R-13. Tissue Response of Calcium Polyphosphate in Beagle Dog

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OBJECTIVE

The purpose of this study was to investigate the tissue response and osteo-conduction capability of Calcium Polyphosphate(CPP) as bone graft material and to compare with the semi-automatic histomorphoric new bone formation between CPP and demineralized freeze-dried bone.

MATERIAL & METHOD

1. Manufacturing Calcium Polyphosphate

Interconnected porous calcium ploypHosphate(CPP) blocks were prepared by condensation of anhydrous $Ca(H_2PO_4)_2$(Duksan Chemical Co., Inc.) to form non-crystalline $Ca(PO_3)_2$. From the latter, an homogenous melt was created by thermal treatment, quenched in distilled water, and the block was then milled to produce CPP powder. And macroporous 3-dimensional scallfods were made using a polyurethane(PU) sponge method[42,43] with addition of Na_2O.

The CPP granule with chitosan was prepared by use of CPP powder. The each powder of CPP, $CaSO_4$, and chitosan were mixed into weight ratio 5:1:1 in 5% chitosan solution as binder. The mixed compound was penetrated into mesh which pore size is 800um and then dried in the fan oven. The size of CPP granule with chitosan was 300-500um.

2. Animal experiments

10 teeth were extracted as premolar teeth are biradicular, 20 alveolar extraction sites were available for bone filling. After sulcular incisions, full- thickness buccal and lingual mucoperiosteal flaps were raised. gingival incisions were extended mesially from the canine and distally to the molar teeth. A vertical interradicular section was performed with a dental bur under sterile irrigation to separate all teeth into 2 pieces and avoid root and alveolar cortical bone fracture during extraction.

All alveolar sites were checked after extraction and thoroughly debrided with a dental curet to remove the periodontal ligament.

Extraction sites were grafted with biomaterial or left unfilled; i.e, the mesial socket of a tooth was left unfilled and the distal socket filled with the composite biomaterial. The CPP granule with chitosan and CPP granule with Na_2O were injected into the extraction socket in a retrograde manner from the bottom of the socket to the top of the alveolar crest. The connective tissue surfaces of the buccal and lingual flap margins were carefully joined together, and non-resorbable hermetic sutures were performed.

The animals were sacrificed 3months after implantation(day 90) by intravenous injection of over-dosed sodium pentobarbital.

3. histological evaluation and bone ingrowth measurements

Both treated and control mandibular and maxillary sites were histologically evaluated with light microscopy. For each socket, 30um thick sections were cut with a hard tissue microtome along the long axis of the root implantaton site and then multiple-stained for light microscopy observations.

Compared in filled and control mandibular and maxillary sites and quantitatively evaluated using a Global Lab Image Analysis System(Data Translation Malboro, MA, USA) . Results are given as the percentages of newly formed bone in mandibular and maxillary extraction sites.

RESULT

1. Histologic findings

All control and experimental sites healed uneventfully with no clinical evidence of inflammatory response to the CPP implants and DFDB. Histologically, although no quantitative measurements were made, the amount of newly formed bone appear to be greater in specimens with CPP granule with Na_2O as compared to the control sites The unresorbed CPP granules with Na_2O and CPP granules with chitosan showed an irregular surface indicating that resporption or dissoultion process of the CPP granules took place prior to laying down of mineralized bone matrix. This is in contrast with the relatively smooth appearing surface which contacted directly newly formed bone around CPP grnaules . However, the tissue appears to demonstrate a decrease in osterblastic activity and some of the CPP granules were simply surround with fibrous connective tissue. The one-way ANOVA showed that all the treatments pooduced statistically significant higher gain in new bone formation than did the control groups($p<0.05$). But the alnalysis showed that, for implanted sites comparisons, there is no significant difference between experimetal sites with implant material.

CONCLUSION

1. The CPP granules contact to new bone directly.
2. The new bone formation was found in CPP granules with chitosan , CPP granules with Na_2O and DFDB group
3. There is significant difference between CPP granules with chitosan, CPP granules with Na_2O and control group.
4. There is no significant difference between CPP granules with chitosan and CPP granules with Na_2O.