Orthodontic bracket failure rate; A comparative clinical study between light cured and chemically cured (no mix) bonding systems

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ABSTRACT

Background: The purpose of this in vivo study was to investigate the difference in brackets failure rate between light cured and chemically cured (no mix) composites used in brackets bonding procedures.

Materials and methods: A total of 729 Roth 0.22 stainless steel brackets were bonded to 40 patients requiring orthodontic treatment in the form of 3 groups; light cured 237, no mix 240, control (split mouth design) 249.

Results: The results showed non significant difference in brackets failure rate between the groups and the majority of the failed brackets were in the posterior region.

Conclusion: Clinically, the light cured bonding system has a comparable strength to no mix.

Key words: Light cure composite, no mix, bonding.

INTRODUCTION

Orthodontic treatment with brackets generally takes approximately 2 years. Bond failure of brackets during this period retards treatment and is costly in terms of time, material, and patient inconvenience. Hypothetically, in-vivo testing in controlled trials is the best way to test the effectiveness of a bonding system and any detrimental effects on the enamel 1.

Bond failure during orthodontic treatment is relatively frequent and undesirable. The time taken to clean, prepare, and bond new bracket can be disruptive in a busy practice and it might also lengthen the overall treatment time2. To overcome bond failure, good bond strength must be achieved which depends on: The nature of enamel surface, Enamel conditioning procedures, the etching time, The shape and the design of the bracket base and The type of adhesive used 3 which should be: Dimensionally stable, Quite fluid, has Excellent inherent strength and Easy to use clinically 4.

The chemically cured composite (self curing acrylic) was the first system developed for orthodontic bracket bonding 5. The polymerization of chemically cured composites starts immediately after mixing, limiting the working time, the number and accuracy of bracket placement with each mix 6.

Auto cured (chemically activated) systems generates a small amounts of heat during curing 7. And The liquid activator of no-mix system is toxic, and allergic reaction has been reported in patients, dental assistants and doctors when such adhesives were used 8-10.

A visible-light curing system was suggested in 1979 by Douglas et al, to be used in the restorative dentistry and orthodontics, to activate polymerization of filled and unfilled resins 11.

Sonis (12) and Hamula (13) stated that the light cured adhesives offer a number of significant advantages over chemically cured ones, unlimited working time during bracket placement, less patient discomfort because of accelerated setting time. Significant less chair time, arch wire can be placed immediately without having to wait 8-10 minutes for the adhesive to bond completely, Bracket placement and flash removal are much easier with the light activated composites, and Easier clean-up.

Read 14 stated that an immediate force could be placed on the bracket after curing because the entire adhesive under the bracket would be polymerized after the initial exposure to the visible light. However, when Helvatjoglou-Antoniadi et al 15 evaluated the degree of polymerization of both visible light and chemically cured adhesives for setting times from 10 minutes to 12 months, they reported a continued hardening or progressive polymerization throughout this period.

MATERIALS AND METHODS

The subjects of this study were a 40 patients requiring treatment with fixed orthodontic appliances meeting the following criteria: the planned mechano-therapies are as similar as possible; their teeth are free of caries, reconstructions or enamel disorders at the facial surface, no undesirable antagonistic contacts between teeth and brackets.

A total of 729 Roth 0.22 (ortho classic) brackets were bonded. for 14 patients; a split mouth design were used in which 127 brackets were bonded by chemically cured composite (no mix).
mix) and 122 brackets were bonded by light cured composite and it is considered as the control group, for 13 patients; 237 brackets were bonded totally by light cured composite and for the rest 13 patients; 240 brackets were bonded totally by chemical cured composite (no mix).

Method: prophylaxis of teeth with non fluoridated pomus followed by etching with 37% phosphoric acid (resilience) liquid etchant from ortho technology, for 30 seconds (al –umar2001), then the teeth washed by water spray for 10 seconds and dried.

Bonding by no mix: a thin layer of a (resilience) liquid activator was applied on the facial surface of the teeth and on bracket base. (Resilience) no mix bracket adhesive was applied to the bracket base which was then placed on the tooth surface and pressed firmly, excess resin was removed around the bracket with a probe.

