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# ORIGINAL RESEARCH

## Surface roughness of glazed and chair-side zirconia using different polishing systems

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***ABSTRACT:***
**Background:** The present study was conducted to compare the surface roughness of glazed and chair-side polished monolithic zirconia. **Materials & Methods:** 35 discs were divided into 5 groups of 7 specimens each. Group I was roughened, unpolished and unglazed. Group II (Positive Control) was glazed without prior roughening, group III was roughened and polished with eZr polishing kit, Group IV was roughened and polished with Optra fine ceramic polishing kit and Group V was roughened and glazed. The surface roughness (Ra) values (µm) were measured. **Results:** The mean surface roughness value in group I was 1.25 µm, in group II was 0.54 µm, in group III was 0.49 µm, in group IV was 0.48 µm and in group V was 0.57 µm. The difference was significant (P< 0.05). **Conclusion:** The present study was conducted to compare the surface roughness of glazed and chair-side polished monolithic zirconia.
**Key words:** Polishing system, Surface roughness, Zirconia.

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## INTRODUCTION

All-ceramic materials such as zirconia or zirconium dioxide-based materials are the viable treatment options for fixed dental prostheses due to their excellent mechanical properties related to transformation toughening and enhanced natural appearance. They have been gaining their popularity due to good chemical properties, dimensional stability, biocompatibility, high flexural strength (900–1200 MPa), high fracture toughness (9–10 MPa/m$^2$), high stiffness (Young's modulus 210 GPa), and a low corrosion potential.

Currently, there are two types of zirconia restorations used; these are zirconia veneered with feldspathic porcelain (ZVP) and monolithic zirconia (MZ). Chipping or fracture of the veneering layer is the most commonly reported clinical complication for ZVP. MZ restorations which contain only zirconia are directly exposed to the oral environment that does not require veneered with esthetic material. Thus, the absence of veneering porcelain could eliminate the chipping problem.

There are several solutions to overcome the veneer cracking problem, namely, alternative application of

techniques for veneering such as CAD/CAM-produced veneer modification of the firing procedures and modification of the framework design. Recently, monolithic or full contoured Y-TZP was introduced to overcome this problem and has become increasingly popular as a result of advances in CAD/CAM technology. The monolithic yttria-stabilized tetragonal zirconia polycrystal has been used in posterior region, especially for single crowns, in patients with limited inter-occlusal space. The present study was conducted to compare the surface roughness of glazed and chair-side polished monolithic zirconia.

## MATERIALS & METHODS

The present study comprised of 35 discs using monolithic zirconia. Approval for the study was obtaining before starting it.

Zirconia discs were measuring 10 mm in diameter and 2 mm in thickness were milled. A single shade (A2) was selected. 5 specimens were randomly selected as the positive control. The remaining discs were abraded for 15 seconds with a red band diamond finishing bur using an air rotor hand piece. Specimens were divided into 5 groups of 7 specimens each. Group I was roughened, unpolished and unglazed. Group II (Positive Control) was glazed without prior roughening, group III was roughened and polished with eZr polishing kit, Group IV was roughened and polished with Optra fine ceramic polishing kit and Group V was roughened and glazed. The surface roughness (Ra) values (μm) were measured quantitatively by a surface analyzer and assessed under a scanning electron microscope (SEM) for surface topography. Results were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

## RESULTS

**Table I Distribution of specimens**

| Groups | Group I | Group II | Group III | Group IV | Group V |
|---|---|---|---|---|---|
| Method | Roughened, unpolished and unglazed | (Positive Control) glazed without prior roughening, | Roughened and polished with eZr polishing kit, | Roughened and polished with Optra fine ceramic polishing kit | Roughened and glazed |
| Number | 7 | 7 | 7 | 7 | 7 |

Table I shows distribution of specimens and type of method used for polishing.

**Table II Assessment of surface roughness values (Ra) in all specimens**

| Specimen | Group I | Group II | Group III | Group IV | Group V |
|---|---|---|---|---|---|
| 1 | 1.08 | 0.50 | 0.49 | 0.46 | 0.42 |
| 2 | 1.24 | 0.51 | 0.50 | 0.49 | 0.52 |
| 3 | 1.32 | 0.52 | 0.46 | 0.46 | 0.71 |
| 4 | 1.33 | 0.54 | 0.47 | 0.47 | 0.77 |
| 5 | 1.34 | 0.49 | 0.46 | 0.48 | 0.52 |
| 6 | 1.35 | 0.65 | 0.52 | 0.54 | 0.51 |
| 7 | 1.24 | 0.34 | 0.51 | 0.50 | 0.52 |

