Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2018;8:2:158-170.

A Comparative Evaluation of the Surface Roughness and Stain Absorption of Two Different Ceramic Materials when Subjected to Reglazing and Chairside Polishing: In Vitro Study

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ABSTRACT

Aim: To evaluate and compare the surface roughness and stain absorption of two ceramic materials when subjected to reglazing and chair side polishing.

Materials and method: Two feldspathic porcelains VITA VMK MASTER (VITA Zahnfabrik, Germany) and CERAMCO 3 (Dentsply International, USA) were used for fabricating 30 ceramic samples to check the efficacy of reglazing and chair side polishing in reducing surface roughness and to correlate the surface roughness with stain absorption after immersing the ceramic samples in Brooke Bond Red Label tea solution for 7 days. These ceramic disc samples were equally divided into 2 groups depending on the material used for fabrication: Group I – VITA VMK MASTER ceramic samples ,Group II – CERAMCO 3 ceramic samples.5 ceramic samples from each group were further subdivided into glazing (control group) (Group I A and II A), reglazing (Group I B and II B), and chair side polishing (Group I C and II C). Out of 30 ceramic samples, 10 Group I ceramic samples and 10 Group II ceramic samples were subjected to surface roughness by using medium grit diamond point. After surface roughness, 5 Group I ceramic samples and 5 Group II ceramic samples were subjected to reglazing. 5 Group I ceramic samples and 5 Group II ceramic samples were subjected to chair side polishing by using Shofu porcelain adjustment kit. The surface roughness was measured and evaluated with the help of surface profilometer and scanning electron microscope . The readings were noted, tabulated and statistically analyzed. After measuring the surface roughness, the ceramic samples were subjected to spectrophotometric evaluation before immersion in tea solution. After noting the readings the samples were then immersed in tea solution for 7 days at 37^0C and evaluated for stain absorption. The difference in the colour shades of all the 30 ceramic samples was calculated, tabulated and analyzed.

Results: The comparison of surface roughness between glazed groups of VITA VMK MASTER and CERAMCO 3 showed the mean surface roughness of 0.083. The comparison of surface roughness between reglazed groups of VITA VMK MASTER and CERAMCO 3 showed the mean surface roughness of 0.088. The comparison of surface roughness between chair side polished groups of and CERAMCO 3 showed the mean surface roughness of 0.093. The comparison of "L*" values of glazed, reglazed and chair side polished groups of VITA VMK MASTER and CERAMCO 3 showed gradual decrease in L* value by the end of 7th day (i.e samples become darker). The comparison of "a*" values of glazed, reglazed and chair side polished groups of VITA VMK MASTER and CERAMCO 3 showed gradual increase in "a*" value by the end of 7th day The comparison of "b*" values of glazed, reglazed and chair side polished groups of VITA VMK MASTER and CERAMCO 3 showed gradual decrease in "b*" value by the end of 7th day (i.e samples become darker)

Received: May. 8, 2018**: Accepted**: June. 20, 2018
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pISSN 2278-0076
eISSN 2321-9270

Conclusion: The average surface roughness is more in chair side polished groups of VITA VMK MASTER and CERAMCO 3 than reglazed and glazed groups VITA VMK MASTER and CERAMCO 3. Also chair side polishing showed more stain absorption than reglazing and glazing, thus affecting the colour stability of the ceramics.

Keywords: Reglazing, surface roughness, stain absorption, ceramic.

INTRODUCTION

Restoration of smile and esthetics are the most challenging tasks for the Prosthodontist while making fixed prosthesis.[1] Dental ceramics are used extensively in a variety of dental restorations including all ceramic restorations, metal ceramic crowns and fixed partial dentures due to its esthetic properties, durability and biocompatibility.[2] Sometimes dental ceramic restorations may require adjustments before cementation of prosthesis. These adjustments can be correction of occlusal inteferences, faulty contours, finishing of margins of ceramic restorations, improving the esthetic appearance and surface smoothness of ceramic restorations.[3,4,5] During these adjustment procedures, glazed layer becomes rough. This rough surface promotes plaque formation. This leads to gingival inflammation and adverse soft tissue reactions. It also causes the wear of enamel surfaces of opposing dentition or restorative material.[6] Studies report that reglazing or polishing after the adjustment procedures is necessary to improve strength and appearance of the restoration.[7,8,9] Polished ceramic restorations when compared to glazed restorations, may also have an advantage of reducing wear of enamel surfaces. Several studies reported different polishing techniques of ceramic restorations and supported the use of polishing as an alternative to glazing.[10,11] Furthermore, finishing and polishing procedures may influence the colour of the dental ceramic. Rough ceramic surfaces are more susceptible to staining than smooth ceramic surfaces.[11,12] Various studies on ceramic colour evaluation and colour stability have been performed. The effect on colour of ceramic acceleration, ceramic thickness, ceramic surface roughness, and repeated firings has been investigated. However there are fewer studies on effect of staining on colour.[13] Therefore, this study was planned to evaluate and compare the surface roughness and stain absorption of different ceramic materials when subjected to reglazing and chair side polishing.

