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Part I

01 Preclinical Assessment of Cementless Total Knee Replacement in the Dog

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Introduction: Although cementless fixation offers a number of important advantages over cemented fixation, its use in total knee replacement (TKR) surgery in humans has been associated with an increased risk of implant loosening. The specific aim of the current study was to determine the feasibility of cementless tibial fixation in canine TKR.

Materials and Methods: 12 skeletally mature Hounds underwent right TKR with either a porous-coated, metal-backed tibial component used without cement, or a standard monobloc UHMWPE tibial component secured with cement. Dogs were evaluated at 1, 6, 26, 39 and 52 weeks post-operatively using a combination of clinical examinations, radiography and bone densitometry. TekScan analysis was used to quantify limb use at the end of the study (14 months). Bone apposition/ingrowth around the cementless tibial component was assessed through microradiography and histology of the bone-implant interface.

Results: There were no significant differences in either peak vertical force or vertical impulse between the operated and control hind limbs at walk or trot. Bone density values in the proximal tibia decreased by 6 weeks after surgery but recovered by 26 weeks. None of the tibial components showed evidence of osteolysis or implant migration. Histology demonstrated good-to-excellent bone apposition and ingrowth within the porous coating.

Discussion/Conclusion: Clinical results with the cementless Biomedtrix TKR implant were excellent at time points out to 1 year. Limb use was similar in the operated limb and the unoperated contralateral limb. Histological examination confirmed bone apposition and bone ingrowth within the porous surface of the tibial component. Prospective clinical studies are now needed to document the long-term clinical performance of cementless TKR in the dog.

Acknowledgments: TKR implants provided by BioMedtrix, LLC.

02 Age-Dependent Prevalence of Radiographic Hip Osteoarthritis of Canine Hip Dysplasia in Golden Retrievers

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Introduction: The diagnosis of canine hip dysplasia (CHD) largely depends on the presence of radiographic osteoarthritis (OA), laxity or both at the time of evaluation. Routine hip evaluations are performed at 2 years of age however recent data indicate linear increase of OA-prevalence with age throughout life. This study aimed to investigate the age-dependent prevalence of hip OA in a group of Golden retrievers (GLDR).

Materials and Methods: PennHIP records of previously evaluated GLDR, <7 years of age were analyzed. Joint laxity (DI) and radiographic OA were recorded. For statistical analysis dogs were grouped by DI-interval: A(0.30–0.39), B(0.40–0.49), C(0.50–0.59), D(0.60–0.69), E(0.70–0.79) and F(0.80–0.89).

Results: 9,814 GLDR with mean age of 1.5 years and mean DI of 0.55 were included. Radiographic OA was present in 13% of the dogs, OA was not found in dogs with DI<0.30. OA-prevalence increased linearly with age irrespective of DI ($R^2=0.863$, $p=0.0003$) and when grouped by DI-interval ($R^2_B=0.930$, $R^2_C=0.969$, $R^2_D=0.925$, $R^2_E=0.974$). Relative risk for OA doubled with every one-year increase in age (RR=1.89) and every 0.10 DI increase (RR=2.44).

Discussion/Conclusion: Prevalence of radiographic OA in this group of GLDR increased linearly with age and DI. Dogs with lax hips had earlier onset of OA and presumably faster disease progression. Nearly all (99%) GLDR in this study had joint laxity in the OA-susceptible range (DI=0.30), therefore OA-prevalence would likely continue to increase with age. It can be concluded that a large number of dogs evaluated at 2 years of age are falsely diagnosed as CHD-free.

Acknowledgments: PennHIP Analysis Center, Malvern, PA

03 Micro Total Hip Replacement for Feline and Small Canine Patients

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Introduction: The Micro Total Hip Replacement (Micro THR) system was introduced in 2005. The initial 66 Micro THR procedures performed on 49 dogs and 8 cats were evaluated. The surgical technique and the clinical outcomes are reported in this study.

Materials and Methods: Patient data was recorded including: signalment, body weight, diagnosis, surgical technique, implant size, intraoperative comments, and postoperative complications. Implant positioning and cement mantle quality were evaluated radiographically. Orthopedic examinations and client interviews were used during the examinations to obtain follow up information.

Results: Micro THR was performed unilaterally on 40 dogs, staged bilaterally on 9 dogs, and unilaterally on 8 cats with OA, traumatic coxofemoral luxation, capital epiphyseal fractures, avascular necrosis of the femoral head, pelvic fracture malunion, femoral head ostectomy revision, or round ligament injury. Mean body weight was 7.20 kg (range 2.45 to 15 kg; median 6.4 kg). Postoperative complications included unmanageable prosthesis luxation in 4 dogs. No femoral fractures occurred. The mean radiographic follow up time was 65.9 weeks (range 5 to 223 weeks). Seven were followed for =3.0 years (mean 3.5 years; range 3.0 to 4.3 years). Sixty of the 66 (91%) Micro THRs had excellent outcomes.

Discussion/Conclusion: Micro THR is considered a satisfactory alternative to femoral head ostectomy in small dogs and cats to provide a pain free joint and to restore function. Success with twenty three (23) small dog breeds and with cats suggests that Micro THR surgery has potential wide spread application.

Acknowledgments: No financial support was received for this study.

04 Anatomic Comparison of Acetabular Ventroversion From Double Pelvic Osteotomy Compared to Triple Pelvic Osteotomy

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Introduction: Triple Pelvic Osteotomy (TPO) has an implant complication rate of up to 70%. Double pelvic osteotomy (DPO) should afford greater stability of the hemipelvis than the TPO. The ventroversion required to produce the same effect as the TPO is not currently known. This study's purpose was to compare the acetabular ventroversion achieved by the DPO technique at 20, 25 and 30 degrees to the standard TPO at 20 degrees.

Materials and Methods: Cadaveric pelvis with intact lumbosacral and sacroiliac joints were hung in a jig to standardize positioning for computed tomography (CT). CTs were made of each pelvis at baseline (NoSx), and after DPO at 20, 25, and 30 degrees, and TPO at 20 degrees. The angles of the medial cortex to the same anatomic mid line were measured in six transverse planes. The values of each angle were compared for the 3 DPO techniques to the TPO20 via concord-

ance correlation in order to determine which of the three DPOs results in the acetabular ventroversion angle closest to the TPO20 value.

Results: Average acetabular angles \pm SD in degrees were: NoSx- 32.89 \pm 2.23, DPO20- 47.39 \pm 4.39, DPO25- 51.43 \pm 5.06, DPO30- 54.75 \pm 4.38, and TPO20- 50.20 \pm 5.76. Concordance correlations compared to TPO20 were: NoSx- 0.027, DPO20- 0.721, DPO25- 0.902, and DPO30- 0.593.

Discussion/Conclusion: These data suggest that DPO at 25 degrees results in the most similar acetabular ventroversion compared with the traditional TPO of 20 degrees.

Acknowledgments: Implants were donated by New Generation Devices, Glen Rock, New Jersey.

05 Multicenter Outcomes Study for Evaluation of Tight-rope CCL for Treatment of Cranial Cruciate Deficiency in Dogs: The First 1,000 Cases

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Introduction: Tightrope CCL (TR) is an extracapsular stabilization procedure for treatment of cranial cruciate ligament (CCL) disease in dogs. As part of a commitment to critically assess outcomes, we enrolled veterinarians in a multicenter study to further assess safety and efficacy in 1,000 cases.

Materials and Methods: This study falls within guidelines of participating institutions' IACUC/ethical treatment of animals standards. Centers were enrolled to prospectively collect outcomes data for all dogs treated with TR. Criteria for reporting time frame, outcome, and complications were from a system proposed for clinical orthopaedic studies in veterinary medicine and were set *a priori*. Data were reported by each center for descriptive analyses and ANOVA to analyze differences among time frames.

Results: 29 centers reported on 1,004 TR cases (weight, 2-93 kg), 58.7% of outcomes were short term (3-6 mos), 31.1% mid term (6-12 mos), and 10.2% long term (>12 mos). Subjective outcomes were considered successful in 93.9% of cases - 54.1% "full function", 39.8% "acceptable function", and 6.1% "unacceptable function". No catastrophic complications were reported. Major complications occurred in 9.9% - subsequent meniscal tears (4%), infection (2.8%), and failure (3.1%). Minor complications were reported in 10.1%, primarily seroma formation. No significant differences in function or complications were noted among time frames.

Discussion/Conclusion: Tightrope CCL is associated with successful outcomes in ~94% of patients. Complications requiring further surgical or medical treatment occur in ~10% of TR cases. These subjective data indicating safety and efficacy of TR for treatment of dogs with CCL disease can be broadly applied.

