

Effect of Chairside Polishing and Glazing on Streptococcal Adhesion on Two Ceramic Surfaces- An *In Vitro* Study

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Abstract

Statement of Problem: Adjustment of ceramic restorations either before or after cementation results in surface roughness. This leads to adherence of *Streptococcus mutans* at restored tooth margins to cause recurrent caries.

Purpose: To evaluate and compare the adhesion of *S. mutans* on auto glazed and chair side polished surface of two feldspathic ceramics.

Materials and Methods: 60 circular ceramic discs, 30 of each material, IPS e max Ceram (Ivoclar Vivadent AG. Schaan) and IPS d SIGN (Ivoclar Vivadent AG. Schaan) were fabricated. To simulate chairside adjustments, all the specimens were abraded for a minute with Shofu yellow finishing diamond points. Six groups were made. (10 specimens per group) i.e. IPS e max Ceram: Group A1 (auto glazed), Group A2 (polished with optrafine), Group A3 (control). IPS d SIGN: Group B1 (auto glazed), Group B2 (polished with optrafine), Group B3 (control). The surface roughness of each specimen was assessed before incubation with *S. mutans* for 48 hours at 37°C with Brain Heart Infusion broth. After sonication and dilution, adherent bacteria were plated for quantification using the plate count method to assay for colony forming units (CFUs). Statistical analysis was performed using 1 way anova and Post Hoc Test.

Results: CFUs (cells/mL) of *S. mutans* were significantly highest for chairside adjusted IPS d SIGN ($5.70E+03$) followed by chairside adjusted IPS e max Ceram ($4.25E+03$) which were not significantly different from each other ($p < 0.05$). Glazed IPS d SIGN ($6.56E+02$), followed by Glazed IPS e max Ceram ($6.31E+02$) with no significant difference within them ($p < 0.05$). Least bacterial adhesion was noted with optrafine polished specimens; IPS d SIGN ($1.52E+02$) followed by IPS e max Ceram ($1.38E+02$) with no significant difference within them ($p < 0.05$).

Conclusion: There is no significant difference in adhesion of *S. mutans* between both the ceramic systems.

Keywords: Chairside Polishing; Streptococcal Adhesion; Ceramic Surfaces; *S. mutans*

Introduction

Ceramics are being used extensively in various dental restorations due to its superior esthetic properties, biocompatibility and durability [1]. With increased esthetic demand, all ceramic restorations with veneering ceramics have also been developed. Ceramic restorations have a smooth surface which has the advantage of impeding plaque accumulation and hence gingival inflammation and secondary caries [2].

The need for proximal contour correction or occlusal correction requires adjustment of ceramic restorations either before or after cementation, following which it is important to create smooth surface to gain the advantage of ceramics. In non-cemented restorations, the choice depends either to chair side polishing of the restorations or to glaze the surface. Cemented restorations on the other hand, when adjusted intra-orally can lead to rough surfaces which result in initial adherence and retention of microorganism [3].

There is always a positive correlation among the surface roughness as well as surface free energy and microbial adhesion [4]. Adhesion of early colonizing bacteria on the restoration surface is an important step in plaque formation [5]. Streptococci bacteria belong to the 'early colonizing bacteria group' and in particular mutan streptococci are known to play an important role in coronal and root caries [6]. Presence of streptococci may also lead to aggregation of other periodontopathic bacteria like *Porphyromonas gingivalis* and *Actinobacillus actinomycetemcomitans* [7]. Hence, along with the other properties, colonization of microorganisms is considered a factor determining the clinical performance of the dental materials.

Glazed ceramic restorations give a natural appearance and are highly regarded for their inertness. By glazing, the small open pores on the surface of ceramic created during adjustments are filled such that it prevents ingress of bacteria and oral fluids. Natural glaze is formed when ceramic is heated to a glazing temperature to form a vitrified layer over the ceramic surface [8]. Overglazing is done by applying glaze material over the ceramic surface and firing. However, in this, the glaze material gets worn off in a short period of time [9]. A study by Priyanka Bawane., *et al.* showed that number of micro-organisms adhering to overglazed surfaces was less compared to self-glazed surfaces [10]. Shirin Lavaf., *et al.* proved that bacterial adhesion was highest in non-glazed surface while overglazed surface showed least adhesion. The glazed surfaces caused less adhesion than the polished surfaces [11].

Ideally, after clinical adjustments, to render a restoration smooth surface, reglazing is required. However, reglazing of restoration may adversely affect the structure of ceramic by devitrification.

Due to the various drawbacks encountered in reglazing, investigators advocate polishing of restoration after clinical adjustments. It is desirable that polishing techniques used following the clinical adjustments should feature minimum bacterial adhesion on ceramic surface. Chairside ceramic polishing is efficient and easy for the clinician. Intra-oral polishing also provides infection control by eliminating repeated laboratory procedures. Various studies also endorse the view that chair side polished surfaces are comparable to glazed restorations [12,13]. According to the study by Filiz Aykent., *et al.* use of Sof-Lex and Shofu polishing kits showed the lowest bacterial adhesion on restorative materials [4].

During chairside adjustment of ceramic prosthesis, veneering ceramic layer is always altered. Hence in the present study, two layering ceramics are used. IPS d. SIGN (feldspathic ceramic) is mainly used as a veneering ceramic material for metal ceramic restoration whereas IPS e max Ceram (lithium disilicate) is used as a veneering ceramic material for all ceramic restorations.

