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Lithium Disilicate Polishability And Finishing After Glazing Using Different Polishing Systems

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Objective
The study is aimed to compare the surface roughness between chairside polished, autoglazed and reglazed surface of lithium disilcate.

Materials and method
Forty five lithium disilcate (Cerec) blocks were used which were cut into rectangular shape, 1mm width of each. The samples were divided into three groups of autoglazed, reglazed and polished, using DirectDia paste(lime flavour) by Shofu, after use of silicone rubber bur on the surface. The surface roughness was measured using a surface profilometer before and after using the polishing paste.

Results
The mean Ra value was found highest for reglazed group (1.13) and was found lowest for autoglazed (1.06).There was no statistical difference between independent samples of the three groups according to Kruskal Wallis test.

Conclusion

There was no statistical difference found on comparing the three groups, however it was observed that chairside polishing paste is a better alternative than reglazing on comparing with autoglazed samples.

Keywords: Dental ceramics; Polishing; Glazing; Surface roughness; Profilometer; Polishing kit.

INTRODUCTION

Modern prosthetic dentistry has taken a great leap towards technological advancements and accommodating it in day to day procedures[1, 2]. Computer Aided Design Manufacturing has now become an integral part of many dental clinics and colleges, it can be wholly completed by using a workflow that may mirror the conventional method. A single restoration unit can be created chairside by using CADCAM[3],[4].

Different ceramic systems have been introduced in dentistry with various mechanical properties suitable for individual cases [5]. Glass ceramics and high-strength core ceramics are used with an esthetic multilayer ceramic to produce a natural appearance[6]. Glass ceramics are traditional sintered feldspathic, Lucite, or lithium disilicate ceramics with Silicon Dioxide as one the key component [7]. These are used for inlays,onlays, veneers and a variety of other purposes. Nonmetallic opaque layered materials like alumina, zirconium, or lithium disilicate restorations come in the second category.[7].

Tooth coloured restorations are highly preferred due their aesthetics but they need to be evenly glazed and smooth. The maintenance of the glaze during clinical trials can be a task as corrections may be inevitable, adjustments may be required for function or the surface may become rough during removal of the excess cement [8],[9]. If the surface remains rough it will lead to plaque accumulation and staining of the ceramic, abrasion of the opposing tooth and eventually its wear, secondary caries, etc. [9]. Post any such correction, reglazing is recommended but time constraints and lab outsourcing procedure can be long and it can add to one more clinical appointment. Also further correction may be needed after the laboratory work is over and therefore chairside polishing paste would be a good alternative,

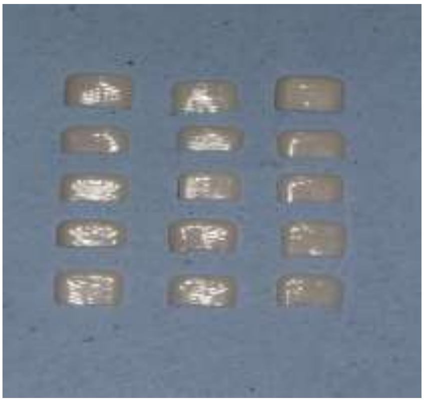
This study focuses on quantitatively checking the surface roughness by using Surface Profilometer for checking the roughness of autoglazed, reglazed and surface polished paste [10].

MATERIAL AND METHOD

Preparation of samples

Forty five lithium disilicate disks were prepared as specimens from the milled CEREC® blocks. Each sample were of 1-1.5mm thickness and approx dimensions of each disk are 0.5cm*1cm.

Figure 1: The samples prepared using used CEREC® blocks (0.5cm*1cm)



The samples of lithium disilicate were divided into three groups with fifteen samples in each group. The groups were segregated as:
GROUP 1: autoglazed lithium disilicate (control)
GROUP 2: reglazed lithium disilicate
GROUP 3: polished chair side lithium disilicate

Group 1 (autoglazed) was checked for its surface roughness and kept as a control group. Group 2 and 3 were roughened with diamond burs of green band, polished with yellow band bur and the silicone wheel bur was used. For polishing, the burs were moved unidirectional and 60 seconds for each sample. Group 2 was then sent for reglazing back to the laboratory and group 3 was polished chairside using DirectDia® polishing paste by Shofu®.

