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A comparative evaluation of effectiveness of chewable tooth brush v/s manual tooth brush in reduction of oral bacterial load in children of 6-10 years of age

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Abstract

Background: Plaque and biofilm provide an excellent adhesion site for the colonization and growth of many bacterial species mainly Streptococcus mutans. Mechanical plaque control dates back to 460 B.C. The goal is to reduce the overall oral bacterial load. There is no evidence in children showing the association between chewable tooth brush and the levels of Streptococcus mutans in the saliva. Therefore, the aim of this study was to evaluate the effectiveness of chewable brush in children in relation to reduction of S.mutans levels in saliva.

Methods: : A prospective study was carried out on 40 children of age group 6-10 years who were then divided into two groups to evaluate salivary S. mutans counts before and after using manual and chewable toothbrushes respectively

Results: There was significant reduction of mutans streptococcus count in both the group i.e. manual tooth brush and chewable tooth brush according to paired t test ($p<0.001$). But the percentage improvement was highest in group that used chewable tooth brush according to unpaired t test ($p<0.001$).

Conclusion: Chewable brush with enriched xylitol and fluoride properties not only showed promising results in reduction of oral bacterial load especially S mutans but also it is easy to use without any special skill.

Keywords: Dental caries, Chewable tooth brush, Fluoride, Xylitol, Streptococcus mutans

Introduction

Microorganisms have a natural tendency to attach to tooth surfaces and form a well-connected matrix embedded ecosystem referred as biofilms. Structured, functionally organised biofilm which is embedded in a matrix of polymers of host and bacterial origin is referred as dental plaque.[1] Plaque and biofilm provide an excellent adhesion site for the colonization and growth of many bacterial species.

Streptococcus mutans is a specific acid producing bacterium which adheres to the enamel salivary pellicle[2] and colonizes on the tooth surfaces causing demineralization of the hard tooth structure in the presence of fermentable carbohydrates. The demineralization process can progress into frank cavitation leading to dental caries.

The control of plaque can be done with various mechanical, chemotherapeutic or chemomechanical agents. The goal is to reduce the overall rate of accumulation of new plaque, remove the existing plaque, inhibit the adhesion and growth of bacteria on the tooth surface and to inhibit the production of substances such as exopolysaccharide.[3]

Mechanical plaque control dates back to 460 B.C when Hippocrates suggested cleaning of teeth using ball of wool soaked in honey. Toothbrushes made of bone and ivory with natural bristles are recorded dating back to 1498 in China. The modern tooth brush was patented by Frederick Wilhelm, a Swedish clockmaker, in 1855.[4]

Toothbrushes have improved oral hygiene and promoted good oral health. And as a result of consistent research there have been modifications and improvements in the toothbrush such as electric toothbrush, sonic toothbrush, Ultraviolet-sterilized toothbrush system, laser toothbrush and ionic toothbrush.[5]

These newer toothbrushes do not just concentrate on mechanically scrubbing the teeth but also have additional oral hygiene promoting action. One such novel toothbrush is chewable toothbrush (Rolly Brush ®). It is a miniature plastic (non – toxic) moulded toothbrush with bristles impregnated with xylitol and fluoride which is known to have anti caries effect. In 2015, Bezgin et al. conducted a study on its effectiveness in removing plaque in children and found no adverse clinical signs or symptoms.[6]

There is no evidence in children showing the association between chewable tooth brush and the levels of Streptococcus mutans in the saliva. Therefore, the aim of this study was to evaluate the effectiveness of chewable brush in children in relation to reduction of S.mutans levels in saliva.

The aim of this study was to compare the efficacy of chewable toothbrushes against manual toothbrushes in children.

Materials and methods

The present prospective study was carried out in the Department of Pedodontics and Preventive Dentistry. 40 children of age group 6-10 years were screened and included in the study. Sample size of 20 per group was calculated with the power of study being 80% at a confidence level of 5%.

