ABSTRACT

Polymerization shrinkage ratio is one of the important properties/factors for composite restorative materials. There are two ways to evaluate the polymerization shrinkage: shrinkage ratio and shrinkage force (stress). Newly developed low shrinkage resin composite, GC Kalore, was compared with commercially available resin composites for both volumetric polymerization shrinkage ratio and polymerization force.

METHODS

Materials

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Shade</th>
<th>Lot No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC TEC</td>
<td>GC Corporation, Tokyo, Japan</td>
<td>A2</td>
<td>007112</td>
</tr>
<tr>
<td>GDP</td>
<td>GC Corporation, Tokyo, Japan</td>
<td>A2</td>
<td>011129</td>
</tr>
<tr>
<td>FS</td>
<td>GC Corporation, Tokyo, Japan</td>
<td>7NA</td>
<td>L07277</td>
</tr>
</tbody>
</table>

Comparison of shrinkage force of various resin composites: Figure 4. Shrinkage force (N)

1. Preparation of the test sample

0.5g each of composite paste was extruded onto the glass plate (unpolymerized sample). 0.5g each of composite paste was polymerized for 40 seconds from top and 40 seconds from bottom by light irradiation with a light curing unit (G-Light, GC)(polymerized sample).

2. Determination of density of unpolymerized sample [D1] and polymerized sample [D2]

The sample placed in position 1(position of the sample in air) on the density measuring apparatus is shown in Figure1. The mass is determined and recorded as Ma. The temperature of the buoyancy medium is measured and recorded. The sample placed in position 2(position of the sample in the buoyancy medium) of the density measuring apparatus. The mass of the sample in the buoyancy medium is determined and recorded as Mb. Density of the sample is calculated with the following equation:

\[ D = \frac{Ma - Mb}{Dg - (Mb - (Mg x (D0 - Dg)))} \]

3. Calculation of polymerization shrinkage

Polymerization shrinkage of this sample is calculated with the following equation:

\[ S = \frac{D - D_0}{D_0} \times 100 \]

Analysis

Statistical analysis was performed using one-way ANOVA and Tukey's test (p-value < 0.05).

RESULTS

Mean values of polymerization shrinkage ratio and force including standard deviations were shown in Figure 3 and 4. (Tests per material: n=5). Same letter means no significant difference.

DISCUSSION

Recently, several new resin composites were introduced in global markets. Some of the new resin composites are claimed as low polymerization shrinkage (KA, TEC, ND, and HD). Those newly introduced resin composites were compared with existing resin composite for volumetric shrinkage rate and shrinkage force. KA, TEC and ND show lower volumetric shrinkage rate than other resin composites, whereas shrinkage ratio and shrinkage force are high correlation. (see, Figure 5). However, KA, GDP and HD shows relatively lower shrinkage force from linear line. Flexural modulus of those resin composites are shown(Figure 6). KA, GDP and HD show low flexural modulus. Low flexural modulus of resin composite may help reduce shrinkage force.

CONCLUSION

1. Some of the recently introduced resin composite shows low volumetric shrinkage ratio and low shrinkage force.
2. Volumetric shrinkage ratio and shrinkage force have high correlation.
3. Lower flexural modulus may help reduce shrinkage force.
4. KA shows significantly lower shrinkage force (p-value < 0.05).