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Effect Of 20% Bleaching Agent on Surface Roughness of Restorative Materials-An In Vitro Study.

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Abstract:
INTRODUCTION-*Bleaching is a popular and common method used to enhance the brightness of teeth, but controversial results have been documented concerning its effects on restorative materials. Bleaching is based upon hydrogen peroxide as the active agent, which may be applied directly or released by a chemical reaction from carbamide peroxide. The purpose of this study was to evaluate the effect of home-bleaching agents (20% CP) on the surface roughness of five restorative materials (composite resins, RMGIC, Miracle Mix, amalgam and ceramic) during 3-week experimental period.*
MATERIALS AND METHOD :-*20% Carbamide peroxide (Opalescence,Ultradent)**, Composite resin-filtek Z350,3M ESPE,USA ,Ceramic-VITA PM9 Press Ceramic System, Germany**, Resin modified Glass ionomer cement-GC Fuji II LC,GC.**, Amalgam-DPI Alloy, Miracle mix- GC Fuji II ,GC.**, Distilled Water**, Finishing and polishing kit SHOFU INC Kyoto Japan.100 round disc of same dimension of various restorative materials was made. The sample was stored in a incubator to simulate the environment similar to oral cavity at 37° c for 24 hours during the test. 20 sample of each group was made for each of the restorative material and further subdivided into two subgroups.*
SUB GROUPING OF SAMPLE:-

a. ***SUBGROUP 1:-*** *(n=10) Control group-in this group sample stored in only distilled Water for 21 days.*
b. ***SUBGROUP 2:-*** *(n=10) In this group 20% Carbamide peroxide was applied on the samples for 6hours a day & remaining 18 hours samples was immersed in distilled Water for 21 days.*

Each sample will be analyzed at baseline and after 21 days by the profilometer. The results were analyzed statistically using analysis of variance and the Student t test
(P < .05). Multiple Comparison: Tukey Test
RESULT- *After using 20% carbamide peroxide bleaching agent composite and ceramic group not showed any significant difference in surface roughness, but remaining all group including RMGIC, amalgam and miracle mix showed significant difference after bleaching.*
CONCLUSION-*Thorough patient examinations must be completed before, during, and after bleaching treatment. Further, replacement treatment should be carried out if it is required.*
KEY WORDS- *carbamide peroxide, surface roughness, composite, RMGIC, amalgam, ceramic and miracle mix*

I. INTRODUCTION

Since the introduction of tooth whitening by Haywood and Heymann in 1989, this trend is getting more popular.[1]

Bleaching is a popular and common method used to enhance the brightness of teeth, but controversial results have been documented concerning its effects on restorative materials [2].

Bleaching is based upon hydrogen peroxide as the active agent, which may be applied directly or released by a chemical reaction from carbamide peroxide [3]. The latter acts as a deposit material releasing hydrogen peroxide and urea [4].Types of bleaching methods include nonvital bleaching, in-office professional bleaching, and home bleaching.

Nightguard home bleaching uses a relatively low concentration of whitening agent and is applied to the teeth via a custom-fabricated mouthguard and is worn at night for a time period of at least two weeks.[5]

It was reported that the bleaching agent, regardless of the whitening products used, will reduce the microhardness of the enamel and promote an increase in surface roughness.[6]

Surface roughness of the restorations is important, as it plays a major role in the formation of biofilms and bacterial adhesion [7], that may lead to gingival inflammation [8]. Furthermore, surface restorations not only results in optimal aesthetics such as extrinsic staining [9] but also provide for acceptable health of soft tissues and marginal integrity of the restorative interface [10].

The effect of bleaching agents on the properties of the restorative materials is important. Several studies have evaluated its effect both on the mechanical and physical properties of restoratives [11].

However, investigations on surface roughness of restoratives after bleaching treatment have shown contradictory results. The opposing results may be attributed to the diverse bleaching protocols and materials tested.

The purpose of this study was to evaluate the effect of home-bleaching agents (20% CP) on the surface roughness of five restorative materials (composite resins ,RMGIC, Miracle Mix, amalgam and ceramic)during 3-week experimental period.

II. MATERIALS AND METHOD

This in vitro study was carried out in the Department of Conservative Dentistry & Endodontics, with the aim to evaluate effect of 20% carbamide peroxide on surface roughness of various restorative material**.**

MATERIALS :-20% Carbamide peroxide (Opalescence,Ultradent)**,** Composite resin-filtek Z350,3M ESPE,USA **,**Ceramic-VITA PM9 Press Ceramic System, Germany**,** Resin modified Glass ionomer cement-GC Fuji II LC,GC.**,** Amalgam-DPI Alloy, Miracle mix- GC Fuji II ,GC.**,** Distilled Water**,** Finishing and polishing kit SHOFU INC Kyoto Japan.

