ORIGINAL ARTICLE

Shear Bond Strength of Orthodontic Brackets Bond with Conventional Light Emitting Diode and Fast Halogen Light

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ABSTRACT

Aim: To compare the mean shear bond strength (MSBS) of metal brackets bonded with conventional LED or fast halogen units.

Methods: This in-vitro comparative study was conducted on 50 extracted human premolars which were randomly divided into 2 groups of 25 teeth each, by lottery method. Following a standard bonding protocol, Group 1, teeth brackets were cured with conventional LED light source and in group 2, by fast halogen light. MSBS was measured using universal testing machine, at a crosshead speed of 1 mm/minute and recorded in megapascals (MPa). Independent t-test was used for comparison of MSBS in both the groups. The level of significance was determined at p≤0.05. Duration of this study was January 2017 to October 2017.

Results: MSBS of metal brackets cured with fast halogen (17.60±3.7 MPa) was similar to conventional LED unit (16.66±3.0 MPa).

Conclusion: Fast halogens are equally effective for curing brackets, as they give similar bond strength when compared with conventional LED lights.

Keywords: Shear bond strength; LED; Halogen.

INTRODUCTION

Light cure composites for orthodontic bonding have been used for many years and got many advantages over self cure composite. Advantages include controlled working time, no need of mixing two pastes, allow accurate bracket positioning, less risk of cross infection, and easy removal of excess composite1,2.

Conventional and fast set halogen light, plasma arc light, argon laser and light emitting diodes (LED) are available light source units3. Light curing units was introduced in 1980s. These light units have a wide wavelength range between 400 and 520 nm that while polymerization of composite resins triggers photo-initiators present in composites4.

Halogen units produce light by heating tungsten filament, but got disadvantages of light power output, noisy fan, short lifetime of 100 hours and only 1% of the total energy input is converted into light; the remainder is wasted as heat5. In 1995, Mills introduced LED units for the polymerization of light composites, LED use junctions of doped semiconductors to produce light and got advantages of low power, 10000 hours life, smaller size, and resistant to shock and vibration6.

According to literature, bonded brackets must have shear bond strength between 6 and 8 MPa7,8,9 in order to achieve successful bonding. Results from previous literature10 revealed that brackets cured with soft mode LED produced highest MSBS (23.86±6.20 MPa) but no significant difference in MSBS was found between fast mode LED (17.14±5.75 MPa) and the halogen group (17.38±5.41 MPa). Previous studies11-13 also suggested that soft LED produce higher MSBS than the fast mode LED or halogen-light polymerizations. Rationale of present research was to compare the MSBS values in order to choose the better curing light. Data is publishing in this regard but results may be different in present study because previously conducted in-vitro studies were on LED and conventional halogen while in present study fast halogens were compared with LED units in reference to MSBS.

The aim of this study was to compare, in-vitro, the mean shear bond strength of metal brackets cured with fast halogen or conventional LED units. Our null hypothesis was that there was no difference in the MSBS of brackets cured with fast halogen or conventional LED units.

MATERIAL AND METHODS

This invitro comparative study. Was conducted at Faisalabad Medical University and de'Montmorency College of Dentistry Lahore. Duration of this study was January 2017 to October 2017. Sample size of 50 was estimated using 95% confidence level, 80% power of test with expected mean shear bond.
strength 17.38±5.41 MPa in halogen group and 17.14±5.75 MPa in LED group10. Non-probability purposive sampling technique was used. Maxillary/Mandibular bicuspids and intact buccal surface were included in the study. While any dental pathology involving buccal surface with history of orthodontic treatment were excluded from the study.

According to selection criteria, 50 extracted human premolars were included and were kept in 0.1% thymol solution. The teeth were embedded perpendicularly in self cure acrylic moulds and polished with pumice. Teeth were randomly allocated into 2 groups by using lottery method. Group A, 25 teeth were cured with Conventional LED unit (1000 mW/cm²) and in group B, 25 teeth were cured with fast halogen unit (1100 mW/cm²). Each curing light was tested and calibrated according to the manufacturer’s recommendations to ensure that maximum intensity output was obtained. The distance of light curing tip was kept at minimum in both the groups i.e., 2mm. The brackets cured with the fast halogen had curing times of 5 seconds each on the mesial and distal sides; the brackets cured with the LED had curing times of 10 seconds each on the mesial and distal sides.