Acknowledgments: Sincerest thanks to the conscientious veterinarians at the participating centers who helped bring TR to clinics in a safe and effective manner and honestly reported these data.

06 Influence of Locking Plates in Tibial Plateau Angle Changes After Tibial Plateau Leveling Osteotomy (TPLO) in Dogs with Cranial Cruciate Ligament Rupture

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Introduction: Tibial plateau angle increases after TPLO performed as a treatment of naturally occurring CCLR in dogs. We speculate that the loss of reduction is related to a repositioning (settling) of the proximal fragment in the immediate postoperative period. Here we compare two populations of dogs (n=120) with naturally occurring CCLR treated with TPLO. Locking plates (fixed angle fixation) were used in one group and non-locking plates in the other.

Materials and Methods: Twenty TPLOs performed were included in the first

group. All dogs received a locking plate. 100 TPLOs were included in the second group. All dogs in the received a non-locking plate. TPA measurements on mediolateral radiographs were performed pre-, immediately post-operative, and at recheck. ANOVA was applied to characterize groups. Paired T-test was used to determine significance of difference.

Results: For the locking group, the TPA change (recheck TPA - post operative TPA) = 0.56° (SDev=1.4°)(p=0.078) was not significant. In the non-locking group, the TPA change = 2.96° (SDev=3.5°) (p<0.001) was significant. No differences in patient variables were noted between groups.

Discussion/Conclusion: Increase in TPA occurs following TPLO. To date, no cause or influencing factors have been identified. Locking plates prevent loss in TPA. This should be considered by the surgeon. Perhaps, if a non-locking plate is used, over-rotation of the proximal fragment to achieve a more aggressive post-operative leveling would accomplish a desirable TPA after settling had occurred.

Acknowledgments: Giselle Hosgood, BVSc, MS, PhD, Diplomate ACVS

07 Intra-Articular Prosthetic Cranial Cruciate Repair

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Introduction: The goal of this project was to develop and test an intra-articular prosthetic cranial cruciate repair (CCL) system

Materials and Methods: Slobodan Tepic (KYON) developed a prosthetic CCL with a new material, titanium screw, and ruby burnishing. Instrumentation was developed to allow placement arthroscopically or through a small medial arthrotomy. Nine patients received the implant starting in March of 2008.

Results: Patients were implanted and monitored at for implant failure, synovitis, infection and screw placement. Two cases had implant failure at the tibial attachment knot noted on the two week recheck. One case developed an infection and an intra-articular failure near the tibial attachment screw. The three failed cases were successfully repaired with implant removal and a TPLO.

Discussion/Conclusion: The implant showed enough promise to warrant further studies. A new device was developed to prevent failure of the tibial attachment knot. In the future in vitro biomechanical testing with axial cyclic loading will be performed. Other in vitro testing will include isometry with different implant attachment sites. Prospective study results should be available on around 100 cases within one year. The prospective testing protocol is being developed now.

Acknowledgments: A patent has been filed by Slobodan Tepic (KYON) and the author.

08 Novel Bone Anchor System Facilitating Intra-Articular Cranial Cruciate Ligament Restoration in the Dog

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San Clemente Veterinary Hospital, Inc., San Clemente, CA **Introduction:** Intra-articular CCL repair has all but been abandoned due to failure of the bone anchor or graft. A novel anchor and implant presented here hopes to serve in this and other capacities.

Materials and Methods: Materials include standard orthopedic tools, sterile polymethylmethacrylate, two hundred pound test monofilament nylon, and a properly sized two channel metal crimp.

A standard lateral parapatellar arthrotomy is performed. The joint is inspected and deficient CCL remnants and torn menisci are debrided. Individually unique proximal and distal tunnels are prepared, entering the femur nearest the origin and tibia nearest the insertion of the natural CCL. A loop of monofilament nylon is threaded into the femoral tunnel and cemented into place using methylmethacrylate. The free ends are threaded into the distal segment, tensioned, crimped, knotted, trimmed, then encased in methylmethacrylate recessing this segment into the proximal tibia. Routine closure is performed.

Results: Outstanding to good reduction of drawer, normal medial tibial rotation, normal range of motion, and rapid return to normal ambulation in the immediate post-operative period are attained. Full return to normal athletic activities

with reduction of osteoarthritic change as long as 2.5 years post-operatively has been observed.

Discussion/Conclusion: This novel method shows tremendous promise for various ligament injuries not limited to CCL repair. Its' durability is not yet proven, but the results to date have been encouraging.

Acknowledgments: Dr. Patrick Echolds, Tara Agostini, Jen Agostini, Brandy Ramirez, and Sara Ciscel for their help and encouragement.

09 Comparison of Complication Rates Between Titanium and Stainless Steel Implants Following Tibial Plateau Leveling Osteotomy in Dogs; 265 Cases (2007–2009)

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Introduction: The objectives of this retrospective study were to identify the incidence and type of complications following TPLO in dogs performed with titanium TPLO implants and compare to those in dogs performed with stainless steel TPLO implants.

Materials and Methods: Medical records of dogs that underwent TPLO were reviewed. Dogs were divided into 2 groups: titanium (Ti) TPLO and stainless steel (Ss) TPLO. Intraoperative and postoperative complications associated with TPLO were identified in each group and the incidence and type of complications were compared.

Results: 171 Ti TPLOs (150 dogs) and 94 Ss TPLOs (85 dogs) were included in this study. The intraoperative complications (n=4, 2.3 %) were found only in the Ti TPLOs and included: hemorrhage (n=3) and a broken screw (n=1). Major postoperative complications (delayed bone healing, fibular fracture, implant problems and patellar luxation) were identified in 11 of the 171 (6.4 %) Ti TPLO and 8 of the 94 (8.5 %) Ss TPLO. The major implant complications in this study were screw breakage and loosening. Osteomyelitis, draining tracts or neoplasia at the surgical site was not found in either group. Minor postoperative complications of any type were identified in 41 of the 171 (23.9 %) Ti TPLO and 15 of the 94 (15.9 %) Ss TPLO. Incisional complications and patellar tendon swelling were the most common minor complications found in this study. There was no statistical difference in the incidence of major and minor complications between Ti TPLO and Ss TPLO in this study.

Discussion/Conclusion: There was no significant difference in the incidence and type of complications associated with TPLO between dogs receiving titanium TPLO implants and dogs receiving stainless steel TPLO implants. The overall incidence of complications associated directly with Ti implants was low and was limited to problems with the screws. Further study may be required to identify any advantage of titanium implants for TPLO in veterinary patients.

Acknowledgments: Dr. Coolman is a consultant for Animal Orthopedics, the titanium implant manufacturer. There was no funding or donation of implants from any manufacturers in this study.

10 Randomized, Controlled, Clinical Trial to Determine the Efficacy of A Topical Epidural for Post-Operative Hemilaminectomy Pain Control

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Introduction: The purpose of this study was to evaluate the efficacy of a topical epidural placed at the time of hemilaminectomy on postoperative pain. Our hypothesis was that dogs receiving the topical epidural would be less painful than dogs receiving only postoperative opioids and would require fewer rescue doses of analgesic.

Materials and Methods: Thirty dogs with surgically confirmed thoracolumbar IVDD were randomly allocated to 3 groups: 1. Hydromorphone alone (0.1 mg/kg IV every 6 hrs), 2. Topical epidural (gel foam soaked in 0.1mg/kg preservative free morphine and 5ug/kg Dexmedetomidine), 3 Both hydromorphone and the topical epidural. Pain was scored by a blinded, trained observer at 3, 6, 12, 18, 24,

36, and 48 hours postoperatively. Confounding factors were recorded and compared among groups. Groups' pain score was compared over time and at each individual time point. Finally, the number of dogs rescued in each group was compared.

Results: None of the potential confounders were different between groups. The group receiving hydromorphone alone was significantly more painful than the group receiving both the topical epidural and hydromorphone at 48 hrs (p<0.05). When rescued dogs were removed from the analysis, additional time points became significant (6 and 36 hours) (p<0.05). Dogs receiving the topical epidural alone were rescued significantly more than dogs in any other group (p<0.01).

Discussion/Conclusion: Topical epidural alone does not provide adequate analgesia, but it appears to have an added analgesic benefit to intermittent hydromorphone alone.

Acknowledgments: No external funding sources were used.

11 Prospective Evaluation of Cold Compression Therapy On Postoperative Pain, Swelling, Range of Motion and Lameness Following Tibial Plateau Leveling Osteotomy

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Introduction: Cold compression therapy (CCT), the use of cold therapy combined with intermittent pneumatic compression, is currently used in human medicine to treat postoperative pain, decrease swelling and improve limb function following knee surgery. Our objective was to determine the effect of CCT on postoperative pain, swelling, range of motion and lameness in dogs undergoing tibial plateau leveling osteotomy (TPLO).

