COMPARATIVE EVALUATION OF TWO ANTI-CALCULUS TOOTHPASTES FOLLOWING CHLORHEXIDINE USE

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Abstract
Background: Calculus is the mineralised matrix of plaque present on the hard and soft tissues of the oral cavity. The breakdown of proteins within dental plaque releases ammonia and carbon dioxide which increases salivary pH and lowers the precipitation constant. Precipitation of the calcium phosphate salts within the plaque facilitates calculus formation. In order to prevent plaque accumulation after oral prophylaxis, chlorhexidine mouthwash is routinely prescribed. However, common side effects of brown staining of the teeth and calculus formation have been seen to occur with frequent use.
Aim: The aim of the study was to assess the efficacy of two anti-calculus tootpastes subsequent to chlorhexidine use.
Materials and methods: 90 patients with calculus formation were selected for the study and broadly categorised into two groups. Following oral prophylaxis, one group of patients used the anti-tartar toothpaste XTAR-TM (ICPA, India) with the active ingredient potassium pyrophosphate while the other used Colgate Total (Colgate-Palmolive) with the active ingredient triclosan. Within this group, the patients were further divided into 3 sub-groups: the first using only the toothpaste, the second using the toothpaste and chlorhexidine mouthwash for a week and the third group that used chlorhexidine for two weeks along with the toothpaste. The calculus accumulation on the lower anteriors was recorded pre-operatively and post-operatively using the Volpe-Manhold index. All the indices and the pockets were measured from baseline to the end of 2 weeks.
Results:Accessing the two week statistical data we were able to find a good prognosis in use of the potassium pyrophosphate tooth paste in comparing the triclosin tooth paste. After the use of chlorhexidine there was a little positivity at the end of second week. Among that group potassium pyrophosphate had better prognosis even after the use of chlorhexidine for 1 week
Conclusion:Use of Anti- calculus has a good prognosis of periodontium along with the use of the chlorhexidine mouth wash. Effect of triclosin on prevention of calculus is minimal but when used with it has a better action. General oral hygiene maintenance by the candidates is important which act as a main criteria for the plaque formation; better oral hygiene prevent the accumulation of the plaque thereby preventing calculus formation

Keywords: bisbiguanide, dentifrice, potassium pyrophosphate, tartar, triclosan, Volpe-Manhold index

1. Introduction

The formation of the dental pellicle on the enamel surface forms as soon as the tooth erupts (1-2 minutes). [1] Pellicle proteins rapidly adsorb onto the enamel surface which favours bacterial adhesion and subsequently results in dental plaque formation. The maturation of this biofilm proceeds with initial Gram positive obligate aerobic cocci which are rapidly followed by the growth of gram negative bacilli and filamentous bacteria that are facultative and obligate anaerobes. [2] Mineralizing agents from the saliva and gingival crevicular fluid (GCF) contribute to the development of supra- and subgingival calculus respectively by mineralizing the plaque intercellular matrix. [3] The calcium ions from saliva are removed by chelation promoting binding of calcium with carbohydrate/protein complexes leading to the precipitation of crystalline calcium phosphate salts, and coalescence of these crystals aids in the formation of calcified mass, thereby leading to calculus formation various theories of calculus formation have been put forth[4]. The epitactic theory suggests that the concentration of certain ions like calcium and phosphate within the saliva is insufficient to precipitate but is capable of promoting the growth of hydroxyapatite crystals once an initial seeding occurs. [5] Seeding agents provoke small foci of calcification enlarge and coalesce to form the calcified mass. The formation of a carbohydrate-protein complex removes calcium from saliva by chelation and binds with the nuclei to stimulate subsequent mineral deposition. [6] In the inhibition theory, calcification occurs only at specific sites because of existence of an inhibiting mechanism at noncalcifying sites. In the absence or alteration of the inhibitor such as pyrophosphate and other polyphosphates, calcification takes place. The enzyme alkaline pyrophosphatase hydrolyses pyrophosphate to phosphate (Russell and Fleisch 1970) which prevents the initial nucleus from growing and inhibits their calcification by poisoning the growth centres of the crystals.[11-15] Another widely discussed theory is the enzymatic theory of calculus formation. This theory proposes that phosphates may be derived from oral tissues or the microbial flora by the action of phosphoric esters of the hexose phosphoric group in salivary-phospahte containing complexes. [7]

Broadly, calculus is classified according to:
a. Location: supragingival and sub-gingival
b. Source of mineralization: salivary and seruminal mineralization
c. Rate of calculus formation: non-calculus formers, slight calculus formers, moderate calculus formers, heavy calculus formers

Supragingival calculus is situated coronal to the gingival margin and is therefore visible in the oral cavity. It is usually white or whitish yellow in colour hard with a clay-like consistency that can be easily detached from the tooth surface. It is readily formed after its removal particularly in the region of the lingual surface of lower anterior teeth. The colour of the supragingival calculus is influenced by factors such as tobacco and/or food etc. [7]Subgingival calculus on the other hand, is located apical to the crest of the marginal gingiva and is thus usually not visible on the routine clinical examination. The location and extent of the calculus may be evaluated by careful tactile perception with delicate dental instruments such as an explorer. The colour of subgingival calculus varies from dark brown to greyish black and it is quite hard and dense allowing it to firmly attach to the tooth surface. [8] The microorganisms in the calculus do not express any pattern and is comprised of cocci, rods and filaments. On treatment with sodium hypochlorite, the filaments disappear when observed under scanning electron microscopy and the supragingival calculus exhibits a honeycomb pattern. In the maxilla dental calculus is more common on the buccal surfaces of the maxillary first molar as

the duct of the parotid gland opens in close proximity to the tooth. Similary in the lower anterior teeth, the sublingual gland duct empties out onto the lingual surface of the lower anteriors. [8]

Chlorhexidine is considered the gold standard among mouth washes due to its unique property of substantivity and the ability to display bacteriostatic and bactericidal property based on its concentration. But side effects of long term use of chlorhexidine include brown tooth staining and subsequently calculus formation[9].

The anti-calculus tooth paste mainly contain sodium monophosphate or potassium pyrophosphate. Sodium monophosphate is one form of fluoride which decreases the formation of plaque[10]. The potassium pyrophosphate inhibits the mineralisation of the calculus before its formation thereby decreasing the formation of calculus.

2. Materials and methods:

A convenient sample size of 90 patients with calculus formation were selected for the study and broadly categorised into two groups. Following oral prophylaxis, one group of patients used the anti-tartar toothpaste XTAR (ICPA, India) with the active ingredient potassium pyrophosphate while the other used Colgate Total (Colgate-Palmolive) with the active ingredient triclosan. Within this group, patients were further divided into 3 sub-groups: the first using only the toothpaste, the second using the toothpaste and chlorhexidine mouthwash for a week and the third group that used chlorhexidine for two weeks along with the toothpaste. The calculus accumulation on the lower anteriors were recorded pre-operatively and post-operatively using the Volpe-Manhold index. Volpe-Manhold index is widely used to test agents for plaque control and calculus inhibition. The V-MI scores calculus deposits on three planes (mesial, mid-lingual and distal) of each of the lower six anterior teeth. A probe is used to measure the linear extent of the calculus in increments of 0.5mm; from 0 to 5mm. The tooth score is calculated as the sum of the scores in the 3 planes while the patient score is calculated as the sum of the tooth score. The results at each step of the procedure was recorded and computed in Microsoft excel and statistics was done The normality tests Kolmogorov-Smirnov and Shapiro-Wilks tests results revealed that the variables follow normal distribution. Therefore, to analyse the data parametric methods were applied. To compare the mean values between groups one-way ANOVA was applied followed by Turkey's HSD post hoc tests for multiple pair wise comparisons. To compare mean values between time points paired samples t-test was applied. To analyse the data SPSS (Statistical Package for Social Sciences, IBM SPSS Statistics for Windows, Version 23.0, Armonk, NY: IBM Corp. Released 2015) was used. Significance level was fixed as 5% ($\alpha = 0.05$).

All the indices and the pockets were measured from baseline to the end of 2 weeks.

3. Results

Plaque index

Table 1 table showing the indices and their p value with respective to time

	P value		
index	Baseline	1 week	2 week
Plaque index	0.399	0.006	0.143
Gingival index	0.973	0.749	0.508
Volpe-Manhold index	0.819	0.571	0.340

Table 2 table showing Tukey HSD Post Hoc Tests for Multiple Comparisons of plaque index scores

criteria	subclass	P value
Group-A	Group-A + MW	0.975
	Group-B	0.007
	Group-B + MW	0.599
Group-A + MW	Group-B	0.022
	Group-B + MW	0.839
Group-B	Group-B + MW	0.153