MATERIALS AND METHOD

The study was carried out to evaluate and compare the surface roughness and stain absorption of two different ceramic materials when subjected to reglazing and chair side polishing. For the study 30 ceramic samples were fabricated. The 30 ceramic samples, 15 of VITA VMK MASTER and 15 of CERAMCO 3 were then divided into two groups:

Group I – VITA VMK MASTER ceramic samples
Group II – CERAMCO 3 ceramic samples

The study was divided into following steps:

1. Fabrication of ceramic samples.
2. Subjecting the ceramic samples to surface roughness.
3. Reglazing of ceramic samples.
4. Chair side polishing of ceramic samples
5. Measuring the surface roughness by profilometer.
6. Evaluation of surface roughness of ceramic samples by scanning electron microscope.
7. Evaluation of stain absorption by spectrophotometer.

A customized split brass mould was used for the fabrication of ceramic discs. CERAMCO 3 (Dentsply International, USA) ceramic is supplied as powder and liquid. CERAMCO 3 powder and liquid (Dentsply International, USA) was dispensed on the glass slab. Brass mould was placed on the glass slab. The ceramic mixture was dispensed into the split brass mould with the help of number 10 ceramic buildup brush (Takanishi, Renfert, Germany). The mixture was then subjected to gentle vibration by tapping the periphery of the split brass mould with the end of the ceramic buildup brush. This is done to remove any air bubbles that would have been incorporated in the mixture while mixing powder and liquid. The customized split brass mould was dissembled to separate the ceramic disc. The ceramic disc was kept in ceramic firing furnace (VITA Vacumat 6000 MP, VITA Zahnfabrik, Germany). The ceramic disc was placed on glass wool and the glass wool was placed on the firing

tray. The temperature was set at 650^{0}C and was gradually increased to 925^{0}C with the heat rise rate of 55^{0}C/min. The firing cycle lasted for 7 minutes. The furnace was allowed to cool and the ceramic disc was removed from the ceramic firing furnace after 5 minutes. The CERAMO 3 glaze powder and liquid was mixed uniformly on the glassslab. A thin layer of glaze was then applied on the disc with a thin brush. The ceramic disc was again kept in the ceramic firing furnace for firing. The temperature was kept at 650^{0}C and it was gradually increased to 920^{0}C for 7 minutes. The disc was then removed from the furnace and allowed to cool. Similar procedure was followed for fabrication of 15 CERAMCO 3 (Dentsply International, USA) ceramic discs. The discs thus obtained were placed inside the split brass mould to check for dimensional accuracy. The 30 ceramic samples, 15 of VITA VMK MASTER (VITA Zahnfabrik, Germany) and 15 of CERAMCO 3 (Dentsply International, USA) were further divided into following subgroups depending upon type of surface treatment done. 5 ceramic disc samples were placed in each of the subdivided groups.

i) Group I A - Glaze (Control)
ii) Group I B - Reglaze
iii) Group I C - Chair side polishing
iv) Group II A - Glaze (Control)
v) Group II B - Reglaze
vi) Group II C - Chair side polishing

Out of 30 ceramic samples (15 samples from Group I and 15 samples from Group II), 10 samples from Group I and 10 samples from Group II were subjected to surface roughness by passing the medium grit diamond sintered bur 3 times over the surface of the ceramic disc.

Reglazing of ceramic samples

5 ceramic samples of each group i.e Group I and Group II were subjected to reglazing . For reglazing of the roughened surface area of ceramic samples of Group I, the VITA glaze material was used .VITA glaze powder and liquid was dispensed on the glass slab and mixed uniformly. The ceramic sample was held in the customized split brass mould with the roughened surface facing upwards. The mixture was applied on the roughened surface with the help of number 10 ceramic buildup brush. The ceramic sample was then removed from the split brass mould and kept on the firing tray in the VITA Vacumat 6000 MP furnace for firing at 500^{0}C and gradually increased to 920^{0}C over a period of 7 minutes with the heat rise rate of 55^{0}C /min. The firing cycle lasted for 7 minutes. Same procedure was followed for all 5 ceramic samples of Group I B. For reglazing of the roughened surface area of ceramic samples of Group II B , the CERAMCO 3 glaze material was used . The temperature of the furnace was kept at 650^{0}C and gradually increased to 940^{0}C over a period of 5 minutes with the heat rise rate of 70^{0}C /min. The firing cycle lasted for 5 minutes. Same procedure was followed for all 5 ceramic samples of Group II B.