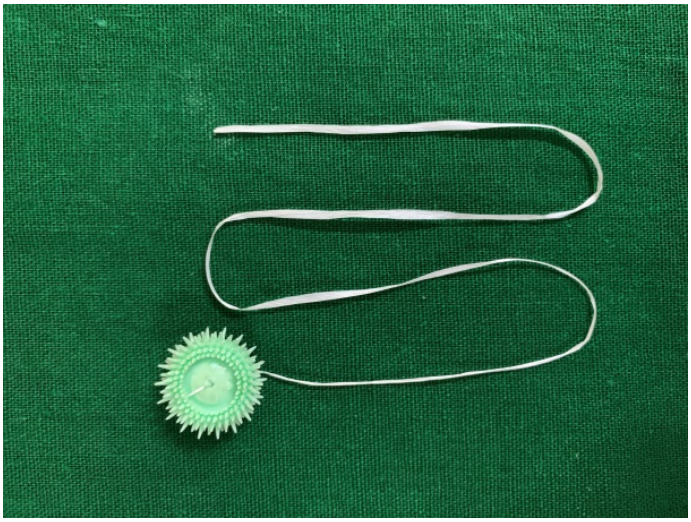


Figure 1: A floss of 15cms tied to the Chewable toothbrush

Subjects willing to participate and free from any systematic diseases were considered in the study. Children with previous medical history, with the history of intake of antibiotics for the past 15 days and uncooperative children were excluded from the study. Informed consent was obtained both from the guardians and the participants. Professional oral prophylaxis was done in all the participants prior to collecting base line saliva samples for standardization. The base line unstimulated saliva samples were collected in a sterile container for 5 minutes. The selected children were randomly divided into two groups using simple randomization [n=20].

Group1

A floss of 15cms was tied to the Rolly chewable toothbrush ® [figure 1] and the participants were explained how to use the toothbrush. The children were advised to brush twice daily for next week under the supervision of an adult.

Group 2

Children were instructed to brush their teeth for 2min using a manual toothbrush [Oral-B Kids Soft Toothbrush] and toothpaste [Colgate] as part of their normal routine twice daily for a week under the supervision of an adult.

The collected saliva sample was sent to the laboratory for estimation of the S.mutans levels. The sample was diluted into a proportion of 1:100 and was spread on the Mitis salivarius - bacitracin culture media. It was incubated for 48 hours at 37°C and colonies were counted by personnel who were blinded. Results were tabulated and statistically analysed.

Results

Paired and unpaired t tests were done for intra and intergroup comparison [Table 1]. There was no much significance noted between the groups before the start of the study whereas there is statistically significant difference noted in the post collected bacterial counts. [Table 2 and 3] [Graph 1 and 2] There was significant reduction of mutans streptococcus count in both the group. [Table 4 and 5] but the percentage improvement was highest in group 1. [Table 6] [Graph 3]

Table 1 Descriptive statistics

GROUP		PRE	POST
CHEWABLE	Mean	616696.500	182546.000
	N	10	10
	Std. Deviation	131609.653	79377.706
	Minimum	423055.00	100000.00
	Maximum	823010.00	309000.00
Tooth Brush	Mean	613870.500	407531.700
	N	10	10
	Std. Deviation	134588.263	136723.308
	Minimum	414280.00	220440.00
	Maximum	793986.00	617830.00

Table 2 Unpaired t test

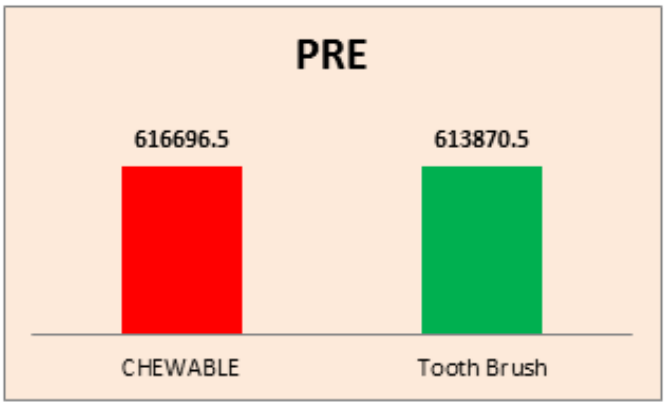
	GROUP	N	Mean	Std. Deviation	p
PRE	CHEWABLE	10	616696.500	131609.653	0.963
	Tooth Brush	10	613870.500	134588.263	

