EVALUATION OF EFFICIENCY OF DIFFERENT OVER-THE-COUNTER PRODUCTS ON TOOTH WHITENING IN INDIA

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ABSTRACT
INRODUCTION: Patient nowadays have been demanding healthy mouth and increasingly want perfect smile. Esthetic dentistry has received increased attention in recent years, especially due to the fact that people are more concerned about the esthetic appearance of their smile. This fact, associated with the decrease in the incidence and severity of caries, has directed the clinician's attention to conservative and non-invasive treatments, like tooth bleaching. Tooth discoloration can be influenced by a combination of intrinsic and extrinsic factors. Intrinsic stains are related to enamel and dentin properties, while extrinsic stains are associated to deposition of either food or beverages stains on the tooth surface. Hence this study is aimed to evaluate the tooth whitening efficacy of commercially available tooth whitening pastes available in India.

MATERIALS AND METHOD: 60 human anterior collected after extraction-the prepared specimens were immersed for 24 hours in black tea mixture-washed in distilled water for 10 seconds and random divided into 6 groups with simple randomisation-brushed with 6 different tooth pastes, soft bristled and taken for examination.

RESULT: After 4 and 8 weeks, ΔL values in the Colgate were significantly higher than those of Dabur red, Himalaya and Sensodyne, but no significant difference was seen on comparison with Close up and Pepsodent.

CONCLUSION: All the over the counter products were effective in comparison with each other slight variations were seen. The main factor determining the efficiency is the duration of use of the products. Further clinical studies are required to confirm the whitening effects of these products in in vivo condition.

KEYWORDS: Microabration,non-invasive, intrinsic stains, extrinsic stain, in-vivo.

INTRODUCTION

People have been demanding more than a healthy mouth in recent years and they increasingly want to have a perfect smile. [1] Consumers and patients alike have always had a strong desire for white teeth and many individuals are dissatisfied with their current tooth color as indicated in a number of recent studies. [2,3,4] Everyone wants whiter teeth to make them feel younger and to provide beautiful smiles with the accompanying increase in self-esteem[5].The color of the teeth is influenced by a combination of their intrinsic color and the presence of any extrinsic stains that may form on the tooth surface. [6,7] Tooth whitening can be achieved by various methods and various chemicals[8].Factors that influence extrinsic stain formation include poor tooth brushing technique, smoking, dietary intake of coloredfoods , subject age and the use of certain cationic agents such as chlorhexidine or metal salts like tin and iron [1,6,7,9,10]. Tooth-whitening methods include the use of peroxide bleaching agents to remove internal discolorations or abrasive products to remove external stains. Peroxide bleaching procedures are completed by the dentist in single or multiple appointments, or by the patient over a period of weeks to months using custom trays loaded with a bleaching agent. Both methods are safe and effective when supervised by the dentist. Microabrasion is indicated for the removal of isolated discolorations that often are associated with fluorosis. Whitening toothpastes remove surface stains only through the polishing effect of the abrasives they contain.The desire for whiter teeth has given rise to a growing trend in the increased use of tooth whitening products [11,12,13].Manufacturers of oral care products are constantly developing improvements and new approaches for tooth whitening in order to meet the demanding expectations of patients and consumers. Thus, today there is a huge range of product types and technologies addressing the problem of tooth discoloration available on the market.

The natural colour of permanent teeth is largely determined by dentine and modified by the thickness and translucency of the overlying enamel. The appearance of the teeth, particularly whiteness, is aesthetically important to individuals and tooth discolouration is a common dental patient complaint. Personal dissatisfaction with the appearance of the dentition has been reported to range from 17.9 to 52.6% and the causes of tooth discolouration are multifactorial and are classified as extrinsic, intrinsic and internalised discolouration. Intrinsic and internalised discolouration arise generally during tooth development or during disease and the more extensive localisation deep within the dental tissues constrains its reversal. Extrinsic staining of the tooth can arise from a variety of sources, such as smoking, red wine consumption.

Patients spend large amounts of money and time to improve the appearance of teeth. Demand for whitening treatments has recently risen, as it comprises a conservative and simple option for the aesthetic treatment of stained teeth[14,15]. Whitening treatment is an effective method for restoring or lightening tooth stains with a variety of methods and systems, and fundamental vital tooth bleaching techniques can be generally classified as at-home (nightguard bleaching), in-office or power bleaching (professionally administered) and over-the-counter (OTC) or mass market products[15].