Chair side polishing of ceramic samples

Out of 10 ceramic samples of each group, 5 ceramic samples of each group i.e. Group I C and Group II C were subjected to chair side polishing. SHOFU Porcelain adjustment kit was used for chair side polishing. The sequence for chair side polishing of the ceramic discs was as follows :

i) Adjustment or contouring of the ceramic sample was done with the help of Dura white stone.
ii) Smoothening of the ceramic surface prior to polishing was done with Standard Ceramist point.
iii) Polishing of the ceramic surface was done with Ultra Ceramist point.
iv) High gloss polishing of the ceramic surface was done with Ultra II Ceramist point.

Small buff wheel with diamond polishing paste of 2 micron particle size was used for final polishing of the ceramic surface.

Measuring the surface roughness

The surface roughness for all the 30 ceramic samples of both the groups was measured using a surface profilometer. A diamond stylus was used under constant measuring force of 25 mN. The instrument was caliberated using reference specimen and then set to travel at the speed of 0.8 mm/s with a transversing length of 1.75 mm during testing. A mean surface roughness profile (Ra) was determined for each specimen to describe the overall roughness of the surface. These values were

tabulated to compare glazed, reglazed and chair side polished surfaces.

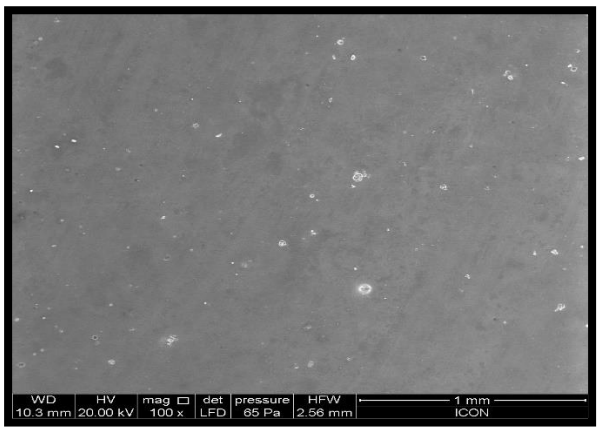

Fig 1: SEM photograph of Group I A ceramic sample showing surface roughness.

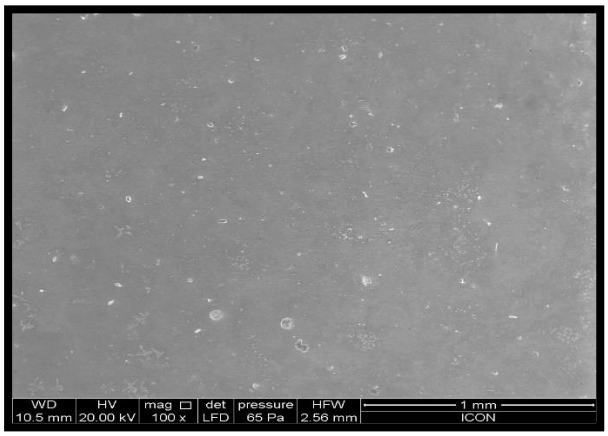

Fig 2: SEM photograph of Group I B ceramic sample showing surface roughness.

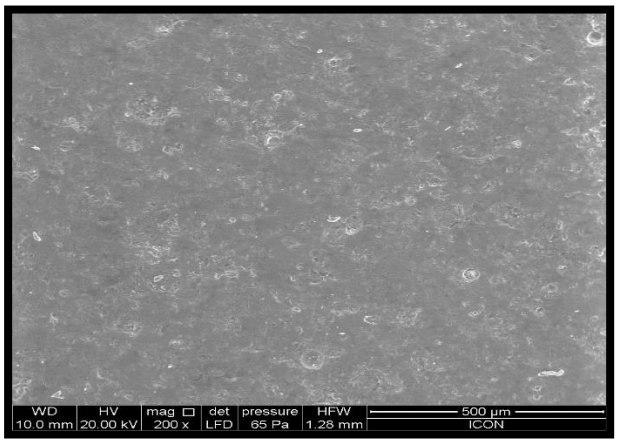

Fig 3: SEM photograph of Group I C ceramic sample showing surface roughness.

