 1 had an average load of 203, 362.7 and 720 N at 3, 5 and 10mm, respectively. Group 2 had an average load of 219, 325.6 and 650.3 N at 3, 5 and 10 mm, respectively. The stiffness of the intact CCL was 184 N/mm compared to 86 and 67 N/mm for Groups 1 and 2, respectively. Mechanism of failure for all grafts in both groups was from ligament pullout from the femoral tunnel.
Discussion/Conclusion: Neither repair was able to replicate the strength of the intact CCL, although both repairs achieved over 33% the strength of the intact CCL. Both repairs would likely be strong enough during the recovery period if the patient were restricted but stronger graft fixation techniques are needed before implantation in a clinical patient.
Acknowledgments: Supported by the AKC Canine Health Foundation Grant.

34 A comparison of two surgical methods for the treatment of arthroscopically identified cartilage lesions of the medial femoral condyle in 43 horses

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Introduction: Cartilage lesions of the medial femoral condyle are commonly identified as a source of low-grade lameness in young sports horses. The cartilage was initially debrided but the technique was later changed to micropicking through the damaged cartilage. The hypothesis was that the cartilage sparing technique would lead to a greater long-term success rate.
Materials and Methods: Selection criteria were a positive response to intra-articular analgesia of the medial femorotibial joint and minimal radiographic findings. Arthroscopic evaluation was performed under general anaesthesia. In the debrided group curettes and rongeurs were used to remove softened, creviced and undermined cartilage. In the micropicked group only loose, fibrillated tissue was debrided, and an orthopaedic awl was used to induce subchondral microfractures in the affected area.
Results: In the debrided group, 21 cases had long term follow-up with a return to previous or intended level of function of 15/21 (71%) at 12 months and 11/21 (52%) at 24 months. In the micropicked group, 13 cases had long term follow-up with a return to previous or intended level of function of 11/13 (85%) at 12 months and 7/11 (52%) at 24 months. The results between the two groups were not significantly different at 12 or 24 months when compared with a Fishers Exact Test.
Conclusions: There was a trend towards improved success with the more conservative method.
Acknowledgments: Alicia Fuller MRCVS and Alice Chatham BSc for data collection. There was no proprietary interest or funding provided for this project.

35 Effect of tibial insertion points for lateral suture stabilization on the kinematics of the cranial cruciate ligament deficient-stifle during early, middle and late stance: an in vitro study

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Introduction: Lateral Suture Stabilization (LSS) is used commonly for treatment of cranial cruciate ligament-deficient (CrCL-D) canine stifles. For optimal tibial fixation with LSS, recent studies have suggested various tibial attachment sites or isometric points. The objective of our study was to evaluate the effect of two tibial attachment sites for LSS on the kinematics of the CrCL-D canine stifle during early, middle and late stance.
Materials and Methods: Thirty two hind limbs from 16 canine cadavers were used in this in vitro biomechanical study. Limbs were mounted in a testing jig and an electromagnetic tracking system was used to determine 3-D stifle kinematics under 33% body weight load during early, middle and late stance in the following sequence: CrCL-intact, CrCL-D and LSS with the distal anchor through the tibial tuberosity (LSS_{TT}) or through the cranial eminence of the extensor groove (LSS_{EG}). The proximal anchor point was the lateral femorofabellar ligament.
Results: Post-LSS stifle kinematics were more comparable to normal than post-transection kinematics for both techniques. Both LSS techniques restored stifle kinematics in CrCL-D stifles to varying amounts but neither technique successfully restored normal 3-D stifle kinematics. LSS_{EG} improved kinematics of the CrCL-D stifle in the medial-lateral direction and axial rotation but performed poorly in restoring stifle kinematics in the cranial-caudal direction as compared to LSS_{TT}.
Discussion/Conclusion: Both LSS_{TT} and LSS_{EG} failed to completely restore normal stifle kinematics in CrCL-D stifles in vitro.
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36 Accuracy of measuring three-dimensional femorotibial joint poses in dogs using non-invasive, single-plane fluoroscopic kinematic analysis

