Clinical and Histological Comparison of Two Allogeneic Bone Grafting Materials for Alveolar Ridge Reconstruction: A Retrospective Study in Humans

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Objectives

Processed human bone is available in different configurations and processing methods differ significantly depending on the tissue bank. To date, little is known about the impact of using different allograft brands. The present study aims to compare two commercially available materials regarding their clinical performance on both, the functional as well as histological and immunohistochemical level, linking those data to in-vitro analytical evaluation of the specific batches used clinically.

Methods

A total of 20 patients were treated with two different commercially available cancellous allograft particles (maxgraft® / Puros®), for lateral ridge augmentation in combination with a collagen membrane in a two stage surgery. After a mean healing period of 5 months, implants were placed and biopsies were taken for histological and histomorphometrical evaluation. After decalcification, several markers for bone remodeling and potential inflammatory reactions were screened. Representative sections were evaluated histomorphometrically to determine the amount of soft tissue, newly formed bone and residual allograft particles. Bone material of the same batches that were used clinically, was obtained separately, subjected to protein extraction and analyzed regarding soluble protein concentration. Further, Enzyme-Linked immunosorbent Assay (ELISA) was used to determine the presence of major histocompatibility complex I (MHC I) molecules in order to investigate potential immunogenic cell remnants that might cause allosensitization.

Results

No differences in the clinical outcome using the two bone allograft materials could be detected and all patients have been restored successfully. Complications during the treatment could not be observed. Histomorphometrical analysis of the bone biopsies regarding the distribution of newly formed bone, residual allograft and soft tissue revealed 41±12, 14±10 and 47±14 % for maxgraft and 27±17, 31±8 and 60±18 % for Puros, respectively. Due to the large deviations within the groups, the differences comparing the two substitute materials proved not to be statistically significant. Active osteoclasts and osteoblasts were detected on the surface of both bone grafting materials, indicating progressive degradation of allogenic material and apposition of new bone. RunX2, a marker for preosteoblast differentiation was only visible in a few subjects. Positive staining for CD5, CD4 or CD8 as marker for inflammatory reactions were hardly detected and were not associated with one another.

Measurements of the soluble protein content in the tested graft materials revealed concentrations ranging from 0.38-1.50 μg/mg dry mass (maxgraft®) and 0.47-1.70 μg/mg dry mass (Puros). MHC I residues could not be detected in any sample.

Conclusion

The two particulated FDBA tested did not differ in terms of clinical performance and can be considered equally suitable for bone regeneration of Seibert class 1 defects. The evaluation of the biopsy cores revealed membranaceous osteogenesis around allogenic graft material forming a bony cancellous network, remodeling of the newly formed bone from fibrous into mature lamellar bone tissue and degradation of the graft by osteoclastic activity.

FDA residues could be identified by empty osteocyte lacune, but hardly differed from vital bone in the histological sections. Correlation between residual protein content in the allografts and the clinical presence of delayed healing or histological signs of inflammation could not be detected.

As no MHC residues were found, a potential allosensitization which has been proven for fresh-frozen bone allograft and postulated for freeze-dried allograft blocks seems to be unlikely with the particulated materials used in this study.

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