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Evaluation of Antibacterial Properties of Chitosan Modified Glass Ionomer on Streptococcus Mutans in Comparison with the Conventional Glass Ionomer

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ABSTRACT

Purpose: To evaluate the antibacterial characters of Glass Ionomer modified with CH on Streptococcus Mutans in Comparison With the original glass ionomer. **Materials and methods:** caries removal of 30 extracted primary molars, these teeth divided into three groups the first group restored with chitosan modified glass ionomer and second one restored with conventional glass ionomer and the third group restored with glacial acetic acid modified glass ionomer then sterilized at oven 60c for 72 hours. Each group was placed in mitis salivarius media with well-defined number of bacteria of streptococcus mutans, then left them for 48 hours , after 48 hours solution of each group was taken and was placed in mitis salivarius plate for another 48 hours and then bacterial counting was made to see if number of bacteria increased or decreased. **Results:** The Chitosan modified glass ionomer had higher antimicrobial effect than conventional glass ionomer and glass ionomer modified with glacial. Statistical analysis between the groups revealed that actually a statistically considerable difference between the all groups (*P*-value < 0.0001). **Conclusion:** Chitosan can be used as a natural material for modification of glass ionomer to increase the antibacterial effect against streptcoccus mutans and also should be supported by in vivo studies.

KEYWORDS

Sreptcoccus Mutans,
Chitosan, Glass Ionomer.

INTRODUCTION

Glass ionomer restorations in restorative dentistry made by the base acid reaction between: poly-acrylic acid with powder: Ca-fluoro-alu-

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mino-silicate glass. Glass ionomers have specific characters for example chemical bond to teeth , it works against bacteria because of flouride. But, this type of restorations have some drawbacks such as brittleness, sensitive to moisture, and weak effect with other materials for restoration [1-3].

Many amendments were formed to the main Glass ionomers to reinforce the antibacterial properties of Glass ionomers because of their low pH in setting and to the liberation of F^+ ions. So, The main Glass ionomers is not sufficient against bacteria to stop the cell activity, adherence and film consistence of S.mutans[4-7].

Several studies were formed for improving the effect of Glass ionomers against bacteria without compromising their strength and physical properties .Chitosan is formed of bio-polyaminosaccharide resulted from chitin deacetylation, having special characteristics for example mucoadhesion, degradable and compatible. Researches showed that mechanical strength of conventional GICs could be enhanced considerably by adding a 10% v/v of Chitosan along with an increase in fluoride release and antibacterial properties[8-12].

Due to a positive charge, chitosan adheres to the bacterial cell wall and cell membrane and can have both bacteriostatic and bactericidal effects. Most strength of this restoration is on Gm +ve microbiota, for example S. mutans, S.sanguis Streptococcus mitus, S. salivarius, and yeasts. CH is a weak base and is not dissolve with H_2O and organic solvents but it dissolves in dilute aqueous acidic solutions for example acetic acid. Also, it has specific properties like biodegradable, mucoadhesion, biocompatible and have increase effect against bacteria and biofilm characters against different types of bacteria .Chitosan was inspected, before, in dental field related to antibacterial effects which attack Streptococcus mutans which have predicting findings [13-20]

MATERIALS AND METHODS

Preparation of teeth:

a. Surface disinfection: the teeth were disinfected with 1% NaOCl.

b. Cleaning: The teeth were cleaned from outside to remove any tissue debris by tooth brush, then washed with water and stored in thymol solution until their use.

Teeth Sterilization:

In oven 60C for 72 hours (3 days)

Grouping of the samples:

The specimens were sectioned to three groups:

1st Group: include 10 samples in which they were restored with chitosan modified glass ionomer to show the antibacterial effect on streptcocuss mutans.

2nd Group: include 10 samples in which they were restored with conventional glass ionomer

3rd Group: include 10 samples in which they were restored wilth glascial acid modified glass ionomer

Preparation of culture media:

Culture media used in this present study was:

Mitis salivarius agar media.

Culture media were prepared as described by manufacturer, sterilized by autoclaving at 121 c for 15minutes at 15psi and stored at 40c until used.

Preparation of Chitosan

By using glacial acetic acid, distilled water and chitosan powder as following:

20 mg of Chitosan was supplied in the form of powder to be mixed with 1.8ml of glacial acetic acid and completed till 100 ml with pillory water in 100ml measured flask .

1 ml of chitosan solution was added to 9ml of GIC liquid to obtain 10% of Chitosan modified glass ionomer .

Each restored tooth was placed in liquid medium which contained well defined number of bacteria 10^{x8} for 48 hours .

The restored tooth was removed from the liquid medium then the liquid medium which contain bacteria was placed in another plate containing mitis salivarius media for another 48 hours and then bacterial count was made to see the number of bacteria decrease with which group .

Statistical analysis

Statistical analysis was made utilizing a commercially available software program (SPSS 19; SPSS, Chicago, IL, USA) to compare between groups and subgroups.

