The atraumatic restorative treatment (ART) approach for primary teeth: review of literature

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Abstract

There is widespread interest in and increasing usage of the atraumatic restorative treatment (ART) technique or approach for the restoration of primary teeth, especially in developing countries. However, most of the published reports of the clinical performance of newer, more-viscous esthetic conventional glass ionomer restorative cements marketed for the technique have been from short-term studies, and there have been very few reports comparing different types of restorative materials and methods of cavity preparation. After 12 months, Class II/multisurface and Class III/IV ART restorations have generally shown success rates of approximately 55-75% and 35-55%, respectively. Failures were usually from restoration losses and fractures. Class I & V/single-surface ART restorations have had much better short-term success rates of approximately 80-90%. Recurrent caries was not a concern at this time, but occlusal wear was relatively high. Further improvements in the mechanical and adhesive properties of the newer cements are still required, together with further clinical investigations of the remineralization of shallow open preparations as an alternative to placing restorations. The ART approach is readily accepted by children and has resulted in the retention of many teeth that would otherwise have been extracted. (Pediatr Dent 22:294-298, 2000)
adjusting the occlusion and sealing the restoration with a varnish (Figs 1-4).

Restoration survivals

Although the newer more-viscous GICs appear promising for the restoration of caries in primary teeth, most of the published reports are only of 12 month’s duration, and very few have compared different types of restorative materials or methods of cavity preparation. Of concern have been the percentages of short-term GIC failures reported for shallow and multisurface load-bearing restorations.

In particular, as shown in Table 1, even with the newer GIC materials, Class II/multisurface and Class III/IV ART restorations generally have low success rates after 12 months, of approximately 55-75% and 35-55%, respectively. After 24 months, one study reported a success rate of 45% and, after 30 months, another study reported a success rate of 54% for Class II/multisurface ART restorations. After 30 months, only 14% of Class III/IV ART restorations were successful.

The use of a high powder: liquid ratio mix of 3.6:1.0 for an autotrue resin-modified GIC (Fuji Plus - GC Int. Corp., Tokyo, Japan), has demonstrated results over 6 months of approximately 78% for Class II/multisurface restorations. These initial, improved results may have been due to better fracture resistance and adhesion to tooth structure of the resin-modified GIC when compared to conventional GICs. But, the relatively higher wear rates of the resin-modified GICs may lead subsequently to lower success rates. Although studies investigating the use of composites for ART restorations in the primary teeth are reported to be underway, there are no published results in literature. The Class I & V/single-surface ART restorations have shown much better success rates after 12 months of approximately 80-95%. Recurrent caries has not been noted as a cause for restoration failures in the short-term studies.

Occlusal wear

There is very little information available on the occlusal wear of the newer more-viscous esthetic GICs in primary molars. One recent study reported cumulative net mean wear rates after 12 months of 66.5 ± 40.4 µm (Fuji IX GP - GC Int. Corp., Tokyo, Japan), and 70.3 ± 48.2 µm (ChemFlex - Dentsply/DeTrey, Konstanz, Germany). These wear rates were higher than for similar occlusal restorations in the permanent teeth of the same subjects, and higher than the 50 µm per year recommended by the American Dental Association guidelines.

Cavity preparations

There are also very few reports of studies investigating the adequacy of different methods of cavity preparations for the newer GICs, either in the primary or permanent dentitions.

After 6 months, in one small study of two encapsulated viscous esthetic GICs placed in primary molars, success rates for Class I preparations were 94% (one failure) for conventional, and 100% for ART instrumentation methods. However, success rates for Class II preparations were 100% for conventional, and 75% (seven failures) for ART instrumentation methods. After 12 months, the success rates for Class I preparations were approximately 92% for both conventional and ART instrumentation, but for Class II preparations the success rates were 87% for conventional and 79% for ART. Failures occurred from restoration losses because of inadequate retention and mechanical properties of the GICs. Lack of retention is also commonly found with Class III/IV ART preparations, as shown in the Table, and where the cements are used to restore shallow occlusal preparations and to seal occlusal pits and fis-
sures. It is sometimes difficult to achieve adequate bulk of cement and macromechanical retention form using the ART hand instruments.

One three-year study of an earlier conventional GIC placed as proximal restorations in primary molars, using conventional instrumentation, found similar cumulative success rates of 75% for microcavities, and 68% for modified G.V. Black’s Class II cavities. Another study over 5-14 months of two earlier conventional GICs also found no clear differences in the success rates between proximal cavities in primary molars prepared with (81%), and without (79%, an occlusal dovetail, when using conventional instrumentation. Generally, the success rates of earlier conventional GICs placed in Class II preparations have been very low, with median survival times of approximately 2-3 years, and amalgam restorations have performed better. Because of their low fracture resistance, care must be taken to avoid premature occlusal contacts on the cements, especially on the marginal ridges of Class II restorations. The use of conventional GICs as posterior restorations has been reviewed recently and, rather than restoring primary teeth which have shallow open preparations, it may be preferable to attempt remineralization by the saliva and with topical fluorides in various forms. Because of their low fracture resistance, care must be taken to avoid premature occlusal contacts on the cements, especially on the marginal ridges of Class II restorations. The use of conventional GICs as posterior restorations has been reviewed recently and, rather than restoring primary teeth which have shallow open preparations, it may be preferable to attempt remineralization by the saliva and with topical fluorides in various forms. Because of their low fracture resistance, care must be taken to avoid premature occlusal contacts on the cements, especially on the marginal ridges of Class II restorations. The use of conventional GICs as posterior restorations has been reviewed recently and, rather than restoring primary teeth which have shallow open preparations, it may be preferable to attempt remineralization by the saliva and with topical fluorides in various forms.