Materials and Methods: Thirty-four dogs undergoing TPLO were included in the study and randomly assigned to one of two groups. Group 1 received CCT during the 24 hour postoperative period and group 2 received no CCT. Pain, degree of lameness, stifle range of motion and swelling were evaluated preoperatively, 24 hours, 14 days and 28 days postoperatively. Logistic regression and linear regression analysis were used to compare the measured variables. P < 0.05 was considered significant.

Results: Treatment resulted in significantly lower pain scores (p=0.004), decreased lameness (p=0.001), increased range of motion (p=0.003) and decreased stifle swelling (p=0.008) 24 hours postoperatively. No difference in the outcome measures were observed at 14 and 28 days postoperatively.

Discussion/Conclusion: Our study supports the use of CCT as part of a multimodal approach to decrease pain and swelling and improve limb function in the immediate 24 hours following TPLO. The benefits of CCT reported here are likely related to the decrease in pain and inflammation and improved regional tissue perfusion achieved during the treatment period. These benefits may prove to be more substantial when CCT is incorporated in long term physical therapy protocols.

Acknowledgments: Cold compression units were provided by Game Ready Equine, Coolsystems Inc.

12 A Description of Motion of the Canine Pelvic Limb in 3 Planes Using a New Inverse Dynamics Model

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Introduction: A new inverse dynamics model was created that derives net joint moments and power from a calculated joint center. The authors hypothesized that this new model would produce an accurate description of motion in the

sagittal, frontal and transverse planes, thus producing the first description of motion in the canine pelvic limb in all three planes.

Materials and Methods: Six dogs were outfitted with medial and lateral reflective markers. A static calibration was collected which allowed for identification of joint centers. Radiographs helped identify the hip joint center. Kinetic and kinematic data were collected as the dogs were trotted across a calibrated spaced. An inverse dynamics method was used to describe the joint net moment and power across the pelvic limb in three planes.

Results: In the sagittal plane, the hock experiences the greatest moments and power of all three joints. In the frontal plane, the hock and stifle abductors and adductors share equal time in the stance phase and the hip abductors cause the net moment in that joint. The moments and power generated in the frontal and transverse planes are one half to one tenth that produced in the frontal plane.

Discussion/Conclusion: Inverse dynamics results derived from joint centers allow for more accurate data. These descriptions of motion in three planes allow for a greater understanding of the biomechanics of the canine pelvic limb and may lead to a better understanding and treatment of pathologic processes.

Acknowledgments: NA

13 Use of a Gingival Autograft to Create An Enduring Bio-Implant Interface for Limb Prosthesis

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Introduction: Applying a gingival autograft to a limb amputation stump was used to create a protective implant-soft tissue interface similar to that surrounding a tooth for providing protection from environmental factors and to prevent the disruptive growth of skin into the implant-bone interface.

Materials and Methods: We adopted a young adult female Saluki with a traumatic mild tibial amputation. A healthy granulation bed was created, and an oral free mucosal autograft was preformed. Later, a custom titanium alloy prosthesis** was secured in the distal tibia with locking screws. After eight weeks, an artificial limb was attached and progressively lengthened. At 75% normal total limb length, limb use increased to nearly continuous. Three months later the endoprosthesis failed through the distal screw hole. A new solid core, partially threaded implant** was screwed 30mm into the bone. A mandibular gingival ridge autograft was harvested and sutured around the implant. Additional mucus membrane was sutured to remaining raw surface. After 8 weeks, limb use was documented with force plate analysis.

Results: After four months the implant failed at the thread-nonthread junction level of the implant requiring implant removal.

Discussion/Conclusion: Preliminary results suggest gingival autografts protect the bio-implante interface, and osseointegrative interfaces can tolerate weight-bearing loads, but strategies to moderate these loads and the design of the implants will be critical.

Acknowledgments: Materials supplied by Kyon Monetary support by many private donations Facilities support by Aspen Animal Hospital, Pet Kare Animal Hospital, Spring Creek Animal Hospital, VTH-Colorado State University

14 Long-Term Follow-up of Lumbosacral Distraction-Fusion Using Combined Dorsal and Ventral Fixation Including a Novel Intervertebral Spacer Device (23 DOGS)

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Introduction: Selection criteria for surgical intervention and long-term outcome data for degenerative lumbosacral stenosis have been poorly defined, particularly concerning significance and mensuration of abaxial neural impingement. We hypothesised that application of a novel tapered, threaded, distraction device (Fitz Intervertebral Spacer Screw, FISS) would result in resilient resolution of clinical signs.

Materials and Methods: 23 dogs presented with signs attributable to lumbo-sacral and sciatic pain and MRI-documented abaxial neuroforaminal impingement. Dorsal laminectomy was followed by insertion of the FISS into the LS IV/D space. 2–5–3mm threaded pins were placed across the LS facets (2), into the vertebral body of L7 (2) and into the sacro-iliac junctions (4) and enshrouded in a bolus of polymethylmethacrylate cement.

Results: Mean time to resolution of pain by clinical examination and owner VAS score was 4.2 weeks (range 2–16 weeks). Clinical outcome was evaluated for 15 patients by telephonic interview at mean 495 days post-operatively: exercise level, 66.6% answered high and 26.6% moderate; degree of pain 60% answered 1, 26.66%, 2 and 13.3%, 3 (1 best, 10 worst). Radiography revealed mean magnitude of intervertebral distraction 3.4mm (range 2–6mm) and maintenance of distraction position for all cases.

Discussion/Conclusion: Addressing exit zone impingement of the L7 nerve roots even with radical foraminotomy and a trans-ilial approach is difficult because of propensity for iatrogenic trauma and encroaching soft tissue and bone may grow back over time. This clinical data supports application of FISS technique and documents resilient maintenance of distraction and lasting amelioration of clinical signs.

Acknowledgments: None

15 Ultrasonographic and Radiographic Assessment of Fracture Healing After Percutaneous Plating and Open Plating of Radius-Ulna Fractures in Dogs

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Introduction: Percutaneous plating has been used for fixation of long bone fractures in dogs. The purpose of this study was to compare fracture healing measured by ultrasound and radiographs between dogs with radius-ulna fractures repaired with percutaneous or with open plating.

Materials and Methods: Clinical cases undergoing percutaneous or open plating were enrolled in the study prospectively. The cases were rechecked monthly until complete healing was noted. A high frequency (7–15MHz, Philips) linear transducer was used to perform the ultrasonographic evaluation in all cases. Vascularization was assessed with power Doppler.

Results: 7 dogs operated with MIPO and 9 dogs operated with open plating were included. The dogs ranged in age from 5 months to 10 years. The age (mean \pm SD) in the percutaneous and open-plating groups was respectively 23.1 \pm 21.8 and 33.3 \pm 55.6 months. Based on ultrasound assessment the fractures healed in 26.4 \pm 10.9 days in the percutaneous plating group and in 50.6 \pm 18.1 days in the open plating group. Based on radiographic assessment the fractures healed in 30.0 \pm 10.5 days in the percutaneous plating group and in 64.2 \pm 14.1 days in the open plating group.

Discussion/Conclusion: Our results suggest that radial fractures repaired with a MIPO technique heal faster and with a larger vascularized callus than dogs treated with open plating. We suspect that preservation of the extraosseous blood supply and periosteal vessels allow an early formation of the callus.

Acknowledgments: The authors did not receive any compensation for this study.

16 Minimally Invasive Plate Osteosynthesis in 36 Tibial Fractures in Dogs and Cats

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Introduction: Plate osteosynthesis of tibial fractures using open reduction and internal fixation (ORIF) has been associated with up to 18% of severe complications, presumably as a result of poor soft tissue coverage and additional surgical trauma. The reported time to clinical union with ORIF and External Skeletal Fixation (ESF) ranges from 41 to 185 days. While minimally invasive osteo-

synthesis (MIO) has been extensively used in people to enhance bone healing and limit complications, MIO in veterinary orthopedics is seldom used. We hypothesized that tibial fractures repaired using MIO techniques carry a lower complication rate and reach clinical union faster than those reported with ORIF or ESF.

Materials and Methods: Thirty six cases presented with extra-articular tibial fractures, amenable to plate osteosynthesis, were treated using percutaneous plating with or without an additional intramedullary rod. Follow-up radiographs were recommended every three weeks until clinical union.

