ORIGINAL RESEASRCH

Effect of Dental Chair Light on Shear Bond Strength of Composite used for Bonding of Brackets - An In Vitro Study

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ABSTRACT

Objectives: The objectives of the study were To compare & evaluate Bond strength of light cured composite with Halogen dental chair light, Bond strength of light cured composite with LED dental chair light, Bond strength of light cured composite by keeping the dental chair light switched off and Bond strength of light cured composites with dental chair light and by keeping it off. **Materials & Method**: In this study 60 therapeutically extracted human premolars were randomly selected and divided into 3 groups of 20 samples each. In group, I and II, bonding of bracket was done by keeping Halogen & LED dental chair light on respectively and in group III it was done by keeping the dental chair light off. For all samples LED light curing unit was used to cure the composite resin. After bonding all samples were tested for bond strength by using the universal testing machine. **Results**: The mean values of Shear Bond Strength (MPa) for Groups I, II and III were 10.7, 10.8 & 11.01 respectively. There was no statistically significant difference ($p > 0.05$) between all the Groups. **Conclusion** : Dental chair light has no effect on bond strength of composite used for bonding of brackets. Hence, dental chair light may be kept on during light curing of composite used for bonding of brackets.

KEYWORDS: Dental Chair, Bond Strength, Composite

INTRODUCTION

Light cure adhesives are commonly used materials for bonding Orthodontic Brackets and other attachments.[1-3] To initiate polymerization, light curing is performed with visible light in the blue area range of the electromagnetic spectrum to excite camphorquinone that possesses an absorption spectrum in the interval between 400nm and 500nm. Polymerization of light cure adhesives is done best at wavelenths between 468nm to 470nm.[4]

In a dental office, different dental chair lights are used. Basically, it helps the operator to work by giving good visibility and optimum illumination. Commonly used dental chair lights are light emiting diode (LED) or halogen type. These lights generate a considerable amount of heat while working as voltage & power supply of these light is more. Usually, we switch off the dental chair light, while light curing of resin-based materials. An interference of the blue light emitted from light curing source by yellow dental chair light is suspected for same; however, the effect on the intensity of the light on bond strength in any way is still unknown. Literature shows that, when the intensity of polymerizing light is reduced there is delay in the degree of polymerization of composite.[5] The delay in degree of polymerization of composite directly influences its mechanical properties.[6] The present study conducted with an aim to determine whether the dental chair light causes any significant effect on the shear bond strength of light cured composites used for bonding of brackets.

MATERIALS AND METHODS

A total number of sixty therapeutically extracted human maxillary or mandibular premolars were randomly collected. The sample was divided into 3 groups of 20 samples each. All the teeth were mounted on the self-cured acrylic blocks with crowns exposed and roots embedded in the acrylic. Before bonding of brackets, the buccal surface was cleaned using the slurry of pumice paste (S.S. White™, Petropolis). The enamel surfaces from Groups I, II, and III were etched with 37% phosphoric acid gel for 15 seconds, washed and air-dried. The ORTHO LITE CURE primer (Fig 1) in Groups I, II and III was applied on etched surface using a microbrush. The teeth were bonded using 0.022" Pre-adjusted edgewise MBT(3M™ Unitek) premolar bracket (maxillary/mandibular) using light cured composite resin

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Figure 1: Light cure adhesive.

(ORTHO LITE CURE™) (Fig 2) and polymerized with the help of LED light curing unit (3M ESPE™ Elipar S10).The curing light tip was kept at a distance of 2mm from the bracket. Halogen and LED light bulb in the dental chair light unit was used for the study as the light source and kept at a distance of 50 cm from the specimen while curing.

