Cement composition effects on enamel demineralization adjacent to orthodontic brackets

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Introduction

Inocent caries lesions or white-spot lesions (WSLs) continue to be one of the most common clinical problems resulting from orthodontic treatment with fixed appliances. It has been reported that enamel demineralization around orthodontic bands and brackets occurs as early as 1 month after starting treatment (O’Reilly, 1987). Several advancements in orthodontic cements have shown promise in reducing the development of these inocent lesions. Recently, a water-based calcium aluminate glass ionomer luting cement (Ceramir) has shown bioactive surface apatite formation which may influence local demineralization and remineralization. This bioactive cement has displayed self-sealing properties (Lof, 2008), creation of an alkaline environment and has exhibited antibacterial properties (Unisson, 2012). Thus, there are indications of this material as an orthodontic adhesive and its potential to inhibit the development of white-spot lesions.

The Canary System is based on analyses of luminescence and thermal behavior of emitted infrared photons caused by demineralization of enamel. The technology is termed multiplexing-acting frequency-domain photothermal radiometry and frequency-domain luminescence, commonly abbreviated PTR-LUM. PTR-LUM has been shown to be capable of monitoring artificially created carious lesions, their evolution during demineralization, and the reversal of lesions under the growth of a remineralized surface (Joxon, 2008). The software generates a Canary number, indicating the lesion severity.

Methods

A sample of 32 caries-free extracted human teeth (under an IRB-exempt protocol) was collected. Orthodontic brackets were cemented to each tooth with either Transbond XT (composite resin cement) or Ceramir (bioactive calcium aluminate glass ionomer cement). A 3x3 mm window adjacent to the bracket was created with acid-resistant varnish for an area to measure. The acid-resistant varnish was applied twice to cover the entire tooth, besides the window, and light cured each time for 12 seconds. Each sample was then placed in a 40 mL airtight polypropylene (bioactive calcium aluminate glass ionomer cement). A 3x3 mm window protocol was collected. Orthodontic brackets were cemented to each

Results

We studied 32 caries-free extracted human teeth to evaluate the possible effects of a bioactive cement on enamel demineralization around orthodontic brackets compared to a composite resin cement. The Canary System was used for data collection as discussed in the materials and methods. Table 1 shows a summary of all of the data collected.

Table 1: Data collection summary

<table>
<thead>
<tr>
<th>Group</th>
<th>Total Average</th>
<th>Total SD</th>
<th>Total Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.24</td>
<td>3.52</td>
<td>0.7-11.8</td>
</tr>
<tr>
<td>B</td>
<td>4.72</td>
<td>10.36</td>
<td>3.2-43</td>
</tr>
<tr>
<td>C</td>
<td>3.52</td>
<td>10.4</td>
<td>0.8-35</td>
</tr>
<tr>
<td>D</td>
<td>0.83</td>
<td>2.3</td>
<td>0.7-11.2</td>
</tr>
</tbody>
</table>

Composite resin cement (p=.0003) and bioactive cement (p = .001) showed significant demineralization around orthodontic brackets compared to the controls as seen in Figure 5. The mean change in Canary score from T0-T1 for Transbond XT was 24±10.5, while Ceramir was 21±213.5. Although the bioactive cement did have a smaller change in mean Canary score when compared with resin composite, this difference was not significant (p=.438).

Conclusions

1. Displayed no significant difference in demineralization inhibition between the cements tested within the limits of this in-vitro study.
2. Demonstrated the ability of the Canary System, using PTR-LUM technology, to monitor progressive enamel demineralization, in-vitro, around orthodontic brackets.

References

2. Lof, 2008. The Canary System is based on analyses of luminescence and thermal behavior of emitted infrared photons caused by demineralization of enamel. The technology is termed multiplexing-acting frequency-domain photothermal radiometry and frequency-domain luminescence, commonly abbreviated PTR-LUM. PTR-LUM has been shown to be capable of monitoring artificially created carious lesions, their evolution during demineralization, and the reversal of lesions under the growth of a remineralized surface (Joxon, 2008). The software generates a Canary number, indicating the lesion severity.

This in-vitro study’s objective was to evaluate possible effects of a bioactive cement on enamel demineralization around orthodontic brackets compared to a composite resin cement. A secondary aim was to determine the capability of The Canary System for detecting and quantifying artificial enamel demineralization around orthodontic brackets.