Figure 2: The polishing burs used in sequence for reglazing lithium disilicate blocks

Figure 3: The polishing paste, DirectDia® used over the lithium disilicate blocks for chair side glazing

The groups were then checked for their surface roughness by using a contact surface profilometer SJ 310®. This profilometer used a probe to detect the surface by physically moving the probe along the surface to acquire the surface height. This is done mechanically with a feedback loop that monitors the force from the sample pushing up against the probe as it scans along the surface. Profilometer uses a probe through a physical moment to detect the surface height. Small vertical features ranging in the height of 10 nanometers to 1 millimetre can be measured through a typical profilometer. The diamond stylus's height position produces an analog signal that is transformed into a digital signal, saved, examined, and shown. The diamond stylus's radius spans from 20 to 50 µm, and the data signal sampling rate and scan speed govern the horizontal resolution. There is a range of less than 1 to 50 milligrams for the stylus tracking force[11].

In this study, the profile is determined along three lines of the surface using a tracking device. The average roughness deviation (Ra) is the parameter under evaluation. The Ra parameter, which is the arithmetic mean, indicates the surface's overall roughness.The average value of all absolute distances inside the measurement length from the centerline in the roughness profile.

Figure 4: The Surface profilometer **SJ 310®** used to evaluate the morphological properties of the glazed lithium disilicate blocks

Statistical Analysis

The roughness was compared for each sample using the non-parametric Kruskal Wallis test for independent samples (p 0.5). IBM SPSS Statistics 23 software was used for extracting the significant differences between the three groups.

RESULTs

SURFACE ROUGHNESS EVALUATION (QUANTITATIVE)

Disks of lithium disilicate blocks (CEREC) were tested for their surface roughness by profilometer [12]. Surface roughness of each group was calculated, Ra values obtained and mean was drawn. The fifteen samples of each group were checked and their mean was as follows, for group 1 autoglazed group it is 1.083, group 2 reglazed group is 1.529 and for group 3 polished group it is 1.1806. On calculating the descriptive statistics of mean of the three samples the Ra values were obtained and it was found that the lowest was for autoglazed and highest mean for reglazed [13] (Table 1). Independent samples Kruskal Wallis test was performed on the three samples. The significance was 0.187 and so the null hypothesis is retained (Table 2).

Further Tukey HSD study was performed on comparing the three groups no statistical difference was found ($p > 0.05$) .

Table 1: Table showing the Mean ± standard error for the surface roughness (Ra) parameter assessed on the lithium disilicate samples using surface profilometer

Samples	Mean ± Standard Error for roughness
autoglazed	1.083 ± 0.107
reglazed	1.526 ± 0.182
polished	1.180 ± 0.132

Table 2: Table showing the results of Kruskal-Wallis test for surface roughness of all the groups

Hypothesis Test Summary

The distribution of roughness is the same across categories of groups.	independent - samples Kruskal-Wallis test	.187	Retain the null hypothesis.

Dependant variable: Roughness

Tuskey HSD

Comparison between groups	Mean difference	Std. error	95% confidence interval		Sig.
			lower	upper	
Group 1-2	-0.455	0.204	-.951	.040	.078
Group 2-3	0.322	0.204	-.173	.817	.266
Group 1-3	0.133	0.204	-.362	.629	.791

Discussion

Since lithium disilicate (LiSi2O5) has outstanding mechanical, biocompatible, and aesthetic features, it has become a prominent material in restorative dentistry.

Glazing Method:

Composition and Microstructure: Silicon dioxide and lithium oxide make up the glass-ceramic substance known as lithium disilicate. By applying a layer of glass to the surface, glazing improves the surface's optical qualities and offers a barrier of protection.

