

# Comparision of the Whitening Properties of Commercially available Whitening Toothpaste using Shade Vision System: An In Vitro Study

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## ABSTRACT

**Introduction:** Since the last 10 years there has been a booming demand for esthetic dentistry, and consequently, the bleaching and whitening products have been made effective augmenting cosmetic dentistry. So a routinely used product and its efficiency in whitening play a major role in esthetics. **Objective:** The study was aimed at estimating the efficacy of commercially available whitening toothpaste in altering the color of the tooth using shade vision system. **Materials And Methods** The study was conducted for one month with the teeth of B2, B1, and B3 shade. Shade vision system was used. The toothpaste included, Colgate visible white, Himalaya sparkling white, Pepsodent whitening toothpaste, and Ten drops teeth whitening solution. Forty natural freshly extracted teeth was taken and divided into four groups of ten natural teeth each. Each tooth was regularly brushed and stored in artificial saliva and variations in the shade was noted. Non-parametric Kruskal-Wallis test was used. The p-value was set at 0.05. **Results:** The mean rank has a dire reduction in mandibular premolar from baseline (35.50) to week IV (9.00). Conterminously the Maxillary Canine showed the radical reduction from baseline (31.00) to week IV (11.31). The ranking variation of Central Incisor and Maxillary premolar was from 28.00 at baseline to 14.50 at week IV. The statistical data showed that all the three brands had nearly the same efficiency far better than the local brand Ten drops. **Conclusion:** In all the three groups, whitening continued over four weeks while the ten drop did show much significant improvement. Further research is required for understanding the comprehensiveness of whitening efficiency of toothpaste.

**KEYWORDS:** Cosmetic dentistry, Dental esthetics, Natural teeth, Shade Vision System, Whitening toothpaste

## INTRODUCTION

A smile is an imperative value that decides a person's beauty and dignity. To keep smiling, there are considerable esthetic factors and out of which teeth color plays a significant aspect in the beauty of it. Color of the tooth usually diversify from person to person. There are several factors that enhance and deteriorate tooth color of which enhancing factors encompass brushing, mouthwash, food and cosmetic treatments and those that deteriorate include food habits, pernicious habits, developmental defects, and trauma and so on.

There has been a booming demand for esthetic dentistry in the past decade and consequently the bleaching and whitening products have been made effective augmenting cosmetic dentistry. Much frequently people prefer a cost effective esthetic remedy that is less technique sensitive, and that is easily in the horizon to the people. Affordability for an esthetic treatment such as bleaching or veneers for an average person becomes strenuous. Instead routinely used product would be better appreciated.

Whitening products are provided by dentists in the dental office, dispensed by dentists for In-home, or purchased Over- The- Counter (OTC), and can be grouped into two

major groups:

- Peroxide-containing bleaching agents
- Whitening toothpaste (dentifrices)<sup>1</sup>

The in-office whitening technique is a minor treatment of choice by patients as it obviously needs a dentist and is technique sensitive and not cost effective. Further, most recently toothpaste plays a major role in whitening of the tooth that is a routine oral care product of varied chemical composition especially changing trends depending on the manufacturers. Toothpaste are considered as the best means of fluoride delivery that effectively protects both deciduous and permanent teeth from caries. However, fluorides are not the only active ingredient in toothpaste, which also includes abrasives, foaming agents, surfactant, the antibacterial agents and so on with specific purposes to treat specific problems like food accumulation and bleeding gums, etc. in the oral cavity. Most recently a toothpaste containing hydroxyapatite has been developed and marketed. This hydroxyapatite-contained toothpaste has three main clinical advantages:

- Efficacy in preventing caries or treatment of periodontal disease.
- Elimination of mouth odor.
- Teeth whitening effect.

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The tooth whitening properties are effective but yet to be examined in detail. The commercially available whitening toothpaste in India include- Crest Pro-Health Whitening Toothpaste, Colgate Max White Toothpaste, Colgate Total Advanced Whitening Toothpaste, Sensodyne Extra Whitening, Pepsodent Whitening Toothpaste and Oral- B Pro-Expert Whitening. Ingredients used in the Himalaya sparkling white paste are :

- Miswak that inhibits the build-up of dental plaque and sequentially prevents of tooth decay.
- The herb that reduces gum inflammation preventing bleeding gums and strengthens gums with its astringent property.
- Mint oils generally have some analgesic properties for which a ingredient called Menthol is added that gives a long lasting fresh breath.
- Almonds which are the best source of tannins tightens gums with its astringent properties.
- Almond Shell contains triterpenoids, flavonoids and phenolic compounds, which possess free radical scavenging properties.<sup>2</sup>
- Pineapple contains a natural enzyme bromelian that removes stains on tooth enamel.
- Papaya contains an enzyme, papain, which is a mild whitening agent.
- Cinnamon contains antimicrobial properties that prevent mouth odor and freshen breath.
- Clove contains eugenol, an anesthetic chemical, which numbs nerves and controls pain. The antiseptic property of Clove oil helps to eliminate oral bacteria.

