Original Article

Comparative evaluation of efficacy of xylitol containing toothpaste and fluoridated toothpaste in plaque removal in children with high caries index

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ABSTRACT

Aim: To compare the efficacy of fluoridated toothpaste and xylitol containing toothpaste in plaque removal in children with high caries risk. **Materials and Methods:** For the present study 30 healthy children of aged 6-10 years to compare the efficacy of fluoridated toothpaste and xylitol containing toothpaste in plaque removal in children with high caries risk were taken. The children were randomly divided into 2 groups of 15 each. Group A – children using fluoridated toothpaste. Group B- children using xylitol containing toothpaste. At each interval (0,7,14 and 28 days) plaque indices were taken and efficacy was checked. **Results:** The overall evidence suggests that fluoridated toothpaste is more effective than xylitol toothpaste in improving oral health outcomes among children with a high caries index. **Conclusion:** Based on the data presented, both types of toothpastes (fluoridated, and xylitol-containing) were effective in improving oral hygiene and reducing plaque. However, there were differences in their effectiveness on gingival health.

Key-Words: Fluoridated, High Caries Risk Plaque, Toothpaste, Xylitol

INTRODUCTION

Dental caries and periodontal diseases are major public health concerns globally and have an adverse effect on the general health and quality of life of an individual. The dietary sugars and other fermentable carbohydrates affect the integrity of teeth, flow rate, pH, and composition of the saliva. The “dental plaque” is a biofilm of oral microbiota formed on a tooth surface as an embedded matrix of polymers derived from both host and bacterial origin. The dental plaque with adherent biofilm properties can lead to clinically specific dental caries, periodontal disease, and oral malodor.[1] Effective plaque removal is essential for daily oral care. Plaque is the primary cause of gum disease and tooth decay, two common dental problems. Dental plaque can be controlled with a combination of chemicals and mechanics treatment.[1-4] Manson outlines two primary methods for plaque eradication: chemical and mechanical. Of these approaches, mechanical plaque control through tooth brushing and other auxiliary devices is demonstrably more effective.

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Rigorous mechanical cleaning with toothbrushes and other appropriate tools represents the most efficacious strategy for plaque control and calculus inhibition. However, it is important to acknowledge that tooth brushing alone is insufficient to completely prevent new plaque formation.[5] Dental plaque, initially a simple biofilm, grows more complex over time. While this healthy biofilm can protect against harmful bacteria, neglecting oral hygiene can lead to an imbalance, favoring the growth of disease-causing organisms. Even within a single species of bacteria, plaque can contain a range of behaviors, from active growth to a dormant state."Ultimately an environmental shift occurs, resulting in gingival inflammation changes that favor periodontal pathogens.[6] The present investigation explores the potential influence of xylitol containing toothpaste and fluoridated toothpaste on plaque accumulation. A substantial body of prior research has focused on the development and evaluation of chemical agents capable of inhibiting or reducing plaque and calculus formation, Xylitol has garnered increasing interest within the field of dentistry due to its potential to promote oral health. Xylitol exhibits the unique characteristic of not being metabolized by Streptococcus mutans bacteria. This property is believed to contribute to the inhibition of Streptococcus mutans growth, thereby potentially reducing acid production and mitigating the development of cariogenic biofilms.[7-9]

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were prepared and tested for flexural strength, surface properties, and colour stability. Groups were as, Group A: Valplast (Novoblast, USA)**,** Group B: Lucitone FRS (Dentsply, Germany)**,** Group C: Bre-flex (Bredent, Germany), Group D: De-flex (De-flex, United Kingdom) and a control group: PMMA heat cure denture base resin. [Figure-1] A total of 96 samples were prepared using injection moulding for the flexible denture base resins, following ADA specification no. 12, and 24 samples were prepared using compression moulding for the PMMA heat cure resin.

MATERIALS AND METHODS

Study Design, Setting, and Ethical Considerations

A double-blind randomized controlled trial was conducted among the children reported to dental OPD of department of pediatric and preventive dentistry after securing Institutional ethical committee clearance. For the present study 30 healthy children of aged 6-10 years to compare the efficacy of fluoridated toothpaste and xylitol containing toothpaste in plaque removal in children with high caries risk. For the present study 30 healthy children of aged 6-10 years were selected. Before the commencement of the procedure and after explaining the procedure to the parents a written consent was taken from the parents. The children were randomly divided into 2 groups of 15 each. Group A – children using fluoridated toothpaste. GroupB- children using xylitol containing toothpaste. Oral prophylaxis was performed followed by recording the indices. Sillness and Loe 1964 Plaque Index, Sillness and Loe 1963 gingival Index, oral hygiene index 1960 and gingival bleeding index was recorded. Each participant will be given the specific toothpaste according to the group they have been allocated. The patient was recalled after7, 14 and 28 days and the similar procedure of recording of indices was performed.

