CARTILAGE REPAIR MIGHT EXPLAIN CLINICAL BENEFIT OF JOINT DISTRACTION IN THE TREATMENT OF OSTEOARTHRITIS.

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**Introduction** Joint distraction is a relatively new approach in the treatment of osteoarthritis (OA). In retrospective and prospective short-term follow-up studies, clinical benefit of joint distraction as treatment of ankle and hip OA has been shown. In the present study clinical effects have been studied in an open prospective study up to 8 years. To evaluate structural changes in cartilage and synovium distraction was performed in an animal model of osteoarthritis.

**Patients, animals and methods** In an open prospective clinical study, patients with severe ankle OA, who were considered for joint fusion (arthrodesis) were treated with joint distraction (n=57). Distraction aimed at a 3-month relief of mechanical stresses on the cartilage preventing further wear and tear (5 mm on X-rays) and maintaining intra-articular fluid pressures, important for nutrition and triggering of chondrocytes (3 ±1 to 11 ±1 kPa during unloading and loading of the distracted joints). For clinical evaluation, a standardized protocol including physical examination, assessment of pain, mobility and functional ability was used. Changes in radiographic joint space width and subchondral sclerosis were measured using the semi-automatic method Ankle Images Digital Analysis (AIDA). To date 47 patients have a follow-up >1 year increasing up to 8 years (n=4) with a mean follow-up of 3.1 ± 2.2 years. The Medical Ethics Review Committee of Utrecht University approved this study.

In an animal study osteoarthritis was induced in 14 Beagle dogs in one knee using the groove model. Ten weeks after induction, articulating joint distraction of the knee was carried out for 8 weeks in 6 dogs. Mechanical stresses on the cartilage were absent (3 mm distraction on X-rays), whereas intra-articular fluid pressure varied intermittently during movement from 3 ± 2 to 12 ± 5 kPa. Twenty-two weeks after distraction (40 weeks after OA induction), joint tissue was analyzed biochemically and histologically. For the animal study the Utrecht University Ethical Committee for animal studies gave ethical approval.

**Results** In the open prospective clinical study significant clinical benefit was found in three-quarter of the patients. One year post-surgery (n=47), the average score for pain decreased by 37% (p<0.0001), function increased by 83% (p<0.0001) and clinical condition increased by 138% (p<0.0001). Joint mobility increased by 1% (ns). Most interestingly the improvement of parameters increased statistically significant over time and the progressive clinical benefit was maintained during the entire period of follow-up (Figure 1).

![Figure 1](image1.png)

**Figure 1.** Clinical results of joint distraction in an open prospective study. Average scores are given before treatment (n=47) and one year after (n=47). 2 years (n=35), 3 years (n=22), 4 years (n=15), 5 years (n=10), 6 years (n=8), 7 years (n=6), and 8 years (n=4) after initiation of treatment. Average JSW increased by 17% (p<0.04) and average subchondral bone density decreased by 10% (p<0.003), one year post-surgery (n=12; Fig.2). Also JSW and subchondral sclerosis improved over time: e.g. 3 years post-surgery JSW increased by an additional 10% (p<0.05).

The increased joint space width after joint distraction combined with the clinical benefit suggests actual repair of cartilage. Unfortunately, this is difficult to evaluate in humans. Therefore, the effects of joint distraction on joint structures have been evaluated in the canine groove model of osteoarthritis. OA induction resulted in macroscopic and histological cartilage damage, changes in cartilage PG turnover, collagen damage, and slight synovial inflammation, all characteristics of OA. Joint distraction was differently tolerated by the treated dogs. Significant use of the treated joint, which results in intra-articular intermittent fluid pressures, showed much better outcome than not using the treated limb at all (mimicking immobilisation of joints). On average, joint distraction resulted in beneficial changes. Macroscopic cartilage damage was significantly decreased compared to that in the untreated OA dogs (p<0.01; Fig.3) and synovial inflammation was slightly diminished (p<0.02). However, changes in biochemical parameters did for the whole group (n=6; those with and those without intra-articular intermittent fluid pressure) not reach statistical significance.

![Figure 2](image2.png)

**Figure 2.** Radiographic changes (assessed using AIDA) after joint distraction in an open prospective study.

![Figure 3](image3.png)

**Figure 3.** Representative macroscopic view of the articular cartilage in the dog. Femoral condyles of the experimental OA knee of control dogs (left) and after joint distraction (right) at 40 wks of follow-up are shown.

**Discussion** The clinical benefit of joint distraction in the treatment of severe OA is proof of concept. Results from the present study open possibilities for treatment of severe osteoarthritis in general. Results from our animal study demonstrate that distraction changes chondrocyte activity beneficially and tends to cartilage repair. Joint use (intra-articular fluid pressure) during treatment influences the outcome beneficially. These results suggest that cartilage repair is involved in the clinical benefit of joint distraction, however, additional animal studies are needed to ascertain these preliminary results.


49th Annual Meeting of the Orthopaedic Research Society
Paper #0045