Considering all the above-mentioned factors, this study was conducted to evaluate the efficacy of a chairside polishing system and compare it to autoglazing technique in order to minimize the adhesion of *Streptococcus mutans* on two different ceramics after clinical adjustments.

The Null hypothesis was that there is no statistically significant difference in adhesion of *Streptococcus mutans* organisms to feldspathic ceramic and lithium disilicate surfaces after chairside polishing with a ceramic polishing system and autoglazing.

Materials and Methods

Fabrication of ceramic specimens

Two feldspathic ceramics were used in the present study, IPS e max Ceram (Ivoclar Vivadent AG. Schaan) and IPS d. SIGN (Ivoclar Vivadent AG. Schaan). The ceramic powder was mixed with modelling liquid as per manufacturer's recommendation. This mixture was

condensed into a metal mold of dimension 10 mm diameter and 4 mm width in increments and condensed. Following this, condensed mass was released from the mold and specimens placed on honeycomb firing tray. The specimens were then placed in the ceramic furnace (Programat Ep 3000) for uniform firing according to the recommended firing schedule (Figure 1 and table 1). With this procedure, 60 circular ceramic discs were made. The larger dimensions of specimens were necessary to allow for firing shrinkage and losses during finishing (Figure 2a).

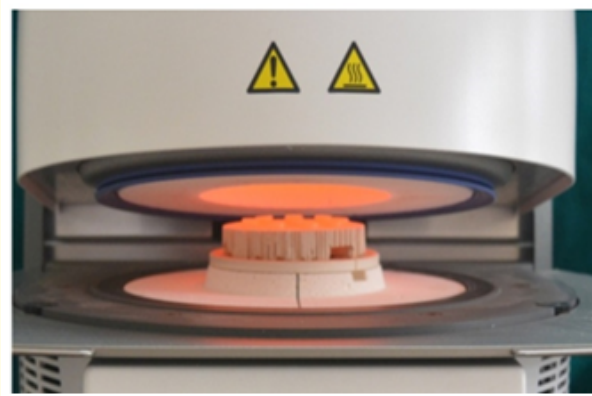


Figure 1: Firing of prepared ceramic mass.

| Dental ceramic | Type of firing | Starting temperature (°C) | Heating rate (°C/min) | Firing temperature (°C) | Holding time (sec) |
|--------------------|----------------|---------------------------|-----------------------|-------------------------|--------------------|
| IPS e max Ceram | Incisal | 403 | 50 | 750 | 60 |
| | Glaze | 403 | 60 | 725 | 60 |
| IPS d. SIGN | Incisal | 403 | 50 | 750 | 60 |
| | Glaze | 403 | 60 | 725 | 60 |

Table 1: Firing schedule for ceramics evaluated.

*: Firing schedule for ceramics evaluated.

Upon cooling, surface alteration of the specimens were carried out to eliminate any irregularities with diamond impregnated bur. The finishing was done using Dura-Green (Shofu Dental Corp., California) silicon carbide grit on both sides to create a flat surface. All the ceramic specimens were finally contoured to the uniform dimensions of 8.5 mm diameter and 2.5 mm width. The ceramic specimens were then cleaned with distilled water in an ultrasonic cleanser, dried and subjected to an auto glaze firing cycle.

To simulate chairside adjustments, all the specimens were abraded for a minute with Shofu yellow finishing diamond points from Shofu Crown and Bridge Preparation Kit (Shofu Dental Corp, California) attached to an air-rotor handpiece (NSK). To maintain constant pressure during adjustment and polishing of specimen, all procedures were done by a single operator.

Baseline texture of all the specimens was assessed using Scanning Electron Microscope.

Randomization of the specimens:

The specimens were then broadly divided into two main groups:

1. Group A - IPS e. max Ceram ceramic specimens.
2. Group B - IPS d. SIGN ceramic specimens. The specimens from each of the above groups were randomly divided into 3 equal groups of 10 specimens (n=10) each.

The six groups thus created were:

- Group A1: The specimens of IPS e max Ceram were roughened with a yellow finishing bur for a minute after the bisque firing and then auto glazed as per manufacturer's recommended auto glaze firing cycle.
- Group A2: The specimens of IPS e max Ceram were roughened with a yellow finishing bur for one minute and then polished with Optra fine ceramic polishing kit. (IvoclarVivadent, Ag, Schaan).
- Group A3: The specimens of IPS e max Ceram were roughened with a yellow finishing bur for one minute and neither polished or auto-glazed. These specimens acted as control.
- Group B1: The specimens of IPS d. SIGN were roughened with a yellow finishing bur for a minute after the bisque firing and then auto glazed as per manufacturer's recommended auto glaze firing cycle.
- Group B2: The specimens of IPS d. SIGN were roughened with a yellow finishing bur for one minute and then polished with Optra fine ceramic polishing kit. (IvoclarVivadent, Ag, Schaan)
- Group B3: The specimens of IPS d. SIGN were roughened with a yellow finishing bur for one minute and neither polished or auto-glazed. These specimens acted as control.

