Impact of biomaterial physical characteristics on bone regeneration: Comparison of three hydroxyapatites

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Introduction

Bone regeneration biomaterials with identical chemical compositions are frequently considered by clinicians as similar. However, the clinical performance of regenerative biomaterial may be influenced by other parameters such as topographical properties.

Aim

The primary objective of this study was to compare the performance and the osteoconductivity (osteogenesis and bone-to-material contact) of three hydroxyapatite-based biomaterials of different origin (natural or synthetic) or manufacturing process in a sinus lift model in rabbits. The secondary objective was to correlate the findings with the physical and topographical characteristics of the biomaterials.

Materials and methods

Two bovine hydroxyapatites (Bio-Oss, Geistlich: BHA and Endobon Biomet: CBHA) manufactured with two different processes and one synthetic hydroxyapatite sintered at high temperature (Osbone, Curasan: SHA) were characterized with scanning electronic microscopy and implanted in a sinus lift model in rabbits. Non-decalcified histology was performed at 1, 5 and 12 weeks after implantation and subjected to histomorphometric analyses.

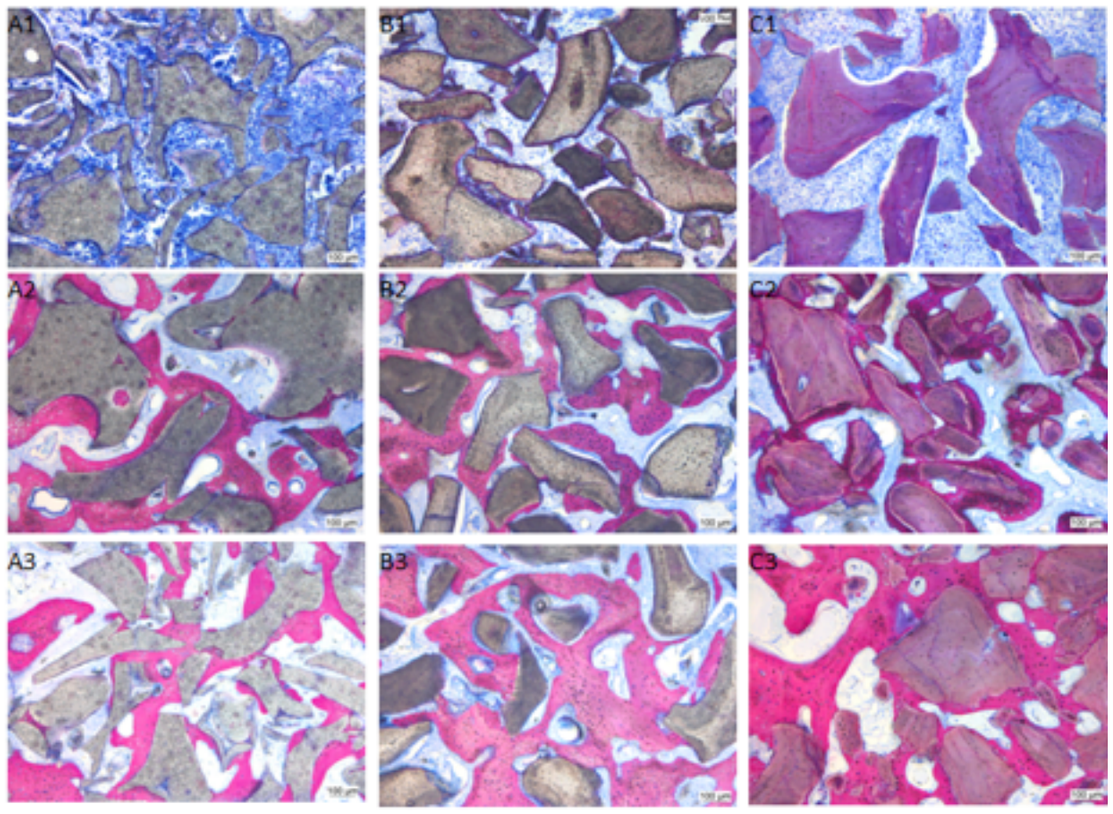

Fig.1: Descriptive histology at 1 week (1), 5 weeks (2), and 12 weeks (3): A) BHA, B) CBHA, C) SHA.

