Journal of Applied Dental and Medical Sciences
NLM ID: 101671413 ISSN:2454-2288
Volume 5 Issue 3 July-Sept 2019

Original Research

Comparative evaluation of effects of Herbal and Non herbal whitening toothpastes on the micro hardness of enamel and nano hybrid composite resin – in vitro study

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ARTICLE INFO

Keywords:
herbal whitening toothpaste, non herbal whitening toothpaste, microhardness, nanohybrid composite resin, powered toothbrush

ABSTRACT

Aim: To compare the effect of herbal and non herbal whitening toothpastes on the microhardness of enamel and nanohybrid composite resin .

Materials and Methods: Forty five human enamel specimens(Group A) and forty five nanohybrid composite specimens (Group B) were divided into following three groups each (total six groups) , according to the whitening toothpaste used for brushing :Group A1 and Group B1: without whitening toothpaste; Group A2 and Group B2: with Herbal whitening toothpaste; Group A3 and Group B3: with Non herbal whitening toothpaste. A brushing regimen was performed using powered toothbrush for 45 days and microhardness values for all groups was determined on 15th, 30th and 45th day using Vickers microhardness tester.

Statistical Analysis: The data obtained was statistically analyzed using ANOVA test

Results: Amongst Group A and Group B respectively, Group A1 and Group B1 showed highest microhardness values followed by Group A2 and Group B2 followed by Group A3 and B3 on all 15th , 30th and 45th day. Highest microhardness values were seen for both enamel and composite specimens on 15th day followed by 30th day with least values on 45th day.

Conclusion: Non herbal whitening toothpaste (Colgate visible white) caused a significantly greater reduction in the microhardness of enamel and nanohybrid composite than Herbal whitening toothpaste (Himalaya sparkling white) and the reduction was time dependent.

INTRODUCTION

Tooth whitening is a rapidly growing area in the field of aesthetic dentistry since tooth colour and its brightness are of great concern for the patients.[1] The American Dental Association has classified tooth whitening procedures into 4 categories: professionally applied (in the dental office), dentist-prescribed/dispensed (patient home use), consumer purchased/over-the-counter (applied by patients) and other nondental options.[2]

Nowadays, whitening toothpastes have achieved popularity for removal of extrinsic stains. Current trend is shifting towards alternate medicinal systems specifically herbal medicines owing to its benefits and medicinal properties.[3]

Enamel is the strongest mineralized tissue in the body with a composition of 96 wt% inorganic material, 4 wt% organic material and water.[4] Resin composites are greatly used for restorative purposes owing to their good esthetic and the potential of establishing a bond to

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enamel and dentin.[5] With the advent of nanocomposites, reduction in polymerization shrinkage and higher resistance to traction, compression and fracture as well as improved optical properties, reduced attrition, and greater retention of gloss became achievable.[6]

Hardness is a surface property of a restorative material to resist deformation and is defined as the resistance of a material to indentation or penetration. Since hardness is related to a materials' strength, proportional limit and ability to abrade or to be abraded by opposite dental structures/materials, any chemical softening may have implications on the clinical durability of restorations.[7]

Several studies have inferred significant changes in the hardness of enamel and composite resins exposed to herbal and non herbal whitening toothpastes depending on the loss or gain of mineral content.[8] Moreover, the movement of agents associated with tooth brushing have potential of altering the surface and physical properties of the restorative material.

Therefore, the purpose of this study was to compare the effect of brushing with herbal and non herbal whitening toothpastes on the microhardness of enamel and nanohybrid composite resin at different time intervals.

METHODOLOGY

Square shaped enamel specimens of dimension 5x5 mm2 were obtained by cutting the crowns of forty five extracted human incisors on all the sides using a sectioning disc and edges of enamel slabs were smoothened and polished using polishing discs and then mounted horizontally on self cure acrylic resin.

Forty five composite specimens were fabricated using a nanohybrid composite resin (Herculite Precis, Kerr , shade – A1) by condensing it in a customized rectangular shaped rubber mould with a square - shaped specimen well of dimension 5x5x3 mm3 open from both the sides .Light curing was done for 30 seconds by a visible light curing device (Monitex BlueLEX GT 1200) and cured composite specimens were retrieved from the mould. The specimens were polished using polishing discs and mounted horizontally on self cure acrylic resin. .