Quantitative bacterial adhesion analysis using colony counting method

Before bacterial adhesion, the ceramic specimens were cleaned for 15 minutes using an ultrasonic cleanser and sterilized in an autoclave following conventional glassware protocol at 121°C for 1 hour. *Streptococcus mutans* (mtcc 890) were grown in brain heart infusion (BHI) broth (Himedia) in an incubator at 37°C. Growth of the organism was assessed every hourly to evaluate the growth curve till early stationary phase of growth for inoculation was attained. 1 ml of this solution was added to BHI broth to make standard suspension of *S. mutans*. Optical density was adjusted to 0.13 at 550 nm with the help of spectrophotometer (UV 1800, Shimadzu, spectrophotometer). This corresponds to concentration of 10⁸ cells/ml.

The ceramic specimens per plate were placed in two 24-well micotitreplates, along with 2 ml of the prepared bacterial suspension with known concentration (Figure 2b). The plates were sealed and incubated at 37°C for 48 hours on a shaker in an incubator. To dislodge loosely bound bacteria, specimens with adhered bacteria were removed and washed thrice with phosphate buffered saline (PBS) solution. Following this, each specimen were placed in sonicator tubes with 1.5 ml of PBS solution and sonicated at frequency of 40 kHz for 30 seconds to disperse the biofilms (Figure 2c). The suspension obtained after sonication was diluted at 10, 100 and 1000 and 10,000 times and aliquots were made. The dilution of *S. mutans* was done to avoid the false results of biofilm adherence, as the organism has a property of formation of biofilm due to coaggregation. 10 µl aliquot of each dilution was seeded on Brain heart infusion agar and incubated at 37°C for 24 hours (Figure 3). Colonies formed on the agar were counted and mean values of colony forming units (CFU) were noted (Figure 4).



Figure 2a: Prepared ceramic specimens (IPS emax Ceram and IPS d. Sign).

Figure 2b: Specimens along with standard bacterial suspension placed in microtitre plates.

Figure 2c: Specimen with phosphate buffered saline placed in sonicator tubes.

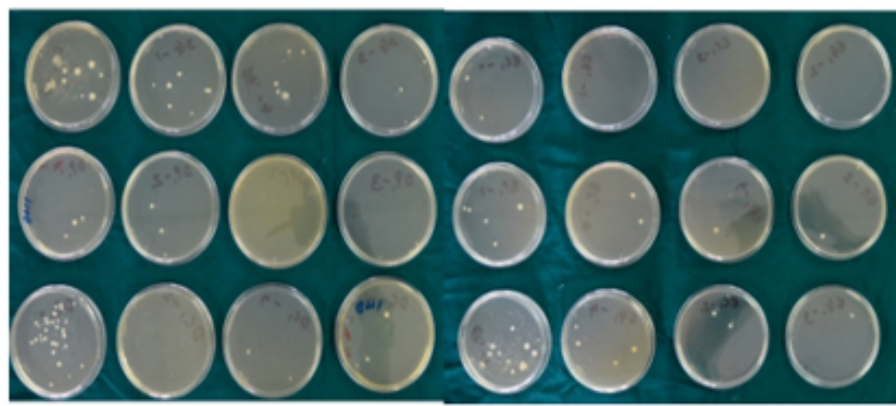


Figure 3: Growth of *S. mutans* colonies on Brain heart infusion agar plates.



Figure 4: Colony counting on the brain heart infusion agar plate.

Qualitative bacterial adhesion using scanning electron microscope (Zeiss Evo 18 special edition)

One specimen from each group was selected and examined under Scanning Electron Microscopy. The specimens were mounted on aluminium stubs using double adhesive tape and observed in Zeiss Evo 18 Special Edition Scanning Electron Microscope. Photographs were captured at magnifications of 1000× to qualitatively evaluate the bacterial adhesion on the specimens (Figure 5 and 6).

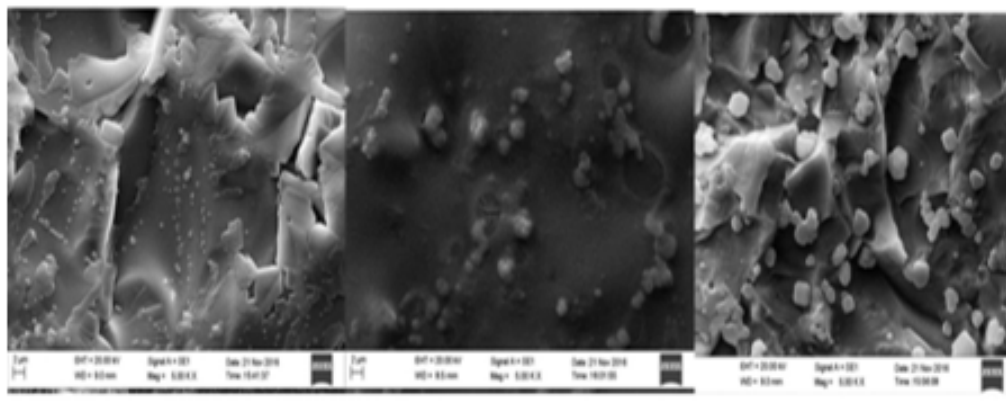


Figure 5: *Ips e max Ceram: glazed, polished and chairside adjusted. (Scanning electron microscope images).*