The teeth were initially cleansed and polished. Each tooth was etched with 37% phosphoric acid gel for 30 seconds followed by rinsing and air drying. Transbond XT primer (3M Unitek) was applied; air thinned and light cured. Premolar brackets with a bracket base area of 11.35 mm² (3M Unitek) were taken and bonded to the buccal surface using Transbond XT adhesive paste (3M Unitek). Samples were stored in distilled water for 24 hours and thermocycled.

The bonded teeth were then tested on universal testing machine at 0.5mm/min. The MSBS was measured in Newton’s and then converted in MPa using the formula: Shear strength (MPa) = Debonding force (N)/bracket base area (mm²) and 1 N/mm².

Data collected was analyzed by using SPSS version 20.0. The MSBS was presented in the form of mean, standard deviation and t-test was applied for comparison of MSBS between the two groups and level of significance was determined at p<0.05.

**RESULTS**

The mean and standard deviation values for the MSBS of two groups are presented in the table I and II. The t-test comparison indicates that there is insignificant difference between the two groups. The fast halogen group has similar MSBS when compared with conventional LED group (Table III).

<table>
<thead>
<tr>
<th>n</th>
<th>Mean</th>
<th>Std</th>
<th>Std error mean</th>
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<tbody>
<tr>
<td>25</td>
<td>16.644</td>
<td>3.0076</td>
<td>1.0371</td>
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<tr>
<th>n</th>
<th>Mean</th>
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<tbody>
<tr>
<td>25</td>
<td>16.644</td>
<td>3.7009</td>
<td>1.6786</td>
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</table>

Table 3: Comparison of 2 groups (Shear bond strength (MPa))

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<thead>
<tr>
<th>T</th>
<th>Sig.(2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
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<td>0.977</td>
<td>0.150</td>
<td>1.0411</td>
<td>0.7866</td>
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</table>

**DISCUSSION**

To increase the polymerization efficiency and because of the demand of orthodontists to bond speedily, manufacturers developed light units with increased intensities. Curing orthodontic adhesives with plasma arc source of 1500 mW cm² intensity produce optimal cure in 3–5 seconds.15 Recently, high-intensity fast halogen lamps have been developed that got 1000 mW cm² intensity, resulting in curing times of around 10 seconds.16

This in-vitro comparative study was conducted to determine the mean shear bond strength of brackets cured with conventional LED or fast halogen units. According to results statistically there was insignificant difference between the two groups, with MSBS of fast halogen group as 17.60±3.7 MPa whereas the MSBS of conventional LED group was 16.66±3.0 MPa. This could have happened because of equal polymerization by high intensity fast halogens16 and LED lights and may also be due to the fact that fast halogen has light energy, luminous intensity, and spectral distribution similar to LED. It is possible that these results reflect the use of powerful halogens as compared to first-generation LED units17.

Results are in agreement with previous laboratory studies on the bond strength of brackets cured with LED that reported no statistically significant differences in MSBS between conventional halogen and LED light18,19,20. However, previously conducted studies were conducted to compare LED and conventional halogens. There are certain differences in conventional and fast halogens, such as fast halogens got high intensity values than conventional LED16.

Results are in agreement with Cacciafesta who compared new model of LED with halogen, and found no significant difference in MSBS21. Similarly, in a study by Usumez, no significant differences were
observed in MSBS between halogen and LED units, at various times of curing\textsuperscript{22}. Bishara reported that in the first 30 minutes after bonding, LED and halogen produced similar MSBS\textsuperscript{23}. Thind showed that there was no difference between the adhesive remnant scores produced by the conventional tungsten-quartz-halogen and LED light sources\textsuperscript{24}. Our results are in contrast with results reported by Wendle who showed that halogen yields stronger MSBS than does LED\textsuperscript{25}.

In this study, we did not evaluate the temperature changes with two curing lights. According to Ramoglu\textsuperscript{26}, the most powerful LED unit having intensity of 3200mW/cm\textsuperscript{2} caused the minimal rise in temperature in comparison to other low intensity LEDs, and that too within the safe range for teeth pulp.

Caution should be exercised when applying the results of this in-vitro study, because it was a laboratory study and could have the limitations of an ex-vivo setup. Despite this limitation, the result of the current study suggests that LED or fast halogen units, can be choose for bonding orthodontic brackets without any compromise in the shear bond strength of orthodontic brackets.

**CONCLUSION**

Fast halogen lights are equally effective for curing orthodontic brackets as they give similar bond strength as compared with conventional LED lights.

**Financial Disclosure:** No relevant financial interests

**Conflict of Interest:** No conflict of interest

**REFERENCES**