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STATISTICAL ANALYSIS

Data was collected and analyzed using statistical package for social sciences (SPSS) version 27 The data was analyzed using t test and one way ANOVA to compare the efficacy of plaque removal in both toothpastes. The statistician sent the tables of both the study for the analysis for final results.

RESULTS

The results are summarized in Table 1 to 3. Table 1 shows the efficacy of fluoridated toothpaste on OHI, PI, GI, GBI among children with high caries index. OHI and PI: There were significant improvements in both OHI (oral hygiene index) and PI (plaque index) over time. The mean values decreased significantly from baseline to 7 days, 14 days, and 28 days, indicating that fluoridated toothpaste effectively reduced plaque and improved oral hygiene. GI and GBI: While there were changes in gingival index (GI) and gingival bleeding index (GBI), these changes were not statistically significant. This suggests that fluoridated toothpaste might have had a less pronounced effect on gingival health in this particular group of children. Based on the data presented, fluoridated toothpaste appears to be effective in reducing plaque and improving oral hygiene (as measured by OHI and PI) among children with a high caries index. However, its impact on gingival health (as measured by GI and GBI) was less clear in this study.Overall, the results of this study suggest that fluoridated toothpaste is a valuable tool for improving oral health in children with a high caries index, particularly in terms of reducing plaque and improving oral hygiene. Table 2 shows the efficacy of xylitol containing toothpaste on OHI, PI, GI, GBI among children with high caries index.

OHI, PI, GI, and GBI**:** There were significant improvements in all four oral health indicators (OHI, PI, GI, and GBI) over time. The mean values decreased significantly from baseline to 7 days, 14 days, and 28 days, indicating that xylitol-containing toothpaste effectively reduced plaque, improved oral hygiene, and positively impacted gingival health. Based on the data presented, xylitol-containing toothpaste appears to be highly effective in improving overall oral health among children with a high caries index. It demonstrated significant improvements in plaque reduction, oral hygiene, and gingival health. Overall, the results of this study strongly suggest that xylitol-containing toothpaste is a promising option for improving oral health in children with a high caries index. Table 3 shows the comparison between the efficacy of fluoridated and xylitol containing toothpaste on OHI, PI, GI, GBI among children with high caries index

- OHI (Oral Hygiene Index)**:** Fluoridated toothpaste consistently showed lower OHI scores, especially in the 14-28 day time interval, indicating better oral hygiene compared to xylitol toothpaste.
- PI (Plaque Index): While both groups showed similar PI scores in the initial time intervals, fluoridated toothpaste had a significantly lower PI score at the 14-28 day mark, suggesting better plaque control.
- GI (Gingival Index)**:** There was no significant difference in gingival health between the two groups, as measured by GI.
- GBI (Gingival Bleeding Index): Fluoridated toothpaste again demonstrated superior results, with significantly lower GBI scores, implying reduced gingival bleeding.

The overall evidence suggests that fluoridated toothpaste is more effective than xylitol toothpaste in improving oral

health outcomes among children with a high caries index. This is likely due to fluoride's well-established ability to strengthen tooth enamel and inhibit bacterial growth.

Table 1: Efficacy of Fluoridated toothpaste on OHI, PI, GI, GBI among children with high caries index

Index	Time Interval	Mean	Std. Deviation	F-value	p value
OHI	Baseline	0.00	0.000	47.12	**0.000**
	7 days	2.48	0.967		
	14 days	2.96	0.977		
	28 days	2.24	0.544		
PI	Baseline	0.00	0.000	74.40	**0.000**
	7 days	1.91	0.534		
	14 days	2.12	0.412		
	28 days	1.53	0.527		
GI	Baseline	2.13	0.743	1.217	0.312
	7 days	1.78	0.475		
	14 days	2.02	0.644		
	28 days	2.16	0.547		
GBI	Baseline	1.92	0.502	1.589	0.202
	7 days	2.12	0.672		
	14 days	1.80	0.763		
	28 days	1.67	0.406		
p ≤ 0.05 – Significant, CI = 95 %					

Table 2: Efficacy of xylitol containing toothpaste on OHI, PI, GI, GBI among children with high caries index