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Introduction: The ability to accurately quantify joint kinematics is vital to our understanding of the pathophysiology of many joint disorders. The purpose of this study was to compare the accuracy of a non-invasive single-plane fluoroscopic technique with radiostereometric analysis (RSA) for determining three-dimensional femorotibial poses in a normal dog stifle.
Materials and Methods: A computed-tomographic scan (CT) of cadaveric pelvic limbs was obtained before and after implanting radiopaque beads into the femur and tibia. Orthogonal fluoroscopic images of the right stifle were obtained at flexion angles from 110° to 150° to simulate a normal gait cycle. Joint poses were calculated from the bi-planar images using RSA and were compared to measurements obtained using CT-derived bone models matched to the single-plane, lateral-view fluoroscopic images. Single-plane measurements were performed by two observers and repeated three times by the primary observer. Mean absolute differences between RSA and single-plane fluoroscopy were determined. Measurements were compared between observers and within the primary observer.
Results: The mean absolute difference between single-plane fluoroscopic analysis and RSA measurements were 0.60mm, 1.28mm and 0.69mm for cranio-caudal, proximo-distal and medio-lateral translations respectively; and 0.62°, 1.56° and 1.64° for flexion-extension, abduction-adduction and internal-external rotations respectively. Intra- and inter-observer repeatability was strong. Intra-observer mean absolute translations and rotations did not vary by more than 0.69mm and 0.96° respectively; mean translations and rotations did not vary by more than 0.28mm and 0.90° respectively between observers.

Discussion/Conclusion: Single-plane fluoroscopic analysis is a non-invasive method for accurately measuring three-dimensional femorotibial joint poses in dogs.

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37 Proximal tibial osteosarcoma following tibial plateau leveling osteotomy in 29 dogs: a veterinary society of surgical oncology retrospective case series

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Introduction: Seven cases of sarcoma at a tibial plateau leveling osteotomy site (TPLO) have been previously described. The purpose of this study was to report the signalment information, TPLO plate type, clinical staging information, latency period, treatment and oncologic outcome for dogs that developed proximal tibial OSA following TPLO surgery.

Materials and Methods: A multi-institutional medical record search was performed to identify dogs with a diagnosis of proximal tibial OSA at least 1 year following TPLO surgery.

Results: 29 dogs met the inclusion criteria; the majority were large and giant breed, female spayed dogs (19/29) with a mean body weight of 45.0 Kg. The TPLO surgeries were performed between 1998 and 2007, and the type of TPLO plates used were Slocum 3.5mm (18 dogs), Veterinary instrumentation 3.5mm (2) and Synthes 3.5mm (1). Mean latency between surgery and osteosarcoma development was 5.3 years (Range: 1.0–10.7 years). Five dogs were documented to have metastases at diagnosis (lymph node (2), lungs (1), liver and kidney (1) and bone (1)). Only 10 dogs were treated with amputation followed by chemotherapy and the median survival time was 313 days.

Discussion: Osteosarcoma following TPLO surgery should be a differential diagnosis for lameness and swelling of the proximal tibia years after a TPLO surgery. Median survival following amputation and chemotherapy in 10 dogs with proximal tibial OSA following TPLO surgery was comparable to previously reported outcomes.

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38 Skin preparation for arthrocentesis; a clinical study of sepsis following injection through clipped or hairy skin

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Introduction: Synovial sepsis following intra-articular injection is a serious complication. Clipping of the hair has been considered part of aseptic preparation, though this is unpopular due to temporary disfigurement of the horse. Experimental investigation has shown that aseptic skin preparation can be achieved using chlorhexidine, without clipping the hair. No clinical information has been presented to support this data.

Materials and Methods: A prospective survey of arthrocentesis without antibiotics was undertaken. The breed, joint and substance were recorded, along with whether or not the skin of the injection site was clipped. Clipping was undertaken according to veterinarian preference and was not randomised. The results were compared using a Fisher's Exact test.

Results: 1500 synovial injections in 656 horses were recorded over three years. Of the joints injected 693/1500 (46.2 %) were clipped and 807/1500 (53.8%) were not clipped. Two cases of iatrogenic joint sepsis were identified in the clipped cases (0.29%) and one was identified in the non-clipped cases (0.12%), p=0.2538. 228 joint injections were in "native" breeds with longer hair coats, including 106 through unclipped hair and there were no cases of sepsis in these breeds.