All the samples were prepared by the same operator using the same technique to avoid manipulative error .

Each 45 enamel and composite samples were randomly divided into 3 groups (total 6 groups) each consisting of respective 15 samples

Group A (n=45) included all the enamel samples.

Group B (n=45) included all the composite samples.

Based on the whitening toothpaste used they were randomly divided into three subgroups each A1,A2,A3 and B1,B2,B3

Group A1 and Group B1 (n=15 each) : served as the control group which were brushed with powered toothbrush only, in moist condition**, without using toothpaste (moist brushing).**

Group A2 and **Group B2** (n=15 each) : specimens brushed with a powered toothbrush using a constant amount of Himalaya Sparkling White **(herbal)** toothpaste.

Group A3 and Group B3 (n=15 each) : specimens brushed with a powered toothbrush using a constant amount of Colgate Visible White **(non herbal)** toothpaste.

All the specimens were subjected to tooth brushing using respective whitening toothpaste , by dispensing a full load of toothpaste (amount covering the bristles over entire length of toothbrush's head) for 2 minutes twice daily with a powered toothbrush (Oral B cross action power) for 45 days. After every brushing, the specimens were cleaned and stored in a container filled with distilled water at room temperature.

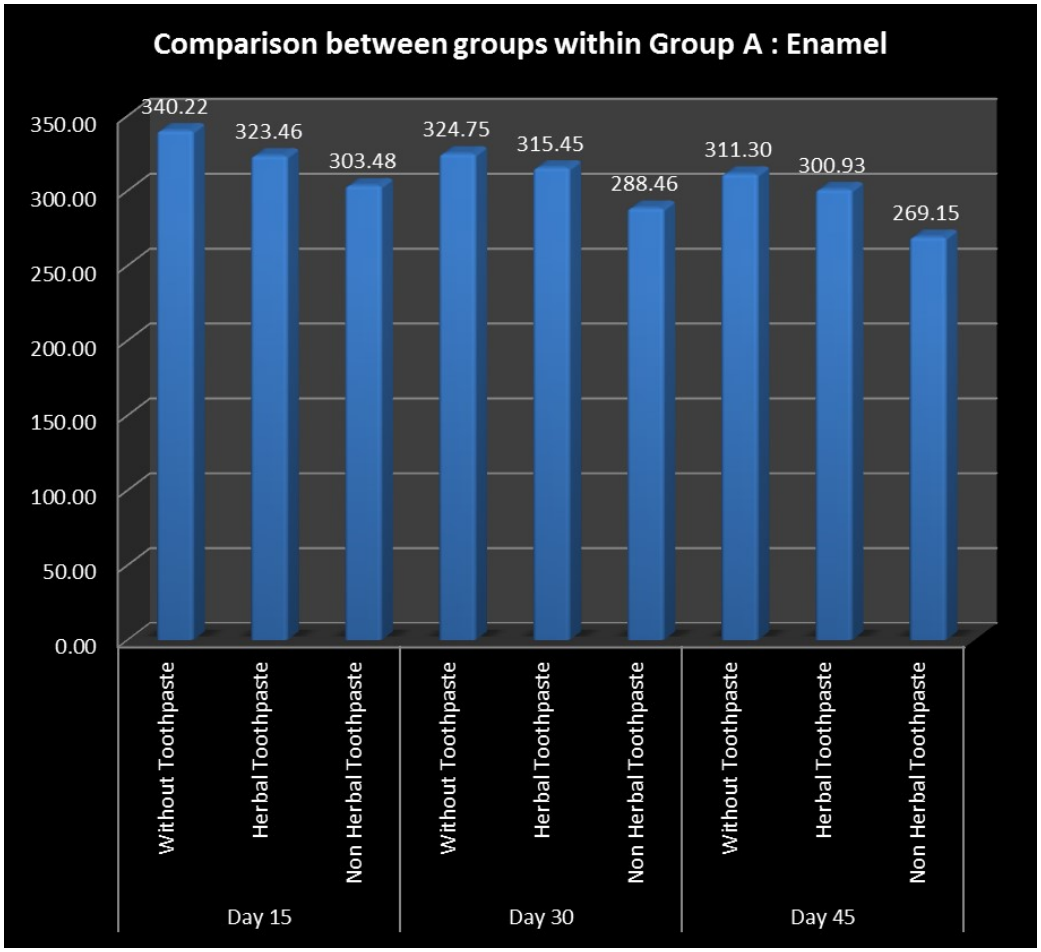
Microhardness test was performed for all the specimens with digital Vickers microhardness testing machine (Mitutoyo HM 100 , Japan) using a load of 300 g and a 15 seconds dwell time at room temperature on 15th day, 30th day and 45th day of tooth brushing and digitally obtained readings were noted.