Results: Six cases, lost to follow-up healed uneventfully per owner interview. Time to clinical union in the 23 cases completing scheduled follow-ups was 36 ± 11.6 days (14–55). The remaining 7 cases had reached bony union by the time of final follow-up. Minor complications were observed in 4/36 cases (11%). Plate fracture occurred in one dog (2.7%), 15 days postoperatively. Following plate replacement using MIO, uneventful healing occurred by 35 days following initial surgery.

Discussion/Conclusion: This report suggests that MIO may be an effective alternative to ORIF and ESF for the treatment of extra-articular tibial fracture. In this study, MIO was associated with a faster healing time and lower complication rate than those reported with conventional osteosynthesis.

Acknowledgments: None

17 Minimally Invasive Application of a Plate-Rod Construct for Fractures of the Radius and Ulna: Technique and Case Series

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Introduction: Diaphyseal fractures of the radius and ulna are common orthopedic injuries in dogs. As these fractures are often secondary to automobile accidents, they are frequently comminuted and difficult to anatomically reconstruct. As such, these injuries lend themselves to management with indirect reduction techniques. The objectives of this study are to describe a minimally invasive plate-rod (MIPR) technique in diaphyseal radius and ulna fractures and present the outcome in a series of cases treated by this method.

Materials and Methods: Medical records (November 2005-June 2009) of 8 dogs with diaphyseal radius and ulna fractures stabilized by a MIPR construct were reviewed. Data retrieved included signalment, weight, limb affected, cause of injury, open vs. closed fracture, number of fragments, implant size, number of screws used and cortices engaged, number of open screw holes, operative time, complications and final outcome.

Results: Dogs with diaphyseal radius and ulna fractures were treated with minimally invasive plate-rod constructs. All fractures were due to trauma and 2 fractures were open. Complications included osteomyelitis associated with the ulnar pin ($n = 1$). Osteomyelitis resolved with pin removal and healing occurred in all cases with no implant failures. Median time to radiographic union was 10.5 weeks.

Discussion/Conclusion: Use of MIPR constructs on diaphyseal fractures of the radius and ulna is an effective technique for managing these fractures using principles of biological osteosynthesis. An intramedullary rod in the ulna assists with fracture reduction and stabilization and rod removal is recommended once fracture healing has occurred.

Acknowledgments: Thank you to the residents at TAMU that contributed these cases.

18 Retrospective Study Evaluating Implant Failure in 213 Cases of Fractures or Osteotomies Stabilized Using Titanium or Stainless Steel Bone Plates

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Introduction: Implant failure is an uncommon problem and limited implant failure has been reported in association with titanium implants in veterinary orthopedics. The purpose of this study was to evaluate implant failure associated with stainless steel (SS) and titanium (TT) plate stabilization of fractures or osteotomies.

Materials and Methods: Medical records were reviewed for animals that had fractures or osteotomies of the long bones or pelvis stabilized using bone plates at the Veterinary Medical Teaching Hospital, Texas A & M from February 2002 to March 2008. The information retrieved included species, breed, sex, weight, bone affected, if the fracture was open or articular, if the fracture was a malunion or non-union and if there were concurrent orthopedic injuries. Further information included material of plate (TT or SS), plate type, use of intramedullary (IM) pin or bone graft, complications, recheck examination and radiographic findings (union and implant failure). A telephone questionnaire was used to obtain client follow-up.

Results: Two hundred and thirteen cases met the inclusion criteria: SS group (180 cases) and TT group (33 cases). Implant failure occurred in 22/73 SS and 9/12 TT cases, with no significant difference ($p=0.138$) found between the groups.

Discussion/Conclusion: This study failed to identify a difference in occurrence of implant failure between SS and TT groups. As a retrospective study there are some inherent limitations but we encourage prospective studies to further evaluate titanium implant use and implant failure.

Acknowledgments: There were no disclosures or acknowledgements for this study.

19 An in Vitro Biomechanical Comparison of Equine Proximal Interphalangeal Joint Arthrodesis Techniques: A New Axial Positioned LCP Versus An Axial Positioned DCP Each with Two Abaxial Transarticular Cortical Screws Inserted in Lag Fashion

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Introduction: Our objective was to compare monotonic biomechanical properties of a new 4.5 mm narrow 3-hole LCP applied axially with an axially applied DCP, each in conjunction two abaxial transarticular 5.5 mm cortical screws inserted in lag fashion for the arthrodesis of the equine PIP joint.

Materials and Methods: Paired forelimbs from mid-humerus distally from 18 adult Thoroughbred horses were randomly chosen to receive the LCP or the DCP fixation technique. The pairs of constructs were divided into three groups (6 pairs per group). The three test groups consisted of single cycle to failure and cyclic fatigue under axial compression and single cycle to failure under torsion loading.

Results: The mean \pm standard deviation (SD) values for the LCP and DCP fixation techniques, respectively, in single cycle to failure under axial compression were: yield load, stiffness, 2.33 ± 0.10 N/mm and 2.64 ± 0.11 N/mm; and failure load, 25.65 ± 2.28 kN and 32.8 ± 3.4 kN. In cycles to failure under axial compression, mean + SD values for the LCP and DCP fixations, respectively, were: $96,558 \pm 10,237$ and $98,362 \pm 10,153$ cycles. In torsion, the mean + SD values for the LCP and DCP fixations, respectively, were: stiffness, 138.99 ± 11.54 N-m/rad and 111.8 ± 10.4 N-m/rad; and failure load, 106.70 ± 11.98 N-m and 91.72 ± 10.2 N-m.

Discussion/Conclusion: Our results support the conclusion that overall there was no significant advantage in using the new 3-hole, 4.5 mm narrow LCP for equine PIP joint arthrodesis compared to the 3-hole, 4.5 mm narrow DCP to stabilize the dorsal aspect of the PIP joint.

Acknowledgments: NSF

20 Preliminary Mechanical Investigation of the 3.5 Titanium SOP

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Introduction: Contouring reduces strength and stiffness of metallic implants. This work investigated the effects of bending and twisting on the strength, stiffness and durability of the 3.5 Ti SOP implant.

Materials and Methods: 1. Four groups of plates were tested in 4 point bending (Straight Steel); (Straight Ti); (Bent Ti); (Twisted Ti). Load deformation curves were used to calculate derived stiffness and strength parameters as defined in ASTM F382–99 2003.

2. Plates were bent to 10, 20 or 40° then straightened repeatedly until failure.

3. Plates were slowly twisted until failure.

Results: The steel SOP was stronger than the Ti ($p < 0.001$) but relative to density, the Ti SOP was stronger ($p < 0.001$). Bending diminished the Ti SOP's stiffness significantly ($p = 0.006$) but its strength only marginally. Twisting changed stiffness and strength insignificantly. The Ti SOP failed after significantly fewer bending cycles: larger bends caused earlier failure. The twisted Ti SOP failed after 168 ± 16^0 compared with 600 ± 30^0 ($p < 0.001$).

Discussion/Conclusion: Contouring reduced strength and stiffness but the contoured implant retains clinically appropriate stiffness and strength. The low ductility of Ti explains the earlier failure of the Ti SOP with cyclic bending or twisting. Locking plates do not require accurate contouring so limitations imposed by the lower ductility of Ti are unlikely to be clinically significant.

The 3.5 SOP can be safely contoured to the extent typically needed in orthopedic surgery. However, cyclic twisting or bending is not well tolerated so repeated or multiple manipulations of titanium plates must be avoided.

Acknowledgments: Orthomed UK supplied implants

21 In Vivo Biomechanical Evaluation of a Novel Angle-Stable Interlocking Nail Design in a Canine Tibial Gap Fracture Model

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Introduction: While in vitro studies have shown that angle-stable interlocking nails (AS-ILN) provide greater construct angular stability than standard nails (ILNs), the relative biological benefit of these nails has not been evaluated. This study compares clinical outcome and final callus biomechanical properties of AS-ILNs and 6-mm bolted ILN (ILN6b) in a canine fracture model. We hypothesize that, compared to ILN6b, 1) functional recovery and clinical union would be faster, 2) callus stiffness, failure torque and energy would be greater and 3) callus bone density (BD) would be greater in AS-ILN treated dogs.

Materials and Methods: Following mid-diaphyseal tibial osteotomy, dogs were treated with AS-ILN ($n = 6$) or ILN6b ($n = 5$). Orthopedic examinations and radiographs were performed every other week until clinical union (18 weeks). Paired tibiae underwent torsional testing to failure prior to CT acquisition. Callus stiffness, failure torque, energy and BD were compared ($p < 0.05$).

