Application of Apatite Carbonate Membrane Effect to Bleeding on Probing after Scaling and Root Planing

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Abstract

This study was conducted to determine the effect of apatite carbonate membrane application towards the healing process after scaling and root planing treatment in chronic periodontitis patients based on the bleeding on probing (BOP) level. A total of 22 chronic periodontitis patients, attending to the Periodontics Clinic of the Dental Hospital of Faculty of Dentistry Unpad were examined with a randomized control trial, double-blind, and split mouth method. The parameters examined is bleeding on probing level at baseline and after the 30th day. All participants were obtaining the scaling and root planing followed by the application of apatite carbonate membrane. Data analysis was performed by the Wilcoxon test. The mean age of participant study was 48,6 in years. The difference mean of BOP on treatment group was 2.23 and control group was 1.59. The P-value was .07 (p > 0.05). Application of apatite carbonate membrane as an adjunctive therapy after scaling and root planing on treatment and control group reduce bleeding on probing level clinically but no different proven to be able to reduce it statistically.

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Introduction

Periodontitis is an inflammatory disease in dental supporting tissues caused by microorganisms or groups of specific microorganisms on the tooth surface. Periodontal disease is a widespread disease, and the progressiveness was needed more time, so the alteration of dental supporting tissue was not perceived in many people were not paying attention or realizing the occurrence of periodontal disease. Periodontitis leads to progressive destruction of periodontal ligaments and alveolar bone, with a pocket formation, recession, or both. Periodontitis shows gingival inflammatory lesions as well as the damage of periodontal ligaments and alveolar bone. These conditions are resulting in the bone loss and an apical migration of the junctional epithelium and also forming of periodontal pocket.[1,2,3]

Bleeding on probing (BOP) reflected the presence of gingival inflammation and served as the marker for diagnosing periodontal disease. The BOP is potentially used as an indicator of periodontal tissue damage due to its easy observation. BOP examination is performed up to the baseline of the pocket and not only surrounding the gingival margin, with gentle pressure to prevent excessive gingival bleeding.[4,5,6,7]

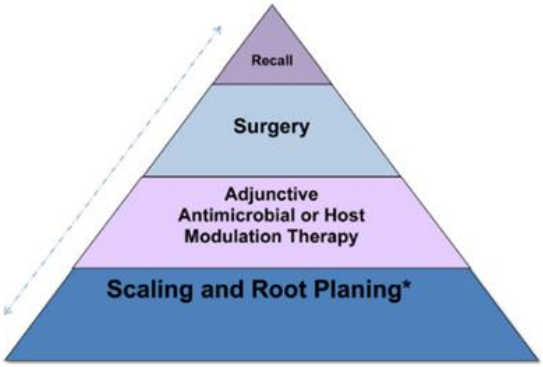

Figure 1. Choice of Periodontitis Case Treatment.[8]

The primary initial therapy for periodontitis case was known as sulcus debridement, scaling, and root planing. However, if this therapy does not respond well; for example, the occurrence of gingival bleeding, adjunctive therapy was needed.

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This theory was consistent with Connie's opinion on the treatment of periodontitis Figure 1.[8]

Currently, the application of apatite carbonate was developed primarily for adjunctive therapy for periodontitis. Apatite carbonate (CHA) was an apatite mineral form ($Ca_{10}F_2(PO_4)_6$ as well as a tissue graft material with good compatibility and bioresorbability.[9] Apatite was a biological part of enamel, dentine, and bone with a stoichiometrical difference with hydroxyapatite (HA) due to the few amounts of carbonate ions. The CHA has a substitution, which was $(CO_3)^{2-}$ with a better bioactivity solubility than hydroxyapatite.[10] The n-CAP material with the formula of $(Ca_{10}(PO_4)_{6-x}(CO_3)_x(OH)_2)$ shows a better biological activity compared to HA due to the incorporation of carbonate into HA that increases its solubility, reduces crystallinity, alters the crystalline form and developing the chemical reactivity due to a weak bonds.[11]