The Colgate visible white toothpaste contains Silica, sorbitol, glycerin, polyethylene glycol, sodium tripolyphosphate, tetra potassium pyrophosphate, sodium lauryl sulphate, Cocamidopropyl betaine, sodium carboxymethyl cellulose, sodium saccharin, sodium fluoride, xanthan, sodium hydroxide, sorbosil BFG51 blue, titanium dioxide in aqueous base.<sup>3</sup>

The Pepsodent whitening toothpaste contains Calcium carbonate, water, sorbitol, hydrated silica, sodium lauryl sulphate, potassium nitrate, flavor, cellulose gum, sodium silicate, benzoyl alcohol, sodium saccharin, perlite, sodium mono fluoro phosphate. Ingredients in top ten drops are yet to be known.

The extrinsic stains are the ones mostly aimed by the whitening toothpastes than to change the natural color through a bleaching action.<sup>4</sup>

The study was aimed at detecting the efficacy of commercially available whitening toothpaste in altering the color of the tooth using shade vision system.

## MATERIALS AND METHODS

An in vitro study was conducted to compare the effectiveness of the commercially available whitening toothpaste just as Colgate visible white, Pepsodent

whitening, Himalaya sparkling white and Ten drops which are available in local market.

The study period was one month within the premises of SRM Dental College Ramapuram. The need of the study were explained to the Institutional Review Board of SRM Dental College Ramapuram, and ethical clearance was obtained. The freshly extracted sound natural tooth that was collected in formalin solution was taken. The teeth of B2, B1, and B3 shade was chosen prior to the study. Shade vision system was used to measure the color of the natural tooth.

The Exclusion Criteria includes:

- Decayed tooth
- Fractured tooth
- Root canal treated tooth
- Non vital tooth
- Fluorosis tooth
- Developmental defects

**Methodology:** A total of 40 natural teeth were taken, which included maxillary central incisor (8), maxillary canine (8), first premolar (8), mandibular first premolar (8) and mandibular molar (8). Each group contains 10 natural tooth which contains 2 Central Incisor, 2 Canines, 2Premolars, 2 Mandibular premolar, 2 Molar and the groups are, group 1-colgate whitening toothpaste, group 2-pepsodent whitening toothpaste, group-3 Himalaya sparkling whitening toothpaste and group-4 top ten drops.

Commercially available artificial saliva named Wet Mouth from ICPA Health Products Limited is used.

The natural tooth is mounted on a holder made of Plaster of Paris where the crown portion is exposed to the environment. Each tooth is placed in the artificial salivary solution in a plastic container at room temperature. The tooth is brushed twice or thrice a day according to the manufacturer's instruction, and the artificial saliva is routinely changed in the container with fresh saliva. Weekly once the tooth shade is measured with shade vision system for a period of one month. Colgate 360 degree toothbrush with medium bristles was used for brushing.

Statistical analysis was done with non-parametric Kruskal-Wallis test for comparison of the whitening effect among four brands of toothpaste from baseline to 30 days. The p-value was set at 0.05. The statistical test was performed using SPSS software version 21.

## RESULTS

The results of the study showed a statistically significant value for whitening effects of the toothpaste.

Table 1 shows the mean of group I which is Colgate visible white toothpaste shows maxillary central incisor tooth has better mean value (1.50) when compare to group IV (2.20) which is top ten drops and similar to group II mean value (1.50) Pepsodent whitening toothpaste and group III shows (1.40) better mean which

is the Himalaya whitening toothpaste .In maxillary canine group I, and group III shows (3.30) better mean value when compared to group II (3.40) and group IV (5.30) where group II is better than group IV. In relation to maxillary premolar, similar to maxillary canine the mean value shows group I and group III (2.80) has a mean value when compared to group II (2.90) and group IV (4.20) where group II is better than group IV. In mandibular premolar, group II mean value (4.50) of Pepsodent whitening which shows better whitening properties when compared to other toothpaste followed by group III (5.00) Himalaya whitening than group I (5.20) and group IV(5.30) mean. In molar, group II and group III shows mean (2.60) similar whitening of the tooth when compared to the mean of group I (2.80) and group IV (4.20).