Values obtained were tabulated and subjected to the statistical analysis using ANOVA test using IBM SPSS-20 software, at the significance level of 0.05 ($p<0.05$=Significant).

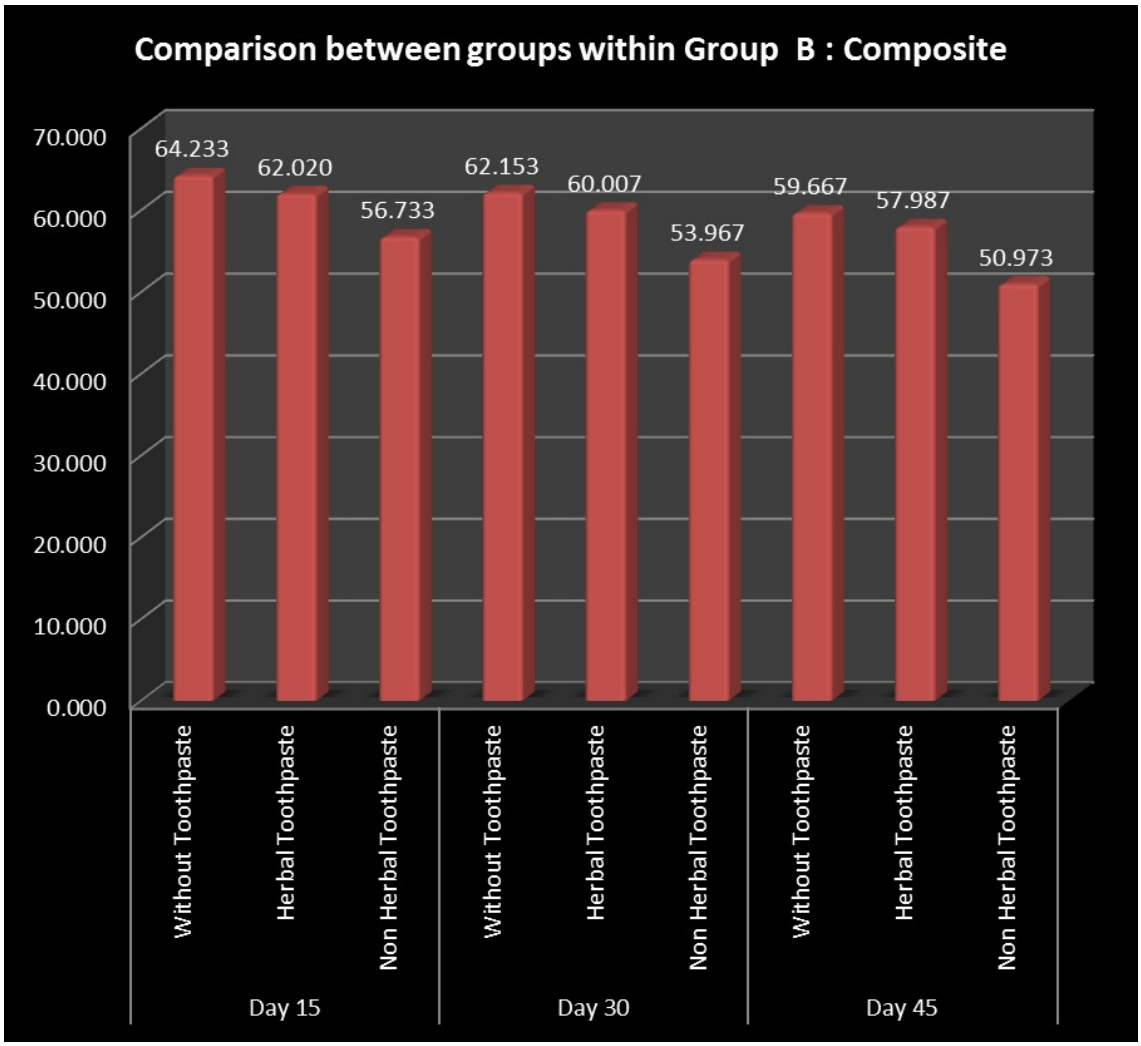
RESULTS

The microhardness values for all samples are given in Graph 1 and 2

One way ANOVA showed that there was a statistically significant difference between all the groups. (Table 1and 2)