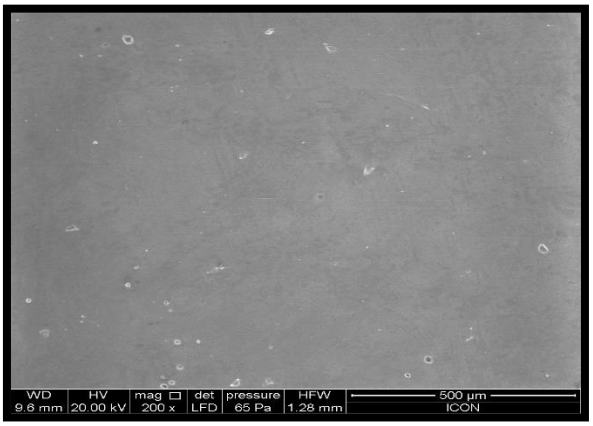

Fig 4: SEM photograph of Group II A ceramic sample showing surface roughness.

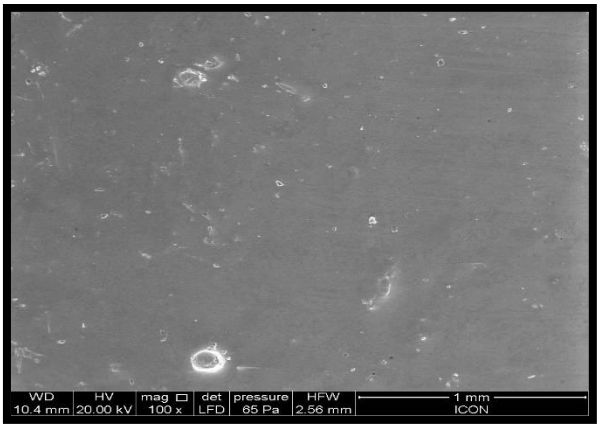

Fig 5: SEM photograph of Group II B ceramic sample showing surface roughness.

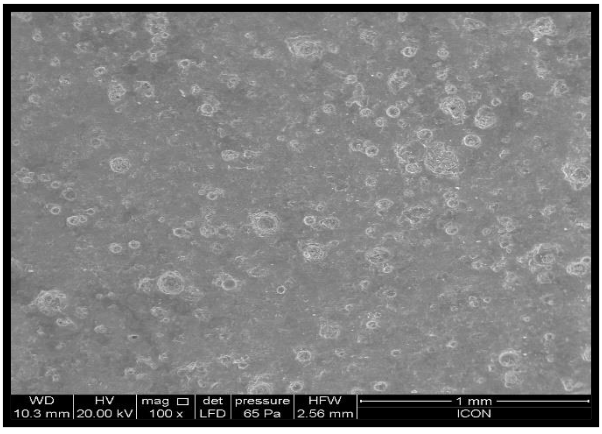

Fig 6: SEM photograph of Group II C ceramic sample showing surface roughness.

Table 1: Surface mean roughness values (ra) for vita vmk master ceramic groups (group I a, group I b, group I c) and ceramco 3 ceramic groups (group II a, group II b, group II c) (in µm).

SR NO.	Group I A	Group II A	Group I B	Group II B	Group I C	Group II C
1	0.14	0.15	0.16	0.16	0.18	0.18
2	0.14	0.16	0.15	0.17	0.16	0.18
3	0.15	0.16	0.15	0.17	0.17	0.19
4	0.16	0.16	0.16	0.16	0.18	0.19
5	0.15	0.15	0.17	0.17	0.18	0.19

Table 2: Comparison of mean surface roughness values (Ra) of vita vmk master ceramic groups (group I a, group I b and group I c).

	N	Mean	Standard deviation	Standard error	Minimum	Maximum
Group I A	5	.1480	.00837	.00374	.14	.16
Group I B	5	.1580	.00837	.00374	.15	.17
Group I C	5	.1740	.00894	.00400	.16	.18
Total	15	.1600	.01363	.00352	.14	.18

Table 3: Comparison of mean surface roughness values (Ra) of ceramco 3 ceramic groups (group II a, group II b and group II c).

	N	Mean	Standard deviation	Standard error	Minimum	Maximum
Group II A	5	.1560	.00548	.00245	.15	.16
Group II B	5	.1660	.00548	.00245	.16	.17
Group II C	5	.1860	.00548	.00245	.18	.19
Total	15	.1693	.01387	.00358	.15	.19

Table 4: Comparison of mean surface roughness values (Ra) between the vita vmk master ceramic groups (group I a, group I b, group I c) and ceramco 3 ceramic groups (group II a, group II b, group II c).

Group Statistics								
	Groups	N	Mean	Standard Deviation	Standard Error Mean	t-test value	Df	p-value
Glaze	VITA VMK MASTER	5	.1480	.00837	.00374	-1.789	8	.111
	CERAMCO	5	.1560	.00548	.00245			
Re -glazed	VITA VMK MASTER	5	.1580	.00837	.00374	-1.789	8	.111
	CERAMCO	5	.1660	.00548	.00245			
Chair side-polishing	VITA VMK MASTER	5	.1740	.00894	.00400	-2.558	8	.034

Group Statistics								
	Groups	N	Mean	Standard Deviation	Standard Error Mean	t-test value	Df	p-value
Glaze	VITA VMK MASTER	5	.1480	.00837	.00374	-1.789	8	.111
	CERAMCO	5	.1860	.00548	.00245			

Table 5: Anova test results of comparison of surface roughness values of vita vmk master ceramic samples (group I a, group I b and group I c).

	Sum of Squares	df	Mean Square	f	Sig
Between groups	.002	2	.001	11.727	.002
Within Groups	.001	12	.000		
Total	.003	14			

Table 6: Anova test results of comparison of surface roughness values of ceramco 3 ceramic samples (group II a, group II b and group II c).

	Sum of squares	df	Mean square	f	Sig
Between groups	.002	2	.001	38.889	.000
Within groups	.000	12	.000		
Total	.003	14			

Table 7: Tukey's multiple comparison test results of comparison of surface roughness values of vita vmk master ceramic samples (group I a, group I b and group I c).

		Mean Difference	Standard Error	p-value
Group I A	Group I B	-0.01000	0.00542	0.197
	Group I C	-0.02600	0.00542	0.001
Group I B	Group I A	0.01000	0.00542	0.197
	Group I C	-0.1600	0.00542	0.030
Group I C	Group I A	0.02600	0.00542	0.001
	Group I B	0.01600	0.00542	0.030

Table 8: Tukey's multiple comparison test results of comparison of surface roughness values of ceramco 3 ceramic samples (group II a, group II b and group II c).

		Mean Difference	Standard Error	p-value
Group II A	Group II B	-0.01000	0.00346	0.034
	Group II C	-0.03000	0.00346	0.001
Group II B	Group II A	0.01000	0.00346	0.034
	Group II C	-0.02000	0.00346	0.001
Group II C	Group II A	0.03000	0.00346	0.001
	Group II B	0.02000	0.00346	0.001

Table 9: Tukey's multiple comparison test results of comparison between vita vmk master ceramic samples (group I a, group I b, group I c) and ceramco 3 ceramic samples (group II a, group II b, group II c).

		Mean Difference	Standard Error	p-value
Glazed	Re-Glazed	-.48600	.28920	.252
	Chair-side	-.98600*	.28920	.013
Re-Glazed	Glazed	.48600	.28920	.252
	Chair-side	-.50000	.28920	.235
Chair-side polishing	Glazed	.98600*	.28920	.013
	Re-Glazed	.50000	.28920	.235

Table 10: Spectrophotometric values of vita vmk master ceramic samples (group I a, group I b and group I c) before immersion in tea solution.

SR NO.	Group I A			Group I B			Group I C		
	L*	a*	b*	L*	a*	b*	L*	a*	b*
1.	88.52	0.9	9.2	87.42	0.8	9	86.24	1	9.43
2.	87.6	1.25	9.1	86.9	1.31	9	85.74	1.17	9.58
3.	86.6	1.1	9.8	86.14	1.22	9.18	85.48	1.18	9.51
4.	87.8	0.8	9.6	85.8	1.3	9.51	84.87	1.65	9.23
5.	85.4	1.18	9.62	85.57	1.29	9.62	84.82	1.42	9.44

Table 11: Spectrophotometric values of vita vmk master ceramic samples (group I a, group I b and group I c) after immersion in tea solution.

SR NO.	Group I A			Group I B			Group I C		
	L*	a*	b*	L*	a*	b*	L*	a*	b*
1.	86.5	1	9.27	86.4	1	9	85.9	1.22	9.5
2.	87.2	1.18	9.18	85.92	1.28	9.21	84.72	1.24	9.62
3.	85.72	1.23	9.88	85.72	1.41	9.24	84.43	1.32	9.61
4.	86.9	1.2	9.69	84.5	1.36	9.62	82.89	1.71	9.33
5.	85.3	1.21	9.6	84.9	1.33	9.8	83.79	1.5	9.5

Table 12: Spectrophotometric values of ceramco 3 ceramic samples (group II a, group II b and group II c) before immersion in tea solution.