Since values were normally distributed (parametric), comparisons were made utilizing one way analysis of variance (ANOVA), then Tukey's post hoc test for pairwise comparisons when ANOVA revealed a significant difference. Independent t test was used for 2 group comparisons. Degree of significance was set at $P < 0.05$.

RESULTS

Chitosan modified glass ionomer showed the highest value in reduction of Streptococcus mutants followed with conventional then control

Table (1) *Comparison of Colony forming unit of Streptococcus mutants ($x10^3$) in all groups (ANOVA test)*

Groups	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
				Lower Bound	Upper Bound		
-Conventional glass ionomer	41.7[b]	14.1	12.7	4.6	88.0	.4	450.0
-Chitosan modified glass ionomer	.11[c]	.08	.02	.08	.14	.02	.29
-Control	815000[a]	8366.6	3415.7	806219.8	823780.2	810000	830000
F	325642.0						
P	<0.0001*						

-Significance level P<0.05

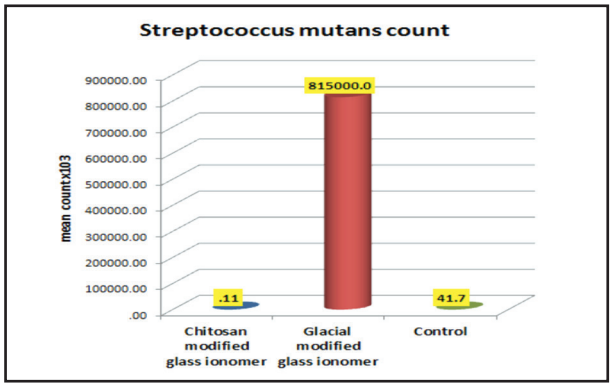

Figure (1): Shows Column chart showing mean value of Colony forming unit of Streptococcus mutants ($x10^3$) in all groups.

DISCUSSION

S. mutans is the main reason of the caries disease and infective endocarditis. Primary causes accompanied with caries formation is acid tolerance, adhesion and acidogenicity. All of these properties put in together to change the properties of dental plaque. Properties alteration are distinguished by increased number of Streptococcus mutans and other types are identical in aciduric bacteria and acidogenic bacteria. This survey based on the properties of bacteria that participate in each

virulence components. Formation of dental decay supported by series of the Streptococcus mutans gene and experiment shapes which represented by plaque biofilm of Streptococcus mutans which responsible for dental caries. In addition to acid formation by S. mutans it has an aciduric property as it preserves glycolytic abilities at which growth are inhibitory (is low pH 4.4). In this study S. mutans was chosen for investigation because S. mutans was established in higher percentage in dental plaque [21-23].

This choice of bacteria was in accordance with other previous studies that used S. mutans. This is because S.mutans possess some virulent factors such as acidogenicity as S. mutans can form lactate, formate, acetate, and ethanol as a fermentation results and aciduricity. S. mutans preserve glycolytic capabilities at low pH. Where other studies used staph- aureus because of the existence of S. aureus found in caries formation development, spread and chitosan modified glass ionomer increase zone of inhibition than conventional one. Other studies used lactobacillus because it's the most resistant oral microorganism to inhibitory effect of GI[14,22,24,25,26,27].

In the current study bacterial counting technique was utilized for knowing an antibacterial efficacy of CH-GI by counting the number of S. mutans on media plates showing reduction of the number of bacteria. Other studies used zone of inhibition to determine the antibacterial efficacy of CH-GIC because they make circular discs of restorations. In the present study modification of GI was done using a natural material which is CH because of its anti-bacterial activity to be compared with conventional one. CH is a natural antibacterial product for modifying GIs . For creating a GIs restoration with important anti-bacterial effect, mostly it relay on the quantity and type of antimicrobial agent added to GIs, modifying GIs with various antimicrobial product without making any side effects on the other physical and bonding properties . By adding CH in the polycarboxylic acid of GIC at v/v ratios of ten percent increase its effect against bacteria than conventional Glass ionomer against SM.[11,14,21,28,29,30].

CONCLUSION

Under the condition of this study we concluded that:

By adding 10% v/v of Chitosan into polyacrylic acid of GIC showed a significant increase in antibacterial effect than conventional one against streptcoccus mutans. So 10% of CH can be used as natural alternative modification in Glass ionomer restorations because of its antibacterial effect against streptococcus mutans. This method could be an effective line for S.Mutans reduction in primary restorative tooth and needed to be confirmed clinically due to presence of other different microrganism and other conditions like pH, solubility of GIC,liquids.

RECOMMENDATIONS

1. This in vitro study of the antibacterial effect of Chitosan modified glass ionomer should be supported by in vivo studies.
2. The effect of CH_GIC on other types of bacteria such as lactobacillus because it's the most resistant microorganism to inhibitory effect of GIC.
3. The effect of chitosan with different concentration that may give higher antimicrobial effect.

Declaration

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