Results: From 4 to 8 weeks, lameness was more pronounced in ILN6b than AS-ILN dogs ($p < 0.05$). Clinical union was reached in all AS-ILN dogs by 10 weeks and in 3/5 ILN6b dogs at 18 weeks. All callus mechanical properties were greater in AS-ILN than in ILN6b specimens ($p < 0.05$). Failure consistently occurred via acute spiral fracture (control and AS-ILN) or progressive transverse fracture (ILN6b). Callus BD was greater in AS-ILN than ILN6b specimens ($p < 0.05$).

Discussion/Conclusion: The use of AS-ILN led to earlier functional recovery, bone healing and callus remodeling, thus suggesting a more favorable postoperative environment. AS-ILN may represent a valid alternative to standard nails in the treatment of long bone fractures.

Acknowledgments: Companion Animal Fund – Michigan State University.

22 Development and Initial Clinical Testing of the SOP-TPLO Plate

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Introduction: TPLO is a common veterinary orthopedic procedure. Subsidence, with loss of plateau levelling and implant associated infection are frequently reported complications which might be reduced by improving implant design and this work documents the development and preliminary testing of a novel, locking TPLO plate.

Materials and Methods: 1. A design for a symmetrical, non contourable locking plate was proposed. The osteotomy acts as datum for consistent implant placement. Epoxy resin models of the plate were manufactured and tested on anatomically correct tibial models before stainless steel prototypes were trialled on cadavers.

2. Twenty stifles in 19 large client owned dogs underwent TPLO surgery using the SOP-TPLO implant. Radiographs were evaluated before surgery, immediately after surgery and approximately four weeks later.

Results: No complications were recorded. Follow up was 31 ± 5 days. Evidence of bone healing was detected in every case. Immediate post surgical tibial plateau angle (TPA) was $3.15^\circ \pm 2.2^\circ$ (range $0-8^\circ$) and after four weeks the TPA was $3.5 \pm 2.3^\circ$ ($0-8^\circ$): this difference is not statistically significant ($P = 0.001$).

Discussion/Conclusion: The SOP-TPLO plate effectively fixed standard cylindrical proximal tibial osteotomies. Early bone healing was consistently good with minimal callus formation. All screws fully engaged bone and none came close to the stifle joint indicating that the screw position and direction imposed by the plate's design is appropriate. There was a small trend to increased TPA at four weeks but this was not statistically significant ($p = 0.001$). In conclusion, this preliminary investigation has provided proof of concept for this implant design. Further work, including longer term follow-up studies and multicenter trialling, is underway.

Acknowledgments: Orthomed UK funded manufacture of prototypes

23 Minimally Invasive Percutaneous Osteosynthesis for Treatment of Extra-Articular Tibial Fractures Using An SOP Plate-Rod Construct

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Introduction: Minimally invasive surgical techniques for fracture repair are currently being described and performed with increasing frequency. The aim of this retrospective investigation was to describe the MIPO technique and clinical results in 9 patients with non articular tibial fractures repaired using the SOP plate system.

Materials and Methods: 8 dogs and 1 cat presented to the Las Vegas Veterinary Referral Center with non articular tibial fractures. All fractures were reduced and stabilized in MIPO fashion using an SOP plate and Steinman pin.

Results: Dogs had a mean age of 3.8 yrs (range 0.75–8yrs) and a mean weight of 34.5lbs (15.7kg) [range 8.4–59.9lbs (3.8–27.2kg)]. The cat was 2.5yrs old, 8.9lbs (4.0kg). Four 3.5mm, one 2.7mm, and four 2.0mm SOP plates were used. An average of 2.2 cortical bone screws were placed proximally (range 2–3) and 2.0 screws were placed distally. The Steinman pins occupied an average of 41% of the diameter of the medullary cavity (range 31–65%). The average ratio of plate length to bone length was 0.83 (range 0.69 – 0.90). All patients in which the MIPO technique was performed using an SOP plate-rod construct had appropriate anatomical alignment and no major complications were associated with-in the healing process. Follow-up radiographs were available for 5 out of 9 cases and of those the mean healing time was 8.9 weeks (range 4.7–14.1 weeks).

Discussion/Conclusion: An SOP-rod construct used in a minimally invasive percutaneous technique is an acceptable option for non-articular tibial fracture repair.

Acknowledgments: None.

24 The Effect of Post-Operative Cefpodoxime On Tibial Plateau Leveling Osteotomy Infection Rates

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Introduction: The tibial plateau leveling osteotomy (TPLO) complication rate is reported to be as high as 28%. The most common complications during the post-operative period are infection related. The hypothesis of this study was that administration of cefpodoxime for 7 days post-operative would have no effect on TPLO infection rates.

Materials and Methods: Dogs undergoing TPLO's during 2006 did not receive post-operative cefpodoxime (Abx -). Dogs undergoing routine TPLO's during the 2007 did (Abx +). Infection was defined as a positive culture, the presence of purulent discharge, or if plate removal was required to resolve a draining tract.

Results: For the Abx - group, 23/178 (12.9%) had an infection and for the Abx + group, 14/168 (8.3%) had an infection ($p = 0.11$, power = 0.33). 25/33 (76%) were *Staphylococcus* spp. Beta lactam resistance was significantly greater in the Abx + group (83.3% resistant) versus the Abx - group (38.9% resistant). As patient body weight increased, the likelihood of developing an infection increased significantly ($p = 0.005$). Of all infected cases, 20/37 (54%) required plate removal to resolve the infection.

Discussion/Conclusion: The decision to place a patient on post-operative cefpodoxime should be made with the understanding that if the patient does develop an infection, it will likely be resistant to first-line antibiotics. We were unable to show a significant benefit of post-operative cefpodoxime use. The data did approach significance, however, and in light of the low power of the study this conclusion should be made with caution.

Acknowledgments: None

25 Temporal Effects of Tendon-Derived Progenitor Cells in Healing Equine Tendon Injury

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Introduction: Tendinitis of the superficial digital flexor (SDF) tendon is a common injury in equine athletes due to its small cross-sectional area and high tensile strength experienced at maximal exertion.

Materials and Methods: Collagenase induced SDF tendinitis lesions were injected with DiI labeled tendon-derived progenitor cells at 1, 2, 4 and 6 weeks prior to euthanasia. Healing was evaluated using fluorescent microscopy and histological for quantification of collagen and proteoglycan content, as well as collagen fiber alignment.

Results: A 10% increase in collagen and a 45% decrease in proteoglycan were noted between 1 week and 6 week post injection of progenitor cells. At 6 weeks post treatment the treated tendon contained 75% of the collagen content present in the normal tendon. Minimal changes in fiber alignment were observed at the various time points.

Discussion/Conclusion: The preliminary results obtained thus far indicate that, histologically tendon-derived progenitor cells may have a positive effect on the extracellular matrix production over time with respect to collagen and proteoglycan production. Collagen fiber alignment is a long term repair process and may require evaluation at longer time intervals. More horses are needed for analyzation at each time point to obtain a significant change over time during the healing process.

Acknowledgments: Funding provided by the American Quarter Horse Foundation

26 Compressive Damage to the Deep Branch of the Lateral Plantar Nerve Associated with Lameness Caused by Proximal Suspensory Desmitis in Horses

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Introduction: Proximal suspensory desmitis (PSD) of the pelvic limbs is a common cause of lameness in horses, and affected horses are frequently unresponsive to conservative treatment. It has been hypothesized that horses with PSD of the pelvic limbs are refractory to conservative treatment because of compressive neuropathy of the deep branch of the lateral plantar nerve (DBLPN), which provides innervation to the suspensory ligament.

Materials and Methods: Sixteen horses determined to be lame because of PSD of one or both pelvic limbs were treated by excising a segment of the DBLPN. Fourteen horses underwent bilateral neurectomy and two horses underwent unilateral neurectomy. Three of the horses undergoing bilateral nerve resection exhibited unilateral lameness. All 30 resected nerves were examined histologically. Follow-up information was obtained at least 6 months after surgery.

Results: Histological changes suggestive of nerve compression were detected in both nerves of 11 bilaterally lame horses and in the lame limb of 5 unilaterally lame horses. Pathological changes identified included expansion of the subperineum, axonal swelling and necrosis, and the presence of Renaut bodies. Nerves resected from the sound limb of 2 of the 3 unilaterally lame horses also demonstrated histological changes compatible with nerve compression. Ten of 16 horses (62.5%) returned to soundness after excision of the DBLPN.

Discussion/Conclusion: Entrapment neuropathy of the DBLPN may be at least partially responsible for the poor response of horses with PSD of the pelvic limbs to conservative treatment. Excision of the nerve resolves the lameness caused by PSD in nearly two thirds of the cases.

Acknowledgments: The authors have no proprietary interest in any of the materials used in this study and received no financial support to complete this study.