A custom made metallic mould measuring 12mm in diameter & 2mm height were fabricated (12mm x 2mm). 100 sample each of amalgam, composite, RMGIC, miracle mix and ceramic were prepared using metallic mould. Amalgam specimens were burnished and polished. Composite, RMGIC, Miracle Mix and ceramic specimens were finished and polished. A pre bleaching surface roughness were measured using Profilometer (TR-110 (ADVANCE) TIME HOLLAND LTD).

The specimens were store in a humid environment oven at 37^{o} c for 24 hours during the test. 20 sample were subdivided into two subgroups of each materials.

SUB GROUPING OF SAMPLE:-

a. **SUBGROUP 1:-** (n=10) Control group-in this group sample stored in only distilled Water for 21 days.
b. **SUBGROUP 2:-** (n=10) In this group 20% Carbamide peroxide was applied on the samples for 6hours a day & remaining 18 hours samples was immersed in distilled Water for 21 days.

carbamide peroxide was applied to all the samples for 6 hours daily, After completion of immersion period the sample was rinsed in tap water dried with absorbent paper, and immersed in distilled water for the remaining 18 hours of the day.

The immersion treatment was performed for 21 days, during which the control sample was store in distlled water.

TESTING OF SAMPLE

Each sample was analyzed after 21 days by the surface roughness tester TR-110 (ADVANCE) TIME HOLLAND LTD.

The results were analyzed statistically using analysis of variance and the Student *t* test ($P < .05$). Multiple Comparison: Tukey Test.

Table-1Descriptive Statistics

Material	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Amalgam	5	0.27	0.15	0.07	0.07	0.46	0.12	0.50
Composite	5	0.16	0.23	0.10	-0.13	0.46	0.01	0.59
RMGIC	5	0.28	0.22	0.10	0.00	0.56	0.10	0.67
Miracle Mix	5	1.31	0.62	0.28	0.53	2.10	0.57	1.85
Ceramic	5	0.07	0.06	0.02	-0.002	0.15	0.02	0.15

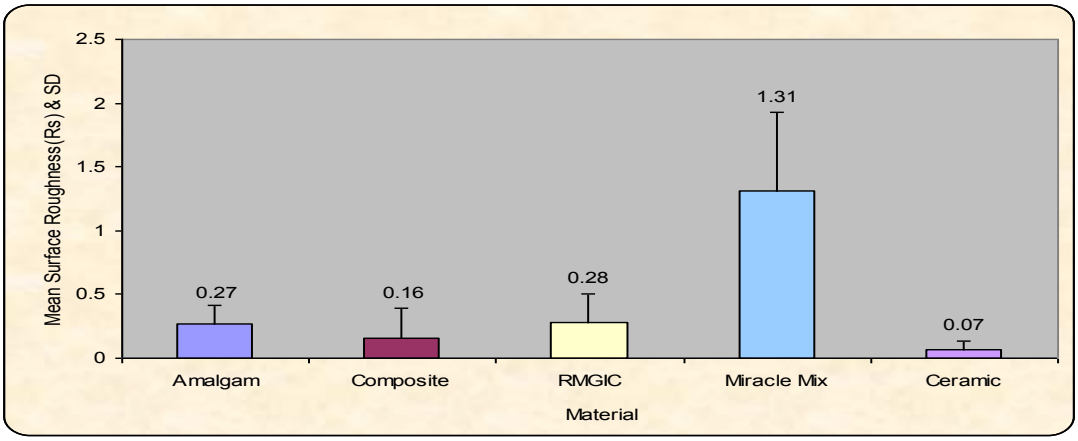
Table-2One way ANOVA

Sources of variation	Sum of Squares	df	Mean Square	F	p-value
Between Groups	5.15	4	1.28	12.07	0.000 S,p<0.05
Within Groups	2.13	20	0.10		
Total	7.28	24			

Table-3Multiple Comparison: Tukey Test

Material		Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Amalgam	Composite	0.11	0.20	0.983,NS,p>0.05	-0.50	0.72
	RMGIC	-0.01	0.20	1.000,NS,p>0.05	-0.62	0.60
	Miracle Mix	-1.04	0.20	0.001,S,p<0.05	-1.66	-0.42
	Ceramic	0.19	0.20	0.870,NS,p>0.05	-0.42	0.81
Composite	RMGIC	-0.12	0.20	0.976,NS,p>0.05	-0.73	0.49
	Miracle Mix	-1.15	0.20	0.000,S,p<0.05	-1.77	-0.53
	Ceramic	0.08	0.20	0.993,NS,p>0.05	-0.53	0.70
RMGIC	Miracle Mix	-1.03	0.20	0.001,S,p<0.05	-1.65	-0.41
	Ceramic	0.20	0.20	0.849,NS,p>0.05	-0.41	0.82
Miracle Mix	Ceramic	1.24	0.20	0.000,S,p<0.05	0.62	1.86

Graph 1: Comparison of Surface Roughness (Ra) in five materials for 20% CP



III. OBSERVATION AND RESULT

According to table1,2 and3 and graph 1 showing composite filtek Z-350 and ceramic was smoother among all the tested group of bleaching followed by Resin Modified GIC, amalgam and Miracle mix.