Table 1 shows the mean and standard deviation of each group at baseline

	Group							
	Group I		Group II		Group III		Group IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Central Incisor	1.50	.53	1.50	.53	1.40	.52	2.20	.42
Canine	3.30	1.42	3.40	1.26	3.30	1.42	5.30	.82
Maxillary Premolar	2.80	1.03	2.90	1.20	2.80	1.03	4.20	.42
Mandibular Premolar	5.20	.42	4.50	1.43	5.00	.67	5.30	.67
Molar	2.80	.42	2.60	.52	2.60	.52	4.20	1.03

Table 2 shows from the baseline to the fourth week, the week IV shows better improvement in whitening of the tooth on the overall mean. The maxillary central incisor shows baseline mean (2.00) has been dropping off to (1.75) on week II and (1.25) on third and fourth week has the similar drop off values. In relation to maxillary canine baseline mean (5.00) which drops to (4.50) on the week I and in week II (4.38) better whitening occurs on week III (2.75) and week IV (2.50) according to the mean. In relation to maxillary premolar baseline mean value shows (4.00) and on the first week has the same mean (4.00), on week II (2.75) mean shows the drop off in the value from baseline and on the week III (2.63) and week IV (2.50). Mandibular premolar mean value of baseline (6.00) and on week I (5.25) which gradually drops on week II (5.00) and week III (4.88) drops on week IV (3.88). The molar mean value on baseline (3.00) and on the week I show

Table 2 shows mean and standard deviation of tooth and colour changes during weeks

	Week									
	Baseline		Week I		Week II		Week III		Week IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Central Incisor	2.00	.00	2.00	.00	1.75	.89	1.25	.46	1.25	.46
Canine	5.00	.00	4.50	.93	4.38	.74	2.75	1.49	2.50	1.69
Maxillary Premolar	4.00	.00	4.00	.00	2.75	1.04	2.63	1.19	2.50	1.31
Mandibular Premolar	6.00	.00	5.25	.46	5.00	.00	4.88	.35	3.88	1.25
Molar	3.00	.00	3.00	.00	3.50	.93	2.88	1.36	2.88	1.36

(3.00) similar value, week II (3.50) where the mean value

is increased and in week III (2.88) and week IV (2.88) shows similar mean value. Downgrading values show greater improvement in the shade of the teeth.

Table 3 and figure 1 shows that the mean rank has a dire reduction in Mandibular premolar from baseline (35.50) to week IV (9.00). Conterminously the Maxillary canine showed the radical reduction from baseline (31.00) to week IV (11.31). Though premolar showed a dire improvement in Shade, the esthetic role of premolar is analogously less.

Table 3 shows the variation in Kruskal Wallis Mean Rank from baseline to week IV in each tooth

	Week	No. of Samples	Kruskal Wallis Mean Rank
Central Incisor	Baseline	8	27.50
	Week I	8	27.50
	Week II	8	21.00
	Week III	8	13.25
	Week IV	8	13.25
	Total	40	
Maxillary Canine	Baseline	8	31.00
	Week I	8	24.13
	Week II	8	23.25
	Week III	8	12.81
	Week IV	8	11.31
	Total	40	
Maxillary Premolar	Baseline	8	28.00
	Week I	8	28.00
	Week II	8	16.44
	Week III	8	15.56
	Week IV	8	14.50
	Total	40	
Mandibular Premolar	Baseline	8	35.50
	Week I	8	22.75
	Week II	8	18.50
	Week III	8	16.75
	Week IV	8	9.00
	Total	40	
Molar	Baseline	8	22.50
	Week I	8	22.50
	Week II	8	26.25
	Week III	8	15.63
	Week IV	8	15.63
	Total	40	

The ranking variation of Central incisor and Maxillary premolar are relatively same. The Central incisor was from 27.50 from baseline to 13.25 at week IV whereas Maxillary premolar was from 28.00 at baseline to 14.50 at week IV. Molars showed a significant rank variation from Baseline (22.50) to week IV (15.63). This showed that a significant color change was seen in all the forms of teeth wherein Canine showed a dire variation and least with the molar.