While a variety of stain removal and tooth whitening procedures are used professionally in the clinic, they are relatively costly and labour intensive. Furthermore, there is considerable demand for ‘over-the-counter’ (OTC) tooth-whitening products that can be integrated into a normal oral hygiene regime, and whitening toothpastes are commonly used for this. In general, tooth-whitening toothpastes function by abrasive removal of extrinsic stain associated with the dental plaque.

OTC products appeared as a low-cost alternative to white discolored teeth without dentist supervision. Different OTC agents are available in supermarkets and pharmacies and on the Internet[16]. These products generally contain lower levels of whitening agent and are self-applied to the tooth by gum shields, strips or paint-on brushes and commonly require twice-daily application for up to two weeks [15]. All of these products contain low concentrations of carbamide peroxide (CP) or hydrogen peroxide (HP) as active agents [16]. HP or CP is capable of penetrating the tooth structure, causing a breakdown of intrinsic stains and the pigments responsible for color alteration. Whitening dentifrices rarely contain CP or HP or any other type of bleaching agent. The mechanism of action of these products is related to the large quantity of abrasives in their ingredients, removing and controlling superficial extrinsic stains[17].

Considering the wide range of whitening agents, many patients and clinicians want to know the whitening effect of OTC products, but available information about the efficacy of these agents is restricted. Therefore, the aim of this in vitro study was to evaluate the whitening effect of four available OTC products (one whitening dentifrice, one mouth rinse, one paint-on gel and one set of strips) compared with a 10% CP at-home bleaching gel. The null hypothesis was that OTC products had no effect on the color change of teeth. Hence the present study aimed to evaluate the tooth whitening efficacy of a novel commercially available tooth pastes in India.

MATERIALS AND METHOD

60 human incisors were collected after extraction. The teeth were stored in a 0.5% chloramine-T solution after the remaining periodontal etiology was manually cleaned with hand scalers and used within 1 week of extraction. Enamel-dentin slabs (5x5 mm and 3-mm-thick) were prepared using a water-cooled diamond saw and embedded in transparent acrylic resin to expose the enamel surface. The buccal surface of each tooth specimen was polished for 10 s with a prophylaxis paste, applied with a polishing brush under manual pressure on a low-speed contra angle, and then washed with distilled water for 10 s. The prepared specimens were immersed for 24 h in a tea mixture prepared by brewing 3.5 g of black tea in 100 mL of boiling water for 10-12 min. The specimens were washed in distilled water for 10 s and randomly divided into 6 groups (n=10) according to the products used as follows: Group

1: The specimens were brushed with Colgate Visible white; Group 2: The specimens were brushed with a pepsodent; Group 3: The specimens were brushed with close up; Group 4: The specimens were brushed with himalaya ; Group 5: The specimens were brushed with sensodyne; Group 6:The specimens were brushed with Dabur red.This procedure was done for 4 h daily for 14 days, and the specimens were immersed in distilled water for the rest of the day (20 h).

Material's properties components are shown below. The stained specimens were brushed with toothbrushes in daily mouth cleaning method for 2 min twice daily for 8 weeks. The brush head had a soft bristle structure and was made of nylon. The specimens were placed in a silicone mold made especially for each specimen and then were brushed with freshly prepared toothpaste mixture, which contained one part dentifrice in three parts deionized distilled water. The toothbrush was fixed on a steel rod with clamp and brushing was performed with a typical force of 200 g , measured with an orthodontic gauge. The toothpaste mixture was applied every 30 s over the tooth and specimens were washed with distilled water for 10 s after brushing. During testing intervals for all groups, specimens were maintained in distilled water at 37 °C.

MATERIALS COMPOSITION

COLGATE
Silica, sorbitol, glycerin, polyethylene glycol, sodium tripoltphosphate, tetrapotassium pyrophospgate, sodium lauryl sulphate, flavour, cocamidopropyl betamine, sodium carboxymethyl cellulose, sodium saccharin, sodium fluoride, xanthan, sodiumhydroxide, sorbosil BFG 51 blue, titanium dioxide in aqueous base.
APPLICATION
Twice daily 2 minutes, each day with toothbrush.

CLOSE UP
Sorbitol, hydrated silica, sodium lauryl sulphate, PEG-32, flavour, cellulose gum, cocamidopropyl betaine, sodium saccharin, sodium fluoride, zinc sulphate, sodium hydroxide, FL 77891, synthetic flurophlogophite, eugenol.
APPLICATION
Twice daily 2 minutes, each day with toothbrush.

PEPSODENT
Sorbitol, calcium carbonate, hydrated silica, sodium lauryl sulphate, trisodium phosphate, flavour, PEG-32, cellulose gum, benzoyl alcohol, sodium saccharin, sodium monofluorophosphate, cl-74160.
APPLICATION
Twice daily 2 minutes, each day with toothbrush.

