

Effects of Xylitol and CPP-ACP Chewing Gum on Salivary Properties of Children with Molar Incisor Hypomineralization

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ABSTRACT

Aim: To compare the efficacy of chewing gum containing casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and xylitol on salivary characteristics in 8–10 years old children with molar incisor hypomineralization.

Materials and methods: A randomized controlled trial using CPP-ACP chewing gums (group I) and xylitol chewing gums (group II) was conducted among 32 children affected with mild molar incisor hypomineralization (MIH). Salivary flow rate, pH and buffering capacity were measured using saliva check kit (GC America). Data obtained were tabulated and subjected to statistical analysis using SPSS software version 20. Descriptive statistics—mean, standard deviation, 95% confidence interval. Inferential statistics—*t* tests were used.

Results: A significant increase in mean salivary pH, flow rate and buffering action was observed from baseline to immediately after spitting the chewing gum in both the study groups (*p* 0.05).

Conclusion: Casein phosphopeptide-amorphous calcium phosphate containing chewing gums improve salivary characteristics in MIH-affected children.

Clinical significance: Xylitol and CPP-ACP chewing gums are recommended in MIH children with early demarcated opacities as it improves the salivary properties in those children and prevents further complications.

Keywords: Casein phosphopeptide-amorphous calcium phosphate, Chewing gum, Molar-incisor hypomineralization, Remineralization, Saliva, Xylitol.

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INTRODUCTION

Dental caries is a multifactorial disease that involves complex interactions among acid-producing bacteria, fermentable carbohydrates, saliva, and teeth. Molar incisor hypomineralization (MIH), a qualitative type of enamel defect, have high concentration of carbon, which could be the cause of increased acid solubility and cause demineralization.¹ Saliva plays an important role in remineralization of the enamel. It has been reported that MIH-affected children have low salivary flow rates, moderately viscous type of saliva, and low pH.^{2,3} Thus, the typical teeth structure and saliva properties favor the enamel breakdown and caries progression.

In developing countries such as India, the parents do not give priority to their child's oral health until they complain of pain. Molar incisor hypomineralization lesions initially appear as white/yellow/brown demarcated opacities that fail to gain attention of the parents. Although the early lesion does not give any subjective symptoms, later the breakdown of the enamel will lead to sensitivity, caries, and sometimes loss of tooth. This problem can be overcome by treating the lesions earlier.⁴

Chewing gums increase the salivary properties by increasing the flow of stimulated saliva which has more buffer ions needed for tooth remineralization (Imfeld, 1999). In this study, we have used compared two types of chewing gum [casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and xylitol] on their efficacy in increasing the salivary properties such as saliva flow rate, pH, and buffering capacity in MIH-affected children.

MATERIALS AND METHODS

Study Design

Randomized controlled trial.

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Conflict of interest: None

Study Population

32 MIH-affected children who were selected from the previous prevalence study conducted among children aged 8 to 10 years from schools in Puducherry, India.

Sample Size Determination

From the literature,⁵ the mean value of salivary buffering capacity using CPP-ACP and xylitol-containing chewing gum is substituted and sample size is calculated, $\mu_1 = 4.7377$, $\mu_2 = 4.1537$, $S_1 = 0.63413$,

$S2 = 0.57153$, $\alpha = 0.01$, $\beta = 10\%$ in the equation and the sample size was calculated as 32.

$$n = \left[\frac{[DEFF * Np(1-p)]}{[(d^2 / Z^2_{1-\alpha} / 2 * (N-1) + p * (1-p))]} \right]$$

Ethical Considerations

The study was approved by the Institutional Review Board and Institutional Ethical Committee (IEC Approval Code: IGIDSIEC2018NRP07PGNMPPD).

Eligibility Criteria

Children with health problems and under antibiotic medication were excluded. Parental consent was obtained from all the parents of the children participated in this study, and assent forms from the participating children were obtained prior to the study.