Conclusions

Although the newer, more-viscous GICs are recommended by manufacturers as definitive restorations for cavity preparations in primary molars, some clinical problems have become apparent over the short-term. These include the early loss of sealant material, the loss of restorations from shallow and non-macromechanically retentive preparations, bulk fracture of multisurface restorations, and restoration wear. Recurrent caries has not been shown to be a problem at this time, but further improvements in the mechanical and adhesive properties of the newer GICs are required for their optimal clinical performance. Further investigations are also required of methods for the remineralization of shallow open carious lesions as an alternative to restorations, and of longer-term clinical studies for the cost-effectiveness of the ART approach. Although there is the need for continued evidence-based research, the ART approach has clearly demonstrated a very high acceptance by children, and has also resulted in the retention of many teeth that otherwise would have been extracted.

References


### Table. Percentage Survivals of GICs Placed Using the ART Technique for Primary Teeth

<table>
<thead>
<tr>
<th>Study</th>
<th>Duration</th>
<th>Material</th>
<th>Manufacturer</th>
<th>Class I &amp; V single-surface</th>
<th>Class III multisurface</th>
<th>Class III &amp; IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO report 1993*</td>
<td>12 mths</td>
<td>ChemFil</td>
<td>Dentsply (not stated)</td>
<td>79.3</td>
<td>55.0</td>
<td>73.1</td>
</tr>
<tr>
<td>Phantumvanit et al. 1994</td>
<td>24 mths</td>
<td>ChemFil</td>
<td>Dentsply (not stated)</td>
<td>94.3</td>
<td>45.0</td>
<td>59.0</td>
</tr>
<tr>
<td>Ewoldsen et al. 1997</td>
<td>10±4.8 m</td>
<td>Fuji Duet</td>
<td>GC Int. (not stated)</td>
<td>91.0</td>
<td>45.0</td>
<td>59.0</td>
</tr>
<tr>
<td>Terada et al. 1998</td>
<td>6 mths</td>
<td>Fuji IX</td>
<td>GC Int.</td>
<td>89.6</td>
<td>78.4</td>
<td>87.0</td>
</tr>
<tr>
<td>Basso &amp; Edelberg 1997</td>
<td>12 mths</td>
<td>Fuji IX</td>
<td>GC Int.</td>
<td>94.4</td>
<td>93.7</td>
<td>20.0</td>
</tr>
<tr>
<td>Franca et al. 1998</td>
<td>12 mths</td>
<td>Fuji IX</td>
<td>GC Int.</td>
<td>75.3 &amp; 90.0</td>
<td>39.1</td>
<td>72.9 &amp; 55.6</td>
</tr>
<tr>
<td>Lo &amp; Holmgren 1998 &amp; 1999</td>
<td>12 mths &amp; 30 mths</td>
<td>Ketac-Molar</td>
<td>ESPE GmbH</td>
<td>86.1</td>
<td>62.5</td>
<td>36.6</td>
</tr>
<tr>
<td>Yu et al. 1998</td>
<td>12 mths</td>
<td>Fuji IX GP cap.</td>
<td>ESPE GmbH</td>
<td>83.8</td>
<td>38.6</td>
<td>36.6</td>
</tr>
<tr>
<td>Luo et al. 1999</td>
<td>12 mths</td>
<td>Fuji IX GP cap.</td>
<td>GC Int.</td>
<td>89.7</td>
<td>64.3</td>
<td>42.9</td>
</tr>
<tr>
<td>Hu et al. 1999</td>
<td>12 mths</td>
<td>(not stated)</td>
<td>(not stated)</td>
<td>88.9</td>
<td>(no classes given)</td>
<td></td>
</tr>
</tbody>
</table>

* Unpublished data Thailand, WHO Collaborating Centre for Oral Health Services Research, Groningen 1993


Letter to the Editor

Information on the Web

In regard to the age one dental visit: information on the web (Pediatr Dent 22:163-164, 2000), Dr. Edelstein must be commended for drawing attention to a very significant issue. Health care information available on the web is unregulated. The ease of designing a basic Web site and the availability of free web hosts has encouraged all and sundry to set up shop on the web to purvey health care information and that too on a global scale. The downside of this web-equalization has been the sidelining of leading national organization. As Dr. Edelstein points out “only a very informed and dedicated consumer” would conduct a meticulous search for authoritative information that “is available on the web but is not readily accessible.” However, most individuals lack the time and the patience to conduct a proper search. Indiscriminate and impatient surfing between Web sites has led to the notion of “eyeball hang time” i.e., the amount of time spent at a Web site.

This disconcerting state of the information must be addressed twofold:

1. As Dr. Edelstein notes, organizations such as the AAPD must formulate “their Web sites in a way that search engines readily recognize authoritative consumer information.”

2. AAPD must consider a partnership with like-minded organizations for creating a Web site to provide consumer information. This must be a dot-com address (URL) rather than a dot-org address, as even on the web, location matters. Web browsers are partial to a dot-com address. For example, simply keying yahoo leads to the yahoo.com site. The Web site must be no more than a simple index with buttons highlighting the various items. These buttons can be linked to the already existing information on the organizations’ Web sites. A suitably coined catchy dot-com address must be publicized through a media campaign. It is prudent to address this issue now rather than later respond to charlatan-generated information or “scare” on the web.

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