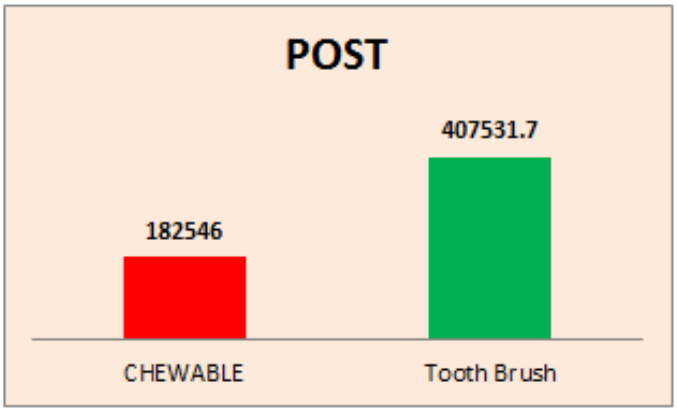
Table 3 Unpaired t test					
	GROUP	N	Mean	Std. Deviation	p
POST	CHEWABLE	10	182546.000	79377.706	<0.001*
	Tooth Brush	10	407531.700	136723.308	

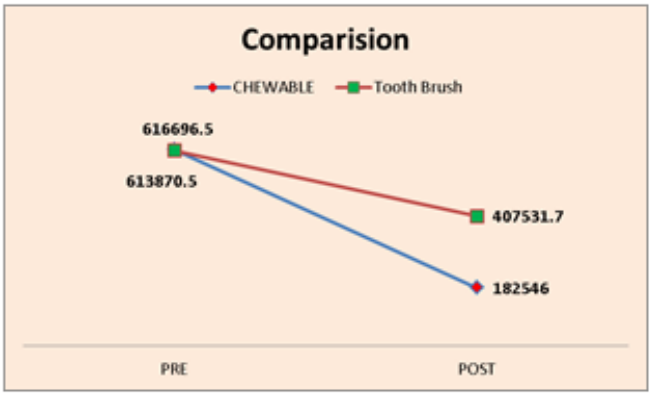
Table 4 Paired t test					
CHEWABLE		Mean	N	Std. Deviation	P
Pair	PRE	616696.500	10	131609.653	<0.001*
	POST	182546.000	10	79377.706	

Table 5 Paired t test					
Tooth Brush		Mean	N	Std. Deviation	P
Pair	PRE	613870.500	10	134588.263	<0.001*
	POST	407531.700	10	136723.308	

Table 6 Unpaired t test					
	GROUP	N	Mean	Std. Deviation	P
Percentage Improvement	CHEWABLE	10	70.763	10.286	<0.001*
	Tooth Brush	10	34.585	12.921	







Discussion

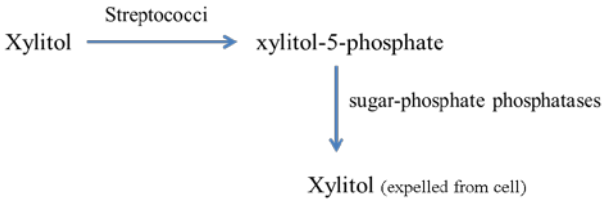
Dental caries in children although preventable is a massive and cumulative health burden. According to Data from the National Health and Nutrition Examination Survey the prevalence of total dental caries i.e. treated and untreated was 45.8% and untreated caries was 13.0% among youth aged 2–19 years.[7] According to the National Oral Health Survey the caries prevalence in India was was 51.9% [mean deft = 2], 53.8% [mean DMFT = 1.8], and 63.1% [mean DMFT = 2.4] at ages 5, 12, and 15 years.[8] Also the Global Burden of Diseases study showed that in the primary dentition dental caries was the 12th most prevalent disease in all ages combined i.e. 560 million children. [9-10] Moreover poor socioeconomic conditions act as a catalyst for development of early childhood caries especially in underdeveloped and developing countries which in turn leads to an economic burden. [11]