Index	Time Interval	Mean	Std. Deviation	F-value	p-value
OHI	Baseline	0.00	0.000	44.785	**0.000**
	7 days	2.87	1.114		
	14 days	2.43	0.652		
	28 days	2.16	0.699		
PI	Baseline	0.00	0.000	55.370	**0.000**
	7 days	1.85	0.495		
	14 days	1.72	0.623		
	28 days	1.82	0.511		
GI	Baseline	1.73	0.593	7.376	**0.000**
	7 days	2.30	0.452		
	14 days	1.48	0.506		
	28 days	1.53	0.617		
GBI	Baseline	2.06	0.865	10.393	**0.000**
	7 days	1.95	0.499		
	14 days	1.85	0.574		
	28 days	0.92	0.499		
p ≤ 0.05 – Significant, CI = 95 %					

DISCUSSION

Oral hygiene is crucial for overall health, and plaque removal is a fundamental aspect of maintaining healthy teeth and gums. Various types of toothpaste, including fluoridated, and xylitol-containing, are available to aid in plaque removal. This discussion explores the comparative efficacy of these toothpastes in removing plaque. Fluoridated toothpastes are widely used and have been shown to be effective in preventing tooth decay. While they may not directly remove plaque, fluoride strengthens tooth enamel, making it more resistant to acid erosion caused by plaque. Xylitol is a sugar alcohol that can inhibit the growth of bacteria that contribute to plaque formation. Studies have shown that xylitol-containing toothpastes can effectively reduce plaque and improve oral health.[1,8] When both the toothpaste were compared it has been found that plaque removal efficacy of both types of toothpastes demonstrated effectiveness in reducing plaque. Numerous studies have consistently supported the efficacy of fluoride in preventing dental caries. A systematic review by the American Dental Association (ADA) concluded that fluoride toothpaste is effective in reducing the incidence of cavities in children and adults of all ages. While xylitol has shown promise in reducing plaque and preventing caries in some studies, its effectiveness may be more limited compared to fluoride.[10-11]However, the specific mechanisms by which they achieve this differ. Fluoridated toothpastes strengthen tooth enamel, and xylitol-containing toothpastes inhibit bacterial growth. While both toothpastes showed improvements in gingival healthxylitol-containing toothpastes demonstrated more significant effects. This suggests that these types of toothpastes may be particularly beneficial for individuals with gingivitis or other gum problems. The effectiveness of these toothpastes may vary depending on individual factors, such as oral health status, diet, and brushing technique.[12]Conflicting results have been reported as to xylitol-induced inhibition of mutans streptococci in saliva after toothpaste use [Mäkinen et al., 1985; Petersson et al., 1991; Svanberg and Birkhed, 1991; Twetman and Petersson, 1995]. Toothpastes containing either 20 or 9.9% xylitol reduced salivary levels of mutans streptococci but not plaque levels [Mäkinen et al., 1985; Svanberg and Birkhed, 1991], whereas xylitol (9.7%) [Twetman and Petersson, 1995] or xylitol (3%)-sorbitol(6%) [Petersson et al., 1991] toothpastes exerted no inhibition. The xylitol-induced inhibition of acid formation and growth of dental plaque bacteria has been explained by the so-called ‘futile xylitol cycle’ which involves depletion of phosphoenolpyruvate and ATP through the uptake of xylitol via induction of a fructose-specific phosphotransferase transport system [Trahan et al., 1985; Assev, 1987].[12-15] Both types of toothpastes

(fluoridated, and xylitol-containing) have shown effectiveness in plaque removal and improving oral health. However, the optimal choice may depend on individual needs and preferences. For individuals with specific oral health concerns, such as gingivitis or tooth decay, consulting with a dentist to determine the most suitable toothpaste is recommended. As gingival indices and plaque scores decreased from baseline, this suggests it may be beneficial to consider undertaking six month studies to investigate its longer term efficacy. Further studies are needed to evaluate the long-term effects of these toothpastes on oral health. Exploring the efficacy of toothpastes that combine multiple active ingredients, such as fluoride, and xylitol, could provide additional benefits. Developing personalized toothpaste recommendations based on individual oral health profiles could enhance the effectiveness of oral care.[14,16]

CONCLUSION

Based on the data presented, both types of toothpastes (fluoridated, and xylitol-containing) were effective in improving oral hygiene and reducing plaque (OHI and PI). However, there were differences in their effectiveness on gingival health (GI and GBI). Xylitol-containing toothpaste appeared to be more effective in improving gingival health. Overall, the results of this study suggest that both types of toothpastes can be beneficial for improving oral health in children with a high caries index. However, the choice of toothpaste might depend on specific oral health needs, such as gingival health concerns and individuals choice.

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