Fit of high translucent zirconia fixed dental prostheses using two different intraoral scanners

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Abstract

Purpose: To assess the marginal and internal fit of monolithic zirconia fixed dental prostheses (FDPs) comparing two different intraoral scanners and assessment methods. Materials and Methods: A maxillary typodont with three prepared teeth allowed the fabrication of five-unit, high-translucency monolithic zirconia FDPs. The typodont was scanned with intraoral scanners Cerec Omnicam and 3Shape Trios 3. A total of 30 FDPs were milled from presintered high-translucency zirconia blocks. Dual-scan and silicone replica assessments were used to determine marginal and internal gaps. Results: Statistical significance was observed for marginal gap (Trios:
74.27 ± 10.4 μm; Cerec: 86.45 ± 14.3 μm) and internal gap (Trios: 126.12 ± 12.7 μm; Cerec: 112.38 ± 17.2 μm) comparisons. **Conclusion:** The outcomes of this study showed that the Trios 3 produced a better overall marginal fit while the Cerec Omnicam created a better internal fit. Additionally, greater overall marginal and internal gap were noted with the silicon replica method over the dual-scan method. *Int J Prosthodont 2022. doi: 10.11607/ijp.8317*

**Introduction**

Digital workflows using intraoral scanners (IOS) and milling machines are replacing traditional prosthodontic methods.¹,² Developments in these new methods allow clinicians to integrate novel materials and techniques into their everyday practice without compromising clinical success.

Recently, Zirconia has become an increasingly popular alternative restorative material to metal-ceramic restorations in the posterior area as they are able to support fixed dental prostheses (FDPs).³,⁴ Traditionally the general opacity of zirconia posed an aesthetic challenge for the anterior region.⁴ Zirconia now has three translucency options, a high, a medium, and a low translucency. The high translucency material is becoming increasingly popular for anterior restorations as they are more aesthetic than metal-ceramic restorations.⁴

The purpose of this study was to determine marginal and internal fit of monolithic zirconia fixed dental prostheses comparing two different intraoral scanners and assessment methods.

**Materials and Methods**
Utilizing a maxillary typodont model without the right lateral incisor and first premolar, the maxillary right second premolar, canine and central incisor were prepared by a single operator to fabricate 5-unit high-translucency monolithic zirconia FDPs.

The typodont was scanned 30 times with 2 different intraoral scanners: 15 times with Cerec Omnicam (Sirona Dental System, Bensheim, Germany) and 15 times with 3Shape Trios 3 (3Shape, Copenhagen, Denmark). Each digital scan was saved in Standard Tessellation Language (STL) file format. All 5-unit FDPs were digitally designed by creating a 50-micron space for cement (internal surfaces only) and fabricated from each corresponding digital scan. After sending each digital scan to the milling machine, a total of 30 FDPs were fabricated from pre-sintered high-translucency zirconia blocks (ZOLID-HT, Straumann AG, Basel, Switzerland) with a 5-axis milling machine.

Two different assessment methods (dual scan and silicone replica) were used to determine marginal and internal fit of the FDPs (Figure 1). For the dual scan method, the typodont with prepared abutments was scanned as the reference. Then all 30 fabricated zirconia FDPs were lined with a separating oil (Yeti Lube, YETI Dentalprodukte, Engen, Germany), thinned and air sprayed. All retainers of the FDP were filled with a polyvinyl siloxane (PVS) light body impression material and placed on the prepared typodont with a 1-kg load until the PVS material set. The FDPs were carefully removed, and excess was trimmed. The PVS material that remained on the prepared teeth represented the discrepancy between the preparations and the intaglio surface of the restorations, then they were scanned again. Both scans were superimposed on each other for digital evaluation (comparison of 20,000 points) by using a 3-D industrial scanner (ATOS II, Triple scan,
SN:110031, Braunschweig, Germany) and an inspection and metrology software (GOM Inspect Professional, version 2017, Braunschweig Germany) (Figure 2).

For the silicone replica method, the intaglio surfaces of the retainers of the FDPs were lined with a light body silicone PVS material and placed on the prepared typodonts with a 1-kg load until the material set. Then, the FDPs were removed, the retainers were filled with a heavy body PVS material and were left to set. The silicone replica was then separated and sectioned at buccolingual and mesiodistal dimensions, producing four sections. Then all sections were magnified and imaged under high resolution (45x magnification, stereomicroscope, SMZ168; Motic, Richmond, Canada) and imported into an imaging software (ImageJ, US National Institutes of Health, Bethesda, MA, USA). For each replica, a total of 32 points of measurement (12 marginal points, 20 internal points [12 axial and 8 occlusal]) were used.

Effects of IOS types (3Shape and Cerec) and assessment techniques (Dual scan and silicon replica) on marginal and internal gaps were statistically investigated by using two-way repeated measures ANOVA since the assumptions of normality and homogeneity in group variances were satisfied. The significance level was set at p < 0.05.

**Results**

Data regarding marginal and internal gaps and descriptive statistics are displayed in Table 1. The overall mean marginal gap for the FDPs showed a statistically significant difference between the 3Shape (74.27 ± 10.4 μm) and the Cerec (86.45 ± 14.3 μm) scanner. The overall mean values for internal gap indicated a statistically significant difference between the 3Shape (126.12 ± 12.7 μm) and Cerec (112.38 ± 17.2 μm) scanner. Although there was no overall difference in
mean marginal gap values between the dual scan and silicone replica methods, there was a statistically significant difference in the overall internal gap values.

**Conclusions**

Based on the findings of this study, the following conclusions were drawn:

1) The 3Shape Trios 3 scanner produced a better overall marginal fit while the Cerec Omnicam scanner created a better internal fit.

2) Greater overall marginal and internal gaps were noted with the silicon replica method than the dual scan method.

**Conflict of Interest:** The authors do not have any conflicts of interest for this article.

**References**


Table 1: Marginal and internal gap values (mean ± standard deviations) of each group. Identical letters (lowercase versus upper case) indicate statistically significant differences (p < 0.01: a vs A, b vs B, c vs C, and p < 0.05: d vs D, e vs E).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Marginal gaps in micron (μm)</th>
<th>Silicon Replica</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dual Scan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Shape</td>
<td>76.23 ± 7.135</td>
<td>72.3 ± 13.092 a</td>
<td>74.27 ± 10.458 b</td>
</tr>
<tr>
<td>Cerec</td>
<td>80.27 ± 4.422</td>
<td>92.63 ± 18.193 A</td>
<td>86.45 ± 14.353 B</td>
</tr>
<tr>
<td>Overall</td>
<td>78.25 ± 6.137</td>
<td>82.47 ± 18.622</td>
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</table>

<table>
<thead>
<tr>
<th>Groups</th>
<th>Internal gaps in micron (μm)</th>
<th>Silicon Replica</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dual Scan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Shape</td>
<td>118.22 ± 10.410 c</td>
<td>134.02 ± 9.868 C</td>
<td>126.12 ± 12.773 D</td>
</tr>
<tr>
<td>Cerec</td>
<td>110.68 ± 11.237</td>
<td>114.07 ± 22.206</td>
<td>112.38 ± 17.216 d</td>
</tr>
<tr>
<td>Overall</td>
<td>114.45 ± 11.229 e</td>
<td>124.04 ± 19.607 E</td>
<td></td>
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</tbody>
</table>
**Figure 1:** Measurement regions for marginal (purple) and internal fit evaluations (blue).

**Figure 2:** Both scans were superimposed on each other for digital evaluation with an inspection and metrology software.