Discussion/Conclusion: This clinical data suggests that injection of joints through surgically prepared but hairy skin does not result in significantly increased risk of iatrogenic synovial sepsis. This data is important for medico-legal purposes. Skin preparation was not randomised but a proportion of the injections were made in thicker coated breeds with no cases of synovial sepsis.

Acknowledgments: The owners of the horses.

39 Synovial sepsis following endoscopic surgery, increased risk associated with the carpal sheath

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Introduction: Surgical site infections of synovial structures are a serious complication. One study evaluating sepsis following endoscopic surgery of joints, bursae and tendon sheaths in horses concluded that draft breeds and the tarsocrural joint were at increased risk. Our aims were to investigate post-operative synovial sepsis following elective endoscopic surgery.

Materials and Methods: The case history of horses that underwent arthroscopy, tenoscopy or bursoscopy at Donnington Grove Veterinary Surgery between 1999 and 2011 were examined. Cases with pre-existing synovial sepsis were excluded. The signalment, anatomical structure involved, use of radio-frequency, tourniquet or motorised resector, the presence of a fracture, whether surgery was performed standing, and the number of structures examined were recorded. Multivariable logistic regression was used.

Results: 1670 horses underwent endoscopic surgery of 3159 synovial structures; 2522 joints, 583 tendon sheaths and 54 bursae. There were 16 cases of post-operative sepsis, always one structure per horse. The infection rate was 10/1000 horses or 5/1000 procedures. Sepsis occurred in 8 carpal sheaths, 3 digital flexor sheaths, 3 carpi, 1 fetlock, 1 stifle joint, and in 5 of 208 joints in which radiofrequency was used.

Discussion/Conclusion: Horses undergoing carpal sheath tenoscopy were 10.8 times (95% C.I. 3.8–30.3 p<0.001) more likely to develop sepsis than those undergoing surgery of another synovial structure. Multivariable analysis suggested that radiofrequency was not associated with an increase in the risk of post operative synovial sepsis. Surgeons should be aware of this risk and may consider altered perioperative antibiotic protocols.

Acknowledgments: The owners of the horses.

40 Metacarpophalangeal joint lesions identified on MRI in horses with lameness that resolves with palmar digital and intra-articular analgesia

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Introduction: Perineural analgesia is used to localize lameness in horses. However, there is increasing concern that this technique is less specific than previously believed. Once the lameness has been localized, if other diagnostic imaging modalities do not provide a diagnosis, magnetic resonance imaging (MRI) is often pursued. This study describes lameness cases that subjectively improved ≥90% with a PDNB that were diagnosed with primary metacarpophalangeal (MCP) joint lesions based on MRI and subsequent intra-articular MCP joint analgesia.

Materials and Methods: Cases were selected from those presented for MRI of the front feet with lameness that resolved following a PDNB. Cases were included if an MCP joint lesion was the most significant MRI finding and, subsequently, the lameness resolved with both a PDNB and intra-articular MCP joint analgesia.
Results: Fifteen horses were included that had a primary MCP joint lesion; thirteen horses had a lesion in the medial aspect of the joint and two horses had a midline lesion. The PDNBs were performed using ≤ 2.5 mL of anesthetic per site and horses were re-evaluated within 10 minutes.
Discussion/Conclusion: In horses with lameness that resolves with a PDNB, consider the possibility of a lesion located at the proximal pastern and/or fetlock when planning MR studies, or when MR findings within the foot do not correlate with the degree of lameness. Repeated or additional blocks should be performed prior to MRI to help ensure the proper anatomic region is imaged.
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41 Comparison of a cluster marker and thigh marker on the 3D kinematic of the hind leg in dogs