27 Comparison of Two Equine Transfixation Pin Casts and the Effects of Pin Removal

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Introduction: Two forms of transfixation pin casts (TPC) are in common usage in equine surgery; one with 2 larger threaded pins and one with 3–5 smaller smooth pins. It was hypothesized that there would not be a significant difference in the reduction in bone strain on the dorsal aspect of the first phalanx (P1) between the two common TPC constructs. A second hypothesis was that removal of one or more pins would increase the bone strain on the dorsal aspect of P1.

Materials and Methods: Paired forelimbs were collected and uniaxial strain gages were placed on the mid-dorsal aspect of P1. Construct 1 consisted of two ¼ inch (6.35 mm) positive profile threaded pins placed in a 30° divergent manner in the distal aspect of the cannon bone (MC3) with incorporation into a half limb cast. Construct 2 was identical with the exception that four 3/16 inch (4.8 mm) smooth Steinmann pins were placed in diverging orientations through MC3. Axial compression was applied with stepwise loading increments of 100 lbs from 100–1200 lbs. The proximal pin of construct 1 and two most proximal pins of construct 2 were removed and limbs re-tested.

Results: At all loads greater than 100 lbs, there was a significant ($p < 0.001$) decrease in strain between both transfixation cast constructs and the non-casted controls. There was no significant difference in strain reduction between the two TPC constructs. Following proximal pin removal there was a 7% and 10% decrease in the amount of strain reduction on P1.

Discussion/Conclusion: Both constructs provided an equivalent reduction in strain across P1, and removal of the proximal pin(s) can potentially allow for dynamic increases in bone healing strength by increasing the amount of strain at the fracture site.

Acknowledgments: None

28 Outcome Measures in Dogs Managed with and without Surgery for Cranial Cruciate Ligament Rupture

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Introduction: Cranial cruciate ligament rupture (CCLR) continues to be one of the most prevalent and debilitating canine orthopedic diseases. Typically, surgery is recommended for management of CCLR although there is a lack of a prospective direct comparison of surgical management vs medical management of CCLR for functional outcome and osteoarthritis progression. This prospective study compared both subjective and objective outcome measures at different time points between overweight unilateral CCL deficient dogs that were randomly assigned to the surgical or non-surgical group.

Materials and Methods: Both groups received medical management for 3 months consisting of a weight loss diet, non steroidal anti-inflammatory medication and physical therapy. The surgical group had a TPLO performed on the affected limb prior to initiation of the medical management. Dogs were evaluated at 0, 6 and 12 weeks and outcome measures included two owner completed questionnaires, gait, lameness and pain score assessment, force platform gait analysis, a body fat percentage using dual energy X-ray absorptiometry (DEXA) and radiographs.

Results: There was a significant difference in the mean weight, BCS and body fat percentage for all dogs between the Day 0 and Week 12 time points. There was no statistical difference in velocity, acceleration, peak vertical force and vertical impulse between the surgical and non-surgical groups at any of the time points.

Discussion/Conclusion: This study reveals that the 12 week outcome of dogs managed with weight loss, physical therapy and anti-inflammatory medication, with or without surgery, had similar outcomes for treatment of unilateral CCLR.

Acknowledgments: none

29 Progression Toward Biological Joint Resurfacing in Dogs

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Introduction: We tested the hypothesis that tissue engineered constructs comprised of allogeneic chondrocytes or growth factor with synthetic scaffolds can functionally replace entire joint surfaces in the stifle and shoulder of dogs and rabbits.

Materials and Methods:

Experiment 1: Two adult mongrel dogs underwent resurfacing of their patellar articular surface using a tantalum metal substrate seeded and precultured with allogeneic chondrocytes.

Experiment 2: Fused deposition modeling was used to create a humeral head replacement implant for 23 rabbits using a composite of poly-ε-caprolactone and hydroxyapatite (PCL:HA; 80:20) and these were implanted surgically.

Experiment 3: Fused deposition modeling was used to create a canine femoral head resurfacing implant of PCL-HA with an intramedullary stem and these implants were tested ex vivo.

Results:

Experiment 1: At 8 weeks post-implantation dogs that had the tantalum metal construct for patellar resurfacing had mild to moderate lameness. Arthroscopic and histologic assessment documented fibrovascular tissue at the center and fibrocartilage at the periphery of the tantalum metal constructs.

Experiment 2: All rabbits resumed ambulation and humeral replacement condyles showed virtually full-surface articular cartilage coverage, confirmed with Safranin-O staining and immunoblotting for Col-II and aggrecan.

Experiment 3: Constructs for canine femoral head resurfacing with PCL:HA were able to be successfully produced and re-surfacing of the cadaveric femoral heads was performed ex vivo.

Discussion/Conclusion: The use of the PCL:HA constructs offer promise for facilitated endogenous repair of entire joint surfaces. We conclude that biologic resurfacing of major weight-bearing joints is feasible and continued testing is warranted.

Acknowledgments: Funding was provided by the NIH and the tantalum metal was donated by Zimmer.

30 Expression of Inflammatory Mediators in Canine Adipose and Bone Marrow Derived Stem Cell Populations as a Function of Cell Culture

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Introduction: Stem cell treatment in the canine utilizes a stromal vascular fraction, containing in part, adipose-derived mesenchymal stem cells. The characterization and standardization of components and mechanisms of effective outcomes is lacking. Stem cells are suspected to mediate outcome through paracrine effects, immunomodulating the inflammatory processes. Cultured allogeneic stem cells provide standardized treatment and allows study of beneficial paracrine effects, selecting for optimal treatment. Our null hypothesis is that no difference between cytokine expression profiles in freshly harvested stem cells and cultured stem cells exists.

Materials and Methods: Fat and bone marrow samples were gathered from six dogs. Gene expression was analyzed by quantitative reverse transcriptase polymerase chain reaction (qRT-PCR) with primers for two pro-inflammatory markers (IL-1β and COX-2) and two anti-inflammatory markers (IL-1ra, and TIMP-2). Gene expression was assessed on samples from time zero, and at culture passages 1–4.

Results: All cell lines underwent changes in cytokine expression as early as the first passage, and were statistically different in bone marrow with IL-1B, TIMP-2 and IL-1ra. IL-1B and IL-1ra were minimally expressed, and COX-2 and TIMP-2 were decreased in cultured cells.

Discussion/Conclusion: Our results demonstrate inflammatory mediator expression differs following cell culture, therefore we reject the null hypothesis. We expect that cell populations with decreased pro-inflammatory expression would increase clinical response to treatment and culturing cells can maximize this potential.

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31 The Effect of Tibial Plateau Leveling Osteotomy On Femorotibial Subluxation: In-Vivo Analysis During Standing

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Introduction: Tibial plateau leveling osteotomy (TPLO) is purported to eliminate cranial tibial subluxation in cranial cruciate ligament (CrCL)-deficient stifles of dogs during weight-bearing; however, no data exists regarding joint stability after TPLO in vivo. The purpose of this investigation was to determine the effect of TPLO on femorotibial stability in dogs with CrCL insufficiency.

Materials and Methods: Ten dogs with unilateral complete CrCL insufficiency were studied. Lateral weight-bearing radiographs of the affected stifle were acquired pre-operatively, and 1, 3 and 6 months post-operatively. Non-weight-bearing lateral radiographs of the affected stifle and weight-bearing radiographs

of the contralateral stifle were acquired pre-operatively. The distance between the origin and insertion of the CrCL (CrCLd) was measured and compared using one-way repeated measures ANOVA.

Results: There was no difference in CrCLd between the non-weight-bearing affected stifle and the contralateral stifle ($P = 0.357$). Pre-operatively in the affected stifle, CrCLd during weight-bearing was 6.4 ± 2.6 mm longer than non-weight-bearing ($P < 0.001$). No differences were observed between pre-operative non-weight-bearing CrCLd, and 1 ($P = 0.306$), 3 ($P = 0.746$), and 6 month ($P = 0.177$) post-operative weight-bearing CrCLd. Pre-operative weight-bearing CrCLd was longer than CrCLd observed at any post-operative time point.

Discussion/Conclusion: Femorotibial alignment in CrCL-deficient stifles was normal when not subjected to load. Marked cranial tibial subluxation occurred during weight-bearing pre-operatively, whereas normal femorotibial alignment was re-established after TPLO. While this finding corroborates that TPLO imparts functional stifle stability when standing, it remains unknown whether normal femorotibial alignment is restored during dynamic activities.

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32 Metacarpophalangeal Joint Lavage Performed Simultaneously with Regional Limb Perfusion in the Horse: Comparison of Two Tourniquets and Determination of Antimicrobial Concentrations in the Lower Limb

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Introduction: Septic arthritis can end a horse's athletic career or life. Treatment often includes regional limb perfusion (RLP) performed simultaneously with joint lavage. The purpose of our study was to determine whether joint lavage performed simultaneously with regional limb perfusion reduces the effectiveness of RLP and to compare two types of tourniquets.