Study Procedure

Children were divided into case and control groups using block randomization. Allocation sequence concealment was done by the Independent investigator who distributed the chewing gums in sequentially numbered pouches to the group I—CPP-ACP (test group) ($n = 16$) and group II—Xylitol containing (control group) ($n = 16$). Double blinding was done, wherein both the children and the principal investigator were blinded.

Children were instructed about the procedure, and demonstration was given 1 day before the study. On the day of the study, children were instructed not to eat/drink 2 hours before the procedure. After obtaining demographic details, the baseline saliva was collected from all the children by passive drool method for exactly 5 minutes. Salivary flow rate, pH, and buffering capacity were measured using Saliva-Check Buffer (GC AMERICA INC). One pellet of CPP-ACP (Trident Recaldent, Thailand) and Xylitol chewing gum (Spry, Xclear Inc., America fork, UT84003, USA) were given for the cases and control group, respectively. In both the groups, children were asked to chew for about 10 minutes under supervision. After 10 minutes, the chewing gum was discarded, and saliva samples were collected using passive drool method for 5 minutes immediately after chewing, after 15 minutes, and after 30 minutes of chewing. Salivary flow rate and buffering action were measured immediately, and salivary pH was measured immediately, after 15 minutes, and after 30 minutes using the Saliva-Check Buffer (GC AMERICA INC).

Statistical Analysis

Data obtained were tabulated and subjected to statistical analysis using SPSS software version 20. Descriptive statistics—mean, standard deviation, 95% confidence interval—and inferential statistics—independent *t* test were used—were measured.

RESULTS

The mean age of the children in group I and group II was 8.5 years and 8.6 years, respectively. Gender-wise distribution of the study groups included 50% males and 50% females in group I and 37.5% males and 62.5% females in group II, respectively.

A significant increase in mean salivary pH was observed from baseline (group I: 6.287 ± 0.772 and group II: 5.825 ± 0.550) to immediately after spitting the chewing gum (group I: 7.412 ± 0.389 and group II: 7.175 ± 0.449) in both the study groups (p value < 0.001). In comparison to baseline salivary pH, salivary pH after

15 minutes (group I: 7.337 ± 0.391 and group II: 7.075 ± 0.412) and pH after 30 minutes (group I: 6.987 ± 0.458 and group II: 6.712 ± 0.379) were found to be increased and was statistically significant. Intergroup comparison for salivary pH showed no statistically significant difference (p value > 0.05) (Table 1).

A significant increase in mean salivary flow rate was observed from baseline (group I: 1.625 ± 0.619 and group II: 1.437 ± 0.512) to immediately after spitting the chewing gum (group I: 7.937 ± 0.853 and group II: 7.562 ± 0.512) in both the study groups (p value < 0.001). Intergroup comparison for salivary flow rate showed no statistically significant difference (p value > 0.05) (Table 2).

A significant increase in mean salivary buffering action was observed from baseline (group I: 6.562 ± 1.209 and group II: 6.625 ± 1.500) to immediately after spitting the chewing gum (group I: 11.812 ± 0.981 and group II: 11.750 ± 0.774) in both the study groups (p value < 0.001). Intergroup comparison for salivary buffering action showed no statistically significant difference (p value > 0.05) (Table 3).

DISCUSSION

Xylitol is a nonfermentable sugar substitute, which in the form of chewing gums helps to increase the flow of saliva.⁶

CPP-ACP, a milk protein, is a remineralizing agent that acts by creating a super-saturated environment of calcium and phosphate on the enamel surface. CPP-ACP in paste/cream form aids in remineralization of demarcated opacities in MIH teeth.^{7,8} The efficacy of CPP-ACP-containing chewing gums on improving the salivary characteristics have been proved in various studies. In this study, we have evaluated the efficacy of CPP-ACP and xylitol chewing gums in MIH-affected children.

