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RESEARCH ARTICLE

CAN WE ADD CHITOSAN INTO POLYCARBOXYLATECEMENT FOR BAND CEMENTATION?

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ABSTRACT

Objective: To investigate the effect of chitosan (CH), a biocompatible polysaccharide, on the antibacterial property of polycarboxylatecements.

Materials and methods: The conventional control group zinc polycarboxylatecements were manipulated in their original composition and for experimental groups, solutions of chitosan added to the commercial liquid in 0.2g/L (0.0044 wt%) concentration. Antibacterial effects against Streptococcus mutans were tested in two groups after 48 hours and the data were submitted to statistical analyses.

Results: The analyses of the results revealed that the highest mean zone of inhibition was recorded in experimental group compared to control group with statistically significant ($P<0.001$).

Conclusion: The antibacterial property can be considerably improved by the addition of a tiny amount of CH. Moreover, in the presence of CH, the release of fluoride ions is catalyzed.

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INTRODUCTION

The orthodontist invests much time and expertise to achieve the goal of a beautiful smile. Enamel demineralization is a common negative sequel of orthodontic treatment that would compromise an otherwise beautiful result. Nearly 50% of orthodontic patients exhibit clinically visible White spot lesions (O'Rellly, 1987; Ogaard *et al.,* 1988; Eliakim Mizrahi, 1983; Christopher *et al.,* 1999) and this can occur in as little as 4 weeks (Eliakim Mizrahi, 1983; Christopher *et al.,* 1999). Because the lesions are unaesthetic and irreversible, fluoride releasing cements may be used for bonding to reduce demineralization (Wei Hua and John, 2005). Glass ionomer cementand Resin-modified glass ionomer cement, silicate cement and polycarboxylate cement has been successfully used as orthodontic luting cement. Recently, various attempts have been made to improve the antibacterial property without compromising the mechanical properties of the material by the incorporation of certain antimicrobials like chlorhexidine, benzalkonium chloride, doxycycline, cetrimide, etc. (Yoshihiko Hayashi *et al.,* 2007), Chitosan(CH), a natural linear biopolyaminosaccharide is an interesting candidate in this respect (TancanUysal *et al.,* 2011). Chitosan, obtained by alkaline deacetylation of chitin is the second most abundant polysaccharide next to cellulose. Chitin is the principal component of protective cuticles of crustaceans such as crabs, shrimps, prawns, lobsters and cell walls of some fungi. Certain properties of chitosan are especially important. It has a pH of 6.3, which is suitable to buffer the oral pH value high enough to prevent the deleterious action of organic acids on the tooth surface. It is biologically safe, non-toxic, biocompatible and biodegradable. It is positively charged and could react with both gram positive and gram negative pathogens to present antibacterial properties against several pathogens, including S. mutans (Vikas Sehgal *et al.,* 2007). Based on the possibility of obtaining a high antibacterial control around orthodontic bands, the present study was carried out to investigate if the incorporation of chitosan in polycarboxylate could increase their anti-bacterial property.

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MATERIALS AND METHODS

This in vitro study was conducted in controlled laboratory settings. The chitosan used in the study was of pharmacy grade with deacetylation of 80.79%.For the experimental groups, solutions of chitosan added to the commercial liquid in 0.2g/L (0.0044 wt%) concentration. The liquid was then mixed with the powder in order to prepare the samples. The antibacterial property was measured.

Measurement of the anti-bacterial activity (Agar plate diffusion test):

Tested microorganism: The antibacterial activities of the test specimens were assessed against *S. Mutans* using the Agar plate diffusion test. The bacterial strains of S. mutans from stock culture were cultivated in brain heart infusion (BHI) agar. All procedures were carried out under aseptic conditions in a laminar airflow cabinet.

Experimental design: Specimens of each group were prepared for the study and prior to their placement on the agar plate, the specimens were sterilized with ethylene oxide gas for 5 hours and degassed for 48 hours. S.mutans strains were incubated at 37^{o} C/48 hours and were spread on the agar plate and left for 30 minutes at room temperature. After the solidification of the culture medium, three wells with 5.5-mm diameters were punched with the blunt end of a sterile pipette in each bacterium-inoculated agar plate, and completely filled with one of the experimental materials or with the control materials. The specimens were mixed for 30 seconds with sterile plastic spatulas to the given ratios and inserted in the wells within 1 minute with full contact with the medium. The plates were then incubated at 37 ^{0}C for 48 hours in a microaerophilic environment to let the microorganisms grow, and then the diameter of the zones of inhibition were measured. Zone of inhibition were compared with control group (polycarboxylate cement without chitosan)

Statistical analyses: The data of antibacterial test were analyzed by student t test. The significance level was set at P= 0.05.

RESULTS

The analyses of the results revealed that the highest mean zone of inhibition was recorded in experimental group compared to control group statistically significant (P<0.001).

Table 1. comparison of control group with experimental group

Group	Mean	Stddev	SE of Mean	Student t test
Control group	15.34	1.03	0.28	(P<0.001).
Experimental group	17.54	1.24	0.34	

Figure 1. chitosan showing zone of inhibition

DISCUSSION

Advances in orthodontics have improved the quality of appliances and treatment protocols, raising the standard of patient care. However, enamel demineralization is still a problem associated with orthodontic treatment. Several methods have been used to prevent or reduce enamel demineralization during orthodontic treatment, including fluoride application in various forms, enamel sealants, rigorous oral-hygiene regimens, etc. Currently, researchers have proposed the addition of certain antimicrobials and antibiotics like chlorhexidinegluconate, cetylpyridinium chloride, cetrimide, doxycycline hyclate, triclosan, etc. in some restorative, luting and filling materials will improve the bacterial control (Vikas Sehgal *et al.,* 2007). Chitosan are interesting candidates in this respect. Chitosan, a polymer obtained by deacetylation of chitin, is a natural substance that has been used in studies on prevention of dental caries as it provides bactericidal and/or bacteriostatic characteristics (Yoshihiko Hayashi *et al.,* 2007; Arnaud *et al.,* 2010; Ming Kong *et al.,* 2010). Chitosan is abiocompatible and biodegradable material which is charged positively. It could react with both Gram positive and Gramnegative pathogens to present antibacterial properties (Yoshihiko Hayashi *et al.,* 2007). This *invitro* study evaluated and compared the effect of chitosan on the antibacterial property of polycarboxylate cement. The results of the antibacterial study at the end of 48 hours showed that the experimental group with 0.0044wt%CH showed the highest mean zone of inhibition compared to polycarboxylate cement. This is because the chitosan has antibacterial property and catalytic effect on the fluoride release. The current study showed that the incorporation of Chitosan with polycarboxylate will increase the antimicrobial property.

Conclusion

polycarboxylate cement with chitosan showed higher zone of inhibition to conventional cement. From the present study it can be concluded that there is a significant improvement in the antibacterial activity of polycarboxylate cement when chitosan was incorporated.

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