SR NO.	Group II A			Group II B			Group II C		
	L*	a*	b*	L*	a*	b*	L*	a*	b*
1.	88.72	1.18	9.4	87.92	1.1	9.1	87.32	1.1	9.34
2.	88.6	1.2	9.2	88.2	1.31	9	86.2	1.17	9.85
3.	87.53	1.15	9.9	86.14	1.14	9.18	86.5	1.28	9.15
4.	89.3	0.9	9.1	85.7	1.3	9.51	85	1.55	9.32
5.	86.2	1.23	9.5	86.4	1.29	9.62	86.92	1.52	9.44

Table 13: Spectrophotometric values of ceramco 3 ceramic samples (group II a, group II b and group II c) after immersion in tea solution.

SR NO.	Group II A			Group II B			Group II C		
	L*	a*	b*	L*	a*	b*	L*	a*	b*
1.	87.62	1.17	9.62	86.4	1.2	9.2	85.9	1.22	9.55
2.	87.92	1.3	9.35	86.9	1.45	9.31	85.2	1.33	9.62
3.	87.2	1.17	9.88	85.4	1.41	9.28	84.4	1.42	9.76
4.	88.4	1.25	9.58	84.3	1.38	9.72	83.3	1.62	9.33
5.	85.3	1.31	9.7	84.9	1.34	9.82	84.2	1.5	9.51

Table 14: Comparison of l*, a* and b* values of vita vmk master ceramic samples (group I a, group I b and group I c).

			Mean	SD	T	df	p-value	Interpretation
Group I A	L	Before	87.184	1.21049	2.631	4	0.058	Not significant
		After	86.324	0.79742				
	a	Before	1.046	0.18995	-1.504	4	0.207	Not significant
		After	1.164	0.09343				
	b	Before	9.464	0.29913	-2.963	4	0.041	Significant
		After	9.524	0.2928				
Group I B	L	Before	86.366	0.77478	5.779	4	0.004	Significant
		After	85.488	0.77364				
	a	Before	1.184	0.21755	-2.06	4	0.108	Not significant
		After	1.276	0.16134				
	b	Before	9.262	0.28883	-2.917	4	0.043	Significant
		After	9.374	0.32662				
Group I C	L	Before	85.43	0.60008	4.15	4	0.014	Significant
		After	84.346	1.11702				
	a	Before	1.284	0.25344	-3.808	4	0.019	Significant
		After	1.398	0.20645				
	b	Before	9.438	0.13103	-6.345	4	0.003	Significant
		After	9.512	0.11692				

Table 15: Comparison of l*, a* and b* values of ceramco 3 ceramic samples (group II a, group II b and group II c).

			Mean	SD	T	Df	p-value	Interpretation
Group II A	L	Before	88.0700	1.22523	5.965	4	0.004	Significant
		After	87.2880	1.19437				
	a	Before	1.1320	.13293	-1.696	4	0.165	Not significant
		After	1.2400	.06782				
	b	Before	9.4200	.31145	-2.56	4	0.063	Not significant
		After	9.6260	.19256				
	L	Before	86.8720	1.11737	9.005	4	0.001	Significant

		After	85.5800	1.06630				
Group II B	a	Before	1.2280	.09985	-3.334	4	0.029	Significant
		After	1.3560	.09607				
	b	Before	9.2820	.26892	-4.68	4	0.009	Significant
		After	9.4660	.28263				
Group II C	L	Before	86.3880	.88404	6.079	4	0.004	Significant
		After	84.6000	.99247				
	a	Before	1.3240	.20330	-2.92	4	0.043	Significant
		After	1.4180	.15369				
	b	Before	9.4200	.26201	-0.967	4	0.388	Significant
		After	9.5540	.15726				

Table 16: Comparison of δe values of vita vmk master ceramic samples (group I a, group I b, group I c) and ceramco 3 ceramic samples (group II a, group II b, group II c).

	Mean delta E	Standard Deviation
Group I A	0.88	0.73
Group II A	0.83	0.33
Group I B	0.9	0.33
Group II B	1.32	0.3
Group I C	1.1	0.56
Group II C	1.82	0.65

Table 17: Anova test results of comparison of δe values of vita vmk master ceramic samples (group I a, group I b and group I c).

	Sum of Squares	df	Mean square	F	p-value
Between Groups	.145	2	.072	.227	.800
Within Groups	3.824	12	.319		
Total	3.969	14			

Table 18: Anova test results of comparison of δe values of ceramco 3 ceramic samples (group II a, group II b and group II c).

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	2.431	2	1.215	5.813	.017
Within Groups	2.509	12	.209		
Total	4.940	14			

Table 19: Tukey's multiple comparision test for comparision of δe values of vita vmk master ceramic samples (group I) and ceramco 3 ceramic samples (group II).