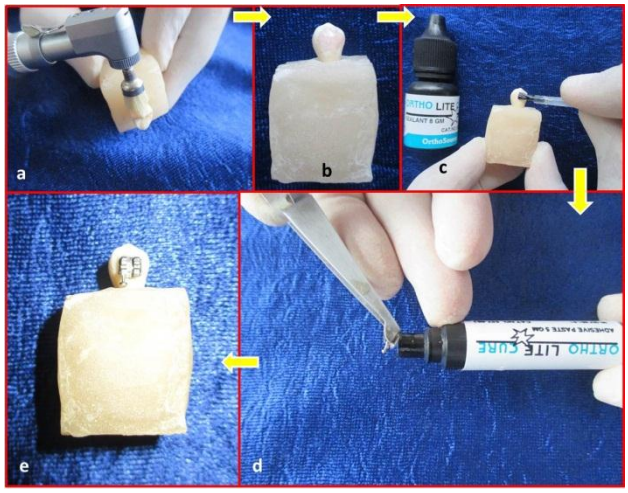

Figure 2: Bonding procedure a) Polishing of Enamel Surface b) Etching with 37% Orthophosphoric acid c) Application of Primer d) Application of composite e) Sample ready for curing

The mounted teeth used in this study were divided into 3 groups of 20 teeth in each group as follows (Fig 3).

- *Group I*: Light curing was done under the Halogen dental chair light.
- *Group II*: Light curing was done under LED dental chair light.
- *Group III*: Light curing was done by keeping the dental chair light switched off.

To measure the amount of light intensity of light curing source Radiometer was used , it was found that light curing source has an intensity of 280 mW/cm2. The intensity of halogen & LED dental chair light was 55W & 12W respectively (given by dental chair manufacturer). After bonding, all the samples were tested for bond strength by using Instron universal testing machine (Instron 5585h series) at the crosshead speed of 0.5 mm/min, with its chisel tip placed onto the enamel/composite interface (Fig 4). The results were obtained in Kgf which were then converted into Newton

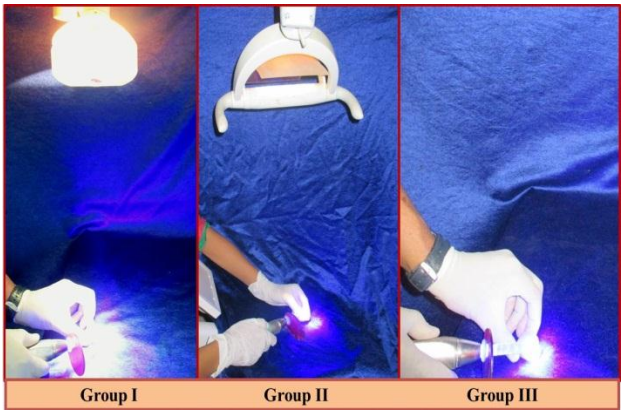

Figure 3: Light curing of composite with different light condition

Figure 4: Shear bond strength testing

(N) which was divided by the bracket area, to obtain values in Mpa.

Statistical Analysis: The bond strength mean values were subjected to one-way analysis of variance (ANOVA).

RESULTS

After applying suitable statistics mean, standard deviation and standard error were calculated. The mean values of Shear Bond Strength for Groups I, II and III were 10.7 MPa, 10.8 MPa & 11.01 MPa respectively (Table 1). There was no statistically significant difference ($p > 0.05$) between all the Groups as well as within the groups (Table 2). Bar diagram showing the comparison of mean shear bond strength values between 3 groups (Fig.5). It

shows all the groups had nearly same bond strength values.

Descriptives Statistics				
BOND STRENGTH (Mpa)				
	n	MEAN	SD	SE
With Halogen dental chair light on	20	10.700	1.0193	0.2279
With LED dental chair light on	20	10.875	0.8705	0.1946
With dental chair light off	20	11.010	0.7539	0.1686

***SD-Standard deviation ***SE-Standard error
Table 1: Descriptive statistics showing mean, standard deviation and standars error.

