Clinical Outcome and Bone Regenerative Effects from Using Calcium Phosphate-based Implants in Cranial Repair

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Introduction

Autologous bone and alloplastic materials used for cranial repair are associated with resorption, infection and extrusion. Materials with regenerative features may improve outcome. A bone regenerative calcium phosphate- based implant was used in the present retrospective study. The primary objective was to determine complication rate, as defined as number of explantations due to infection and/or extrusion. The secondary objective was to uncover evidence of bone formation induced by the implant.

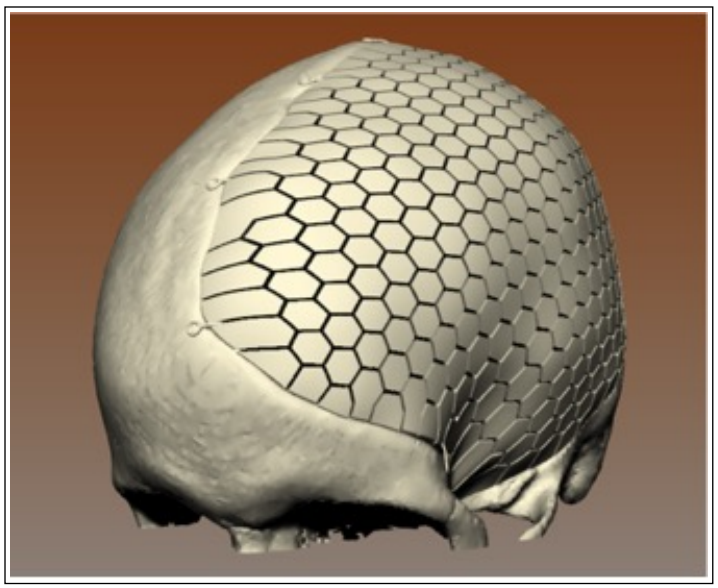

Figure 1. *The calcium phosphate implant i digitally designed before manufacturing by moulding technique. A reinforcing titanium net is included and completely embedded in the ceramic material.*

Methods

150 patients with cranial defects were treated. The follow-up time was 1-60 months (mean 23 months). In two patients, biopsies were taken 9 and 50 months after surgery, respectively, for gene expression analyses and histological examinations.

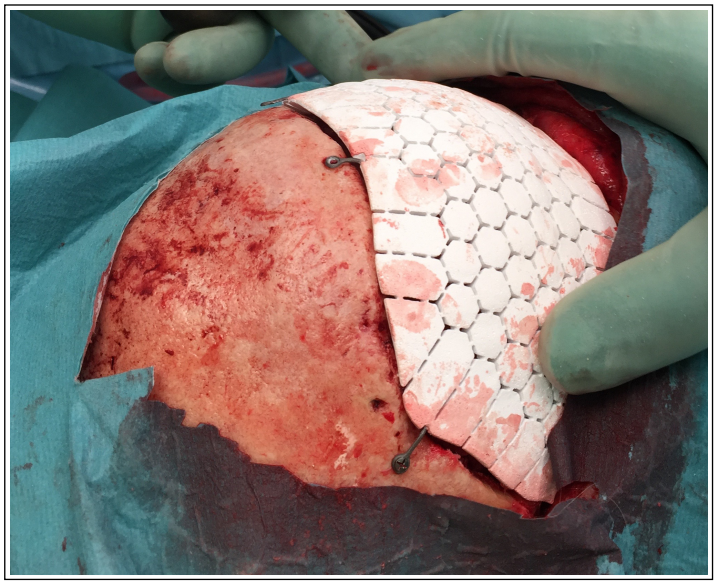

Figure 2. *. Perioperative picture showing the ceramic customized implant.*

Results

The explantation rate was 5,3 % in the cohort where approximately 40 % of treated patients had a history of previously failed autologous bone flaps or conventional implants. Early postoperative wound dehiscence and infection occurred in 8 cases. Five patients had local revision due to wound dehiscence that healed without implant removal. A majority of failures occurred within 3 months after surgery. Two patients had late onset titanium exposure adjacent to the ceramic implants that necessitated partial revision. Gene expression analyses 9 months postoperatively revealed expression of osteocalcin, type I collagen, osteopontin, calcitonin receptor, and cathepsin K within the reconstructed area, and up-regulation of type I collagen expression in the soft tissue covering the implant. Histological examination 50 months postoperatively revealed vascularized compact bone within the reconstructed area.

Conclusions

Weak quality of soft tissue covering the implant and smoking are identified as major risk factors. We believe that new bone formation as well as new collagen deposition in skin induced by the ceramic implant may contribute to a reduction of the number of postoperative complications.

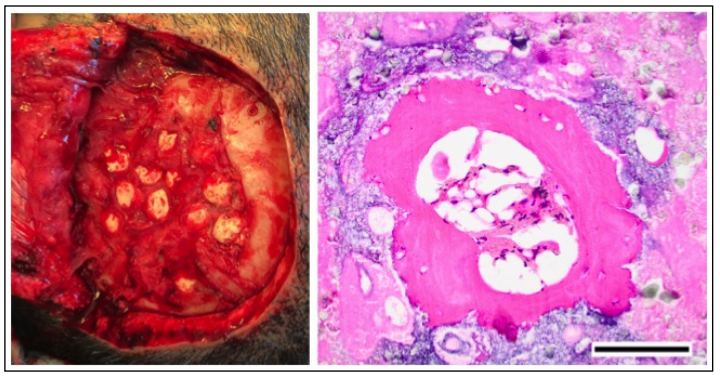

Figure 3. *Left: Gross inspection 50 months after implantation shows ceramic tiles transformed into compact bleeding bone. Right: Histology reveals blood vessels surrounded by bone tissue. Remnants of ceramic materials and osteoid are found in the perifery of the picture. H&E staining. Bar= 100 um.*

References

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