INTRODUCTION
Osteoarthritis (OA) is a degenerative joint disorder characterized by progressive cartilage damage, peri-articular bone changes, and often secondary joint inflammation. These tissue structure changes coincide with pain, stiffness, and functional disabilities. Replacement of the affected joint using an endoprosthesis is currently the accepted treatment option in end-stage disease. Joint distraction might be an alternative, especially in younger patients. This treatment of OA in humans results in long-term clinical benefit. Tissue structure modification was suggested to be involved. The mechanism responsible for this structure modification is unclear. Therefore, joint distraction was applied in a canine experimental model of OA to study the involvement of tissue repair.

METHODS:
This study included 16, skeletally mature, female dogs (mixed, mongrel breed), mean age 1.6±0.5 years, weighing 18.0±1.3kg. This study included 16, skeletally mature, female dogs (mixed, mongrel breed), mean age 1.6±0.5 years, weighing 18.0±1.3kg. The dogs were randomly divided into two groups. Distraction therapy was performed in 9 dogs. Ten weeks post-surgery, the right knee joint was distracted for 3-5 mm by use of a hinged external fixator for 8 weeks. The femoral and tibial frame were connected via hinges medially and laterally of the knee joint. Seven dogs were left untreated (control OA group). Distraction of the knee was checked every 2 weeks by X-ray of both knee joints in identical loaded position. Besides absence of mechanical stresses, intra-articular fluid pressure changes as observed during clinical treatment were measured in the first 5 dogs treated with joint distraction by means of a pressure transducer connected to an intra-articular positioned canule. Both the treated and the contralateral healthy knee joint were evaluated.

RESULTS:
In baseline measurements (weight, age and force plate analysis) there were no differences between both groups. Within 1 week after application of the distraction frame, all treated dogs were active again. The OA controls had resumed their normal loading patterns. During distraction period, the dogs appeared to use their joint more or less with some flexion in the joint and partial load-bearing. Distraction was checked by loaded X-rays and a clear increase in joint space width was observed suggestive for the absence of mechanical contact. Also the intermittent hydrostatic fluid pressure changes during flexion and extension were present during joint distraction. Flexion and extension of the joints revealed a comparable change in intra-articular fluid pressure in both the distracted and contralateral control joint (+4.4±1.0 vs +4.1±0.7 kPa, respectively). In all treated animals, macroscopic cartilage damage of the tibial plateau was less severe than observed in the OA dogs, on average statistically significant (p<0.04). These macroscopic observations were confirmed by histological analysis (fig2). Compared to the OA dogs, a trend towards a decrease in cartilage thickness was observed in the OA dogs. This improvement of cartilage integrity and chondrocyte activity is also reflected in a clear improvement of gait pattern, i.e. improvement in function/pain of the treated joint. The improvement of cartilage integrity and chondrocyte activity is also reflected in a clear improvement of gait pattern, i.e. improvement in function/pain of the treated joint. Both the brake force as the stance force normalized completely in the treated dogs compared to the OA dogs (-7±3% p<0.02; fig2). Also collagen release after distraction was diminished, although not statistically significant (+0.3±1%, fig2). The chondrocyte activity was positively influenced upon joint distraction treatment. Compared to the chondrocyte activity of the OA dogs, the treated animals showed an average normalization of the newly formed proteoglycan release and total proteoglycan release (+53% and +53% resp., both p<0.01 compared to the OA dogs). Proteoglycan synthesis rate had a tendency to normalize; however, this was not statistically significant.

DISCUSSION:
Due to complexity and logistics this experiment is performed in three stages. The presented results are an interim analysis of the first two sets of experiments. Distraction treatment in dogs is a challenge when aiming at preservation of joint function, as during distraction a dog can easily walk on three legs. Therefore weight bearing might be somewhat limited; however, the flexion within the frame appeared quite normal. The OA induced, developed in ten weeks and represents an early phase of the disease. As such, it cannot be distinguished whether joint distraction in this model just slows down development of progression, or that actual repair is induced.

The, for OA typical, increase in proteoglycan synthesis is seen, and seems ineffective as release of newly formed proteoglycans was also increased, when compared to control joints. This demonstrates that there is a decreased retention of newly formed proteoglycans in the cartilage matrix of OA joints. A relation between structural tissue improvement and pain is suggested as structural cartilage changes in vivo result in actual improvement of function (normalization of loading at force plate analysis). Joint distraction results in less cartilage damage and less pain (based on normalization of loading of the affected knee) in a canine model of experimentally induced osteoarthritis. The results of this animal in vivo study corroborate with the observed cartilage repair and clinical benefit in human studies.

SIGNIFICANCE:
Distraction therapy in humans is the first and only treatment, at the moment, for end-stage OA resulting in not just clinical but also structural cartilage changes. The mechanism responsible for these changes needs further investigation and with the use of an animal model it is possible to analyse the joint changes in more depth.

REFERENCES: