

Extrinsic stain removal with a toothpowder: A randomized controlled trial

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Abstract:

Objectives: The efficacy of a commercially available toothpowder was compared with toothpaste in removing extrinsic dental stains.

Methods: In this single-blind, randomized controlled trial, 77 volunteers were included from a residential professional college. All study subjects (control toothpaste users and test toothpowder users) plaque control measures. All study subjects were instructed to rinse with 5 ml 0.12% chlorhexidine mouthwash for 1 minute, twice and one cup of double tea bag solution three times daily for three weeks. Subjects were randomized into test (n=36) and control (n=36) groups. Toothpaste (control) and toothpowder (test) was used for two weeks to see the effects on removing stains on the labial surfaces of 12 anterior teeth. For measuring dental extrinsic stains Lobene Stain Index (SI) was used.

Results: The amount of stain following the use of toothpaste and toothpowder was more controlled with the experimental toothpowder. For all sites combined, there was evidence that the experimental toothpowder was significantly superior to toothpaste in reducing stain area ($p<.001$), stain intensity ($p<.001$) and composite/product (area x intensity) ($p<.001$).

Conclusion: Stain removing efficacy of toothpowder was significantly higher as compared with toothpaste. A toothpowder may be expected to be of benefit in controlling and removing extrinsic dental staining.

Key Word: Essential Oil, Toothpowder, Toothpaste, Dental Extrinsic Stains, Lobene Stain Index (SI)

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Introduction:

Today, tooth discoloration is a major oral health concern and has been seen to affect the quality of life of an individual. While the majority of intrinsic tooth discoloration is due to ingested chemical or drug taken during teeth forming years; extrinsic stains are mostly related to the individual's personal harmful practices which include smoking, tobacco chewing, beetle leaves (paan), areca nut chewing and dietary habits.⁽¹⁻³⁾

There is a wide and high level of interest in products which could have some stain-removing effect. Over the years, scientists have compared chemical and mechanical approaches for stain removal.⁽⁴⁾ Studies of chemical agents have focused on chelants, surfactants, and enzymes which could prevent or remove extrinsic dental stains.^(5, 6) Various ingredients that could assist in the stain-removal process have been tested, but none of them have been indicated as a potential addition to food due to their toxicity. Consequently, controlled chemical, non-abrasive agents like chewing gum or mouthwash are being favored as a delivery vehicle for these stain removing ingredients.^(7, 8)

On the other hand, mechanical approaches have focused on tooth brushing. It is established that tooth-brushing is the most commonly used methods of oral hygiene maintenance.⁽⁹⁾ It has been noted that tooth-brushing with dentifrices helps decrease plaque and calculus deposits on teeth as well as support in eradicating stains and discolorations.⁽¹⁰⁾ It must be realized that stains are deposition of a variety of pigments originating from the diet or tobacco use on the tooth surface.⁽⁷⁾ This deposition can be reduced by effective oral hygiene practices, which focuses on toothbrushes and dentifrices.^(6, 7) The dental professionals need to know the actual efficacy and the correct indications of the available products in order to recommend one appropriate to the individuals and the communities. Studies like the present may answer these questions in order to guide consumers and professionals in using oral home-care products.

Dentifrices in the form of toothpowder, toothpastes or in some other form have been used since early Egyptian era.⁽⁸⁾ The main aim of using these products was to remove stains

and to freshen breath.⁽¹¹⁾ Studies have compared a variety of toothpastes in removal of stains;^(4, 12, 13) however, our search of literature indicated that there are no studies that have compared the efficacy of toothpowder in elimination of dental stains. In the absence of any documented clinical evaluation of the anti-staining efficacy of toothpowder; a traditional evidentiary clinical study in the form of 5 weeks clinical trial was planned. This is considered a reasonable and necessary first step to provide the data that will both justify and allow for the rational and efficient design of a long-term clinical trial.

Material and Methods:

In this clinical trial, 77 healthy students aged between 18 and 20 year resident of a college were enrolled after screening of 106 subjects over a time period of 2 weeks. Exclusive criteria included subjects with any systemic disease, paan/chalia eaters, smokers and dental fluorosis were excluded from the study. All subjects should have a minimum 20 natural teeth, including all 12 anterior teeth, good gingival health, but having no fillings or removable/fixed appliances. At baseline, complete intraoral soft-tissue examination was conducted to document the status of oral mucosa and record any pathological conditions and normal variations. The clinical examiner was completely blinded as regard to which material was used by each subject during the study period.