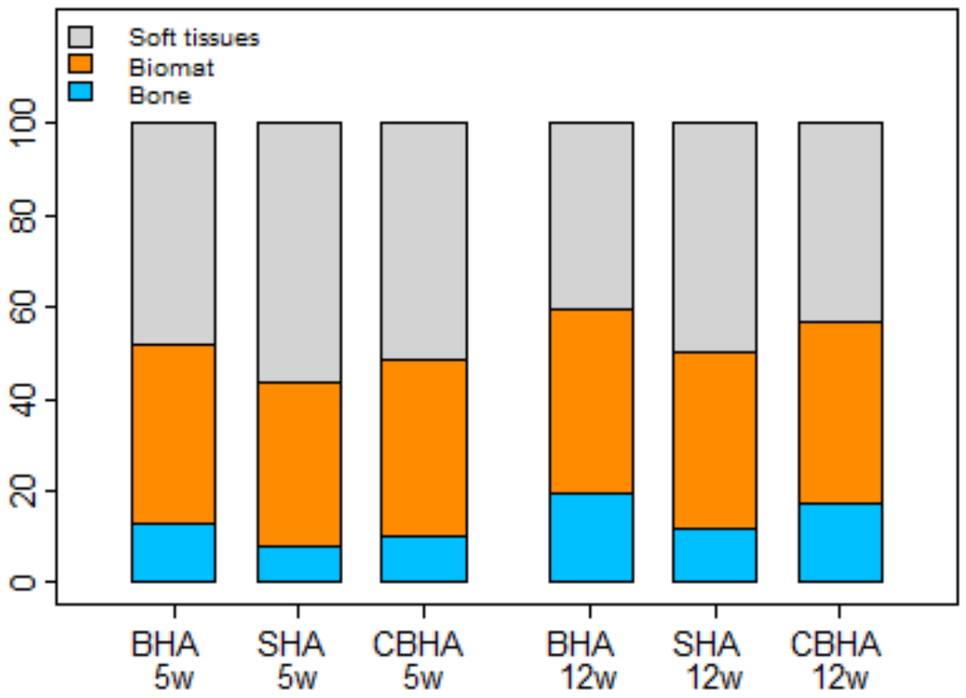

Fig. 2: Percentages of newly formed bone in the total region of interest at 5 and 12 weeks

Results

The studied biomaterials displayed a different surface topography illustrated in **fig. 3**. The two natural HA displayed significantly higher bone quantities (BHA vs SHA p=0.0018 and CBHA vs SHA p=0.033) at 5 and 12 weeks compared to the synthetic one (SHA) (**figs. 1, 2**). Moreover, the osteoconductivity (bone to material contact) was significantly higher in BHA group compared to the two other groups (BHA vs SHA : p=0.023 et BHA vs CBHA : p=0.033) (**fig. 4**).

