MARGINAL AND INTERNAL FIT OF METAL COPING CAST FROM WAX PATTERNS FABRICATED BY CAD/CAM AND CONVENTIONAL WAX UP TECHNIQUES

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ABSTRACT

Background: Metal-ceramic crowns are currently the most commonly used crowns for fixed prostheses. The present study was conducted to compare marginal and internal fit of metal coping cast from wax patterns fabricated by CAD/CAM and Conventional Wax up Techniques.

Materials & Methods: The present in vitro study comprised of 30 brass dies were prepared in a lathe were randomly divided into 2 groups based on wax-patterns fabrication method used. Group I used CAD/CAM technique and group II used conventional method.

Results: The mean absolute marginal discrepancy (µm) in group I was 250.6 and in group II was 88.2, marginal gap (µm) was 156.2 in group I and 69.4 in group II, internal gap axial (µm) was 82.7 in group I and 60.8 in group II, internal gap occlusal (µm) was 180.4 in group I and 119.2 in group II and internal gap total (µm) was 112.5 in group I and 78.4 in group II. The difference was significant (P< 0.05).

Conclusion: Conventional method of wax-pattern fabrication produced copings with significantly better marginal and internal fit than CAD/CAM (machine-milled) technique.

Key words: Coping, Metal-ceramic crowns, Wax-pattern fabrication

I. INTRODUCTION

Metal-ceramic crowns are currently the most commonly used crowns for fixed prostheses, but when esthetics are a priority, ceramic crowns are the best choice because they are visually appealing and are also a biocompatible material. Marginal fit, esthetics, and fracture resistance are considered to be the most important criteria for the clinical quality and success of ceramic crowns. Inaccuracy in the marginal adaptation of ceramic crowns can reduce longevity and lead to other adverse effects, such as dissolving of the luting material, microleakage, and plaque retention, which can then cause secondary caries, pulpitis, and periodontal disease. However, despite its importance, no consensus exists regarding the maximum acceptable marginal gap size.

Conventionally, wax patterns were fabricated with wax and waxing instruments for example the popular PKT instruments. Wax is used to make the patterns because it can be conveniently manipulated, precisely shaped and can also be completely eliminated from the mold by heating. The fabrication of the wax pattern is the most critical and labor-intensive step in making the porcelain fused-metal crown. In this time-consuming task, the wax-up’s quality is dependent on the skilled labor of the individual.

By introducing different CAD/CAM systems, it is possible to fabricate the wax patterns made from castable materials and omit several limitations of conventional wax-up technique. CORiTEC President DCS system and Everest system are among the CAD/CAM systems that have the ability to mill frameworks made from castable acrylic. The present study was conducted to compare marginal and internal fit of metal coping cast from wax patterns fabricated by CAD/CAM and Conventional Wax Up Techniques.
II. MATERIALS & METHODS

The present invitro study comprised of 30 brass dies were prepared in a lathe to simulate full coverage PFM crown preparation with a chamfer margin around the entire circumference. A height of 5.5 mm, width of 6 mm at the margin, the convergence angle of 6 degrees, 0.7 mm chamfer width, chamfer radius of 2 mm and an anti-rotational surface was formed. They were randomly divided into 2 groups based on wax-patterns fabrication method used. Group I used CAD/CAM technique and group II used conventional method. All the wax-patterns were fabricated in a standard fashion by means of contour, thickness and internal relief. CAD/CAM milling machine was used to fabricate the CAD/CAM group wax-patterns. The copings cast from 24 wax-patterns were cemented to the corresponding dies. For all the coping-die assemblies cross-sectional technique was used to evaluate the marginal and internal fit at 15 points. Results thus found were assessed statistically. P value less than 0.05 was considered significant.

III. RESULTS

Table I Distribution of specimen

<table>
<thead>
<tr>
<th>Groups</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>CAD/CAM technique</td>
<td>Conventional method</td>
</tr>
<tr>
<td>Number</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Table I shows that each group comprised of 15 dies.

Table II Assessment of marginal and internal gap

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group I</th>
<th>Group II</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute marginal discrepancy</td>
<td>250.6</td>
<td>88.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Marginal gap</td>
<td>156.2</td>
<td>69.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Internal gap axial</td>
<td>82.7</td>
<td>60.8</td>
<td>0.05</td>
</tr>
<tr>
<td>Internal gap occlusal</td>
<td>180.4</td>
<td>119.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Internal gap total</td>
<td>112.5</td>
<td>78.4</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Table II, graph I shows that mean absolute marginal discrepancy (μm) in group I was 250.6 and in group II was 88.2, marginal gap (μm) was 156.2 in group I and 69.4 in group II, internal gap axial (μm) was 82.7 in group I and 60.8 in group II, internal gap occlusal (μm) was 180.4 in group I and 119.2 in group II and internal gap total (μm) was 112.5 in group I and 78.4 in group II. The difference was significant (P< 0.05).