HIMALAYA
Sorbitol, aqua, hydrated silica, glycerin, silica, sodium lauryl sulphate, bromelain, xanthan gum, titanium dioxide, flavour, sodium saccharin, sodium benzoate, potassium sorbate, papin, menthol, Salvadora persica stem extract, sodium citrate, prunus amygdalus dulcis shell extract, cinnamomum zeylanicum bark oil, Eugenia caryophyllus bud oil, thymol, citric acid.
APPLICATION
Twice daily 2 minutes, each day with toothbrush.

SENSODYNE
Aqua, hydrated silica, sorbitol, glycerin, pentasodium triphosphate, potassium nitrate, PEG-6, aroma, titanium dioxide, cocamidopropyl betaine, sodium methyl cocyl taurate, xanthan gum, sodium hydroxide, sodium saccharin, sodium fluoride, sucralose.
APPLICATION
Twice daily 2 minutes, each day with toothbrush.

DABUR RED
Maricha, pippali, shunthi(zingiber officinale), tomar, lavanga(syzygium aromaticum), karpura(cinnamomum camphorated), pudina, garlic powder, sodium benzoate, methyl paraben, propyl paraben.
APPLICATION
Twice daily 2 minutes, each day with toothbrush.

RESULT

Result in statistics

Groups	ΔE		ΔL		Δa		Δb	
	4 weeks	8 weeks	4 weeks	8 weeks	4 weeks	8 weeks	4 weeks	8 weeks
Dabur red	3.40 ± 1.98a	2.95 ± 2a	0.12 ± 2.40a	1.20 ± 2.20a	-1.60 ± 1.70a	-1.90 ± 1.30a	-0.36 ± 2.30a	-0.40 ± 1.05a
Himalayas	3.15 ± 1.26a	4 ± 1.05a	1.9 ± 1a	2.40 ± 1.10a	-1.97 ± 0.88a	-2.15 ± 0.55a	-0.10 ± 2.02a	-0.47 ± 1.73a
Sensodyne	11.40 ± 1.83b	12.40 ± 1.67b	7 ± 1.44b	8 ± 2.30b	-4.85 ± 1.60b	-5 ± 1.49b	-4.40 ± 4.65b	-6 ± 1.85b
Pepsodent	19.30 ± 4.95c	20.55 ± 4.30c	11.15 ± 3.50c	10.90 ± 3.35c	-4.80 ± 1.99b	-5.50 ± 1.80b	-14.90 ± 3.50d	-17 ± 3.12d
Closeup	17.60 ± 5.70c	19.77 ± 4.30c	12 ± 5.30c	11.80 ± 3.25c	-7.60 ± 3.80c	-8 ± 3.60c	-11.56 ± 2.60c	-13 ± 2c
Colgate	21.30 ± 3.6c	22 ± 3.35c	13.70 ± 3.20c	13.7 ± 4.46c	-5.70 ± 1.93b	-5.90 ± 1.80b	-14.60 ± 4d	-16.22 ± 3d

The table shows the means and standard deviations of ΔE, ΔL, Δa, and Δb values from the staining period to 8 weeks of the treatment period. After both 4 and 8 weeks, sensodyne, pepsodent, closeup and Colgate showed significantly higher whitening effect (ΔE) than the remaining groups ($p<0.05$). After 4 and 8 weeks, no significant difference was found in tooth whitening (ΔE) between the Dabur red and himalaya groups ($p>0.05$). After 4 and 8 weeks, tooth whitening (ΔE) exhibited by the Pepsodent and Closeup groups was similar to colgate. After 4 and 8 weeks, color change of the Sensodyne group was significantly greater than that of the Himalaya group. After 8 weeks of treatment, no significant difference in color change was found between the Dabur red and Himalaya groups. The closeup and Colgate groups exhibited a significant increase in tooth whitening from 4 to 8 weeks of treatment ($p<0.05$).
Color measurements were performed with standard D65 illumination with a digital spectrophotometer, over a white background. Color measurements were performed after staining and after 4 and 8 weeks of treatment. The spectrophotometric data obtained relating to each sample were recorded as the L* a* b* values. The L* value represents the degree of lightness of a specimen and varies from black (0) to white (100). The a* and b* values represent the degree of red (+a) - green (–a) and yellow (+b) - blue (–b) in the specimens, respectively. The total color difference (ΔE) was calculated by the following equation: $\Delta E = \{(\Delta L^*)2 + (\Delta a^*)2 + (\Delta b^*)2\}1/2 = \{(L1-L0)2 + (a1-a0)2 + (b1-b0)2\}1/2$.