After using 20% carbamide peroxide bleaching agent composite and ceramic group not showing any significant difference in surface roughness, but remaining all group including RMGIC, amalgam, and miracle mix showed significant difference after bleaching.

Miracle mix showed highest surface roughness amongst all the five restorative materials after bleaching treatment.

IV. Discussion

Interaction between whitening agents and oral structures is of critical importance, and some chemical aspects involved in bleaching could negatively interfere with this. The oxidative process, with its low resulting pH, has been considered as a potential source of adverse effects [12, 26].

Surface roughness is a clinically important property that warrants investigation, since it can influence both aesthetics and health.

A plethora of home bleaching products, most containing 20% carbamide peroxide, are currently available.[27-30].

Thereby, in the present study, the effects of 20% bleaching agent on surface roughness of key restorative materials (composite, Resin Modifide GIC, ceramic, amalgam and Miracle mix.) were evaluated.

The results obtained from this *in vitro* study demand rejection of the first null hypothesis that there were no significant differences in surface roughness among the restorative materials tested after bleaching.

This is in agreement with previous studies, which investigated the effect of home-bleaching agents on surface roughness of various restorative materials [31-35].

Composite filtek Z-350 and ceramic is smoother among all the tested group of bleaching followed by Resin Modifide GIC, amalgam and Miracle mix.

After using 20% carbamide peroxide bleaching agent composite and ceramic group not showing any significant difference, but remaining all group including RMGIC, amalgam and miracle mix showing significant difference after bleaching.

In the current study, surface roughness of universal nanocomposite (Filtek Z350), did not affect significantly by 20% carbamide peroxide.

The increased surface roughness may be attributed to erosion of resin matrix from free radicals of peroxide which leads to debonding of resin-filler interfaces and to dislodgment and elution of fillers. Consequently, the higher the volume and the size of leached particles of the materials, the rougher the resulting surface.[36].

On the other hand, little is known about the influence of bleaching on ceramics [37].

Zavanelli *et al.*,[38] found no alterations on ceramic surfaces treated with 10% or 15% carbamide peroxide for 126 h.

Butler et al. [39] reported that porcelains might have significant roughening from 10% CP treatment.

No Significant alteration in ceramic surfaces was observed after bleaching in the current study.

The changes in physical, mechanical and corrosion characteristics are related to the nature of the amalgam matrix and the corrosive environment of the mouth. The mercury matrix phase is a major phase in any set amalgam and an important source for continuous and sometimes prolonged mercury release, which may be increased by exposure to heat, acids, or other agents [40,41,42].

In this study, carbamide peroxide may have facilitated the degradation of the amalgam surface. Acidic environment significantly affects corrosive behaveior of the alloys and particularly the amalgam, so mercury release can be related to this acidic pH rather than the effect of the peroxide by- products itself.

An increase in roughness has been observed in composite resins or glass ionomers after bleaching treatment, [38,43].

Particle size has been shown to play an important role in how well a material polishes. Some

studies have been recorded the highest values of surface roughness for the materials with larger particle size.[44,45].

The average particle size of miracle mix (metal modified GIC) is greater than resin modified GIC.[46].

Also, the storage media of GIC specimens can affect their surface roughness. In the present study, the prepared GIC specimens were stored in distilled water at 37 °C for 24 h to mimic clinic conditions. The chemical dissolution process can produce an increase in surface roughness [47].

However; one study evaluated the effects of storage media upon the surface micromorphology of resin-based materials and revealed no statistically significant difference in surface roughness between specimens exposed to distilled deionized water or artificial saliva.[48].

In the current study out of all the five restorative materials miracle mix showed the highest surface roughness after bleaching agent application.

However the literature regarding the surface roughness of miracle mix after bleaching application is very rare, so further research in this field should be carried out .

V. Conclusion

Thorough patient examinations must be completed before, during, and after bleaching treatment. Further, replacement treatment should be carried out if it is required.

LIMITATION OF THE STUDY

- Study performed in in-vitro condition which may not simulate oral environment for restorative material.
- Limited restorative material required were compare with limited concentration of bleaching agent.
- Long term clinical trial must be done in future.

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