Graph no. 1: Comparison of mean microhardness (VHN) of all groups for Group A



Graph No. 2: Comparison of mean microhardness (VHN) of all groups for Group B

Table No. 1: Comparison between Group A using Anova

		Sum of Squares	df	Mean Square	F	Sig.
Day 15	Between Groups	10149.63	2.00	5074.81	47.79	.000
	Within Groups	4459.98	42.00	106.19		
Day 30	Between Groups	10657.46	2.00	5328.73	104.31	.000
	Within Groups	2145.51	42.00	51.08		
Day 45	Between Groups	14473.82	2.00	7236.91	126.15	.000
	Within Groups	2409.41	42.00	57.37		

Table No. 2: Comparison between Group B using Anova

		Sum of Squares	df	Mean Square	F	Sig.
Day 15	Between Groups	445.488	2	222.744	294.648	.000
	Within Groups	31.751	42	.756		
Day 30	Between Groups	540.556	2	270.278	462.956	.000
	Within Groups	24.520	42	.584		
Day 45	Between Groups	637.916	2	318.958	378.853	.000
	Within Groups	35.360	42	.842		

(p Value <0.05 = significant)

Amongst Group A and Group B respectively, statistical analysis indicated that mean VHN was significantly highest for Group A1 and Group B1 followed by Group A2 and Group B2 , with least VHN for GroupA3 and GroupB3 on all 15th, 30th and 45th day.

For both Group A and Group B, statistically highest microhardness was seen on 15th day followed by 30th day with least values on 45th day.

DISCUSSION

There has been a booming demand for esthetic dentistry in the past decade and consequently whitening products have been effectively developed to augment aesthetic dentistry which has led to the recent emergence of whitening dentifrices, mouthwashes, whitening strips and bleaching chewing gums [9].

Amongst all, whitening toothpastes have flooded the market with an upsurge of herbal products for the treatment and prevention of various diseases including oral diseases. There is public perception that side effects are minimized or prevented totally when natural ingredients in herbal toothpaste replace the synthetic chemicals. Hence, this study compared the effects of Herbal and Non herbal whitening toothpaste

The toothpaste used in this study were Himalaya Sparkling White (herbal) toothpaste and Colgate Visible White(non herbal) toothpaste because of their popularity and ease of availability.

The Himalaya sparkling white toothpaste contains Sorbitol, Aqua, Hydrated Silica, Glycerin, Silica, Sodium Lauryl Sulphate, Bromelain, Xanthan Gum, Titanium Dioxide, Flavour, Sodium Saccharin, Sodium Benzoate, Potassium sorbate, Papain, Menthol, Salvadora Persica Stem Extract, Sodium Citrate, Prunus Amygdalus Dulcis Shell Extract, Cinnamomum Zeylanicum Bark Oil, Eugenia Caryophyllus Bud Oil, Thymol, Citric Acid, Eugenol.[10]

The Colgate visible white toothpaste consists of 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.[10]

Resin composites are greatly used for restorative purposes owing to their good esthetic and the potential of establishing a bond to enamel and dentin.[5] Nanocomposites are commonly preferred for restorations as they provide good aesthetics and longevity. A study recommended nanocomposite to be the restorative material of choice if whitening (bleaching) has to be done following restoration [11] .

Hence, nanohybrid composite material Herculite Precis , Kerr shade A1 was used in this study.

Herculite Précis has an optimized resin matrix of Bis-GMA, UDMA, TEGDMA that works in harmony with Kerr's 0.4 micron proprietary filler and nanotechnology to create the ideal composite. Three fillers—prepolymerized filler (PPF), nanoparticles (20 – 50 nm), and a submicron hybrid filler (0.4 micron) work together to achieve the ultimate esthetics and strength [12].

People opting for tooth whitening regimens may have composite restorations in their teeth. The effects of such products on the properties of tooth and the existing restorations need to be investigated and understood before advocating them. [7]

A motorized toothbrush (powered Oral B toothbrush)with a hybrid brush head design that combines an oscillating/rotating part, a Powerhead, with a non-moving part with CrissCross bristles [13] specially designed to pulsate along with the vibrations was used to deliver uniform brushing strokes.