BOND STRENGTH	ANOVA F=0.613 P<0.05 ,Significant			
	SUM OF SQUARES	DF	MEAN SQUARE	P- VALUE
Between Groups	0.966	2	0.483	0.545
Within Groups	44.936	57	0.788	0.544
Total	45.902	59		

***DF-Degreeof freedom ***ANOVA- Analysis of variance
Comparison of bond strength (Mpa) between groups and within groups by using ANOVA.Comparison of bond strength between groups and within groups were not Statistically significant as P >0.05.

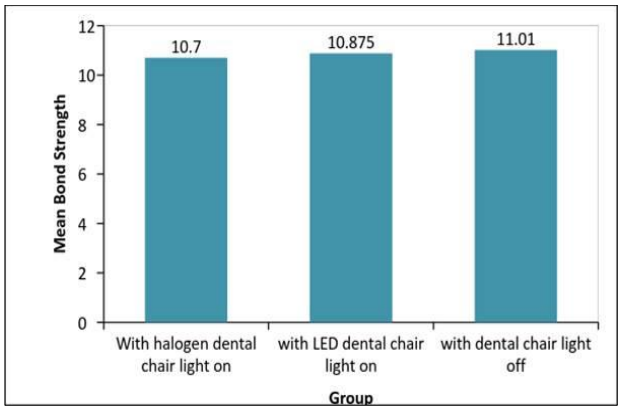

Figure 5: Bar diagram showing mean shear bond strength value in each group

DISCUSSION

In the present study mean values of Shear Bond Strength for Groups I, II and III were 10.7 MPa, 10.8 MPa & 11.01 MPa respectively (Table 1). No statistically significant differences were found in the bond strength during exposure with LED & halogen dental chair light as well as by keeping it switched off (P>0.05) (Table 2). The debonding forces remained constant in all 3 groups.

This might be because of visible light with proper wavelength & sufficient intensity is required for polymerization of light activated composite resin.[4,7] Similarly, duration & exposure intensity of visible light are important factors for the polymerization of the composite.[8,9] Previous studies showed that power density (temperature), exposure time, distance, wavelength, all these factors affect the bond strength of light cured composite resin .[7-12]

It was also known that ,energy (intensity of light/power density) as well as distance can affect the bond strength of light cured composite resin.[7-12] Similarly, energy has an inverse relationship with wavelength of light.[13] The dental chair light has more energy output (55W with halogen & 12W with LED dental chair light) as compared to the light curing unit (280 mW). Hence, curing was initiated due to heat generated from light, but camphorquinone activation was not there to initiate polymerization, as it activates at specific wavelength i.e. 468 to 470 nm wavelength range.[4] The absorption curve for camphorquinone extends between 360 nm to 520 nm, with its maximum at 465 nm. Within this range optimal emission bandwidth of light source lies between 450 nm to 490nm. Nomoto R suggested that the most efficient wavelength was 470 nm, and an adequate wavelength was in the 450-490 nm range. The absorbance of camphorquinone strongly affects polymerization, especially during the initial stage.[4]

Similarly, the distance between dental chair light and patient was also more, as we are keeping dental chair light away from patient face at an optimum distance (50cm) to avoid discomfort to the patient while working. This distance was not effective to achieve sufficient bond strength when composite was cured i.e. dental chair light exposure from this distance (50cm) has no additive effect on bond strength, previous studies also showed importance of distance on bond strength and power density, as distance between light source and object to be cured increases bond strength decreases.[10,11]

It was also observed that a significant reduction of the depth of cure is observed for composite tested when using a light device with an intensity of light more than 300 mW/ cm2 as well as using a distance from the curing tip higher than 20mm.[14] Xu X et al. also showed that dentin shear bond strengths decreased significantly with increasing distance.[11]

The bond strength of light cured composite resin not only depends on the intensity of light but also on the exposure time required for curing.[8] Intensity of light & exposure time has an inverse relationship to each other to maintain the bond strength. If there is a decrease in intensity of the light then increase the exposure time or vice a versa. Yoshida S et al. showed that an increase in exposure time increases bond strength more than did an increase in light intensity for most of orthodontic adhesives.[9] Increase in the curing time can compensate for the decreased bond strength. This might be because of a decreased irradiance that occur with increased curing distance.[11] But in the present study we had kept exposure time constant for all the samples(20 seconds). Hence, there was a negligible exposure time effect on bond strength.