Dental caries has a complex/ multifactorial causation pathway and it is an endogenous, biofilm-mediated

disease that occurs when acidogenic/aciduric members of resident oral flora obtain a selective ecological advantage over other species, disrupting the homeostatic balance of the plaque biofilm and initiating the disease process. [12-13] Particularly no single microorganism is solely responsible for development of dental caries yet there is a strong association between high levels of mutans Streptococci and dental caries. [14] Preventative methods which delay the colonization of mutans Streptococci can have a long-term influence on the caries experience. [15] At the individual level, control of dental caries remains largely dependent on mechanical oral hygiene in the form of tooth brushing with fluoride dentifrices.

Xylitol is a naturally occurring 5 carbon polyol sweetener that has shown evidence in reducing the levels of mutans Streptococci in plaque through both non-specific and specific effects. [16]

Non-specific effects of Xylitol	Specific effects of Xylitol
1. Does not act as a substrate for acid production in plaque [17]	Mutans Streptococci when exposed to Xylitol can develop mutant xylitol-resistant strains which may be less virulent in the oral cavity.[19]
2. Decreases acidogenicity of plaque [18]	When plaque is exposed to xylitol there is an increase in the concentrations of amino acids and ammonia that in turn neutralise plaque acids.[20]
3. Does not allow the plaque to adhere to tooth surface [19]	Has a bacteriostatic action. The streptococcus phosphorylates xylitol to xylitol-5-phosphate, resulting in the formation of intra-cellular vacuoles and degraded cell membranes. [21]
	Xylitol can cause a 'futile metabolic cycle'. Xylitol-5-phosphate is split by sugar-phosphate phosphatases and the xylitol is then expelled from the cell unchanged. [22]



The most constant and commonly used anticariogenic element for prevention of dental caries in the past has been Fluoride. In 2007, a resolution was passed that universal access to fluoride for caries prevention was to be part of the basic right to human health by WHO.[23] Anti cariogenic effects of fluoride is a result of cumulative effect of a number of different mechanisms. [24]

Non-specific effects of Fluoride	Specific effects of Fluoride
1. Fluoride gets incorporated with the	Fluoride is an inhibitor of the glycolytic

	hard tissue of the tooth and converts hydroxyapatite to fluoroapatite which is comparatively less susceptible to solubility.[25]	enzyme enolase, which is inhibited in a quasi-irreversible manner.[29] [present in Streptococcus salivarius, Streptococcus sanguis, and S. mutans] [30]
2.	Fluoride enhances remineralization during alkalinization phases of the plaque pH cycle, as saliva is supersaturated with respect to the phosphate-calcium hydroxyapatite equilibrium.[26]	Membrane ATPase of streptococci is inhibited by fluoride.[31]
3.	Fluoride Inhibits acid production by bacteria in plaque.[27]	Fluoride inhibits heme-based catalases and peroxidases of oral bacteria. [32]
4.	Exposure of growing oral bacteria to fluoride is known to reduce production of intracellular deposits of iodophilic polysaccharide or glycogen. [28]	Fluoride inhibits pymvate kinase and phosphoglycerate mutase of S. mutans. [33]

Frandsen[34] noted that apert from the above reasons the method of brushing plays a huge role in oral hygiene maintainance. The Rolly ® Chewable toothbrush is small with bristles impregnated with Xylitol and Fluoride. The platic bristles mechanically displace the plaque, and the other active ingredients prevent the microorganisms from causing cariogenic ecosystem.

