**Introduction**

Early implant fixation is important for long-term survival of total joint replacements. A new bone preparation technique, bone compaction, has enhanced early implant fixation in vivo [1,2]. The bone compaction technique prepares the implant cavity by compacting cancellous bone. Hereby an autograft surrounding the implant is created in situ. However, the long-term implant stability might be jeopardized if the autograft is resorbed too quickly. The autograft has a large surface that is not covered with osteoid, to which topically applied bisphosphonates can adhere. We investigated whether topically applied bisphosphonates would decrease the early resorption of this compacted bone autograft.

We tested the hypothesis that topical alendronate treatment would increase implant fixation, bone-to-implant contact, and peri-implant bone density of implants inserted with bone compaction.

**Materials and Methods**

In a study approved by our Animal Care and Use Committee, we used eight skeletally mature hound dogs, with a mean body weight of 21.5 kg. One weight-bearing porous coated titanium implant was inserted into each medial femoral condyle. The implants were cylindrical with a height of 10.0 mm and a diameter of 5.6 mm. In the right femur 15 mg alendronate dissolved in 15 mL saline was topically administered prior to bone compaction. On the left side the same amount of saline was used as control prior to bone compaction.

**Surgery**

By use of sterile technique we drilled a 16 mm deep hole in the weight-bearing portion of the medial femoral condyle. The 10 mm deep part of the hole had a diameter of 4.5 mm, and the 6 mm superficial part had a diameter of 6.0 mm (the superficial, drilled portion was necessary to prevent the compaction from occurring in cortical/subchondral bone). After applying alendronate or saline solution, the hole was prepared for implantation by use of bone compaction. The compaction protocol gradually expanded the 10 mm deep part of the cavity by use of a specially designed bone compactor. The final result is a cavity with a diameter of 5.6 mm at the 10.0 mm deep part, and an unchanged diameter at the 6.0 mm superficial part. After inserting the implant, a 6.0 mm high PE-plug was screwed onto the implant. This PE-plug protruded slightly above the articular cartilage, and thereby allowed load to be transferred through the implant. Unrestricted weight-bearing was allowed postoperatively.

**Evaluation**

All dogs were killed after 4 weeks. Two sections were cut of each femur condyle perpendicular to the long axis of the implant. The section closest to the articular surface was used for mechanical push-out test. The other section was used for histomorphometrical analysis. We used Wilcoxon Signed Rank test to test for differences between the two groups, since data were not normally distributed. Two tailed p≤0.05 were considered significant.

**Results**

No implants were excluded and there were no infections. **Bone-to-implant contact:** We found that topical alendronate treatment increased total bone-to-implant contact by 89% (p = 0.008). The increase was a result of increased non-vital bone-to-implant contact by 550% (p=0.008), and increased vital bone-to-implant contact by 30% (p=0.14). **Bone density:** Alendronate treatment increased total bone density in a 0-500μm zone around the implants by 85% (p=0.008). This increase was a result of increased non-vital bone density by 1350% (p=0.008), and increased vital bone density by 17% (p=0.055). See Figure 1+2.

**Discussion:**

This weight-bearing study was designed to investigate the effect of topical alendronate treatment on in situ compacted bone, prior to implant insertion. We found that topically applied alendronate increased total bone density and total bone-to-implant contact due to increases in non-vital bone density and non-vital bone-to-implant contact. Despite the increase in non-vital bone covering the implants, we found no increase in mechanical fixation of the implants in the alendronate group. However, this non-vital bone might exert important osteo-conductive properties for long-term implant fixation. Further long-term studies are warranted to investigate whether the increased non-vital bone in the alendronate group might enhance implant fixation after long-term remodeling at the bone implant interface. Although this implant model is loaded, in cancellous bone, and allows access of synovial fluid to the interface, results are limited to the four-week observation period.

**References**
