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Evaluation of biological tissue response of β-TCP bone substitute in high molecular sodium hyaluronate matrix in sheep for improved handling properties

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Introduction:
Autograft bone is generally considered to be the most successful bone filling material because of its osteoconductive, osteoinductive and osteogenic properties [1]. Drawbacks of autograft use are increase of operation time and co-morbidity following the bone harvesting at the iliac crest. To encounter this problems, synthetic bone substitutes have become more and more popular in the last 20 years [1]. Particularly porous beta tricalcium phosphate (β-TCP) is a very promising osteoconductive, ceramic bone substitute. β-TCP ceramics are available in either granules or preforms. To enable surgeons an easier defect filling with β-TCP, chronOS granules have been embedded into a high molecular sodium hyaluronate matrix to form a kneadable putty, a β-TCP putty.
The biological tissue response to the bone substitute β-TCP putty, was evaluated as a function of time following implantation in bone of sheep and compared to the local tissue response to medically accepted material chronOS granules or a sham defect [2].

Methods:
The sheep study was performed at Harlan, Bioservice For Science, in accordance with the principles of Good Laboratory Practice. Three implantation periods, lasting 3, 6 and 12 weeks were employed. In each sheep, the test (β-TCP Putty) and reference (chronOS granules) device were implanted into cylindrical defects of 4 x 12 mm in both tibiae and a sham operation (no material) was performed [2].
During the implantation periods, clinical observations, measurements of body weight and evaluation of implantation sites were performed. After each implantation period, the designated animals were sacrificed. The implantation areas were explanted, bone samples were prepared and preserved for histopathological examination.

Results / Discussion:
After the 3-week implantation period, the materials chronOS granules and β-TCP Putty supported bone formation due to their osteoconductive nature. Newly built bone tissue was outgoing from the margins of the wound. Frequently, absorption or degradation of β-TCP particles by macrophages were observed [3].
At the end of the 6 week implantation period, there was a closed bone bridge between both margins of the wounds after implantation of chronOS granules and β-TCP Putty. Mostly, the individual granules or particles were completely imbedded within new bone tissue. Following the sham procedure, the wounds were closed in most samples [3].
After the 12 week implantation period, the formerly drilled holes filled with either chronOS granules or β-TCP Putty were completely closed and the sham sites healed up completely [3].

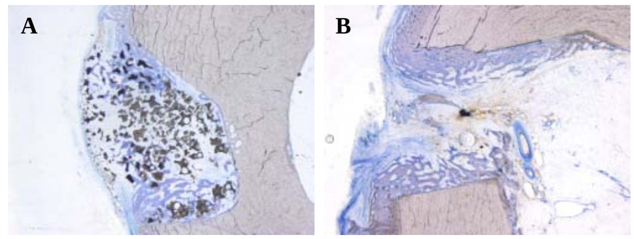

Fig. 1: Comparison of a defect filled with β-TCP Putty (A) and the sham defect (B) after 3 weeks of implantation.

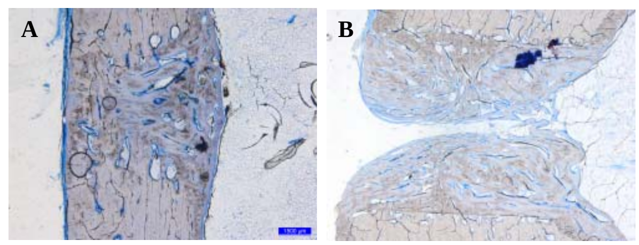

Fig. 2: Comparison of a defect filled with β-TCP Putty (A) and the sham defect (B) after 6 weeks of implantation.

Conclusions:
In conclusion, β-TCP appeared to be a bone replacement material with optimal biocompatibility, resorption characteristics and bone conduction properties for the clinical use. The addition of high molecular sodium hyaluronate to chronOS granules did not influence the local tolerance as well as the osteoconductive properties of the material, however, significantly improved the handling properties of chronOS granules.

References:
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