Influence of Extraoral Polishing of the Crown-Abutment Interface on the Marginal Fit of Screw-and-Cement Retained Prostheses: A Clinical Pilot Study

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ABSTRACT

Purpose: To assess the effect of extraoral polishing of the crown-abutment interface on the marginal fit of implant-supported screw- and cement-retained prostheses (SCRP). Materials and Methods: In 31 patients, the marginal gap of SCRPs before and after polishing of the crown-abutment interface was measured using a stereomicroscope, and the paired data were compared. Results: The marginal gap was significantly decreased after surface polishing, regardless of the material of the
prosthesis ($P < .001$). **Conclusion:** Extraoral polishing of the crown-abutment interface could improve the marginal fit of SCRPCs. *Int J Prosthodont* 2021. doi: 10.11607/ijp.6971

**INTRODUCTION**

Implant-supported fixed dental prostheses (FDP) are classified into screw-retained, cement-retained, or screw-and-cement retained type, according to the retention mechanism of the suprastructure to the underlying implant. The screw-and-cement retained prosthesis (SCRP) has features of both screw- and cement-retained prostheses. The cementation of crown provides passive adaptation to the prosthetic abutment, which reduces the harmful residual stresses and the sensitivity of manufacturing process. The presence of the screw access hole in the crown enables the removal of the crown-abutment complex by unscrewing the abutment screw. Accordingly, the excess cement can be removed outside the mouth immediately after cementation of the crown. The prosthesis can be retrieved with ease in case of mechanical complications occurring in the follow-up period.

Marginal fit of the crown to the abutment is an important factor in determining the prognosis of FDP. The marginal fit has been assessed using diverse methods. The existing methods can be classified into destructive and nondestructive techniques based on the reusability of the FDPs after evaluating the adaptation. The sectioning technique that uses the mechanical section of the prosthesis involves an irreversible defect to the prosthesis and therefore cannot be used in the clinical setting. In contrast, nondestructive methods enable repeated measurements of the abutment–prosthetic interface without damage to the prosthesis. Among the nondestructive methods, stereomicroscopy is widely considered reliable for
evaluating prosthesis fit. The examination with a stereomicroscope for the marginal gap provides a higher degree of misfit detection. In the literature, marginal discrepancies have been reported with a wide range from 1.2 to 187.5 µm. Low marginal fit accuracy can increase plaque accumulation and bacterial growth along the margins, leading to inflammatory peri-implant diseases, and loss of supporting alveolar bone. The marginal misfit is also associated with cement dissolution and subsequent loss of prosthesis retention.

Although the importance of the marginal fit of the prosthesis has been emphasized, there have been few studies on the minimization of crown marginal gap after cementation in SCRP. The purpose of this research was to evaluate the effects of polishing the crown-abutment interface on the marginal fit of SCRP in a randomized clinical study. The null hypothesis was that no significant differences would be found in the marginal gap before and after the polishing of the crown-and-abutment interface area of SCRP.

**MATERIALS AND METHODS**

Thirty-one consecutive patients (12 men, 19 women; age range, 18-76 years; mean age, 56 ± 13.49 years) who required implant-supported FDP were included in this clinical study as per the following inclusion criteria: SCRP type; premolar or molar area; and monolithic zirconia or metal-ceramic prostheses. The exclusion criteria included the screw- or cement-retained type, incisors or canine areas, complete cast or bilayered zirconia prostheses. The overall study protocol (described in Fig 1) was approved by the Institutional Review Board of Kyungpook National University Dental Hospital (2019-03-06-00).

An identical prosthetic treatment procedure was used for all the enrolled patients. A pick-up type silicone impression (Aquasil Ultra XLV and Aquasil Ultra LV,
Dentsply Sinora) was made with the open-tray technique. Customized abutments were designed with the dental CAD software (IDC D1, Amann Girrbach), and fabricated by milling titanium alloy blocks (Ti6Al-4V ELI, Perryman Company) using a 5-axis milling machine (Ceramill Motion 2, Amann Girrbach). The finish lines on the abutments were designed as the deep chamfer form at the buccal area and chamfer form at the other areas. Definitive metal-ceramic prostheses were made with traditional lost wax and casting technique using a casting alloy (4-all, Ivoclar Vivadent) and a veneering porcelain (VITA VMK Master, Vita Zahnfabrik). Monolithic zirconia prostheses were prepared using a zirconia block (Prettau, Zirkonzhan). A gap of 50 µm was set for the cementation space of the prostheses. On the day of delivery, the customized abutment was connected to the implant with a torque force of 25 N/cm² using an electric torque driver (MEG-TORQ, MegaGen), and the final prosthesis was fixed to the abutment with resin cement (RelyX Unicem, 3M). The crown-abutment complex was removed following cementation, and stepwise surface polishing was performed with a polishing system (Jota kit 1434, Jota). A fine-grit stone was first gently brushed over the surface of interface area of the complex from abutment to the crown to remove steps. This was followed by brushing with a medium-grit silicone wheel and a fine-grit silicone point. Polishing was done using a low-speed electronic handpiece with 20,000 rpm, under no water spray as per the manufacturer’s instructions. When the smooth surface was obtained, the remaining polishing compound was removed via steam cleaning. After the polishing step, the crown-abutment complex was finally connected to the implant with a torque force of 25 N/cm².