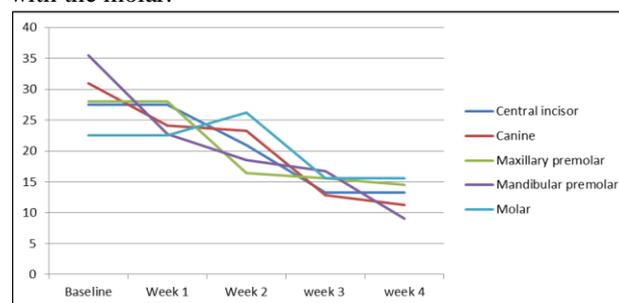


Figure 1 shows the variation in Kruskal Wallis Mean Rank from baseline to week IV in each tooth

Table 4 and figure 2 shows that group 4 showed higher ranks i.e. the ten drops brand is must extravagant than the

**Table 4 shows the variation in Kruskal Wallis Mean Rank between the four groups**

	Group	No. of Samples	Kruskal Wallis Mean Rank
Central Incisor	Group I	2	18.00
	Group II	2	18.00
	Group III	2	16.10
	Group IV	2	29.90
	Total	8	
Maxillary Canine	Group I	2	16.40
	Group II	2	17.00
	Group III	2	16.40
	Group IV	2	32.20
	Total	8	
Maxillary Premolar	Group I	2	16.90
	Group II	2	17.90
	Group III	2	16.90
	Group IV	2	30.30
	Total	8	
Mandibular Premolar	Group I	2	21.90
	Group II	2	17.10
	Group III	2	19.10
	Group IV	2	23.90
	Total	8	
Molar	Group I	2	19.10
	Group II	2	15.70
	Group III	2	15.70
	Group IV	2	31.50
	Total	8	

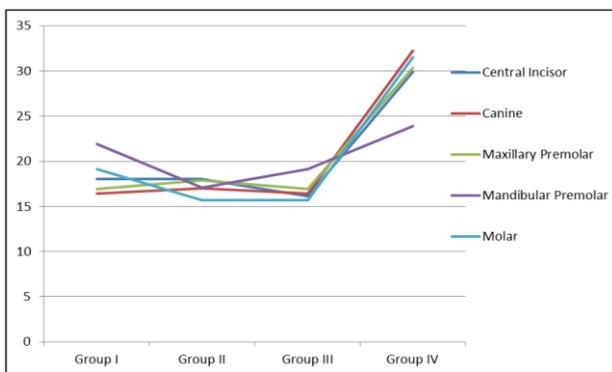


Figure 2 shows the variation in Kruskal Wallis Mean Rank between the four groups

rest of the brands. Furthermore, there exists a radical difference between the other brands and ten drops. The mean ranks of Canine are comparatively the lowest especially with the group I (16.40) (Colgate visible white) and Group III (16.40) (Himalayan Sparkling white). The statistically observed data showed that all the three brands of Group I, II and III are nearly the same and their efficiency was far better than the local brand Ten drops.

## DISCUSSION

The data is procured by measuring the shade using the visual instrument Vitapan classic original shade guide system. There aren't sufficient studies for estimation of the whitening capability of commercially available toothpaste. In a study by Lima Danil et al,<sup>5</sup> the enamel and dentin is removed from the tooth and coated with nail polish, and it is immersed in tea to stain, and then the toothpaste is used and colorimeter is used for measurement although in the present study the natural tooth is taken and placed in artificial salivary medium and a shade vision system is used. When compared to the present study, there is a slight change in methodology which not only involved tea stains but all generalized

stains that teeth might be exposed. A study by Araujo et al,<sup>6</sup> measured the enamel lesion that occurs due to whitening paste and also color changes of the tooth which were measured using spectrophotometry and scanning electron microscope. The results were not congruous to the present study which may be attributed to the use of Spectrophotometry and Scanning Electron Microscope. In the present study only the color change which means the whitening effect of the toothpaste is measured not the enamel lesions. A study by O'Brien et al,<sup>7</sup> showed that each tooth has a different color in different parts of the oral cavity. The extracted tooth was collected and placed in the artificial solution and measured the color through the spectrometer. This showed the different levels of variation of mean ranks in the present study. But the whitening efficiency is measured through shade vision system, but the regions of the tooth were not of priority in the present study. So this can be attributed to slightly low accuracy in measuring the shade of the tooth. A study by M. Suleiman et al,<sup>8</sup> showed that sectioning of the third molar after exposing it to tea solution for staining and the color is measured with the clinical shade vision system and calorimeter. Further, the shade of the tooth is measured after bleaching the tooth. Though an invitro study, the artificial exposure of stains and then bleaching of the tooth may show a vast variation in results comparatively to the present study. Nevertheless, this study was pertained to esthetic dentistry there exist few infirmities. The study was done in an in vitro fashion, and hence there might exist a variation in the shading pattern of teeth due to lack of normal tissue replenishments. Further the study was done on a short span of one month which might not suffice for observing changes in the shades of the teeth. Moreover, microscopic mechanism of toothpaste is not taken into consideration. Altogether the effectiveness of whitening paste is superficially understood, and in-depth researches are required.

## CONCLUSION

It was concluded that the whitening toothpaste used in this study had considerable whitening effects on the teeth over a four week period. In all the three groups, whitening continued over four weeks while the ten 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.

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