The Porosity of Occlusal Margins of Amalgam Filling

The Effect of Overfilling and Burnishing

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Abstract: The present study was conducted to investigate the effect of overfilling and burnishing upon the structure of occlusal margins of lathe cut and spherical alloy amalgam. All the experimental fillings were made in cavities (5 mm in diameter, 3.5 mm in depth and 120° in cavosurface angle) cut in cylinders of plexiglass. The condensation was completed in following three different techniques. 1) The cavities not overfilled, the margins not burnished. 2) The cavities overfilled, the margins not burnished. 3) The cavities overfilled, the margins burnished. The amalgam fillings in the cavities were embedded, sectioned and polished. Microphotographs of the sections of the filling margins were enlarged (328 times) and copied on paper. The porosity was determined on the enlarged prints using the line-sectioning method. In the group of lathe cut alloy amalgam, the differences of the percentage porosity between marginal technique 1 and 2, or 2 and 3 were statistically significant, while in the group of spherical alloy amalgam, there were no significant differences between technique 1 and 2 or 2 and 3. Comparing the two groups, lathe cut and spherical alloy amalgams, technique 1 showed highly significant difference and technique 3 showed probably significant difference but technique 2 showed no significant difference. According to the results of this study, overfilling and burnishing were significantly decreased the porosity of occlusal margins of lathe cut alloy amalgam filling. In the case of spherical alloy amalgam, overfilling and burnishing were not so effective to decrease the porosity.

1. Introduction

Previous studies by Jorgensen and Saito reported that optimal structure of the filling margins can be obtained only by systematic overfilling and burnishing of the margins and by subsequent removal of the excess by carving. In that studies, only one lathe cut alloy was used.

The present study was conducted to investigate the effect of overfilling and burnishing upon the structure of occlusal margins of lathe cut and spherical alloy amalgam.

2. Materials and Methods

Dialloy (G-C Dental Industrial Corp. Japan) as spherical alloy and True Dentalloy (The S.S. White Dental Mfg. Co., G.B.) as lathe cut alloy were selected for use in this investigation (Table 1).

All the experimental fillings were made in cavities cut in cylinders of plexiglass with a diameter of 12 mm and a height of 10 mm. The cavities had a diameter of 5.0 mm and a depth of 3.5 mm, and they were bounded "occlusally" by a conical face which formed an angle of 120° with the cavity wall (Fig. 1).

These amalgams were in all cases mixed in a Wig-L-Bug, 20 seconds with pestle followed by 2 seconds without pestle. Condensation was carried out on a specially designed balance, which enabled the use of a constant condensation pressure. The condensation was in all cases finished within 7 min after trituration.

In Group A, True Dentalloy and mercury were mixed in the proportion 1.120 g/1.034 g (mercury content of 48%). The mix was divided into six increments and each increment was condensed
into the cavity with 30 thrusts of a circular flat plugger with a diameter of 1.8 mm under a controlled condensation pressure of 2 kg. Soft mercury-rich excess was removed after condensation of each increment.

In Group B, Dialloy and mercury were mixed in the proportion 1.120 g/1.9184 g (mercury content of 45%). The subsequent procedure was regulated at 300 g because the plugger penetrated into the filled mix and could not condense under the condensation pressure of more than 300 g.

The condensation was completed in following three different ways.

1. The cavity was not overfilled and not burnished. Only five of the six increments were used. The surface of the filling was smoothed with a wad of dry cotton-wool.

2. The cavity was filled with the five increments and overfilled with the sixth. Excess was removed with a sharp carving instrument, and the filling surface was smoothed with a wad of dry cotton-wool.

3. The cavity was filled with five increments and overfilled with the sixth. The amalgam was then burnished with a slightly convex, circular burnisher (diameter of 2.5 mm) under the same pressure as the condensation pressure. Burnishing was carried out by moving the instrument from the filling toward and across the filling margins. The whole circular area of the filling was given one treatment by the burnisher.

Group A and B were each combined with 1, 2 and 3, so that 6 different test groups resulted. Ten fillings were made for each of these 6 groups. After the preparations had been cut through, a total of 20 filling margins was thus available for the study in each of the 6 groups.

The amalgam fillings in the cavities were embedded in an epoxy resin (Epofix, Struers), sectioned through the axis of the cylindrical specimens, polished on 220, 320, 500 and 1000 grinding paper under running water and finally finished with alumina powder (Fig. 2).