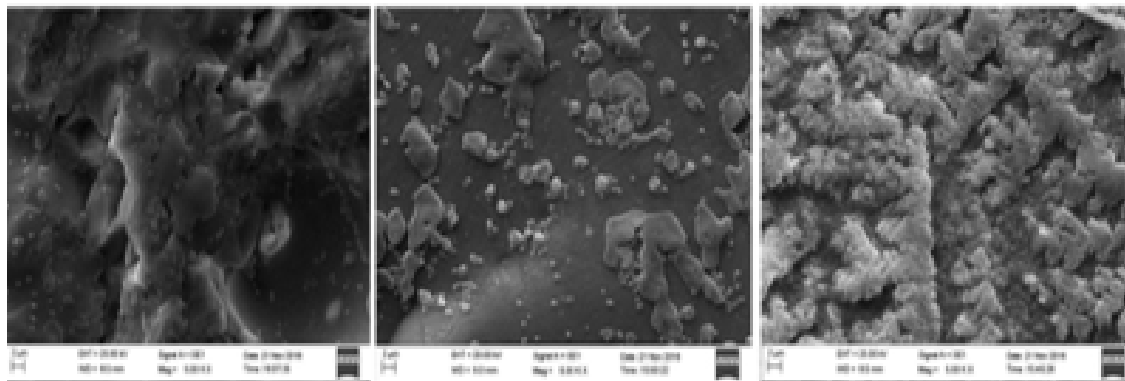
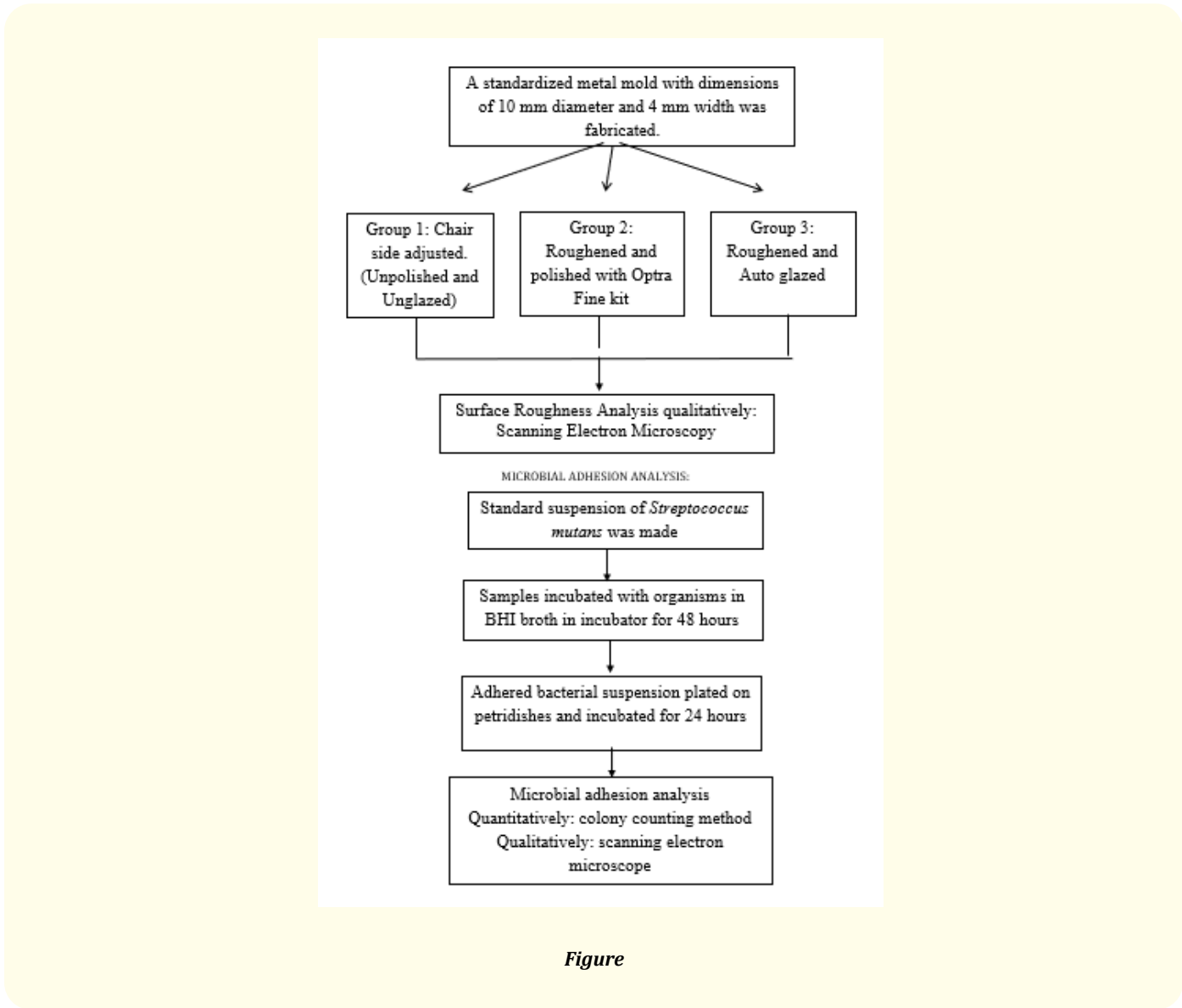


Figure 6: *Ips d Sign: glazed, polished and chairside adjusted. (Scanning electron microscope images).*

Statistical analysis was conducted using independent t test to compare respective subgroups of each ceramic system. One-way anova to test the bacterial adhesion difference among the different ceramic system. Significant differences were further analyzed by the Post Hoc Tests of multiple comparisons using LSD (Least Significant Difference).