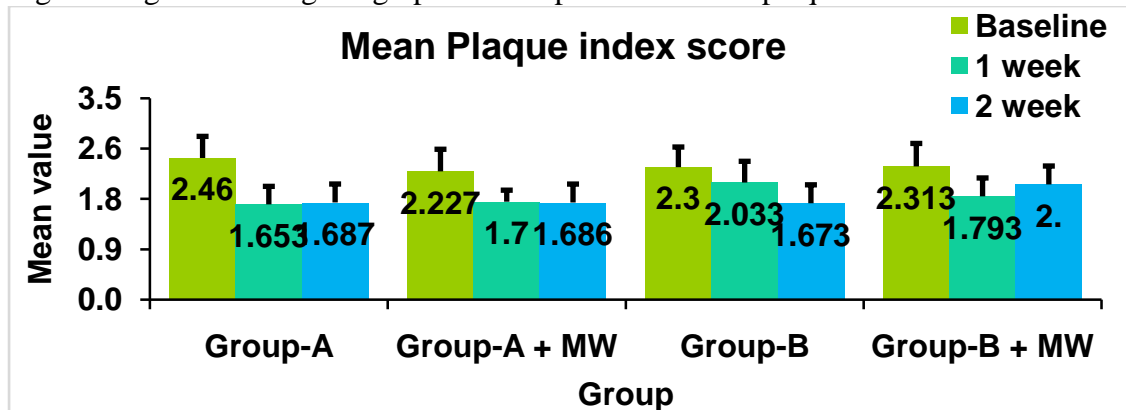Figure 1 figure showing the graphical comparism of mean plaque index score

Table 3 table showing Paired sample t-test for gingival index without use of mouthwash

Group	Pair		p-Value
Group-A	Pair 1	Baseline	<0.001
		1 week	
	Pair 2	Baseline	0.001
		2 week	
	Pair 3	1 week	0.909
		2 week	
Group-B	Pair 1	Baseline	0.475
		1 week	
	Pair 2	Baseline	0.147

		2 week	
	Pair 3	1 week	0.057
		2 week	

Table -4 table showing Paired sample t-test of gingival index scores with use of mouth-wash

Group	Pair		p-Value
Group-A + MW	Pair 1	Baseline	0.024
		1 week	
	Pair 2	Baseline	0.067
		2 week	
	Pair 3	1 week	0.448
		2 week	
Group-B + MW	Pair 1	Baseline	0.003
		1 week	
	Pair 2	Baseline	0.037
		2 week	
	Pair 3	1 week	0.394
		2 week	

Figure 2 figure showing the graphical comparism of the mean gingival index scores

Mean Gingival index score
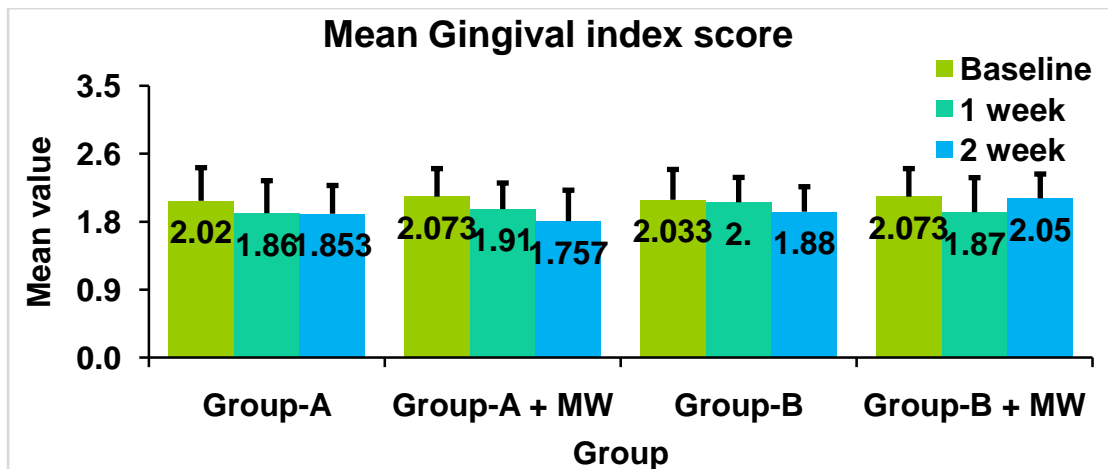
Table 5 table showing Paired sample t-test of Volpe-Manhold index without the use of mouthwash

Group	Pair		p-Value
Group-A	Pair 1	baseline	0.010
		1 week	
	Pair 2	baseline	<0.001
		2 weeks	
	Pair 3	1 week	<0.001
		2 weeks	
Group-B	Pair 1	baseline	0.002
		1 week	
	Pair 2	baseline	<0.001
		2 weeks	
	Pair 3	1 week	<0.001
		2 weeks	