Children were selected in the age range of 8–10 years, as chewing gums/mints/ hard candies were not recommended for the children below 4 years of age due to risk of choking (AAP guidelines).⁹

In some studies, it has been reported that flavor of chewing gum alters the salivary flow rate.¹⁰ Hence, to prevent bias, we have used chewing gums with same color, size, and flavor (spearmint) for both the groups. In this study, the saliva samples were collected in the afternoon (11:00–12:00 pm) to minimize the effect of circadian variation in the flow rates of saliva from all the glands. GC saliva-check Buffer kit (GC AMERICA INC) was used to check the salivary properties, as it was a commercially available, easy-to-use, and reliable method.¹¹

In our study, maximum peak rise in salivary pH was observed immediately after spitting the gums in both the groups which was similar to studies by Hegde et al.⁵ and Vantipalli et al.¹² The immediate increase in salivary pH was due to increase in bicarbonate concentration in saliva which was proportional to the salivary flow rate. In our study, the salivary pH reached its peak, immediately after spitting and gradually decreased after 15 and 30 minutes, but the pH was found to be higher when compared to baseline pH, and the results were similar to study by Vantipalli et al.¹²

There was no statistically significant difference observed in accordance with mean salivary pH, and it can be concluded that CPP-ACP-containing chewing gums have similar efficacy as xylitol, and results were similar to the studies by Hegde et al.⁵ and Dawes and Kubieniec.¹³ This is because chewing the gum for long time will increase the stimulated saliva which in-turn led to an increase in pH irrespective of the chewing gums.

Table 1: Intergroup comparison of salivary pH at different intervals (measured using GC saliva check kit)

Study parameter	Group	N	Mean	SD	t value	p value
pH baseline	CPP-ACP	16	6.287	0.772	1.950	0.061
	Xylitol	16	5.825	0.550		
pH immediately after spitting	CPP-ACP	16	7.412	0.389	1.597	0.121
	Xylitol	16	7.175	0.449		
pH 15 minutes after spitting	CPP-ACP	16	7.337	0.391	1.847	0.075
	Xylitol	16	7.075	0.412		
pH 30 minutes after spitting	CPP-ACP	16	6.987	0.458	1.848	0.275
	Xylitol	16	6.712	0.379		

Table 2: Intergroup comparison of salivary flow rate (mL/minute) (measured using GC saliva check kit)

Study parameter	Group	N	Mean	SD	t value	p value
Flow rate at baseline	CPP-ACP	16	1.625	0.619	0.933	0.187
	Xylitol	16	1.437	0.512		
Flow rate immediately after spitting	CPP-ACP	16	7.937	0.853	1.506	0.375
	Xylitol	16	7.562	0.512		

Table 3: Intergroup comparison of buffering capacity (measured using GC saliva check kit)

Study parameter	Group	N	Mean	SD	t value	p value
Buffer capacity at baseline	CPP-ACP	16	6.562	1.209	0.130	0.898
	Xylitol	16	6.625	1.500		
Buffer capacity immediately after spitting	CPP-ACP	16	11.812	0.981	0.200	0.843
	Xylitol	16	11.750	0.774		

There was no statistically significant difference observed in accordance with salivary flow rate and was similar to studies by Hegde et al.⁵ and Ribelles Llop et al.¹⁴

There was no statistically significant difference observed in mean of saliva buffering action between the two groups. But CPP-ACP group showed increase in salivary buffering action and was similar to study reported by Padminee et al.¹⁵

CONCLUSION

We can conclude that use of chewing gum enhances the salivary properties irrespective of the type of chewing gum. No differences were noted in any of the parameters between the two groups. A nonsignificant increase in the salivary characteristics was observed in CPP-ACP group compared to xylitol group. Thus, CPP-ACP-containing chewing gums could improve salivary characteristics and also aids in remineralization in MIH-affected children.

CLINICAL SIGNIFICANCE

Xylitol and CPP-ACP chewing gums are recommended in MIH-affected children with early demarcated opacities, as it improves the salivary properties in those children and prevents further complications.

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