Flowchart of the methodology

Fabrication of ceramic specimens



Figure

Results

SEM photomicrographs’ evaluation showed that chairside adjusted surfaces have the roughest surface and highest *S. mutans* adhesion in both the dental ceramics. Surface polished with optrafine polishing kit had smoothest surface compared to glazed specimens and lesser bacterial adhesion.

With respect to bacterial adhesion, statistical analysis revealed no significant difference when comparison was done between the two ceramics using independent t test ($p < 0.05$) (Table 2).

| | | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
|--------------------|------------|----|-----------------|-----------------|-----------------------|---|-----------|
| | | | | | | Lower | Upper |
| Glazed | Dilution 0 | 14 | .075 | -2.50E+01 | 1.30E+01 | -5.29E+01 | 2.90E+00 |
| | Dilution 1 | 14 | .130 | 2.75E+02 | 1.71E+02 | -9.18E+01 | 6.42E+02 |
| | Dilution 2 | 14 | .745 | -3.75E+03 | 1.13E+04 | -2.80E+04 | 2.05E+04 |
| | Dilution 3 | 14 | .000 | 3.75E+04 | 7.26E+03 | 2.19E+04 | 5.31E+04 |
| Polished | Dilution 0 | 14 | .065 | -8.38E+01 | 1.10E+01 | -1.07E+02 | -6.01E+01 |
| | Dilution 1 | 14 | .120 | 3.50E+02 | 7.41E+01 | 1.91E+02 | 5.09E+02 |
| | Dilution 2 | 14 | .110 | 2.00E+04 | 5.82E+03 | 7.51E+03 | 3.25E+04 |
| | Dilution 3 | 14 | .227 | 7.50E+03 | 5.94E+03 | -5.24E+03 | 2.02E+04 |
| Chairside adjusted | Dilution 0 | 14 | .060 | -1.45E+03 | 3.19E+01 | -1.51E+03 | -1.38E+03 |
| | Dilution 1 | 14 | .072 | -9.01E+03 | 1.10E+02 | -9.25E+03 | -8.78E+03 |
| | Dilution 2 | 14 | .012 | -4.88E+04 | 1.28E+04 | -7.63E+04 | -2.12E+04 |
| | Dilution 3 | 14 | .050 | -1.89E+05 | 1.20E+04 | -2.15E+05 | -1.63E+05 |

Table 2: 't' test was used to compare between respective sub-groups of different porcelains (IPS emax Ceram and IPS d.SIGN) and 'p' values were calculated.

*: 't' test was used to compare between respective sub-groups of different porcelains (IPS emax Ceram and IPS d.SIGN) and 'p' values were calculated.

Statistical analysis using one-way anova revealed significant difference within IPS e max Ceram (F = 25854.521, p < 0.05) and IPS d SIGN (F = 38393.419, p < 0.05) (Table 3).

| | | | Sum of Squares | df | Mean Square | F | Sig. |
|-----------------|----------------|----------------|----------------|----------|-------------|-----------|------|
| IPS e max Ceram | Dilution 0 | Between Groups | 8.08E+07 | 2 | 4.04E+07 | 25854.521 | .000 |
| | | Within Groups | 3.28E+04 | 21 | 1.56E+03 | | |
| | | Total | 8.09E+07 | 23 | | | |
| | Dilution 1 | Between Groups | 5.88E+08 | 2 | 2.94E+08 | 6695.822 | .000 |
| | | Within Groups | 9.23E+05 | 21 | 4.39E+04 | | |
| | | Total | 5.89E+08 | 23 | | | |
| | Dilution 2 | Between Groups | 2.28E+12 | 2 | 1.14E+12 | 2965.674 | .000 |
| | | Within Groups | 8.09E+09 | 21 | 3.85E+08 | | |
| | | Total | 2.29E+12 | 23 | | | |
| | Dilution 3 | Between Groups | 1.24E+12 | 2 | 6.21E+11 | 2375.679 | .000 |
| | | Within Groups | 5.49E+09 | 21 | 2.61E+08 | | |
| | | Total | 1.25E+12 | 23 | | | |
| IPS d. SIGN | Dilution 0 | Between Groups | 1.48E+08 | 2 | 7.42E+07 | 38393.419 | .000 |
| | | Within Groups | 4.06E+04 | 21 | 1.93E+03 | | |
| | | Total | 1.48E+08 | 23 | | | |
| | Dilution 1 | Within Groups | 2.06E+09 | 2 | 1.03E+09 | 12743.425 | .000 |
| | | Total | 1.70E+06 | 21 | 8.08E+04 | | |
| | | Between Groups | 2.06E+09 | 23 | | | |
| | Dilution 2 | Within Groups | 2.72E+12 | 2 | 1.36E+12 | 2805.815 | .000 |
| | | Total | 1.02E+10 | 21 | 4.85E+08 | | |
| | | Total | 2.73E+12 | 23 | | | |
| Dilution 3 | Between Groups | 2.49E+12 | 2 | 1.24E+12 | 3473.384 | .000 | |
| | Within Groups | 7.53E+09 | 21 | 3.58E+08 | | | |
| | Total | 2.50E+12 | 23 | | | | |

Table 3: One Way ANOVA (Analysis of variance) shows the comparison between the groups within IPS e max and IPS d.SIGN with their probability 'p' values.