Glazing enhances the translucency and colour stability of restorations made of lithium disilicate. In order to get a natural appearance that melds in perfectly with the surrounding dentition, this is essential.

Protection of the Surface: The glazed layer serves as a shield against wear and other outside elements like staining agents. This helps the restoration last longer and keep its attractive appearance over time[14].

Chair-side Polishing:

Surface Smoothing: A crucial step in fine-tuning the surface morphology of lithium disilicate restorations is chairside polishing. To get a smooth finish, mechanical polishing tools, including those with diamond impregnated instruments, are frequently used.

Enhancement of Aesthetics: Polishing improves lithium disilicate's optical qualities, increasing light reflection and giving it a glossy look. This is especially crucial for restorations in the oral cavity's visible regions.

Biocompatibility: Chairside polishing makes sure that there are no surface defects in the restoration, which lowers the possibility of bacterial adherence and improves gingival health. Biocompatibility is still a crucial factor in dental materials.

After cementation, ceramic surfaces frequently need to be adjusted. Unglazed ceramics that have been shown to enhance wear on the opposing teeth will be exposed by finishing, which will also lessen the ceramic material's strength[15].There is still disagreement.

In the investigation into the best intraoral polishing method for ceramics that yields a glaze-like finish[16] As declared previously, the glazed and polished ceramics' surface roughness when surfaces were examined, it was found that polishing could create a surface that is similar to a glazed surface.[17] The study of roughness after finishing allows glass ceramics to be screened and superficially analysed based on their surface characteristics. Roughness can be described by a number of three-dimensional (Sa, Sq, Sz) or linear (Ra, Rq, Rz) qualities. For the purposes of this investigation, Roughness Average (Ra), which is the most commonly used metric for evaluating the effect of finishing methods on dental ceramics, was looked at out of these. Ra is the most widely used metric for assessing how finishing processes affect dental ceramics. It is defined as the mean arithmetical value of all the absolute distances of the profile inside of the measuring length.[18][19].

In dentistry, Ra is a commonly used measure of surface roughness, particularly when used in conjunction with tactile profilometry.[19] Most frequently, a Ra value is utilized as a typical approximation of surface abrasion. According to Sarikaya I et al., "Ra parameter characterizes a surface's general roughness and is determinable as the

total absolute distances' arithmetical average value of the middle line's roughness profile inside the measurement "length." Additionally, with contact gadgets like Profilometer, measuring it is simple, and the device is affordable and accessible. Non-contact gadgets often employed lasers or a light beam to scan the surface[18, 20]. This results from the dispersing impact of the glared light. In the given study we compared the surface roughness of autoglazed lithium disilicate disks with disks which were roughened by the silicone burs and polished by TF 21 yellow band diamond bur at controlled speed, uniform direction and uniform timing. One group was the control and other two groups on which burs were used were divided in group 2 and 3 as reglazed and polished respectively. Group 2 was sent to the laboratory for reglazing in a curing unit and group 3 we used chairside polishing paste diamond dia by Shofu. On conducting the statistics it was found that there is not much significant difference between the 3 groups as independent samples for surface roughness parameters but in Tukey HSD study when compared among them it was found that group 1 did not have much significant difference compared to the other two groups. Also, on comparing group 2 and 3 no significant difference was found. Thus, concluding that autoglazed restoration requiring no adjustments will be the choice of interest but in practicality that is not the case scenario always and hence a good chairside polishing paste is a good alternative to sending the restoration back to the lab[21]. It saves appointment, patients time and cost beneficial as well and also a polishing paste can cover more surface area and since its a paste it will give us controlled movement compared to to using chairside polishing disks and burs[14]

CONCLUSION

Within the limitation of this invitro study, the following conclusions were drawn:

1. Autoglazed had the lowest Roughness average(Ra) among the three groups.
2. On comparing the two polishing methods used between laboratory and chairside, statistical difference was not found . It can be ventured into for a more elaborate study with different more polishing systems.

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CONFLICT OF INTEREST

Authors had no conflict of interest.

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