Gelatin as a biodegradable material has been proven for tissue regeneration. Previous research suggested that gelatin membrane could be degraded and resorbed between the 5th and the 10th days influenced by the proteinase enzyme content in the tissue.[12] A study conducted by Ardhani et al. have developed the use of membranes with the combination of gelatin film, and platelet-rich plasma (PRP) can be functioned as a scaffold material and source of the growth factors in the regeneration of peripheral nerve tissue.[13] Another study conducted by Ardhani et al. about the use of apatite carbonate membranes suggested that the membrane acts as a metronidazole carrier system for periodontal disease, enhances the cell proliferation and oxygen and nutrition transport capability.[14] Gelatin supplemented with CHA was a good innovation for hard tissue regeneration and will intensely degrade and replaced with new hard tissue structures.[15] The chemical bonds between gelatin and apatite are carboxylate bonds between the two phases of the material and occur between Ca^{2+} ions in apatite and COO^- groups in gelatin.[16,17] Sivakumar and Rao's research showed the addition of HA with a chemical structure similar to CHA in gelatin was a carrier candidate in a drug delivery system technology (DDS)[18]. Research conducted by Kim with apatite compositions of 20%, 40% and 60% in the HA gelatin membrane suggested that the higher concentration of the apatite composition in gelatin, the less fiber and crystalline formations will occur. A high concentration of apatite composition will increase the mechanical strength of the material and decrease water absorption.[16,19]

The use of materials combined with n-CHA and collagen showed the applicability in many fields of medicine due to its flexibility, mechanical strength, easy manipulated, good biocompatibility, and controlled bioresorption. The apatite carbonate membrane was expected to be applied as adjunctive therapy for the treatment of periodontitis cases, particularly on reducing the rate of gingival bleeding (BOP).

Case Report

All research procedure was conducted after the approval from the Health Research Ethics Committee of Faculty of Medicine, Padjadjaran University, Bandung, Indonesia, number 850/UNG.C.1.3.2 /KEPK/PN/2016. After the patient was given a detailed description of the research procedure, the patient's consent on following all of the procedure was stated by signing informed consent.

The study was conducted towards as much as 22 patients with chronic periodontitis who came to the Periodontics Clinic of Faculty of Dentistry Universitas Padjadjaran, Bandung, Indonesia. The inclusion criteria were men and women, aged between 36-62 years old, having at least two caries-free teeth per quadrant with the pocket depth ≥ 5 mm, and willing to follow the research by signing informed consent. The exclusion criteria were having a history of systemic diseases, smokers, and having antibiotics treatment and anti-inflammatory drugs for the past six months or using a prosthesis or orthodontic appliance.

Initial examination was performed by recording the general data, medical history, extraoral and intraoral examination, including assessment of bleeding on probing (BOP) according to Ratetitschak Figure 4. BOP examination was performed by inserting the probe tip to the base of the sulcus on the interdental papilla and idled for 20 - 30 seconds, then the gingival condition was recorded.

Figure 4. BOP Assessment.[2]

Pocket depth was recorded to determine the criteria of the study sample, then the scaling and root planing was performed singularly across the region. Scaling was performed to remove dental plaque and calculus or calcified deposits on the surface of the teeth in the supragingival and subgingival area, whereas root planing was performed to remove the calculus and necrotic radicular cementum to make a smooth, rough, and clean surface of the teeth.

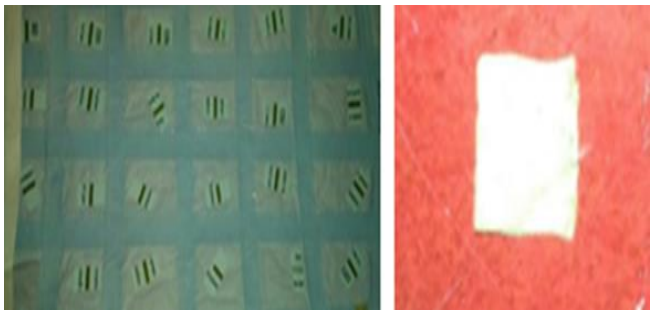

Figure 2. CHA Membrane Preparation in the Available Package (Left) and Membrane Sheet (Right).

