INTRODUCTION

Implants of carbon fiber composite have been widely used in orthopedic and spinal applications. Tantalum has also been in clinical use since before 1940 and has found a wide range of diagnostic and implant applications with overall excellent results. However, in a series of studies using carbon fiber reinforced cages, we constantly found a fibrous layer interposed between the implant and the surrounding bone [1,2,3]. The aim of the present study was to test a carbon-carbon (C-C) composite cage with a thin layer of tantalum coating in a spinal fusion model in an attempt to improve its biocompatibility.

RESULTS

All pigs went through the observation without major complications. One C-C cage broke at 8 weeks’ checkup (Colloss-filled). The rest of the cages demonstrated good radio-transparency for serial evaluation of bone formation inside (Figure 1). Due to short observation time, fusion rate was not given with radiograph evaluation. With clinical CT (MX8000, Marconi) evaluation, new bone formation could be clearly demonstrated inside the cage. Excellent biocompatibility was demonstrated by micro-CT images, in which bone in direct contact with the Ta-coated cages was abundant (Figure 2). Fusion rate for Colloss evaluated with reconstructed micro-CT images improved to 85.7% (6/7). Micro-CT evaluation showed that there were no differences of the bone volume fractions (BV/TV), surface densities (BS/BV) and trabecular thickness (Tb.Th) between the two graft materials. Only trabecular space (Tb.Sp) and trabecular number (Tb.N) had significant differences between them (P=0.02 and P=0.03 respectively). Histology sections also demonstrate intimate contact of trabecular bone to the cage (Figure 3).

CONCLUSION

We concluded that Ta-coated C-C implants have good biocompatibility with excellent bone ingrowth. The bone formation can be followed with serial radiographs, while the thin Ta coating can serve as a marker and also an enhancement for bone anchorage. The bovine bone protein lyophilisate—COLLOSS achieved the same bone formation with that of autograft in this model after 12 weeks.

REFERENCES


ACKNOWLEDGEMENT

This project was supported by the Danfoss Bionics A/S, Nordborg, Denmark, and Interdisciplinary Research Group “Nanoscience and Biocompatibility”, grant no. 2052-01-0049, Danish Research Agency.