Bone morphogenetic protein-2 coprecipitated biomimetic calcium phosphate for periodontal regeneration

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Abstract

Introduction: Sufficient regeneration has been only reported in 2- or 3-wall periodontal defects and it appears to be difficult in cases with supra-alveolar periodontal defect.

Aim: In this research, we will explore the periodontal regeneration of bone morphogenetic protein-2 (BMP-2) coprecipitated biomimetic calcium phosphate (BioCaP) (BMP-2-cop.BioCaP) in an experimental periodontitis model with supra-alveolar periodontal defect.

Methods: Chronic experimental periodontitis model with supra-alveolar periodontal defect was created in the mandibular of beagle dogs. The defects were randomly assigned with BMP-2-cop.BioCaP + Bio-Gide®, BioCaP + Bio-Gide®, Bio-Oss® + Bio-Gide®, Bio-Gide® or no grafts (N=6). After 8 weeks, clinical parameters, microcomputed tomography (micro-CT) examinations and histomorphometric analysis were evaluated to access periodontal regeneration.

Results: Clinical appearances including plaque index, bleeding index and probing depth were similar for all experimental conditions. In contrast, the attachment loss was significantly reduced in defects receiving BMP-2-cop.BioCaP. Besides the result from Micro-CT show much more bone regeneration in BMP-2-cop.BioCaP filled defect than other groups.

Conclusion: These results suggest that BMP-2-cop.BioCaP can be a benefit biomaterial for periodontal regeneration with supra-alveolar periodontal defects.

Background and Aim

Severe periodontitis is considered to be the sixth most prevalent condition in the world affecting about 11% of world population¹. Supra-alveolar periodontal defect is one of the most common manifestation of severe periodontitis. However, sufficient regeneration has been only reported in 2- or 3-wall periodontal defect and it appears to be difficult in cases of supra-alveolar defect or 1-wall defect². Previously, our team developed an innovative, optimized, enhanced biomimetic bone substitute material BMP-2-cop. BioCaP³. It is osteoinductive and can induce bone formation at both ectopic and orthotopic sites. As a new class of bone substitute material, BMP2-cop. BioCaP may have great potential for periodontal regeneration applications in supra-alveolar periodontal defect. In this research, we will explore the periodontal regeneration of BMP-2-cop. BioCaP in an experimental periodontitis model by clinical and micro-CT evaluations.

Methods and Materials

Animals

Beagle dogs are 18 to 24 months old with an average weight of 12 kg.

Grouping

① BMP-2-cop.BioCaP + Bio-Gide®,
② BioCaP + Bio-Gide®,
③ Bio-Oss® + Bio-Gide®,
④ Bio-Gide®,
⑤ no grafts.

The surgical process is shown in Figure 1.

Clinical parameters

The plaque index (PI), bleeding index (BI), probing depth (PD) and clinical attachment level (CAL) are recorded at 0, 8, 12, 20 weeks.

Micro-CT imaging and analysis

The samples are scanned and representative sections are cut out after 3D reconstruction with the built-in software of the micro-CT. The defect height and bone height in the central/ furcation/ proximal space of the root are measured.

Histomorphometric analysis

The following measurements were taken for the buccal and lingual surfaces of each root of the teeth, including: defect height, junctional epithelium, connective tissue repair, cementum formation, bone formation, bone area and ankylosis.

Figure 1

Results

BioCaP + Bio-Gide®

BMP-2-cop.BioCaP + Bio-Gide®

Considerable periodontal tissue regeneration was observed after healing. Gingival recession was less serious in BMP-2-cop.BioCaP group compared with the other groups (Fig. 2).

Clinical appearances including plaque index, bleeding index and probing depth were similar for all experimental conditions. In contrast, the attachment loss was significantly reduced in defects receiving BMP-2-cop.BioCaP (Fig. 3).

Figure 3

The result from Micro-CT show much more bone regeneration in BMP-2-cop.BioCaP filled defect than other groups (Fig.4). Defect height was similar for all groups, ranging from 5.3 to 5.5 mm. The new bone height was higher in BMP-2-cop.BioCaP filled defect than other groups in the central of the root.

Figure 4

The newly formed bone and cementum extended from the apical were observed in all groups (Fig.5). Numerous well defined trabeculae were apparent in BMP-2-cop.BioCaP filled defect. While abundant of residual granules and limited new bone were observed in Bio-Oss® filled defect. Ankylosis tended to be rare in all groups.

Blank Bio-Gide® Bio-Oss® + Bio-Gide® BioCaP + Bio-Gide® BMP-2-cop.BioCaP + Bio-Gide®

Figure 5

Much more findings on histomorphometric analysis are in full swing.

Conclusions

These results suggest that BMP-2-cop.BioCaP can be a benefit biomaterial for periodontal regeneration with supra-alveolar periodontal defects.

References

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