RADIOFREQUENCY TREATMENT OF PARTIAL-THICKNESS CARTILAGE DEFECTS IN THE SHEEP KNEE JOINT LEADS TO CARTILAGE INJURY

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INTRODUCTION:
Use of Radiofrequency (RF) energy is recently gaining increasing popularity for treatment of articular cartilage partial-thickness defects. The rationale behind thermal treatment is to smoothen and stabilize the cartilage surface to retard the development of osteoarthrosis. Goal of this study was to analyze the effect of RF-treatment on grade II partial-thickness defects in the intact or anterior-cruciate-ligament (ACL) deficient knee joint, were higher cartilage surface stress due to increased joint laxity is expected.

METHODS:
The left knee joint of 21 adult Merino sheep was arthrotomized under general anesthesia. The joints were either left intact or the ACL was transected. Standardized grade II cartilage surface defects were created in the main load bearing area on the medial and lateral femoral condyle using a specific scratching device consisting of 4 parallel K-wires. The cartilage lesions were treated randomized on either the lateral or the medial condyle, using a monopolar RF-electrode (4mm ball, K. Storz GmbH, Tuttlingen, Germany). RF-treatment was performed by sliding with the ball along the scratches under continuous rinsing for a few seconds until surface smoothening was seen without change of cartilage color (Power setting 60W soft coagulation mode). Another 10 samples of sheep femoral condyle cartilage were scratched in vitro and half of the samples RF-treated. 24 weeks after surgery the animals were sacrificed and samples were harvested and processed for macroscopic evaluation, histologic evaluation following hematoxin/eosin and Safranin-O staining and surface analysis by Scanning Electron Microscopy.

RESULTS:
24 weeks following surgery, macroscopic and histologic analysis revealed in the central area of all RF-treated samples an grade IV defect of average 5x5 mm size (Fig. 1). Histological findings confirmed the macroscopic impression showing these central ulcer and chondrocyte death in the RF-treated regions. There was no difference to be found between the group with intact and ACL-deficient knee joint with regard to cartilage surface morphology. Cartilage surface which was not subjected to RF-treatment showed partial surface irregularities with partial defect repair and no chondrocyte death 24 weeks postoperatively. The in vitro treated samples did show smoothening of surface following RF-treatment (Fig. 2a) compared to untreated samples (Fig. 2b).

DISCUSSION/CONCLUSION:
In this study RF-treatment showed an deleterious effect on articular cartilage of sheep femoral condyle 24 weeks following surgery. ACL-deficiency did not have any additional effect on the RF-treated and untreated cartilage surface. In this study temperature measurement was not performed but RF-treatment controlled by time and visually (no change of color as under clinical conditions). It was shown that RF-treatment of partial-thickness cartilage defects leads to articular cartilage damage and therefore can not be recommended for clinical use if applied only by visual control.

Fig. 1: Sheep femoral condyle 24 weeks following RF-treatment. Medial condyle (left) showing grade IV defect. Slight scratches on the lateral condyle (right) which got no thermal treatment.

Fig. 2a: SEM-image of in vitro RF-treated cartilage surface showing surface smoothening compared to no treatment (Fig. 2b).

Fig. 2b: Cartilage surface of femoral condyle showing scratches running obliquely which were not treated with RF (SEM-image). Cliffs which are seen running vertical are due to preparation for SEM.