The colour and appearance of teeth is a complex phenomenon, with many factors such as lighting conditions, translucency, opacity, light scattering, gloss and the human eye and brain influencing the overall perception of tooth colour. The measurement of tooth colour is possible via a number of methods including visual assessment with shade guides, spectrophotometry, colourimetry and computer analysis of digital images.
After 4 and 8 weeks, ΔL values in the Colgate were significantly higher than those of Dabur red, Himalaya and Sensodyne, but no significant difference was seen on comparison with Close up and Pepsodent.

DISCUSSION

This study assessed the effectiveness of stain removal with whitening agents containing different concentrations of peroxide and brushing with a tooth paste without bleaching agents for 8 weeks of treatment. The repeated measures ANOVA showed that treatment period and OTC products were important factors for color change.Whitening toothpaste used in this study includes abrasives and chemical agents such as pyrophosphate, surfactant, hydrated silica and titanium dioxide. Pyrophosphates have a strong binding affinity and manage to desorb stain components[18]. Hydrated silica has a great cleaning ability and greater ability to remove stains from enamel and dentin compared with other abrasives.The results of our study corroborate the findings reported by previous clinical studies and in vitro studies, where whitening toothpaste indicated no significant differences for the removal of extrinsic stain on tooth surface compared with conventional toothpaste[19]. On the other hand, another study reported that a whitening toothpaste containing hydrogen peroxide presented statistically significant better results for both tooth whitening and prevention of extrinsic tooth stain than the conventional toothpaste[20].
Extrinsic stain on the tooth surface may be removed by means of something abrasive in toothpaste, whereas intrinsic stain can be removed by means of oxidation, based on HP or CP that helps lighten the intrinsic discoloration in the tooth. The use of HP or CP in toothpaste is limited[21]. Whitening toothpaste tested in this study does not contain peroxide-based whitening agents. Therefore, it can help remove surface stains but does not bleach teeth.
Whitening mouth rinse used in this study presents low concentration of HP and sodium hexametaphosphate that may prevent new stains on the tooth surface. These agents work either by bleaching or by removal and prevention of stain[16].A previous study showed that different peroxide-based whitening mouth rinses did not have a bleaching effect on stained teeth[22].
Whitening rinses are in contact with the teeth for a short time compared with at-home bleaching, strips and paint-on systems. In addition, it has the bleaching agent in low concentrations and consequently may have less whitening effect. Statistical analysis in this study showed that immersion time in mouth rinse was a significant factor for tooth whitening. Mouth rinses containing HP provide gradual whitening of teeth over a given period of time with continuous use and it is easy to maintain the whitening, but the continuous use of mouth rinse for more time than that recommended by the manufacturer may bring side effects such as mucosa desquamation, pulp sensitivity, ulceration, allergic reactions and burning–mouth sensations[22].

One of the key functional ingredients in whitening toothpastes is the abrasive system. In general, these have been designed to give effective removal of extrinsic stains and help prevent tooth stains from reforming without undue abrasivity towards the dental hard tissues. Whitening toothpastes may contain additional agents that augment the abrasive cleaning by aiding the removal and/or prevention of extrinsic stains, for examples, peroxide, enzymes, citrate, pyrophosphate and hexametaphosphate, or optical agents such as blue covarine which can improve tooth whiteness following tooth brushing. In vitro methods used to evaluate tooth whitening efficacy typically determine the ability of a toothpaste formulation to remove/prevent model extrinsic stains on substrates such as enamel or hydroxyapatite or changes in the intrinsic color of tooth specimens. Clinical protocols for evaluating the efficacy of whitening toothpastes typically determine either stain removal or prevention, where changes in natural stain or chlorhexidine/tea induced stain are measured typically over 2-6 weeks. In some clinical studies the overall tooth color change was measured using techniques such as Vita shade guides, colorimeters and image analysis of digital photographs of teeth.

CONCLUSION

It is concluded that the whitening toothpaste used in this study had considerable whitening effects on the teeth over a four week period. In all the six groups, whitening continued over four weeks while the three drop group did show much significant improvement. In addition, this study has shown that the study on whitening toothpaste require further in-depth research. In such trials, both the number of participants and the length of time that the toothpastes are used should be increased. The abrasive effect and pH of the toothpastes and their active ingredient should also be taken into account. All the over the counter products were effective in comparison with each other slight variations were seen. The main factor determining the efficiency is the duration of use of the products. Further clinical studies are required to confirm the whitening effects of these products in in vivo condition.

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