Frequent contact with chlorhexidine and tea has been instructed to encourage extrinsic tooth stains, with limited brushing to promote staining for a customized swift clinical trial model.⁽⁴⁾ Using this model a five-week (2nd week of June 2011 to 3rd week of July 2011) randomized controlled, examiner blind, clinical trial was conducted to compare the stain removing efficacy of a toothpowder and toothpaste manufactured by the same company (ALA CHEMICALS PAKISTAN).

Before randomization, mechanical periodontal therapy (scaling and polishing) was performed for all subjects in order to remove stains/deposits and it was ensured that they had stain free teeth. The subjects were then instructed to rinse with 5 ml 0.12% chlorhexidine mouthwash for 1 minute twice and one cup of double tea bag solution three times daily for three weeks. All participants

were allowed to do normal tooth brushing twice a day as routine with very low abrasive toothpaste except on the labial surface of the 12 anterior teeth. Tooth brushing on the labial surface of 12 anterior teeth were performed with water for 30 seconds with normal brushing. After generations of stains on tooth surfaces, all subjects were randomized into two groups (test and control) i.e. 36 subjects in each arm by application of the simple random method.

Each subject was handed over a sealed pack containing a teeth cleaning kit (test or control dentifrices and a new soft toothbrush) along with written and verbal instructions. They were advised to brush their teeth twice a day with the given dentifrices and toothbrush for two weeks.

After two weeks of this practice an oral examination was conducted to measure the stains by Lobene index score.⁽¹⁴⁾ This index measures the intensity (I) and area (A) of stain respectively on the gingival crescent and body of the tooth on the buccal surfaces of each assessable incisor, and canine teeth (12 anterior teeth). The Lobene index⁽¹⁴⁾ has three variables, and is calculated for each subject by averaging the intensity (I) score (sum of all intensity scores/all graded sites), the area (A) score (sum of all area scores/all graded sites), and composite/product score (sum of all intensity x area/all graded sites). After completing the study, all participants were thoroughly examined to remove any stain, plaque and calculus.

The statistical difference in effectiveness of toothpowder with toothpaste was measured through Analysis of Variance (ANOVA) method. The t-test was applied to test the difference in the means between the two arms i.e. test and control cases. Ethical approval was taken from the ethical committee of

Sheikh Zayed Federal Postgraduate Medical Institute (FPGMI) Lahore. Formal permission from the college authority and informed consent was taken from the participating subjects.

Results:

The results for intensity (I), area (A) and Composite/product (IxA) in the gingival and body site are shown in Table 2. When the intensity (I) of the stains was measured in the participants using the toothpowder, they were categorized into no-stain and light stain category with a mean score of 0.28 ± 0.13 , 0.29 ± 0.13 and 0.29 ± 0.08 in body, gingival and combined sites respectively. On the other hand mean stain intensity (I) score was observed 1.77 ± 0.14 body, 1.82 ± 0.09 gingival, 1.79 ± 0.10 on combined sites in the control arm, showing that on an average this group fell in light to moderate stain category.

The second criteria measured were the area covered with the stains; here the toothpowder users were found to have less area involved. The mean stain area (A) score in the test group was observed $0.35 \pm .09$, $.42 \pm 0.08$, 0.38 ± 0.05 in body, gingival and combined sites respectively. The toothpaste users were observed to have stains in almost half of the tooth surface, and were found to be with the mean stains score, 1.85 ± 0.13 on body site, 1.97 ± 0.07 gingival sites and 1.91 ± 0.07 on combined site.

Similarly, when mean stain product was calculated it was seen to be much higher in the toothpaste group 3.26 ± 0.26 , 3.58 ± 0.15 , 3.42 ± 0.17 as compared with the test arm mean stain scores of 0.09 ± 0.05 , 0.12 ± 0.06 , 0.11 ± 0.03 at all three sites. The repeated measures ANOVA revealed a significant difference ($p < 0.001$). Intensity, area and product scores declined for the Test group after 2 weeks use of test material.

