Bone Formation in a Rat Critical Sized Bone Defect Upon Implantation of an Intrinsically Osteoinductive Calcium Phosphate Ceramic, with or without rhBMP-2

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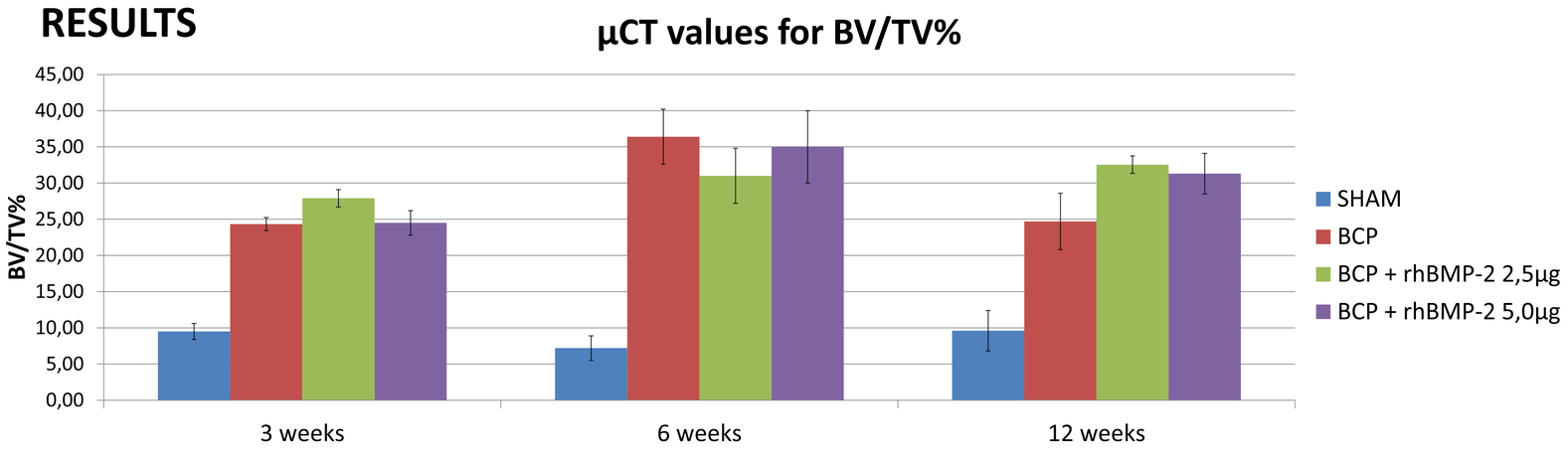
OBJECTIVES

The aim of this study was to investigate the ability of an osteinductive calcium phosphate ceramic alone or in combination with rhBMP-2 to bridge a critical sized calvarial defect in rats. The hypothesis was that the use of intrinsically osteoinductive ceramic could minimize the dosage of rhBMP-2.

METHODS

120 male Wistar Han rats were used upon approval by institutional animal ethics committee (IMI,Zg,HR). 14mm critical sized circular defects were created on calvaria of animals by using a dental drill. Animals received a PTFE ring Ø14mm h 4mm, that was filled with either only a biphasic calcium phosphate ceramic BCP, particles 150-500 µm, consisting of ß tricalcium phosphate and hidroxyapatite in 20:80 ratio, or BCP loaded with 5µg of rhBMP-2, or 2.5µg of rhBMP-2 or left empty (sham). Animals were sacrificed at 3, 6 and 12 weeks post-implantation. Bone formation was quantitatively evaluated using µCT (SkyScan 1076, BE).3D reconstruction was performed by CTAn software, different tresholding values were used to distinguish ceramic particles from the newly formed bone and to determine BV% in total volume of interest BV/TV. ANOVA with Duncan`s post hoc test was used to compare different conditions, in addition qualitative histological analysis on Goldner trichrome-stained tissue sections.