An increase in temperature speeds up rate of the curing.[15,16] However, Uno & Asmussen suggested that low-temperature light from light curing source had an advantage of decreased rate of curing & causes less physical shrinkage during setting of composite resin.[17]

Various factors affect depth of cure of composite. Price RB showed that, the power density, light dispersion, and the depth of curing is affected by the light guide of a light curing unit. [10] Staudt CB et al. also showed that shear bond strength dependence on power density of light.[12]

All above factors are correlated with each other to achieve optimum mechanical properties of the composite. According to findings in the present study bond strength of composite resin material is not affected by dental chair light (Halogen and LED).

CONCLUSION

It can be concluded that Dental chair light has no effect on bond strength of composite used for bonding of brackets. Dental chair light may be kept on during light curing of composite used for bonding of brackets.

REFERENCES

1. Bishara SE, VonWald BA, Laffoon JF, Warren JJ. The effect of repeated bonding on the shear bond strength of a composite resin orthodontic adhesive. Angle Orthod. 2000; 70:435-41.
2. Cal-Neto JP, Miguel JAM. An in vivo evaluation of bond failure rates with hydrophilic and self-etching primer systems. J Clin Orthod. 2005; 39:701-2
3. Pandis N, Polychronopoulou A, Eliades T. Failure rate of self-ligating and edgewise brackets bonded with convenvional acid etching and a self-etching primer. Angle Orthod. 2006;76:119-22.
4. Nomoto R. Effect of light wavelength on polymerization of light- cured resins. Dent Mater J 1997;16:60-73.
5. McCabe JF, Carrick TE. Output from visible-light activation units and depth of cure of light-activated composites. J Dent Res Nov 1989;68(11):1534-39.
6. Ferracane JL. Correlation between hardness and degree of conversion during the setting reaction of unfilled dental restorative resins. Den Mater 1985;1:1114.
7. Sobrinho LC, de Goes MF, Consani S, Sinhoreti M.A.C.,Knowles J.C. Correlation between light intensity and exposure time on the hardness of composite resin. Journal of material science.2000;11:361-364
8. Miyazaki M, Oshida Y, Moore BK, Onose H. .Effect of light exposure on fracture toughness and flexural strength of light-cured composites. Dent Material 12(6):328-32, 1996
9. Yoshida S, Namura Y, Matsuda M, Saito A, Shimizu N. Influence of light dose on bond strength of orthodontic light-cured adhesives. Eur J Orthod. 2012 Aug;34(4):493-7
10. Price RB, Dérand T, Sedarous M, Andreou P, Loney RW .Effect of distance on the power density from two light guides.. J Esthet Dent. 2000;12(6):320-7.
11. Xu X, Sandras DA, Burgess JO . Shear bond strength with increasing light-guide distance from dentin. J Esthet Restor Dent. 2006;18(1):19-27
12. Staudt CB, Krejci I, Mavropoulos A. Bracket bond strength dependence on light power density. J Dent. 2006 Aug;34(7):498-502.
13. White & Pharaoh .Textbook of oral medicine & radiology.
14. Leloup G; Holvoet PE; Bebelman S; Devaux J Raman scattering determination of the depth of cure of light-activated composites. J Oral Rehabil;29(6):510-5, 2002
15. Lovel LG, Newman SM, Bowman CN .The effect of light intensity , temperature ,and comonomer compostion on the polymerization behaviour of dimethyl dental resind.J Dental Res : 1469-1476,1999.
16. Hannig M , Bott B. In vitro pulp chamber temperature riseduring composite resin polymerization with variouslight curing source .Dent Mater,15:275-281,1999.
17. Uno S , Asmussen E. Marginal adaptation of a restorative resin polymerised at reduce rate . Scand J Dent Res, 99: 440-444,1991.

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