Table – 6 table showing Paired t-test of Volpe-Manhold index with use of mouthwash

Group	Pair		p-Value
Group-A + MW	Pair 1	baseline	0.038
		1 week	
	Pair 2	baseline	0.030
		2 weeks	
	Pair 3	1 week	0.002
		2 weeks	
Group-B + MW	Pair 1	baseline	0.001
		1 week	
	Pair 2	baseline	0.059
		2 weeks	
	Pair 3	1 week	0.741
		2 weeks	

Figure 3 figure showing the graphical comparism of the mean Volpe-Manhold index

Mean Volpe-manhold calculus score
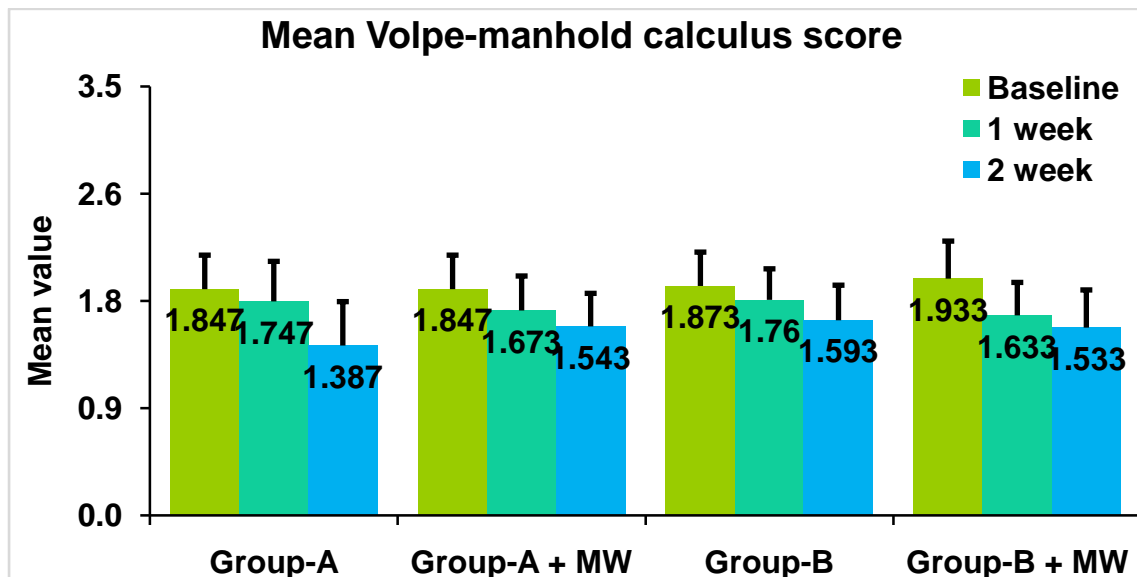
4. Discussion

While analyzing plaque indices, group a+MW showed better when compared to the other two groups. There was a significant improvements in the plaque scores from the baseline to the first week in group a, group a+mw(0.001)and b+mw the scores dint not vary much when compares to the second week in group a, a+mw. There was an increase in the plaque scores in group b+mw in the second week. The most significant improvement in the gingival index were observed in group a and group a+mw from the baseline to the first week and second week. However there was significant increase in the gingival index in the second week in the group b+mw. Assessing all the three groups of Volpe-Manhold index showed improvements from baseline to the first week and baseline to second week as well as between first and second week except for the group b+mw

PetcharatKraivaphan et.al.., has done a study where he has compared the efficiency of three toothpaste which were Abhaibhubejhr Herbal toothpaste, Colgate total, Colgate cavity protection toothpaste were used. Time period were divided into 8 weeks and 1
2 weeks. In the 8 week period the patients were noncalculus control fluoride toothpaste and soft bristled toothbrush and the subjects were advised to brush his/her teeth twice a day for 1 minute a day. In that of the 12 week candidates were given the assigned toothpaste and soft toothbrush and were advised to brush twice a day for one minute. The Colgate total toothpaste was more effective in the duration of 12 weeks when compared to the other two toothpaste.

5. Conclusion

Use of Anti- calculus have a good prognosis of periodontium along with the use of the chlorhexidine mouth wash. The conventional triclosin tooth paste has good prognosis in preventing dental plaque accumulation. Its effect on prevention of calculus is minimal but when used with it has a better action. General oral hygiene maintenance by the candidates is important which act as a main criteria for the plaque formation; better oral hygiene prevent the accumulation of the plaque thereby preventing calculus formation

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