Table 1: Demographic variables at baseline

Demographic Variables		Frequency	%
Gender	Male	72	100
Age	18	50	69.4
	19	16	22.2
	20	6	8.3
Education Status	Intermediate	72	100

Table 2: Mean (SD) values for stain intensity and area after use of test (Toothpowder) and Control (toothpaste)

Gingival and body sites combined	Mean stain Intensity (I)	p	Mean stain Area (A)	p	Mean stain Product (I x A)	p
Test Toothpowder	.29 (.08)	<0.01	.38 (.05)	<0.01	.11 (.03)	<0.01
Control Toothpaste	1.79(.10)		1.91 (.07)		3.42 (.17)	
Gingival sites						
Test Toothpowder	.29 (.13)	<0.01	.42 (.08)	<0.01	.12 (.06)	<0.01
Control Toothpaste	1.82 (.09)*		1.97 (.07)		3.58 (.15)	
Body sites						
Test Toothpowder	.28 (.13)	<0.01	.35 (.09)	<0.01	.09 (.05)	<0.01
Control Toothpaste	1.77 (.14)		1.85 (.13)		3.26 (.26)	

Mean difference is significant at $p < 0.01$

Discussion:

Toothpastes are thought to be more reliable in reducing or removing the extrinsic dental stains. This can be observed by the increasing number of mouth whitening toothpastes in the market.⁽¹⁵⁾ According to this study, the abrasives contained in the toothpastes remove not only the pellicle but also the extrinsic dental stains itself. Additionally, it is argued that there are chemical actions that may be instituted by some active ingredients in some toothpaste that may actually reduce staining by either stain inhibition or by removing the stain directly. Such active ingredients include oxygenating agents, detergents and enzymes all of which may be included in the toothpaste formulations.⁽¹⁶⁾

The results of the present study indicated a statistically significant stain removing property of toothpowder when compared with toothpaste using toothbrush as a standard tool for application of both products. This is an

unexpected finding since we would have expected that the one of the components of the formulations in the toothpaste was sodium lauryl sulphate which has been shown to have stain reducing effect in vitro.⁽¹⁷⁾

A single subgingival application of stannous fluoride reduced numbers of subgingival black pigmented anaerobic rod.⁽¹⁸⁾ Despite the reported positive results, there are no conclusive data demonstrating stain reducing benefits of the use of stannous fluoride in teeth staining.

Our results on the use of toothpowder are in agreement with what was reported by Chapple et al. (2012)⁽¹⁹⁾ where the authors indicated that there was a small but significant reduction in the percentage of the sites that were bleeding when using the juice concentrate powder. This was also consistent with the observation by Baumgartner et al. (2009),⁽²⁰⁾ who observed that the inflammatory status of the bleeding gingival tissues may actually

influence the accumulation of plaque biofilm leading to the intensity of staining at the affected body sites. Since the toothpowder was applied directly, a probiotic effect upon the bioaccumulation is most likely since the application was localized and thus the observed reduction in the tooth staining overall among the toothpowder users. The resulting effects can also be attributed to altered systemic host response upon the periodontal film as suggested by Marsh and Devine (2001).⁽²¹⁾

The findings, however indicate a significant statistical difference in the decline of intensity of staining in both the body suits and the gingival sites in the test compared to the control groups. The study confirms that toothpaste which has fluoride as their main active ingredient can promote tooth staining and the intensity of staining in various body parts. Since the toothpowder contained essential oils as active ingredients, we can argue that the oils offered a protective coat and thus the staining kept on diminishing with time.

In the current study, the patients used the assigned products to equal extents and ruled out the chance that some individuals did not use the products due to aesthetic issues. The patients did not report any side effects arising from the use the toothpowder such as ulceration, burning sensation, taste and sensitivity discomfort implying that the active ingredients in the two products did not have such effects in the short or long term. Furthermore, some active ingredients like pyrophosphates, detergents and flavorings contained in most commercially available dentifrices have been shown to have negative side effects on the users.⁽²²⁾ Thus the toothpowder containing calcium carbonate and essential oils may be recommended for controlling tooth staining as it was shown to have no side effects. This study showed a significant anti staining properties of the toothpowder over the toothpaste.

Conclusion:

This clinical trial showed that stain removing was statistically better in toothpowder users than toothpaste. However a longitudinal study is warranted for evaluation of anti-staining properties of toothpowders, using placebo of toothpowder (control).

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