Introduction
Currently, the surgical treatment of localized cartilage defects has its limitations. Alternatively, localized cartilage defects may be treated with small biocompatible metal cartilage tacks. The purpose of this study was to investigate safety and effects on opposing cartilage of using defect-size femoral implants in comparison to treatment with microfracturing in a goat model of established localized cartilage defects.

Materials and Methods
In 9 Dutch milk goats, a medial femoral condyle defect (Ø 5.0 mm) was created in both knees in the weight bearing area. After 10 weeks, these defects were randomly treated by microfracturing or by placing an oxidized zirconium (OxZr) implant (Ø articulating surface 5.0mm; fixation pin of 13.5 mm in length). The animals were sacrificed after 26 weeks. The joint was evaluated macroscopically. Cartilage quality was analysed macroscopically using the Macroscopic Cartilage Score and microscopically using the OARSI Osteoarthritis Cartilage Histopathology Assessment System (OOCAS, including subchondral bone) and the modified Histological Histochemical Grading System (HHGS, not including subchondral bone). Cartilage proteoglycan incorporation was determined in explants from each of the four separate regions in the knee by 4 hours incubation in the presence of $^{35}$SO$_4^{2-}$ after which the explants were cultured for another 72 hours in the absence of $^{35}$SO$_4^{2-}$. Incorporation of radiolabelled GAGs was measured by liquid scintillation analysis of tissue digests. GAG release and total GAG content of explants were measured by Alcian blue assay of conditioned medium and tissue extracts, respectively (Figure 1).

Results
The healing of the microfractured defects was extensive, although not complete (18.38±0.43 out of a maximum of 24); the mean bone-implant contact was appropriate (14.6±5.4%) and bone formation surrounding the implant was extensive (40.3±4.0%). The macroscopic cartilage evaluation did not show any significant differences. By microscopic evaluation, the cartilage of the medial tibial plateau articulating directly against the treated defect demonstrated significantly more degeneration in the microfracturing-treated knee as compared to joints treated with implants (p<0.05) (Figure 2). This was in accordance with a significantly higher GAG content, higher synthetic activity and decreased GAG release of the medial tibial plateau cartilage of implant-treated knees (p<0.05). The other locations in the knee did not show any differences between both treatments (Figure 3).

Conclusions
This study showed that small OxZr implants used as a treatment for established localized cartilage defects in the medial femoral condyle caused less cartilage degeneration of the opposing tibial cartilage compared to the microfracturing technique. Osseointegration was limited. Although only one single time point after treatment was evaluated, this is the first in vivo study implicating a beneficial effect of small metal implants as a treatment for localized cartilage defects.

References