Table 1 Amalgam alloys used

<table>
<thead>
<tr>
<th>Brand</th>
<th>Manufacturer</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Dentalloy</td>
<td>S.S. White Limited. (England)</td>
<td>707408</td>
</tr>
<tr>
<td>Dialloy</td>
<td>G-C Dental Industrial Corp. (Japan)</td>
<td>JM 14</td>
</tr>
</tbody>
</table>

Fig. 1. Cylindrical cavity cut in plexiglass.

Fig. 2. Sectioned and polished surface of the specimen.

Fig. 3. The triangular area of the amalgam margins measured. On the magnified photos, parallel lines were drawn at a distance of 5 mm. Magnification 328 times. $\alpha=60^\circ$, $\beta=45^\circ$. 

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Table 2 Porosity (%) of amalgam margins (n=20)

<table>
<thead>
<tr>
<th>Technique</th>
<th>Technique 1</th>
<th>Technique 2</th>
<th>Technique 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. True Dentalloy</td>
<td>6.9 ± 1.5</td>
<td>3.8 ± 1.9</td>
<td>2.9 ± 1.0</td>
</tr>
<tr>
<td>B. Dialloy</td>
<td>4.9 ± 1.3</td>
<td>4.1 ± 1.6</td>
<td>3.7 ± 1.2</td>
</tr>
</tbody>
</table>

Table 3 Values for Student’s t-test

<table>
<thead>
<tr>
<th>A2</th>
<th>A3</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>5.9***</td>
<td>10.3***</td>
<td>4.6***</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>2.0*</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>2.6*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>1.7</td>
<td>3.0**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Degree of freedom=38

***The difference was highly significant when \( t \geq 3.6 \) (\( p \leq 0.1\% \))

**The difference was significant when \( 3.6 > t \geq 2.7 \) (\( 0.1\% < p \leq 1\% \))

*The difference was probably significant when \( 2.7 > t \geq 2.0 \) (\( 1\% < p \leq 5\% \))

Fig. 4. The percentage porosity of the amalgam margins studied.

A. lathe cut alloy (True Dentalloy). B. spherical alloy (Dialloy). 1. the cavities not overfilled, the margins not burnished. 2. the cavities overfilled, the margins not burnished. 3. the cavities overfilled, the margins burnished. (T lines show the standard deviations.)

Microphotographs of the sections of the filling margins were uniformly enlarged (approximately 328 times) and copied on paper 13 x 18 cm. The porosity was determined on the enlarged prints using the line-sectioning method. From the point of cavity wall, at the depth of 13 cm, a line angled 45° with cavity wall was drawn. Parallel lines to this line were drawn at a distance of 5 mm up to the marginal edge (Fig. 3). Total length of parallel lines on amalgam filling and the sum of line length sectioned by pores surrounded by amalgam were measured and the percentage porosity of the amalgam margins was calculated.

3. Results

The results are shown in Table 2, 3 and Fig. 4. Table 2 shows mean value and standard deviation for porosity, while Table 3 gives the values for Student’s \( t \)-test.

In the group A, the differences of the percentage porosity between marginal technique 1 and 2, or 2 and 3 were statistically significant, while in the group B, there were no significant differences between technique 1 and 2, or 2 and 3. Comparing group A and B, technique 1 showed highly significant difference and technique 3 showed probably significant difference but technique 2 showed no significant difference.

4. Discussion

It is known that the spherical alloy amalgam is well condensed under a low pressure. But this also means that a high condensation pressure is not applicable. In this study, it was revealed that the overfilling and burnishing were not so effective to reduce the marginal porosity of spherical alloy amalgam.

On the other hand, a high condensation pressure is applicable for the lathe cut alloy amalgam, and the overfilling and burnishing effectively reduce the marginal porosity. When compared with the best results of two groups, the marginal porosity of the lathe cut alloy amalgam was significantly lower than that of the spherical alloy amalgam.

Although the materials and methods were almost same as the previous studies by Jørgensen and Saito about True Dentalloy, the percentage porosity did not agree with the results of this study. About technique 1 and 2, this discrepancy may be explained by the difference of measuring methods. As regards the vertical edge of amalgam filling, they drew a mid-line for the surface roughness and measured the area between this line and filling as the porosity. While in this study only the porosity surrounded by amalgam was measured. But about technique 3, above described reason may not be applicable, since the data in this study was larger than that of previous studies. It may be caused by the difference of operator.
5. Conclusions

The effect of overfilling and burnishing upon the porosity of occlusal margins of lathe cut and spherical alloy amalgam was investigated.

According to the results of this study, overfilling and burnishing were significantly decreased the porosity of occlusal margins of lathe cut alloy amalgam filling.

In the case of spherical alloy amalgam, overfilling and burnishing were not so effective to decrease the porosity.

References


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