Storing samples in artificial saliva is known to form a surface protective salivary layer on the restorative material which influence the findings [14] and temperature influences the effects of whitening on surface and subsurface microhardness of restorative materials.[15] Hence, were stored in distilled water at room temperature.

Vickers hardness test is a type of microhardness test which is commonly used to evaluate surface microhardness of brittle and restorative materials. [16] In vitro models allow the broad investigation and comparison of various treatments and products under standardised operating conditions, at reasonable cost and without so many technical difficulties .[17] Hence, an in vitro study was performed.

The mechanism of action of whitening agents on tooth structures is mainly by abrasion and also apparently due to oxidation of enamel and dentin molecules causing changes in color leading to chemical softening of the organic matrix [18]. In our study, the decrease in the microhardness of enamel could be because of mechanical and chemical effect of whitening agents present in the whitening toothpastes.

Himalaya sparkling white predominantly acts by the use of natural whitening ezymes like papain and bromelain which are very gentle on the enamel surface than Colgate visible white which contained high cleaning abrasives like silica , pyrophosphates, polyphosphates .Thus , Group A1 which was not exposed to whitening ingredients showed greatest microhardness than Group A2 followed by GroupA3 .

Our results are supported by Anton Rahardjo, et al.[8] who concluded that tooth brushing with whitening toothpaste decreases enamel microhardness and that done for a prolonged time increases enamel roughness and decreases enamel microhardness thus supporting the time dependent reduction observed in our study.

A study of Anurag Aggarwal, et al. [3] concluded that herbal toothpastes were less abrasive on tooth surface compared to Nonherbal.

Composite resin materials undergo physical changes because of the polymerization reaction and interaction when exposed to reagents causing softening of the resin matrix [19] thus reducing microhardness of Group B2 and B3 as they were acted upon by the whitening ingredients and abrasives.

Our finding is similar to FC Garcia, et al.[20] who suggested that ingredients of the toothpastes influence substratum surfaces affecting the surface characteristics of composite materials. Moreover, other factors such as particle size and shape, source and purity can affect

agent abrasivity . Thus, difference in the microhardness values obtained were attributed to milder abrasives in herbal toothpaste and high cleaning abrasives in non herbal toothpaste.

Mohan Thomas Nainan , et al.[7] also concluded that non herbal whitening toothpaste had a greater impact in bringing about reduction in the microhardness of nanohybrid resin composite than herbal whitening toothpastes.

Hardness of the toothbrush produces alteration in surface hardness of the resin composite on which it is used . Josue Martosa, et al. [21] showed that composites presented hydrolytic degradation of ester groups in the resin matrix due to aging in aqueous environment. E.K Hansen [22] stated that the surface hardness of dental composites may be significantly affected by both water absorption and the contact time with the aqueous media. The water sorption highly rely upon the chemistry of the monomers. It is greater for Bis- GMA-based resins(due to the hydrophilic ether linkages) compared to urethane resins , and lowest for ethoxylated Bis-GMA (Bis-EMA) resins [23]. Composites containing zinc and barium glasses show more susceptibility to aqueous attack since they are electropositive and tend to react with water .[24] Thus a storage period of 45 days in distilled water showed reduction microhardness of Herculite Précis composite . K B Roopa ,et al. [25] found out in their study that the effect of whitening dentifrice on micro hardness is time and material dependent. Thus, a greater reduction in microhardness was seen as the time duration advanced.

CONCLUSION

Based on the employed methodology, limitations of the study and obtained results in the present study, it can be concluded that Non herbal whitening toothpaste caused a significantly greater reduction in the microhardness of enamel and nanohybrid composite than Herbal whitening toothpaste. On both the substrate, enamel and nanohybrid composite, the reduction in microhardness was time dependent and thus, a greater reduction in microhardness values was seen on 45^{th} day , an intermediate reduction on 30^{th} day with least reduction in microhardness on 15^{th} day .

Thus, one must be cautious before prescribing or administering whitening toothpaste. The use of Herbal whitening toothpaste (under supervision **)** can be advocated when whitening of teeth is desired. However further researches need to be conducted to evaluate, confirm and verify the findings in in-vivo conditions with larger sample size.

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