Teeth with a minimum 5 mm in pocket depth were divided randomly using split mouth method into 2 groups, which were treatment group and control group. The selected region of the treatment group applied with apatite carbonate membrane Figure 2 to the gingival sulcus Figure 3, while the control group was not given any application, then both regions were isolated for 1 week using a periodontal pack. After 30 days, the BOP in the selected region was recorded. Apatite carbonate membrane was provided by Universitas Gadjah Mada, Yogyakarta, Indonesia.

Figure 3. CHA Membrane Application on the Treatment Group.

The result of the clinical examination of the gingiva after treatment (H_{30}) found no BOP in the treatment and control group with the same range which was 0-3 degrees. The difference in BOP mean value in the treatment group was higher than the BOP mean value in the control group. Changes in the BOP value of the treatment group showed better results compared to the control group. The mean of the BOP in the treatment group was 2.23 with the highest value was 4, and the lowest value was 0, with a standard deviation of 1.11. While in the control group, the mean value of the BOP was 1.59 with the highest value was 3, and the lowest value was 1, with a standard deviation of 1.14.

Group	N	Mean	Std Deviation	Std.Error Mean
Treatment	22	2.23	1.11	.24
Control	22	1.59	1.14	.24

Table 1. Descriptive Data of BOP Value Differences in the Treatment And Control Group.

Treatment	Control	Mean difference	t	2-tailed
2.23 (±1.11)	1.59 (±1.14)	.64	1.88	.06

*Correlation is significant at the 0.05 level (2-tailed)

Table 2. Decreasing BOP Value Between H_0 and H_{30} on the Treatment and Control Group.

Discussion

Periodontal tissue inflammatory process is caused by the accumulation of plaque bacteria and calculus. The presence of gingival

inflammation may be characterized by bleeding on probing (BOP). The goal standard of periodontitis treatment was periodontal tissue debridement known as scaling and root planing, but if this therapy does not respond well, for example, the occurrence of gingival bleeding, adjunctive therapy was needed. The material currently being developed as adjunctive therapy for periodontitis was apatite carbonate membrane.

The results of this study were indicated the conventional mechanical action of scaling, and root planing in the treatment group as well as in the control group has proven effective as initial therapy to remove the etiology of chronic periodontitis.[11,20] In this study, the application of adjunctive therapy with carbonate apatite membrane may decrease gingival bleeding more effective.

The results of this study were consistent with previous research suggested that carbonate apatite was increasing the ability of cell proliferation, and also oxygen and nutrients transport capabilities were needed for the tissue healing and regeneration.[14] Carbonate apatite in the membrane form was histologically recognized of having excellent biocompatibility, and deposited carbonate concentration will increase gradually along with the increased solubility of the collagen apatite membrane.[9] A study conducted by Liao et al. on the use of the Guided Tissue Regeneration (GTR) membrane with combination of various carrier materials with hydroxyapatite or nano carbonate active ingredients were able to increase the periodontal ligaments cell adhesion and proliferation as much as 30%, and inhibition of epithelial cell adhesion and proliferation by 30%.[21]

The oral condition, especially gingival sulcus was free from plaque bacteria and calculus after scaling and root planing which was added with the carbonate apatite membrane application in this study was able to achieved. Therefore, the etiology of periodontitis was successfully removed, and gingival bleeding was also successfully eliminated. This study suggested that carbonate apatite membrane was able to be recommended as an adjunctive therapy for periodontitis.

Conclusion

Although application of carbonate apatite membrane after scaling and root planing was not proven significant to be able to reduce the gingival bleeding level statistically, but it was proven to be able to reduce it clinically.

Declaration of Interest

The authors report no conflict of interest and the article is not funded or supported by any research grant.

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