*: One Way ANOVA (Analysis of variance) shows the comparison between the groups within IPS e max and IPS d.SIGN with their probability 'p' values.

Post hoc test revealed that, on comparison between glazed sub-group and sub-group polished with Optrafine polishing kit the ‘p’ value is 0.000 with positive mean difference (4.35E+02 for IPS d SIGN and 4.94E+02 for IPS e max Ceram). Therefore, the Optrafine polished surfaces has lesser bacterial adherence than the glazed surfaces. On comparison between glazed sub-group and chairside adjusted sub-group the ‘p’ value is 0.000 with negative mean difference (-5.04E+03 for IPS d SIGN and -3.62E+03 for IPS e max Ceram). Therefore, the glazed surface has lesser bacterial adherence than the chairside adjusted surface. The ‘p’ value on comparison between Optrafine polished sub-group and chairside adjusted subgroup is 0.000 with negative mean difference (-5.48E+03 for IPS d SIGN and -4.12E+03 for IPS e max Ceram). Therefore, Optrafine polished surface has lesser bacterial adherence than the chairside adjusted surface (Table 4 and 5).

| Dilutions | One Way Analysis of Variance | Post Hoc Test for Multiple comparisons using Tukey HSD | | | | | |
|------------|------------------------------|--|---------|--------------------|---------|--------------------|---------|
| | | Group 1vs Group 2 | | Group 1 vs Group 3 | | Group 2 vs Group 3 | |
| | | Mean difference | p Value | Mean difference | p Value | Mean difference | p Value |
| Dilution 0 | F=38393.41’ p=.000 | 4.35E+02 | .000 | -5.04E+03 | .000 | -5.48E+03 | .000 |
| Dilution 1 | F=12743.42’ p=.000 | 3.40E+03 | .000 | -1.77E+04 | .000 | -2.11E+04 | .000 |
| Dilution 2 | F=2805.81’ p=.000 | 1.85E+05 | .000 | -6.04E+05 | .000 | -7.89E+05 | .000 |
| Dilution 3 | F=3473.38’ p=.000 | 1.26E+05 | .000 | -6.11E+05 | .000 | -7.38E+05 | .000 |

Table 4: IPS d sign comparison (Post Hoc Test).

| Dilution | One Way Analysis of Variance | Post Hoc Test for Multiple comparisons using Tukey HSD | | | | | |
|------------|------------------------------|--|---------|-------------------|---------|--------------------|---------|
| | | Group 1vs Group2 | | Group 1vs Group 3 | | Group 2 vs Group 3 | |
| | | Mean difference | p Value | Mean difference | p Value | Mean difference | p Value |
| Dilution 0 | F=25854.52’ p=.000 | 4.94E+02 | .000 | -3.62E+03 | .000 | -4.12E+03 | .000 |
| Dilution 1 | F=6695.82’ p=.000 | 3.33E+03 | .000 | -8.44E+03 | .000 | -1.18E+04 | .000 |
| Dilution 2 | F=2965.67’ p=.000 | 1.61E+05 | .000 | -7.20E+05 | .000 | -5.59E+05 | .000 |
| Dilution 3 | F=2375.67’ p=.000 | 1.56E+05 | .000 | -3.85E+05 | .000 | -5.41E+05 | .000 |

Table 5: IPS e max ceram comparison (Post Hoc Test).

Discussion

Clinical adjustments performed in ceramic restorations for correction of occlusal contacts and inadequate contours create roughened surfaces which lead to soft tissue irritation, plaque accumulation and gingival inflammation. Mechanical polishing and glazing are the methods to create smooth ceramic surfaces. It was seen that some polishing methods can produce ceramic surface texture equal to the glazed ceramic specimens [13-15] while other studies found the results superior to the glazed surfaces [16-19]. Hence, no definite conclusion can be drawn from the existing studies regarding the best technique for creating a smooth surface which will allow the least bacterial adhesion following clinical adjustment [20-22].

In the present study, two layering ceramics are used. IPS d. SIGN (feldspathic ceramic) is mainly used as a veneering ceramic material for metal ceramic restoration whereas IPS e max Ceram (lithium disilicate) is used as a veneering ceramic material for all ceramic restorations. All 60 specimens used in present study were made of incisal layering material, which is the surface layer of ceramic that undergoes changes during clinical adjustments. This is in accordance with the study conducted to compare polished and self-glazed ceramic by Warren C. Wagner and Marion J. Edge [23].

Clinical adjustments were undertaken by a single operator. It was simulated by roughening the specimen using fine yellow finishing diamond points attached to an airtor hand piece for standard time duration of one minute with limited strokes. Fine grit diamond points were used since medium or high grit points cause opening of large pores. These large pores are difficult to close with both reglazing and chair side polishing [24].