The marginal gap of the prosthesis at mid-buccal and lingual sites was measured before and after the polishing procedure using a stereomicroscope.
(EGVM-452M, EGTECH) at a magnification of ×60 (Fig 2). Each value was calculated by averaging three measurements to reduce the error of measurement. Paired t-test and two-way analysis of variance (ANOVA) were performed to investigate the effect of polishing on the marginal gap in different prosthesis materials (SPSS Statistics v25.0, IBM; α=.05). All prosthetic treatment, polishing, and measurements were carried out by a single clinician.

RESULTS
Marginal gap measurements of the prostheses before and after polishing are shown in Table 1 (17 monolithic zirconia, 23 metal-ceramic). At all measurement points, the marginal gap was significantly decreased after polishing (P<.05; Fig 3). Initial marginal misfit was larger in the zirconia prostheses than in the metal-ceramic prostheses. Two-way ANOVA did not show a significant interaction between the polishing and the prosthesis material on the resulting marginal gap change (F=.161; P=.72).

DISCUSSION
The results of this study showed that the marginal fit was enhanced by the polishing of the crown-abutment interface, regardless of the prosthesis material. Thus, the null hypothesis of this study was rejected. Where intraoral access allows, margins can be finished directly inside the mouth. The areas where access for finishing is restricted, such as the proximal or subgingival areas, are precisely where plaque control is difficult. The crown-abutment complex can be retrieved with ease in SCRP, but not in the cement-retained prostheses. Thus, an advantage of SCRP is that it permits extraoral surface polishing.

The basic objective of margin polishing is to obtain a highly polished surface without steps at the transition area between the prosthesis to abutment. The present
study showed that a marginal gap can be substantially improved by extraoral polishing in the SCRP prostheses. The gap reduction mechanism may be attributed to the burnishability of the abutment margin. Polishing the interface area with stones and silicone burs can cause elongation of abutment margins due to the plastic deformation of the abutment alloy by extrinsic forces.\textsuperscript{9} The plastic deformation increases in alloys with high malleability. Thus, it is assumed that the polishing effect could be more significant with higher abutment malleability. Moreover, when the crown portion is also an alloy, the marginal gap may further decrease. Time spent for the extraoral margin polishing enabled us to obtain smooth margins, potentially resulting in longer lasting prostheses. Care must be taken not to remove materials excessively than is necessary. Excessive finishing could incur problems in the emergence profile and weaken the finished prosthesis.

Although the finding of this study was drawn in the design of a controlled clinical trial, the effect of polishing on the marginal gap can vary according to the polishing method, type of cement, and emergence profile. Further comprehensive clinical studies are needed to verify the results of this study and facilitate the application of margin polishing in the SCRP.

CONCLUSION

The removal of the crown-abutment complex after crown cementation and surface polishing of the interface area could decrease the marginal gap in SCRP.

ACKNOWLEDGMENTS

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REFERENCES


**Table 1** Marginal Gap of Zirconia and Metal-Ceramic Prostheses Before and After Polishing (µm)

<table>
<thead>
<tr>
<th>Prosthesis</th>
<th>Polishing</th>
<th>Before</th>
<th>After</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconia</td>
<td>Buccal</td>
<td>117.9 ± 88.1</td>
<td>86.5 ± 76.0</td>
<td>0.002</td>
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<tr>
<td></td>
<td>Lingual</td>
<td>148.0 ± 101.1</td>
<td>101.7 ± 80.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Metal-ceramic</td>
<td>Buccal</td>
<td>64.5 ± 49.0</td>
<td>37.4 ± 27.1</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>Lingual</td>
<td>66.8 ± 46.8</td>
<td>36.5 ± 28.4</td>
<td>&lt;0.001</td>
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</tbody>
</table>
### Table 2 Two-way ANOVA for the Change of Marginal Gap

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polishing</td>
<td>26935.256</td>
<td>1</td>
<td>26935.256</td>
<td>11.063</td>
<td>.001</td>
</tr>
<tr>
<td>Prosthesis material</td>
<td>103045.508</td>
<td>1</td>
<td>103045.508</td>
<td>42.324</td>
<td>&lt;.001</td>
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<tr>
<td>Polishing×Prosthesis material</td>
<td>392.188</td>
<td>1</td>
<td>392.188</td>
<td>0.161</td>
<td>.689</td>
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<tr>
<td>Error</td>
<td>262944.112</td>
<td>108</td>
<td>2434.668</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1143810.690</td>
<td>112</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Corrected total</td>
<td>393317.064</td>
<td>111</td>
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</table>
Figure Legends

Fig 1 Workflow of this study.

Fig 2 Schematic image showing measurement of the marginal gap using a stereomicroscope.

Fig 3 Microscopic view of the marginal gap (a) before polishing in the zirconia crown, (b) after polishing in the zirconia crown, (c) before polishing in the metal-ceramic crown, (d) after polishing in the metal-ceramic crown.
Figures

Fig 1
Fig 2

Microscope

Crown-abutment complex

Marginal Gap
Fig 3

(a)  

(b)  

(c)  

(d)