Graph I Assessment of marginal and internal gap

IV. DISCUSSION

Since ceramic crowns were introduced, many changes in their composition have been made to improve their properties. A number of different types of ceramic systems are available for clinical use, but the most common are lithium disilicate and zirconia. The zirconia-based ceramics contain yttrium cation-doped tetragonal zirconia polycrystals (Y-TZP) that have a particular quality known as “transformation toughening.” This gives them excellent mechanical properties for use in the fabrication of frameworks for fixed dental prostheses (FDPs). Ceramic restorations are typically coated with feldspathic ceramic to achieve a natural appearance, but some issues with this coating have been noted, including one main problem that involves the bond between the core and the veneer, which leads to chipping of the veneer ceramic. This disadvantage is associated with a multistep manufacturing process, and several factors may be involved, such as residual tensile stresses following veneering, differences in the toughness between the core and the veneer, and the bond between the core and veneer. Monolithic crowns were developed to solve these problems, although a major esthetic drawback exists.
for these monolithic restorations. The present study was conducted to compare marginal and internal fit of metal coping cast from wax patterns fabricated by CAD/CAM and Conventional Wax up Techniques.

In present study, mean absolute marginal discrepancy (µm) in group I was 250.6 and in group II was 88.2, marginal gap (µm) was 156.2 in group I and 69.4 in group II, internal gap axial (µm) was 82.7 in group I and 60.8 in group II, internal gap occlusal (µm) was 180.4 in group I and 119.2 in group II and internal gap total (µm) was 112.5 in group I and 78.4 in group II. Vojdani et al compared the marginal and internal fit of copings cast from CAD/CAM and conventional fabricated wax-patterns. Twenty-four standardized brass dies were prepared and randomly divided into 2 groups according to the wax-patterns fabrication method (CAD/CAM technique and conventional method) (n=12). The overall mean (SD) for absolute marginal discrepancy (AMD) was 254.46 (25.10) um for CAD/CAM group and 88.08 (10.67) um for conventional group (control). The overall mean of internal gap total (IGT) was 110.77(5.92) um for CAD/CAM group and 76.90 (10.17) um for conventional group. The Student’s t-test revealed significant differences between 2 groups. Marginal and internal gaps were found to be significantly higher at all measured areas in CAD/CAM group than conventional group (p< 0.001).

Reich et al reported that systems; which depend on optical impression, experience problems with rounded edges and ‘over-shooters’. The ‘rounded edges’ and ‘over-shooters’ phenomena have been described for the Cerec intraoral camera, but they apply to all CAD/CAM systems that acquire their optical impression by means of striation projection such as the scanner used in current study. Since there is no elevation of the die geometry in reality, an increase of internal discrepancy may result. Also the scan spray that used to inhibit the reflection during scanning could somehow increase the internal gap, as it makes a fine layer on the brass dies.

Freire et al evaluated the marginal fit among monolithic zirconia, monolithic lithium disilicate, and conventional metal-ceramic crowns and to compare the buccal and lingual surfaces. Thirty standardized stainless steel master dies were fabricated (height: 5 mm; convergence: 6°; chamfer: 1 mm). The dies were randomly divided into three groups (n = 10 each) according to the material used to construct the crowns: group 1 (LM): Lava Plus; group 2 (DM): IPS e.max CAD; and group 3 (MC): Metal-ceramic. The crowns were luted in a standard manner onto the stainless steel master dies using conventional glass ionomer cement. The vertical marginal gap of the restorations was evaluated under a scanning electron microscope (SEM) at 500x magnification. Significant differences among the three groups (p = 0.0001) were recorded. DM group showed the lowest discrepancies (27.95 ± 9.37 µm). Significant differences were observed for the buccal (p = 0.007) and lingual (p = 0.0001) surfaces between the DM group and the other groups.

V. CONCLUSION

Authors found that conventional method of wax-pattern fabrication produced copings with significantly better marginal and internal fit than CAD/CAM (machine-milled) technique.

REFERENCES