Glazing forms a thin layer of glass over the surface of ceramic and gives an apparent shining appearance in SEM photomicrographs. A thicker glaze layer would probably provide a smoother surface, but it would also produce a duller surface [25].

Optra fine ceramic polishing kit (Ivoclar Vivadent) was used since this polishing system employs final finishing with diamond polishing paste. Use of diamond paste during final stages of polishing gives best possible finish [26] due to its smaller particle size [27].

Streptococcus mutans has been identified as the major etiological agent of human dental caries and composes a significant proportion of the oral streptococci in carious lesions. Growth of bacteria was carried out in Brain heart infusion medium which is highly nutritious, for culturing fastidious and non fastidious anaerobic microorganisms such as streptococci. Inoculation of ceramic samples was done for 48 hours in a standardized bacterial suspension. Time period of 48 hours was chosen after learning the growth curve of the organism. Standard bacterial suspension was made using spectrophotometer according to the optical density [28]. In order to achieve a countable number of bacteria from a high concentration culture; the serial dilution technique is employed: a series of dilutions of the original population is made, and samples from each dilution are spread onto agar plates. In the present study, three dilutions are made.

In the present study, surface roughness was evaluated qualitatively using a Scanning Electron Microscope. The bacterial adhesion was evaluated both quantitatively and qualitatively using Colony counting method and Scanning Electron Microscope respectively. This is in consensus with a study performed by Diane T Vo., *et al.* for assessing the adherence of *Streptococcus mutans* on lithium disilicate ceramic specimens [28].

As results showed a significant difference within the groups by ANOVA analysis, the null hypothesis of this study has been rejected. The result of this study as analyzed by average colony forming units (CFU) have shown that there is a difference found in the amount of bacterial adhesion on ceramic surfaces after using chair side ceramic polishing system and auto glazing the ceramic specimens. When the two ceramic systems were compared, there were no statistically significant differences between microbial adhesions in the two ceramics.

According to the SEM photomicrographs, the Optrafine chair-side ceramic polishing system produced smoother surfaces than both chairside adjusted and glazed surfaces. The extremely smooth surface finish with the Optra fine kit can also be explained by the smaller particle size of the diamond polishing paste. The quantitative results obtained using the microbial colony counting was in accordance with the qualitative result obtained using SEM photomicrographs after adhesion of *S. mutans*.

Within the limited scope of the study, it can be concluded that glazing could be an effective alternative to Optrafine chair-side polishing system in order to get a smooth surface with lesser bacterial adherence.

The present study has some limitations, finishing and polishing of the specimen were limited to a single protocol. Newer techniques of finishing and polishing and comparison with different polishing systems can be employed in future. Surface roughness varies amongst different finishing techniques in feldspathic ceramic [29-31].

In this study comparison amongst autoglazed and polished ceramic surfaces have been undertaken. Overglazing of the ceramic surfaces gives a much satisfactory results than polished ceramics [10,11]. However, the overlying glaze wears off overtime [9]. The future study should take overglazed ceramic surfaces under consideration. Also, bacterial adherence has been compared amongst two different ceramic materials, the assessment against enamel or cementum would have been more beneficial.

The true biofilms intraorally are heterogenic consisting of different microorganisms, however, the present study was composed of a single microorganism type, *S. mutans* [32].

Growth conditions of bacteria can also be manipulated to better recreate the typical oral environment. Instruments such as a drip flow reactor, laminar flow conditions, etc. can be used to simulate such an environment [33].

The results of this study is requires verification with a larger sample size and by taking into consideration the above mentioned points.

Conclusion:

Within the limits of this *in vitro* study, the following conclusions can be drawn:

1. Any clinically adjusted ceramic restorations should be either glazed or polished to reduce the bacterial adhesion.
2. Ceramic surfaces polished with Optrafine ceramic polishing kit (Ivoclar Vivadent) exhibits the least *Streptococcus mutans* adhesion in both IPS emax Ceram and IPS d.SIGN ceramics.
3. Polished surfaces of both ceramics showed less bacterial adhesion than autoglazed surfaces in terms of bacterial adhesion.
4. Scanning Electron Microscopic observations and bacterial colony counting analysis indicates that polishing yields smoother surface and least bacterial adhesion compared to autoglazed surfaces.
5. There is no significant difference in adhesion of *S. mutans* on both the ceramic systems.

Bibliography

1. Heather J Conrad., *et al.* "Current ceramic materials and systems with clinical recommendations: A systematic review". *Journal of Prosthetic Dentistry* 98 (2007): 389-404.
2. Zalkind M., *et al.* "Porcelain surface texture after reduction and natural glazing". *Journal of Prosthetic Dentistry* 55 (1986): 30-33.
3. Newitter DA., *et al.* "An evaluation of adjustment and postadjustment finishing techniques on the surface of porcelain-bonded-to-metal crowns". *Journal of Prosthetic Dentistry* 43 (1982): 388-395.
4. Aykent F., *et al.* "Effect of different finishing techniques for restorative materials on surface roughness and bacterial adhesion". *Journal of Prosthetic Dentistry* 103 (2010): 221-227.
5. Ekedo M., *et al.* "Effect of surface characteristics on adherence of *S. mutans* biofilms to indirect composite resin". *Dental Materials* 26.6 (2007): 915-923.
6. WF Liljemark and C Bloomquist. "Human oral microbial ecology and dental caries and periodontal diseases". *Critical Reviews in Oral Biology and Medicine* 7.2 (1996): 180-198.
7. Al Marzok M and Al Ajjawl H. "The effect of surface roughness of porcelain on adhesion of oral *Streptococcus mutans*". *The Journal of Contemporary Dental Practice* 10.6 (2009): 1-7.
8. Sarac D., *et al.* "The effects of porcelain polishing systems on the color and surface texture of feldspathic porcelain". *Journal of Prosthetic Dentistry* 96 (2006): 122-128.
9. Jacobi R., *et al.* "A comparison of the abrasiveness of six ceramic surfaces and gold". *Journal of Prosthetic Dentistry* 66 (1991): 303-309.