RESULTS

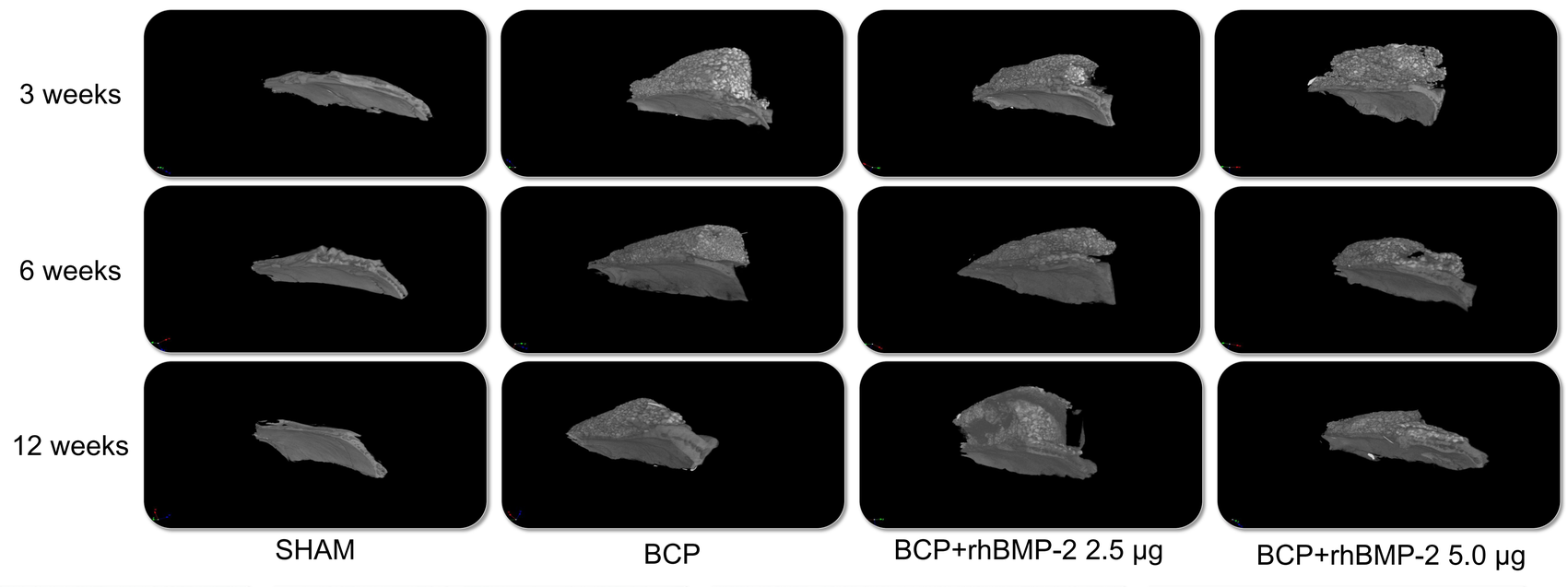


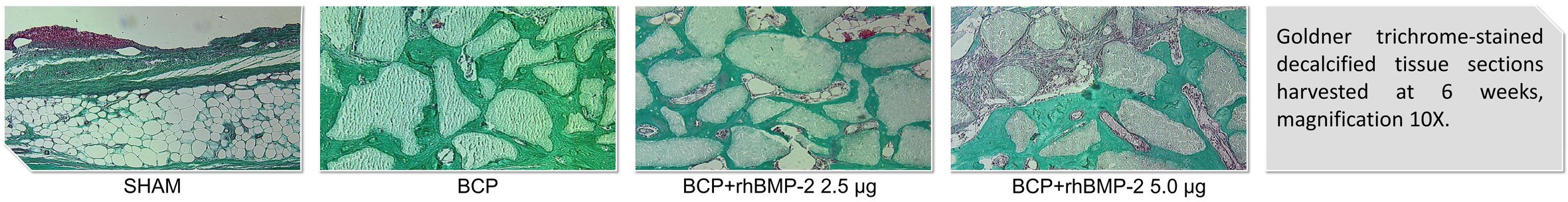
µCT values for BV/TV%

(% bone volume in total volume of interest) at 3,6,12 weeks, ANOVA statistics, Duncan's post hoc test (mean ± SD), N=10.

3D model of calvaria from microCT images

A 3D model of calvaria was generated using reconstructed images obtained by microCT.





Goldner trichrome-stained decalcified tissue sections harvested at 6 weeks, magnification 10X.

CONCLUSIONS

Study results showed no statistically significant differences in bone formation between the BCP alone and loaded with 2.5 or 5 µg rhBMP-2 in a critical sized calvarial deffect in rats. While it is generally thought that CaP biomaterials are not osteoinductive, BCP used here was previously shown to possess intrinsic osteoinductivity which may explain comparable performance in this study in terms of dynamic bone formation and the total amount of bone formed in presence and in absence of rhBMP-2.

REFERENCES

- Daculsi et al. 2006, 2007, 2008
- Habibovic et al. 2010
- Okanove et al.2012

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