Group Statistics							
Groups	N	Mean	Standard Deviation	Standard Error Mean	t-test value	Df	p-value
VITA VMK MASTER	5	.8840	.72896	.32600	.146	8	.888
CERAMCO 3	5	.8320	.32538	.14551			
VITA VMK MASTER	5	.9000	.32992	.14755	-2.081	8	.071
CERAMCO 3	5	1.3180	.30475	.13629			
VITA VMK MASTER	5	1.1000	.56201	.25134	-1.861	8	.100
CERAMCO 3	5	1.8180	.65461	.29275			

Evaluation of surface roughness by scanning electron microscope.

On completion of profilometric evaluation, all the samples of Group I (Figure 1,2,3) and Group II (Figure 4,5,6) were prepared for SEM evaluation. Scanning electron microscopewas utilized to evaluate surface roughness of all 30 ceramic samples. The ceramic samples were sputtered with palladium powder using a fine coater machine and then mounted on a mounting plate . After mounting, the samples were subjected to SEM evaluation with 200x magnification.

Preparation of ceramic samples for spectrophotometric evaluation:

After evaluation of surface roughness, all 30 ceramic samples were immersed in distilled water for 24 hours and thoroughly dried with an air spray. The samples were immersed in distilled water to remove any surface impurities.

Evaluation of stain absorption by spectrophotometer:

The spectrophotometric evaluation of change in colour of Group I and Group II ceramic samples was done in 2 parts: by first checking the samples before immersing in tea solution and later after subjecting the ceramic samples to tea solution.

Preparation of tea solution:-

Standardised tea solution was prepared by boiling 5 grams of tea (Broke Bond Red Label) in 100 ml of distilled water for 5 minutes and filtered through filter paper. Fresh tea solution was made each day for the immersion study of 7 days.

The ceramic samples of both the groups were immersed in the standardized tea solution for 7 days at 37^0C. At the end of 7 days, the samples were removed from tea solution, washed with distilled water and dried with tissue paper and then mounted on the mounting plate and evaluated for colour change. The readings were tabulated and the data was statistically analysed.

RESULTS

Surface mean roughness values (ra) for Vita Vmk Master ceramic groups (group I a, group I b, group I c) and ceramco 3 ceramic groups (group IIa, group II b, group II c) were obtained.(Table 1)

Comparison of mean surface roughness Vita Vmk Master ceramic groups (group I a, group I b, group I c) and ceramco 3 ceramic groups (group IIa, group II b, group II c) were obtained.(Table 2,3)

Comparison of mean surface roughness values between the vita vmk master ceramic groups (group I a, group I b, group I c) and ceramco 3 ceramic groups (group II a, group II b, group II c) indicate (Table 4)

1. Since p-value for VITA VMK MASTER against CERAMCO 3 is greater than that of 0.05 indicates no significant difference for glaze.

2. Since 3 p-value for VITA VMK MASTER against CERAMCO is greater than that of 0.05 indicates no significant difference for reglaze.

3. Since p-value for VITA VMK MASTER against CERAMCO 3 is less than that of 0.05 indicates significant difference for chair side polishing.

Anova and Tukey's multiple comparison tests were done to compare surface roughness between and within the groups for Group I (Table 5,7).It shows that since p value for glaze against reglaze is greater than 0.05 , there is no significant difference. But p value for glaze against chair side polishing and reglaze against chair side polishing is less than 0.05, indicating significant difference.

For Group II p value for glaze against reglaze , glaze against chair side polishing and reglaze against chair side polishing is less than 0.05 , indicating significant difference. (Table 6,8)

Tukey's multiple comparison test results of comparison between Vita Vmk Master ceramic groups (group I a, group I b, group I c) and ceramco 3 ceramic groups (group IIa, group II b, group II c) indicate that p-value for glaze and chairside is significant but for others it is not significant.(table 9) Spectrophotometric analysis for Group I and Group II was done before and after immersion in tea solution (Table 10 ,11,12,13) and comparison of L*, a* AND b* VALUES show that for Group Ia,Ib,Ic and Group IIa,IIb,IIc there is significant difference between the mean of before and after value. Comparison of **ΔE** values of Group Ia,Ib,Ic and Group IIa,IIb,IIc was obtained (Table 16) . Tukey's multiple comparison tests show that there is no significant difference for auto-glazed, reglazed and chair side polishing for Group I against Group II.