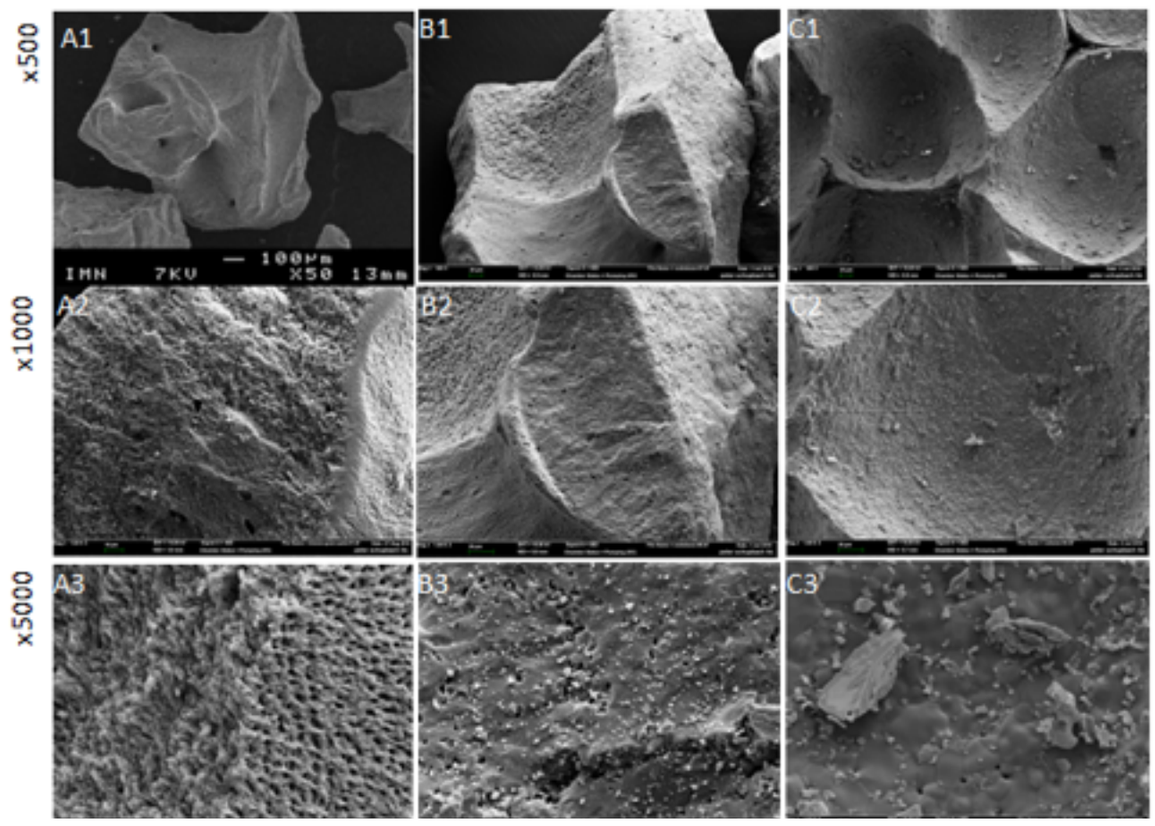

Fig. 3: Scanning electronic microscopy of the studied biomaterials at different levels of magnification: A) BHA, B) CBHA, C) SHA.

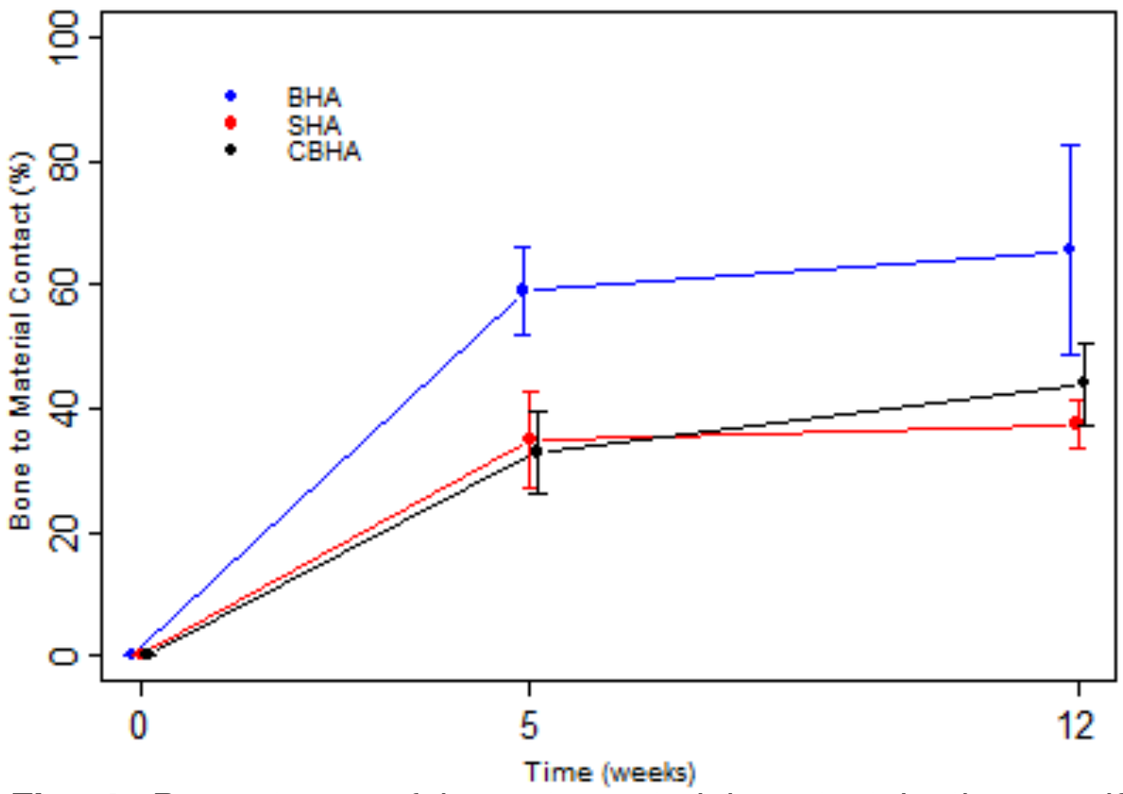

Fig. 4: Percentages of bone to material contact in the specific region of interest at 5 and 12 weeks

Conclusion

HA-based biomaterials from diverse origins and manufacturing processes displayed different topographical characteristics. The regenerated bone architecture is significantly different; more bone was found with natural HA compared to the synthetic one and significantly higher bone to material contacts were found with BHA.

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