Bonding with light cure: a thin layer of (resilience) sealant resin were applied on the teeth and exposed for 10 seconds per tooth to a visible light source (wood pecker ) led type from (Guilin wood pecker medical instruments ),wave length;480nm and intensity of 850-1000mW/cm². (Resilience ) light cured bracket adhesive was applied to the base of the bracket, which was then applied on the tooth surface and pressed firmly, excess resin was removed around the bracket with a probe.

10 minutes after brackets bonding the corresponding arch was placed for the split type group and the chemically cured group, (while for the light cure group it is placed immediately)12,13, and the first wire was 0.14 NiTi (svenska orthocut) to be replaced later by the corresponding sequence of arches. Bracket bond failure was recorded only for the first-time failures, and the observation period was 9months16. Bond-failure rates during the nine-month period were estimated for each type of adhesive and Failure rates were analyzed using $\chi^2$ test statistics at $\alpha = .05$ level of significance.

### RESULTS

The numbers and rates of brackets failure for the three groups are shown in table (1). The chi – squared test showed no significant difference in brackets failure rate between the groups (p= 0.100),Table (2) shows the distribution of brackets failure rates among the teeth for all the groups. The result shows that the majority of failed brackets were for the premolars.

### Table 1: Bond failure rates

<table>
<thead>
<tr>
<th>Group</th>
<th>Brackets(n)</th>
<th>Failures(n)</th>
<th>Failure rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>249</td>
<td>18</td>
<td>7.2</td>
</tr>
<tr>
<td>Light cured</td>
<td>237</td>
<td>9</td>
<td>3.7</td>
</tr>
<tr>
<td>No mix</td>
<td>240</td>
<td>15</td>
<td>6.2</td>
</tr>
</tbody>
</table>

The chi-squared test found no significant differences (p=0.14) in brackets failure between the groups

### Table 2: Failure rate distribution among teeth

<table>
<thead>
<tr>
<th>Group</th>
<th>Control (n)</th>
<th>Rate (%)</th>
<th>No mix (%)</th>
<th>Rate (%)</th>
<th>Light cured (n)</th>
<th>Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors &amp;canines</td>
<td>2</td>
<td>11.1</td>
<td>2</td>
<td>13.3</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>premolars</td>
<td>16</td>
<td>88.8</td>
<td>13</td>
<td>86.6</td>
<td>8</td>
<td>88.8</td>
</tr>
</tbody>
</table>

### DISCUSSION

The advantages of the split mouth design is; time saving, fewer subjects required and the uniform reaction toward the material and technique regarding the affinity of the teeth to the adhesive, but the patient might use one side more than the other which makes it liable to errors, in addition to that, the comparison between split mouth and full mouth design provides an opportunity to test the material in a wider range of possibilities.

The result of this study shows non significant difference between groups in bracket failure rates which is compatible to the result of in vivo study made by Armas et al17, and coincide with the result of the invitro study of chamda and Stein18, while Saeytijd et al19 found in a clinical study that the brackets bonded by a chemically cured composite failed significantly less than the light cured composite which disagree with our result, but the type of comparison made in this study strengthen the findings of armas et al17 and chamda and Stein18.

The non significance in bracket failure rates between groups indicates that the ease of use of the light cured composite for brackets fixation will not be a problem regarding bond longevity in contrast with the traditionally used chemically cured one.
The result of bracket failure rates for previously done studies were 6.6% (20), 6.34% (21) and 6.08 (22), which are close to the rate obtained in this study (7.2%), indicating that the use of light cured and chemically cured composites for bonding produces results close to this average, while the rates for the, light cured, chemically cured, composites separately were; 3.7%, 6.2% respectively which differs from that of Koupis et al 16 who found it 5.00% for the light cured with LED light source and 3.33% for the light cured with halogen light source, and Armas et al 17 who found it 11.3% for the light cured and 12% for the chemical cured.

The distribution of the bracket failure rate in this study indicates that the higher rate was for the posterior teeth regarding both types of adhesives which differ from that of Saeytijd et al 19 who found it more posteriorly for the light cured and distributed more equally over the dental arches for the chemical cured.

**REFERENCES**