DISCUSSION

Dental ceramics are popular because of their esthetic advantages, biocompatibility and ability to yield smooth surfaces which minimizes plaque adherence and subsequent periodontal inflammation.[1]

Glazing the ceramic surface produces a smooth shiny and impervious outer layer, and also reduced crack propogation. The essential objective of glazing is to avoid loss of surface details by increasing the pyroplastic flow of the dental ceramics.[10] Some authors have advocated reglazing or polishing the ceramic restorations after clinical adjustment.[7] Some researchers advocated that adjusted ceramic surface should be reglazed.[11] It has been a common practice to reglaze the adjusted ceramic surface prior to cementation. However various disadvantages have been reported with reglazing like devitrification, marginal distortion which is affected with the thickness of glaze, wearing of reglazed layer in short period of time and lastly an extra appointment to the patient.[10]

Studies conducted by Sarac S and co-workers[14] in 2006 and Wright MD and co-workers[15] in 2004 concluded that during reglazing of the ceramic surface, applying a sialin coupling agent reestablishes the hydroxyl bond between the ceramic surface and the reglazed layer. Thus the smooth and glossy texture can be achieved like glazed layer. Bottoni MC and co-workers[13] in 2006 stated the problems associated with reglazing. They concluded that one cannot achieve perfect ceramic margins by reglazing and there is also marginal distortion occurring by reglazing.

The study of comparative evaluation of various methods to obtain a smoothest ceramic surface is limited. Various authors found the initial smoothness of a glazed surface to be superior than the polished surface.[11,12,16] Some authors have found no significant difference between glazed and polished surfaces.[16,17,18] Others have concluded that chair side polishing could equal or surpass the smoothness accomplished with surface glazing.[19] Some investigators concluded that glazing or reglazing created a much smoother ceramic surface than surface polishing.[16,18,19,20]

Finishing and polishing of dental ceramics after surface adjustments influence the colour of ceramics.[3,6] The adjusted ceramic surface has affinity to absorb stains from food or liquids. Surface roughness is directly proportional to stain absorption. More the surface roughness more is the stain absorption. This is because after surface adjustments the ceramic surface pores become wide

open and also there is formation of peaks and valleys on the adjusted ceramic surface.[9,10]

Earlier studies have tested different properties affected or influenced by the finishing technique.[16,21] However, the basic property that influences other properties is the surface roughness. More is the surface roughness more is the wear caused, more is the plaque accumulation, lesser is the fracture strength and poorer is the final esthetic appearance.[6,9]

During reglazing of a ceramic surface, there is formation of glassy matrix which is not as homogenous as glaze as it has to also compensate for the peaks and valleys that are formed during ceramic adjustment. Due to this there is formation of weak hydroxyl bond between the glassy matrix and ceramic surface.[22] During chair side polishing, the polishing burs cause incomplete reduction of peaks on the ceramic surface thus leaving some amount of rough ceramic surface. Also the smoothness of ceramic surface depends upon the size of the particles of diamond polishing paste. The particles in a diamond polishing paste themselves cause some amount of roughness of ceramic surface. Therefore, diamond polishing paste with particle size of 2µm or less should be used.[23]

The L*, a* and b* values of the present study were in accordance with the study done by Ghahramanloo and co-workers.[24] The comparison of ΔE values between glazed groups of VITA VMK MASTER and CERAMCO 3 showed the mean difference of 0.88. The comparison of ΔE values between reglazed groups of VITA VMK MASTER and CERAMCO 3 showed the mean difference of 0.9 . The comparison of ΔE values between chair side polised groups of VITA VMK MASTER and CERAMCO 3 showed the mean difference of 1.1. These results conclude that the mean ΔE is more in chair side polished groups of VITA VMK MASTER and CERAMCO 3 than reglazed and glazed groups of VITA VMK MASTER and CERAMCO 3.

LIMITATIONS OF THE STUDY

1. Size and number of pores or flaws that are opened due to grinding of porcelain depends upon the extent of condensation ceramic particles. In this present study, since the ceramic disc samples were subjected to different surface treasatments, one cannot be sure about the uniformity of the condensation in the ceramic disc samples.

2. Operator's variable which limits the standardization for grinding and polishing. Manual grinding and polishing is always difficult to standardize.

3. It has been reported that different solutions affect the ceramic colour differently. But in this present study only 1 staining solution was used which limits this study.

4. The ceramic disc samples were immersed in standardized tea solution at 37^0C for 7 days without the use of saliva. So the oral environment was not completely simulated.

CONCLUSION

This study suggests that glazing and reglazing are better surface treatments than chair side polishing both in terms of surface roughness and stain absorption and also VITA VMK MASTER is a better ceramic material than CERAMCO 3.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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