In the current study the efficacy of the chewable toothbrush with both the added benefits of xylitol and fluoride is observed. There is a steep reduction in the S mutans count in the samples tested after using chewable brush. [Graph 4] The mean value dropped from 616696.5000 to 182546.0000 pre and post usage of the chewable brush consecutively. The chewable brush was effective in reducing the oral bacterial load not just due to its mechanical action but also with the added benefits of xylitol and fluoride. [Figure 2 and 3]

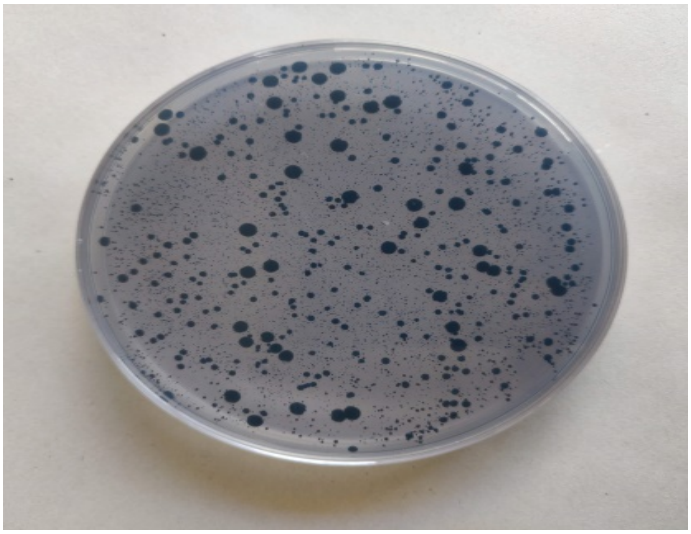


Figure 2: S mutans count in the saliva sample prior to usage of chewable toothbrush

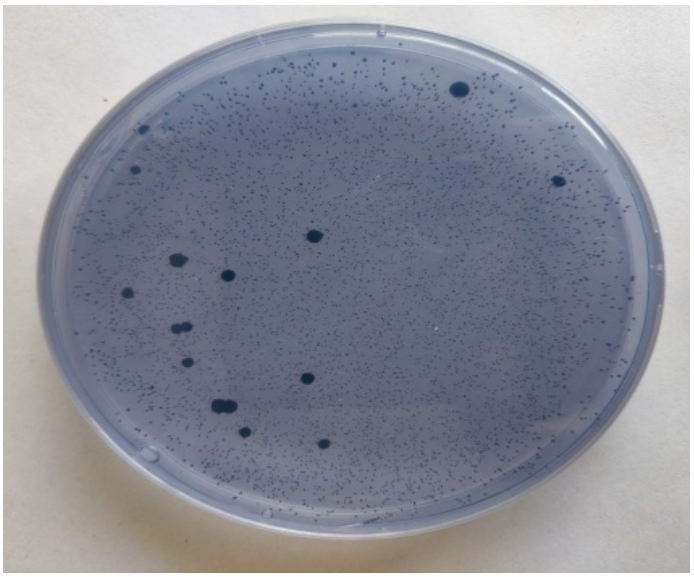


Figure 3: S mutans count in the saliva sample after using chewable toothbrush

Govindaraju et al.[35] in their study found similar results while using a chewable toothbrush.

Additional caution should be exercised before reaching a conclusion as one of the main reasons for steep reduction in oral bacterial count could come from the motivation effect of kids as chewing brush is a new device. Long term studies as to be done in this regard.

Conclusion

Manual dexterity and method of brushing plays a huge role in effectiveness of manual tooth brushing especially in children. Chewable brush with enriched xylitol and fluoride properties not only showed promising results in reduction of oral bacterial load especially S mutans but also it is easy to use without any special skill. Hence, it can be a preferable way to maintain oral hygiene in children above 6 years provided it is used under the supervision of adults.

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