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Introduction: Kinematic research has focused on refining techniques to quantify and minimize errors associated with skin-mounted markers. We compared locations of the knee center and its effect on kinematics of the stifle in dog using either independent markers or a cluster-marker. We hypothesized that these two methods would yield similar results.
Materials and Methods: Limb segments were defined using retroflective markers with the lateral stifle marker being a cluster of 4 markers. Local coordinates of the stifle joint centers were determined using either the cluster or 3 single markers. Those respective coordinates were used to measure joint angles at the trot and results between 2 groups were compared.
Results: Differences in Fourier coefficients were detected in the sagittal plane for the knee and in the frontal plane for the hip. In the sagittal plane, the differences were small. They resulted from a slightly more caudal joint center in the cluster group. In the frontal plane, the curves were within the 95% CI for the hip and tarsus but did differ for the stifle. Transverse plane kinematic for the hip and stifle was largely different.
Discussion/Conclusion: Both methods yielded very similar results in the sagittal planes with only minor variations making the cluster a valid alternative to individual markers in sagittal plane analysis. Differences were observed in the frontal and transverse planes for the stifle and in the transverse plane for the hip making those measurements questionable.
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42 Cone-beam computed tomography (CBCT) for imaging of equine lower limb

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Introduction: Volumetric imaging of the equine lower limb is expensive and usually requires general anesthesia. Cone-beam computed tomography (CBCT) has shown to provide excellent image resolution and is commonly used for diagnosis of maxillofacial and dental disease in human medicine. CBCT offers a potentially effective means of imaging the equine lower limb. The aim of this study was to investigate the image quality of CBCT of the equine lower limb.
Materials and Methods: Two equine forelimb specimens were scanned with a multi-slice CT and a CBCT unit. Subjective bone and soft tissue image quality, as well as objective morphological measurements were compared between the 2 units.
Results: Images obtained with CBCT had better bone image quality and equivalent soft tissue image quality compared to multi-slice CT. Measurements of condylar width did not indicate any noticeable geometrical differences between measurements performed by a CBCT scan compared to a traditional CT scan.
Discussion/Conclusion: Cone-beam CT has similar or superior image quality compared to multi-slice CT in tasks pertinent to the equine lower limb. Cone-beam CT offers a potentially valuable volumetric imaging technique for equine extremities.
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43 Evaluation of thoracic limb alignment in healthy Labrador Retrievers using recumbent versus standing view frontal plane radiography and the center of rotation of angulation (CORA) methodology

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Introduction: The objectives of this study were to develop a technique to obtain thoracic limb radiographs in standing dogs and to determine limb alignment and joint reference values in standing or recumbent positions. We hypothesized that standing values would be significantly different from recumbent values.
Materials and Methods: Twenty-nine healthy Labrador Retrievers >15 months of age were enrolled. Caudocranial thoracic limb radiographs of 58 limbs were obtained in standing and recumbence.
Results: Mean±SD mechanical (m) joint angles were determined using the CORA methodology for recumbent (r) and standing (s) radiographs: medial proximal radioulnar angle (mMPRUA): 80.41±2.87° (r), 79.39±2.74° (s); lateral distal radioulnar angle (mLDRUA): 86.06±2.91° (r), 85.07±2.55° (s); lateral proximal carpometacarpal angle (mLPCMCA): 86.35±3.26° (r), 84.79±3.67° (s); humeral radioulnar angle (mHRUA): 9.16±2.75° (r), 10.41±3.74° (s); radioulnar metacarpal angle (mRUMCA): 6.75±2.56° (r), 9.41±3.33° (s); thoracic metacarpal angle (mTMCA): 2.53±2.01° (r), 4.51±2.21° (s); elbow mechanical axis deviation (eMAD): 3.05±1.16% (r), 3.30±1.50% (s); carpus mechanical axis deviation (cMAD): −0.49±0.78% (r), −1.10±0.99% (s); elbow compression angle (ECA): 0.58±0.71° (r), 1.86±1.18° (s); and elbow rotational position (ERP): 45.63±3.26 (r), 43.53±5.09 (s). With the exception of eMAD, all reference values were significantly different when obtained from standing versus recumbent radiographs.
Discussion/Conclusion: This is the first study to report thoracic limb alignment and joint reference values in healthy, standing dogs. Future studies are necessary to determine if alignment values in dogs with elbow dysplasia are significantly different from those of healthy dogs.
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Part II to follow in the next issue.

