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Design of Injectable Pre-Mixed Dental Putty for Bone Regeneration Applications in Dentistry

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***Abstract*— In the recent years, a dramatic increase in the number of commercial products has emerged in recent introduction of first injectable bone grafts. Bone substitutes developed as water soluble hydrogel structured polymers and calcium phosphate based ceramic composites have gained popularity especially in dental applications. These injectable bone grafts support bone tissue, which is absorbed by healthy tissue after implantation, allowing bone tissue regeneration. The aim of this study was to develop synthetic injectable dental grafts that do not require dental membrane application.**

I. INTRODUCTION

Injectable calcium phosphate-based (CaP-b) grafts have been regarded as promising bone grafts because of their similarity to the mineral phase of the bone and in-situ mineralization support. In addition, CaP-b grafts do not exhibit toxic effects and trigger reactions within the body, are biologically compatible, and most importantly promote bone regeneration even in irregular bone defects. The limiting feature of CaP is its fragile structure, poor mechanical strength and also need for membrane after implantation to enable graft in the defect site [1]. The use of polymeric adjunct materials, amino salicylic acid, and phosphorylated chitosan as a carrier for CaP-b grafts is a common research topic to avoid existing restrictions. Among these, the most promising agents are synthetic polymers within hydrogel structure. The polymer-ceramic composite paste is injected into the bone defect as a paste, allowing the irregular cavity to be completely filled. In this way, most of the practical disadvantages of the blocks or granules could be overcome [2].

Requirement of bone grafts as well as dental membranes increases costs and complexity of the flap surgery in dentistry. The graft material used in the Powerbone Dental Putty is a silicate enriched CaP-b grafts, which is designed as sterile, ready to use (no mixing required) bioactive injectable graft material and above all no demand for dental membrane. Due to its dense and moldable structure, it can fit perfectly the defect shape, stays there without membrane coverage, and increase amount of bone contact which also increase the cell migration into the graft. The graft material sets hard in the applied area and bonds to the implant and completely resorbed and replaced with native bone tissue in 3 months.

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II. MATERIALS AND METHODS

The implantation test was performed in accordance with ISO 10993 standard. The rabbits were anaesthetized by injecting Nembutal into an ear vein, about 40 mg/kg body weight. The operative sites were shaved and disinfected with iodine. The muscle pedicle was dissected to a length of 1 cm and graft was fixed, so as to be in touch with the cut-off muscle.

Sinus lift procedure performed in 42 years old male patient without membrane application.

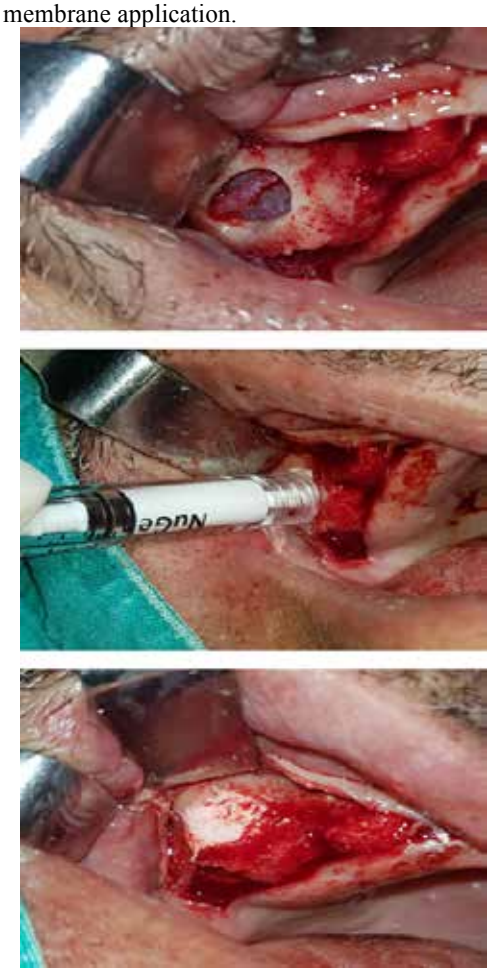

Figure. 1. *Use of Powerbone Putty in sinus lifting operation.*

III. RESULTS

Osteoid formation can be seen in Figure 1. It was speculated that resorbed β-TCP grafts released calcium and phosphate ions into the surrounding tissue which enhances osteogenic differentiation of neighborhood mesenchymal stem cell and induce formation of osteoids.

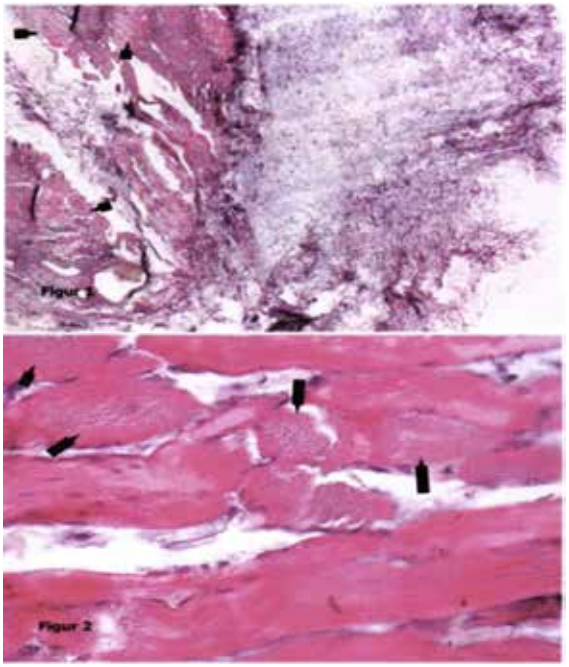

Figure. 2. *Osteoid formation (Osteoinductive characteristics) 2 months after implantation of Powerbone Putty in skeletal muscle.*

Due to its dense and moldable structure, it can fit perfectly the defect shape, stays there without membrane coverage, and increase amount of bone contact which is also increase the cell migration into the graft. The graft material sets hard in the applied area and bonds to the implant and completely resorbed and replaced with native bone tissue in 3 months (Figure 3).

Figure. 3. *The sinus defect filled with Powerbone Putty heals completely after 5 months.*

IV. CONCLUSION

Powerbone Dental Putty does not set like a cement but has a transient hemostatic effect designed to provide a comfortable environment for the clinician to work with. Putty has great retention and can adapt to the defect shape. Therefore, we predict that Powerbone dental putty will be widely preferred in dental surgeries.

REFERENCES

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