10. Bawane P, *et al.* "Comparative evaluation of microbial adhesion on porcelain subjected to two different surface treatments". *TPDI* 4.1 (2013): 17-19.
11. Lavaf S., *et al.* "In Vitro Effects of Four Porcelain Surface Treatment Methods on Adhesion of Lactobacilli Acidophilus". *Journal of Dental School* 33.2 (2015): 131-137.
12. Owen S., *et al.* "Finishing and polishing porcelain surfaces chairside". *International Dentistry - Australasian Edition* 6.4 68-73.
13. Sethi S., *et al.* "An in vitro investigation to compare the surface roughness of auto glazed, reglazed and chair side polished surfaces of Ivoclar and Vita feldspathic porcelain". *The Journal of Indian Prosthodontic Society* 13 (2013): 478-485.
14. Brewer JD., *et al.* "Clinical discrimination between autoglazed and polished porcelain surfaces". *Journal of Prosthetic Dentistry* 64 (1990): 631-635.
15. Sulik WD and Plekavich EJ. "Surface finishing of dental porcelain". *Journal of Prosthetic Dentistry* 46 (1981): 217-221.
16. Jagger DC and Harrison A. "An in vitro investigation into the wear effects of unglazed, glazed, and polished porcelain on human enamel". *Journal of Prosthetic Dentistry* 72 (1994): 320-323.
17. Haywood VB., *et al.* "Effects of water, speed and experimental instrumentation on finishing and polishing porcelain intraorally". *Dental Materials* 5 (1989): 185-188.
18. Zalkind M., *et al.* "Porcelain surface texture after reduction and natural glazing". *Journal of Prosthetic Dentistry* 55 (1986): 30-33.
19. Kamala KR and Annapurni H. "Evaluation of surface roughness of glazed and polished ceramic surface on exposure to fluoride gel, bleaching agent and aerated drink: An in vitro study". *The Journal of the Indian Prosthodontic Society* 6 (2006): 128-132.
20. Klausner LH., *et al.* "Polished versus autoglazed porcelain surfaces". *Journal of Prosthetic Dentistry* 47 (1982): 157-162.
21. Campbell SD. "Evaluation of surface roughness and polishing techniques for new ceramic materials". *Journal of Prosthetic Dentistry* 61 (1989): 563-568.
22. Jacobi R., *et al.* "A comparison of the abrasiveness of six ceramic surfaces and gold". *Journal of Prosthetic Dentistry* 66 (1991): 303-309.
23. Edge JM and Wagner WC. "Surface cracking identified in polished and self-glazed dental porcelain". *Journal of Prosthodontics* 3 (1994): 130-133.
24. Oh W., *et al.* "Factors affecting enamel and ceramic wear: A literature review". *Journal of Prosthetic Dentistry* 87 (2002): 451-459.
25. Massimo Fuzzi., *et al.* "Scanning Electron Microscopy and Profilometer Evaluation of Glazed and Polished Dental Porcelain". *The International Journal of Prosthodontics* 9 (1996): 452-458.
26. Goldstein GR., *et al.* "Profilometer, SEM and visual assessment of porcelain polishing methods". *Journal of Prosthetic Dentistry* 65 (1991): 627-634.
27. Al-Wahadni A. "An in vitro investigation into the surface roughness of glazed, unglazed and refinished ceramic materials". *Journals: QI Quintessence International* 37 (2006): 311-317.
28. Diane T Vo., *et al.* "Adherence of *Streptococcus mutans* on lithium disilicate porcelain specimens". *Journal of Prosthetic Dentistry* 114.5 (2015): 696-701.
29. Aravind P, *et al.* "Comparative evaluation of the efficiency of four ceramic finishing systems". *International Journal of Oral and Dental Health* 5 (2013): 59-64.

30. Kawai K., *et al.* "Effect of surface roughness of porcelain on adhesion of bacteria and their synthesizing glucans". *Journal of Prosthetic Dentistry* 83 (2000): 664-667.
31. Viera AC., *et al.* "Evaluation of the Surface Roughness in Dental Ceramics Submitted to Different Finishing and Polishing Methods". *The Journal of Indian Prosthodontic Society* 13.3 (2013): 290-295.
32. Hojo K., *et al.* "Bacterial interactions in dental biofilm development". *Journal of Dental Research* 88 (2009): 982-990.
33. Goeres DM., *et al.* "A method for growing biofilm under low shear at the air- liquid interface using the drip flow biofilm reactor". *Nature Protocol* 4 (2009): 783-788.

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