Materials and Methods: Two groups of six horses were tested using a pneumatic or an esmarch tourniquet. RLP with amikacin (500 mg) was performed at T0. Simultaneously the fetlock joint was lavaged with 2 liters Lactated Ringers and egress fluid collected. Samples from the coffin joint synovial fluid and blood from the digital and jugular veins were collected at set time intervals. Amikacin concentrations were determined by fluorescence polarization immunoassay.

Results: The esmarch tourniquet effectively prevented amikacin from entering the systemic circulation, but not the pneumatic tourniquet. Amikacin concentrations in the synovial fluid from the coffin joints of the esmarch tourniquet group ranged from 45.1 to 1968 $\mu\text{g/mL}$ and from the pneumatic tourniquet group from 1.68 to 92.32 $\mu\text{g/mL}$ just prior to the release of the tourniquets (T30). Total loss of amikacin in the egress fluids from the joint lavage ranged from 0.3 to 7.72 mg for the esmarch tourniquet group and from 0.3 to 1.748 mg for the pneumatic tourniquet group.

Discussion/Conclusion: Our study showed that standing regional perfusion performed simultaneously with joint lavage results in negligible loss of antibiotics in the egress lavage fluid. We believe that esmarch tourniquets are more reliable, easier to use and cheaper than pneumatic tourniquets.

Acknowledgments: Purdue University

33 Distal Phalangeal Wounds Managed with Phalangeal Casts: A Retrospective Study of 50 Cases (1995–2006)

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Introduction: A recent study showed heel bulb lacerations treated with distal phalangeal casts had a shorter period of recovery than with bandaging. In addition, horses with involvement of synovial structures had a poorer prognosis for complete recovery. The purpose of the study reported here was to evaluate heal-

ing and soundness of horses treated with distal phalangeal casts for immobilization of wounds in the distal phalangeal region. We hypothesized that distal phalangeal lacerations treated with distal phalangeal casts would have a good prognosis for both cosmetic healing and soundness, cases that presented acutely (< 24 hours) would have better outcomes than cases that presented chronically (>24 hours), and that lacerations involving synovial structures would have a poorer outcome than those that did not.

Materials and Methods: Medical records of 49 horses that were treated for 50 cases were evaluated and follow-up information was obtained. Outcome variables were analyzed statistically using Fischer's Exact test.

Results: In this study the horses treated with distal phalangeal casts had a good prognosis for soundness (91.1%) and cosmetic healing (86.1%). Surprisingly, this study showed lacerations which entered distal phalangeal synovial structures carried a fair prognosis for soundness (87.5%) and there was no statistical difference for outcome of soundness between the horses that had synovial structure involvement and those that did not. Also, there was no statistical difference in outcome for soundness between those horses that presented acutely (<24 hours) and those that did not.

Discussion/Conclusion: In these cases the distal phalangeal cast was well-tolerated, efficient, and effective treatment for distal limb lacerations.

Acknowledgments: There was no funding for this study.

34 In Vivo High-Field 3 Tesla Magnetic Resonance Imaging to Assess Osteochondral Healing in An Equine Model

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Introduction: The goal of this study was to develop quantitative methods to evaluate knee osteochondral defects at 6, 12 and 24 weeks after surgery using high-field 3 Tesla MRI combined with knee coils.

Materials and Methods: Five skeletally mature Shetland ponies, under general anesthesia, had osteochondral defects drilled bilaterally on both condyles of the distal femur. Defects were injected with a variety of protocols including viral vectors coding for human bone morphogenetic proteins. At 6, 12 and 24 weeks, under general anesthesia, the ponies underwent MRI using a 3-Tesla MRI. Simultaneously in weeks 12 and 24, a 4-channel array of 10cm surface loop coil was set up on each pony knee. dGEMRIC, T2 mapping and DCE-MRI were performed.

Results: The 4-channel arrays of the knee coils were far superior, obtaining higher resolution images compared to the 6 week MRIs performed with only body coils. dGEMRIC analysis showed that there was a higher T1 in healthy cartilage than the cartilage within the defect. There was no significance difference among treatments at 12 or 24 weeks for T1 pre-and post-contrast. DCE amplitude was low in healing cartilage and high in the bone defect regions. Curves of exercised knees compared to unexercised knees were shifted to the left indicating more rapid distribution to the joint.

Discussion/Conclusion: The knee coil dramatically enhanced the image quality of 3-Tesla imaging of pony knees. Exercise accelerated the distribution of Gd into cartilage shortening the MRI procedure. Healing cartilage had less GAG than surrounding cartilage as expected. In conclusion, dGEMRIC, T2mapping and DCE-MRI Analysis in a pony model using a high-field 3Tesla MRI combined with the surface loop coils produced additional and new information in the assessment of healing defects.

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35 Osteochondral Allografting in Dogs: A Small Series of Cases

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Introduction: Articular defects are a common problem for which treatment success is limited. Based on research in our laboratory, we implemented osteochondral allografts (OCA) for treatment of articular defects in 6 dogs.

Materials and Methods: This study was approved by our IACUC. Dogs presenting for lameness associated with articular defects were included when owners consented to OCA and data collection. After full diagnostics, discussion of treatment options, costs, and prognosis, affected joints underwent OCA via arthroscopy. OCA grafts were harvested aseptically from dogs euthanatized for unrelated reasons and cultured in chondrogenic media. Pre-operative, intra-operative, and postoperative treatments varied among patients. Outcomes measures included complications, radiographs, and clinical function.

Results: Six patients were included: Husky with humeral condyle dysgenesis; Labrador with patellar malunion; Mastiff with stifle OCD; mixed-breed dog with stifle OCD; St. Bernard with hock OCD; Pointer with severe stifle OA. Appropriately sized OCA grafts were cultured with no evidence of infection and successfully implanted in all patients using various methods of fixation. No rejection, infection, or fixation failure was noted. Follow-up was performed 8–10 weeks after surgery and at variable time points (range 8 weeks – 29 months). Radiographic assessments indicated graft incorporation in all, however, OA progressed in all and implant migration requiring K-wire removal occurred in 2. 4/6 cases returned to full athletic function. The hock OCA improved, but did not achieve athletic function by 14 months. The Pointer with femoral condylar and tibial plateau OCAs is at 8 weeks at this time.

Discussion/Conclusion: OCA can be successfully performed in select dogs with major articular defects in the elbow, stifle, or hock resulting in acceptable functional outcomes

Acknowledgments: None

36 Comparison of Canine Mesenchymal Stem Cell Yield from Different Locations of Bone Marrow and Adipose Harvest

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Introduction: There is increasing interest in using stem cell therapy for clinical use in small animal surgery. This study is the first known examination of characterizing mesenchymal stem cells (MSCs) derived from bone marrow and adipose tissue in the canine. This study also compares collection sites and provides information on the best tissue and the best site from which to harvest MSCs.

Materials and Methods: Ten dogs were used for sample collection. Adipose tissue was collected from the caudal scapular region and falciform ligament. Bone marrow was collected from the ilium, humerus, and tibia. Fat and bone marrow were harvested and processed to obtain a stem cell preparation. Samples were treated with commercially available antibodies with attached fluorochromes (CD 14, CD 34, CD 44, CD 45, CD 90, CD 166). The bone marrow and adipose samples were tested with flow cytometry for cell population comparison.

Results: Results showed that adipose tissue had the highest concentration of MSCs, but bone marrow had the highest number of cells at harvest. Cell yield was greatest from humerus, followed by ilium and tibia with the least. Falciform was found to have significantly higher cell yield than caudal scapular subcutaneous tissues.

Discussion/Conclusion: This information is relevant to clinical applications and future research in regenerative medicine. It describes the best type and location for stem cell collection as well as documenting a technique for examination of MSC populations using particular markers during flow cytometry for analysis.

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37 The Effect of Carprofen On Osteogenic Differentiation of Canine Mesenchymal Stem Cells

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Introduction: The clinical association between use of NSAID and delayed bone healing has led to increasing concern regarding their routine use in human orthopedics. Currently there are no studies evaluating the effects of NSAID on bone healing in dogs.