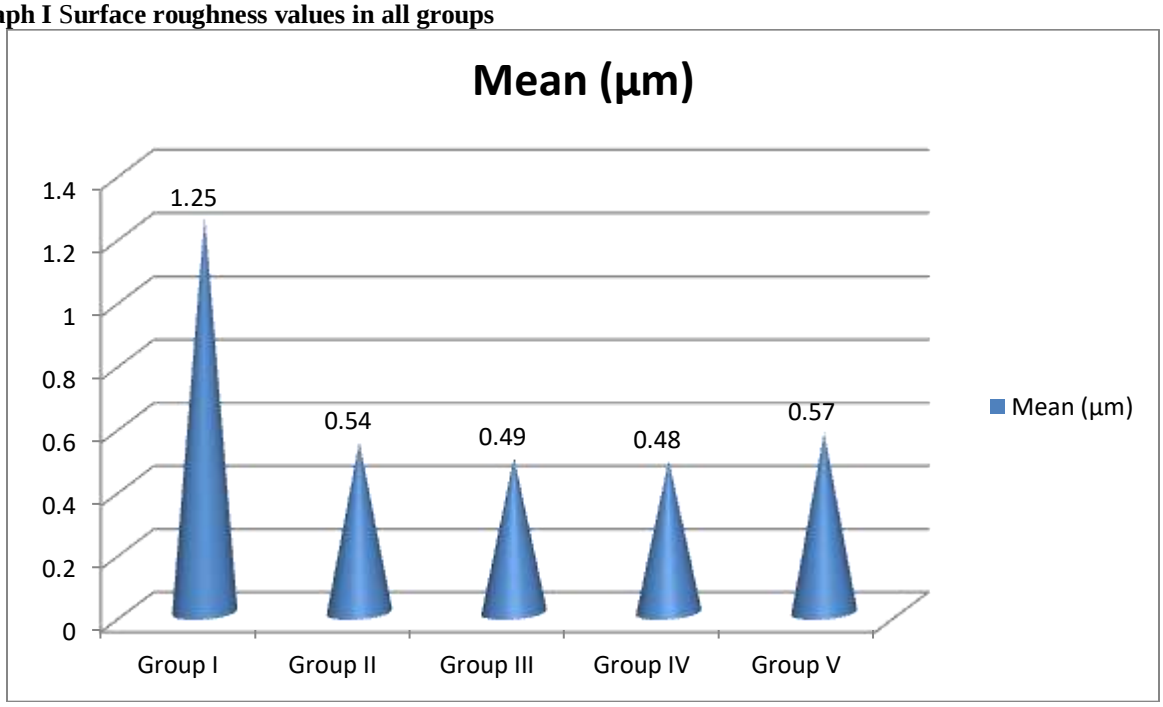
Table II shows the average surface roughness values (Ra) obtained in micrometers (μm) in all groups.

**Table III Surface roughness values in all groups**

| Groups | Mean (μm) | P value |
|---|---|---|
| **Group I** | 1.25 | 0.001 |
| **Group II** | 0.54 | |
| **Group III** | 0.49 | |
| **Group IV** | 0.48 | |
| **Group V** | 0.57 | |

Table III, graph I shows that mean surface roughness value in group I was 1.25 μm, in group II was 0.54 μm, in group III was 0.49 μm, in group IV was 0.48 μm and in group V was 0.57 μm. The difference was significant (P< 0.05).

**Graph I Surface roughness values in all groups**




## DISCUSSION

Over the last decades, there have been a large number of dental materials and new ceramic systems have been successfully introduced for clinical use in dentistry. Recently, the popularity of Y-TZP ceramics (yttrium-stabilized tetragonal zirconia polycrystalline) has increased for prosthetic dentistry due to its excellent mechanical properties, biocompatibility and esthetic potential compared to conventional dental ceramics. Intraoral polishing systems have become an alternative method for re-glazing, which is important to prevent or minimize rapid wear of the opposing teeth. In addition, polishing improves the longevity and esthetics of restorations by eliminating the defects created by surface grinding. Zirconia is a polymorphic metastable material and exists in several major phases: monoclinic (m), cubic (c) and tetragonal (t). However, this material undergoes microstructural changes by the stress application and phase transformation from t phase into the m phase. The present study was conducted to compare the surface roughness of glazed and chair-side polished monolithic zirconia.

In present study, zirconia specimens were divided into 5 groups of 7 specimens each. Group I was roughened, unpolished and unglazed. Group II (Positive Control) was glazed without prior roughening, group III was roughened and polished with eZr polishing kit, Group IV was roughened and polished with Optra fine ceramic polishing kit and Group V was roughened and glazed. Gaonkar evaluated the efficiency of two commercially available polishing systems in reducing surface roughness of a monolithic zirconia after clinical adjustment and to compare them to glazed zirconia. The lowest Ra value was found in Group 4-Roughened and polished with Optrafine ceramic polishing kit (Ra=0.47µm) as compared to Group 3-Roughened and polished with eZr polishing kit (Ra=0.49µm) and Group 5-Roughened and glazed (Ra=0.59µm). There was no statistically significant difference between two polishing systems. SEM analysis of surfaces polished with Optrafine polishing kit revealed smoother and regular morphology as compared to surfaces polished with eZr polishing kit. The Optrafine polishing kit created more smoother and uniform surfaces as compared to surfaces polished with eZr polishing kit both quantitatively and qualitatively. Also, lowest surface roughness values were produced by optrafine ceramic polishing kit on monolithic zirconia as compared to glazed monolithic zirconia after their clinical adjustments. Thus Optrafine ceramic polishing kit can be used as alternative to glazing.

We found that mean surface roughness value in group I was 1.25 µm, in group II was 0.54 µm, in group III was 0.49 µm, in group IV was 0.48 µm and in group V was 0.57 µm. Caglar et al evaluated and compared three polishing systems on the surface roughness and phase transformation of monolithic zirconia. 100 disk shaped specimens (10 mm diameter, 3 mm thickness) were fabricated from monolithic zirconia blocks. 20 specimens were left as a control group and remaining specimens were grinded by diamond bur to simulate the occlusal adjustments. All polishing groups showed a smoother surface than group G. Among 3 polishing systems, group M and group E exhibited a smoother

surface than the group P. However, no significant differences were observed between group M and group E (P>.05). Grinding and polishing did not cause phase transformations in zirconia specimens.

## CONCLUSION

Authors found that lowest surface roughness values were produced by optrafine ceramic polishing kit on monolithic zirconia as compared to glazed monolithic zirconia.

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