Conclusions: The overall results suggest that oral HJ administration could increase HA concentration, which as well could be related to improvements of the clinical condition of the affected joint. However further research is necessary to confirm these findings.

THE GROOVE MODEL OF OSTEOARTHRITIS APPLIED TO THE OVINE FETLOCK JOINT

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Purpose: Until now there have been no appropriate models for metacarpophalangeal osteoarthritis (OA), even though OA in this joint is a significant medical and economic problem in horses. A good model would be useful to evaluate progression and treatment of OA, particularly in this joint. Therefore, we translated the canine Groove model of knee OA to the ovine metacarpophalangeal (fetlock) joint.

Methods: Cartilage surfaces of the metacarpal side of one fetlock joint were surgically damaged (grooved), followed by intermittent forced loading of the experimental joint. After 15 and 37 weeks, joints were analyzed for macroscopic, histologic, and biochemical features (proteoglycan turnover) of OA, and subchondral bone parameters were evaluated.

Results: Technically, the model was difficult to use because cartilage surfaces were very thin. Nonetheless, all macroscopic, histological, and biochemical cartilage parameters demonstrated features of OA. Macroscopic and histological cartilage damage was present at 15 and 37 weeks (delta change of 1.7 vs.3.3 and 1.8 vs.3.1 for 15 and 37 weeks, macroscopy vs. histology, respectively). Proteoglycan synthesis rate was enhanced (+8% and +15%) while the retention of these newly formed proteoglycans was diminished (+30% and +16%) at 15 weeks and 37 weeks post-surgery (all p<0.05). Also the release of proteoglycans was diminished for both time points (+55% and 38%; p<0.05). Decreased proteoglycan content suggested slow progression of cartilage degeneration over time (+2% (ns) and -12% (p<0.02) for 15 and 37 weeks respectively), while synovial inflammation as measured by macroscopy and histology diminished (delta change of 2.0 vs.1.7 and 0.6 vs.0.5 for 15 and 37 weeks, respectively). Impaired subchondral bone quality, reflected by a decreased trabecular thickness (-6%; p<0.05) and cortical bone thickness (-14%; p<0.04), and osteophyte formation were found. Although osteophyte formation was progressive, subchondral bone changes diminished over time.

Conclusions: The canine Groove model of OA appears to a limited extent transferable to the ovine fetlock joint. Despite development of features of experimental OA, use of the groove model in the ovine fetlock joint has technical limitations. Using larger animals, such as horses, may significantly improve the technical procedures and with that may provide a more reliable model of metacarpophalangeal osteoarthritis that is based primarily on intrinsic cartilage damage, appropriate to evaluate the progression and treatment of cartilage driven OA changes in particular this joint.

MODELING INTRAARTICULAR FRACTURE IN ANIMAL JOINTS: A PILOT STUDY WITH AN ORGAN-LEVEL MODEL

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Purpose: Intraarticular fractures (IAFs) are a leading cause of post-traumatic osteoarthritis (PTOA). Commonly, the predominant biomechanical mechanism causing this type of fracture is an axial compressive load of very short duration (milliseconds). Besides this supra-physiologic transarticular impaction load fracturing juxta-articular bone, it also mechanically damages articular cartilage. Cell- and tissue-level damage in fractured cartilage, including death/dysfunction of chondrocytes and disruption of collagen fibers, presumably triggers a pathologic cascade leading to PTOA. An animal model of IAF that accurately replicates pathophysiology of fracture-associated cartilage damage is essential for understanding these pathomechanical details, as well as for developing new treatment strategies to forestall PTOA. In this study, a fracture insult technique for such an animal model was piloted in an organ-level model.

Methods: Three pairs of porcine hock specimens were harvested from juvenile animals immediately after euthanasia, and they were subjected to a quasi-physiologic fracture insult, specifically a transarticular compressive impaction using a drop-tower device. For controlling of fracture morphology by concentrating compressive load onto the anterior tibia, the tibial shaft was tilted 15 degrees posteriorly with respect to the compressive force axis ("offset" impaction technique). One of each pair was subjected to a high-energy impaction (energy delivery = 60 joules levels), and the other was to a moderate-energy impaction (40 joules). Fracture fragments were sampled immediately and incubated over night. TUNEL reaction analysis was performed on cartilage histological sections for assessing chondrocyte viability in fractured cartilage.

Results: A distal tibial fracture occurred in every specimen, with the fracture morphology very consistent across specimens (Figure). In every pair, fracture displacement was greater with higher energy delivery. Apoptotic chondrocytes were found in every specimen, and the great majority occurring near fracture edges. There was a trend that fractional apoptosis was higher in the transitional to deep zone than in the superficial zone.

Conclusions: With use of the off-set impaction technique, experimental fractures were created with reasonable reproducibility in fracture morphology and severity. The distribution of apoptotic chondrocytes, in terms of relationship to fracture edges, was consistent with human clinical cases (Kim et al., 2002), supporting the validity of the insult technique utilized. A larger-scale experiment using this organ-level model with skeletally mature specimens would allow investigating details of IAF-associated cartilage pathology, as well as testing clinically relevant hypotheses, such as the therapeutic effect of biologic intervention. The concept of the off-set impaction technique is potentially extrapolable to creating a survival animal model of IAF.