Materials and Methods: Canine bone marrow-derived mesenchymal stem cells were cultured in monolayer in four groups: 1) osteogenic medium (OM); 2) OM plus 4 µg/mL carprofen; 3) OM with 100 ng/mL recombinant-human bone morphogenetic protein-2 (rhBMP-2); 4) OM with rhBMP-2 and carprofen. At days 0, 3, 6, and 9, samples were collected and analyzed using real-time RT-PCR to quantify changes in *cox1*, *cox2*, *collagen I*, *collagen II*, *BMP-2*, *alkaline phosphatase*, *noggin*, *gremlin*, and *vascular endothelial growth factor (VEGF)* gene expression and ELISAs to measure BMP-2, osteocalcin, and alkaline phosphatase protein levels. Results were analyzed using a two-way ANOVA with Bonferroni post-test to compare between groups. A *p*-value less than 0.05 was considered significant.

Results: Carprofen significantly downregulated *VEGF* gene expression (*p* < 0.001), but did not significantly change *alkaline phosphatase* or *BMP-2* gene expression (*p* > 0.05). Carprofen did not significantly affect BMP-2 or alkaline phosphatase protein expression (*p* > 0.05).

Discussion/Conclusion: Downregulation of *VEGF* gene expression was found in canine stem cells in response to NSAID. This may account for decreased osteogenic differentiation and delayed bone healing with the use of NSAIDs *in vivo*.
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38 IL-1beta Driven Osteoblasts Alter Chondrocyte Phenotype and Result in Cartilage Matrix Degradation in An In Vitro Co-Culture Model of Equine Osteoblasts and Chondrocytes

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Introduction: A co-culture system of equine osteoblasts and cartilage explants was developed. Our aim was to investigate whether IL1β driven osteoblasts are able to effect changes in the chondrocyte phenotype and ultimately lead to cartilage matrix breakdown.

Materials and Methods: Osteoblasts were isolated and differentiated then treated with IL1β or left untreated. Co-cultures of osteoblasts and cartilage explants were established. The effect of osteoblast co-culture on chondrocyte phenotype was measured by qRT-PCR, MMP-13 fluorometric assay and GAG analysis.

Results: Gene expression was compared between chondrocytes co-cultured with i) osteoblasts pre-treated with IL1β (O+IL1β+C) and ii) osteoblasts not pre-treated with IL1β (O-IL1β+C) as fold differences compared to cartilage explants cultured without osteoblasts (C-O). In O+IL1β+C chondrocytes, *ADAMTS4* (*P*<0.0001), *MMP1* (*P*=0.001) and *MMP3* (*P*=0.005) expression were increased; and *COL2A1* (*P*=0.0003) and *BGN* (*P*=0.001) expression were decreased. There was a trend towards increased *MMP13* expression (*P*=0.006). Total MMP13 was increased in O+IL1β+C media as compared to O-IL1β+C (*P*<0.0001) and C-O (*P*<0.0001). Active MMP13 was increased in O+IL1β+C (*P*<0.0001) and O-IL1β+C (*P*<0.0001) as compared to C-O. GAG release was increased in O+IL1β+C cultures at all time points. At 144 hours there was a significant increase in GAG release in O-IL1β+C (*P*=0.02).

Discussion/Conclusion: A co-culture model simulating equine osteochondral disease has been developed. Normal osteoblasts pre-treated with IL1 β can alter gene expression of chondrocytes. GAG release from cartilage explants co-cultured with IL1 β pre-treated osteoblasts was shown, but matrix breakdown was attenuated as the majority of MMP was not in its active form.

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39 Molecular Characterization of Early Osteochondrosis in Prepubescent Foals

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Introduction: The objective was to elucidate the expression of Ihh, PTH-rP, VEGF, PDGF, and MMP-13 in osteochondrotic cartilage of prepubescent foals. The hypothesis was that osteochondrosis (OC) develops as a result of increased expression of these molecules via cartilage canals during development.

Materials and Methods: Cartilage was harvested from femoropatellar joints of 26 foals =6 months old. Equine-specific Ihh, PTH-rP, VEGF, PDGF-A, MMP-13 and 18S mRNA expression levels were evaluated by real-time qPCR. Spatial tissue protein expression was determined by immunohistochemistry. Statistical analysis was performed using the Wilcoxon signed rank test ($p < 0.05$).

Results: There was significantly increased Ihh gene expression in early OC cartilage compared to age-matched controls. A trend ($p=0.08$) was found for increased VEGF, PDGF-A, and MMP-13 gene expression in early OC cartilage. No difference was found in PTH-rP gene expression between OC and normal cartilage. Protein expression of Ihh, VEGF, PDGF, and MMP-13 was mainly observed along the osteochondral junction, cartilage canals, superficial matrix, and deep cartilage layer.

Discussion/Conclusion: Increased Ihh expression in early OC cartilage of this study was similar to previous reports describing advanced OC lesions in older foals, providing stronger evidence for its role in osteochondrosis. Because PTH-rP expression was not altered in early OC cartilage, it seems less likely that PTH-rP is involved in the etiology. Trends for increased VEGF, PDGF, and MMP-13 gene expression suggest that pathways involving endochondral maturation and the invasion of the ossification front are altered in early osteochondrosis.

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40 Comparison of Osteotomy Techniques for the Correction of Antebrachial Angular Limb Deformities in the Dog: Investigation of a Novel Dome Osteotomy Saw Blade

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Introduction: A novel dome saw blade (DOMESAW® Matrix Orthopedics Inc., Twin Falls, ID) was developed which creates a spherical osteotomy potentially useful for ALD correction. This study compared dome and closing wedge osteotomies in modeled canine radial ALDs examining accuracy, apposition, and bone length.

Materials and Methods: Stereolithographic models of 6 groups of ALDs created from a canine radius that underwent CT/CAD manipulation were used: Group 1 = valgus (25°), Group 2 = procurvatum (30°), Group 3 = external torsion (60°), Group 4 = procurvatum/valgus, Group 5 = torsion/valgus, Group 6 = torsion/procurvatum/valgus. Each was corrected using one of two methods: closing

wedge osteotomy (STR) or dome osteotomy (DOME). Post-correctional accuracy, bone length and apposition were determined and compared.

Results: Frontal plane accuracy was largely the same between osteotomy types, however, DOME under or over-corrected Groups 2,4,5 and 6 in the sagittal plane. STR resulted in significant shortening of most groups; DOME did not cause shortening. Apposition decreased greatest with DOME in the more complex deformities.

Discussion/Conclusion: Dome osteotomies correct ALDs through angulation and translation but increases in discrepancy between saw and bone diameters are directly related to decreasing apposition. Matching dome blade size to the frontal plane versus the narrower sagittal plane resulted in compromise of sagittal plane apposition and correctional accuracy. The STR technique resulted in accurate angular correction while shortening the bone.

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41 Radiographic Measurements of the Axes and Joint Angles of the Canine Radius and Ulna

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Introduction: The purpose of this study is to describe a method of radiographic measurement of the anatomic and mechanical axes and joint angles of the canine antebrachium and establish normal ranges in a population of Labrador retrievers and a population of similar-sized non-Labrador retrievers.

Materials and Methods: Orthogonal radiographs of 52 Labrador and 52 non-Labrador antebrachii were completed. A ratio signifying elbow rotational position (ERP) was utilized to determine proper radiographic positioning of the frontal view. Radiographs were used to determine radial anatomic and radial-ulnar mechanical axes, elbow and carpal joint reference lines, and the intersecting angles of each: aMPRA, aLDRA, mMPRUA, mLDRUA, aPCdRA, aDCdRA, mPCdRA, mDCdRA (anatomic and mechanical; medial and lateral; proximal, distal, and caudal; radius and radial-ulnar angles respectfully).

Results: One hundred and four canine limbs met the inclusion criteria, including 52 Labrador limbs and 52 non-Labrador limbs. No difference existed between right and left limbs. Means \pm SD reference ranges for Labradors were aMPRA 82.50 \pm 2.83°, aLDRA 86.00 \pm 3.32°, mMPRUA 83.60 \pm 2.75°, mLDRUA 89.40 \pm 1.83°, aPCdRA 85.08 \pm 3.56°, aDCdRA 76.92 \pm 3.69°, mPCdRA 78.17 \pm 3.08°, and mDCdRA 74.71 \pm 3.73°. Reference ranges for non-Labradors were aMPRA 81.11 \pm 3.38°, aLDRA 87.77 \pm 2.60°, aPCdRA 88.00 \pm 3.68°, and mPCdRA 80.58 \pm 3.79°. All parameters were different between Labs and non-Labs ($p < 0.05$) except for the following: ERP, mMPRUA, mLDRUA, aDCdRA, and mDCdRA.

Discussion/Conclusion: This radiographic methodology established reference ranges useful for diagnosis, surgical corrective planning, and postoperative analysis of canine antebrachial ALDs and especially for bilaterally affected patients. The ERP may assist in radiographic positioning of the antebrachium in the frontal plane view.

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Part II to follow in the next issue.