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Research Article

COMPARISON OF SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS CURED USING ARGON LASER AND CONVENTIONAL LIGHT CURING SYSTEM

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A R T I C L E I N F O

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A B S T R A C T

Background: The argon laser (AL) can polymerize a light-cured orthodontic adhesive 4 times faster with the same or even higher bond strength and with less frequency of enamel fracture at debonding than with the conventional curing light
Objective: The purpose of this study is to compare the bond strength of orthodontic bracket cured with a conventional curing light and with the argon laser
Method: 60 extracted premolars were collected for this study. All the specimen was standardized into two groups. Group A was orthodontic brackets cured with a conventional curing light and group B was orthodontic brackets cured with argon laser. Bonding of Both groups was done by using Transbond XT primer and adhesive. The shear bond strength of both groups was recorded using the universal testing machine. Results were analyzed using an unpaired t-test.
Results: Shear bond strength of both groups were calculated. A comparison of mean and SD between two groups was done by using an unpaired t-test to assess whether the mean difference between groups is significant or not. Descriptive statistics of each variable were presented in terms of Mean, standard deviation, and standard error of the mean. The results showed that the shear bond strength of both groups was statistically non-significant.
Conclusion: It can be concluded that the shear bond strength of orthodontic bracket cured with conventional curing light is comparable to that of an argon laser and acceptable clinically

INTRODUCTION

From the commencement of orthodontics, bonding remains the basic procedure in the fixed orthodontic treatment. With the introduction of acid etch technique by Buonocore in 1950s followed by the bonding of orthodontic brackets by Dr. George Newman, clinicians were able to attach the brackets directly to tooth.[2,3]

Application of light-cured adhesives became the most popular method of bonding brackets because of their simplicity of use and the extended time they permit for bracket placement. Clinicians whose primary focus was efficiency had been hesitant to switch to light-cured adhesives, due to additional 20–40 seconds of curing time is required for the curing process.[4,5]Recently, the argon laser (AL) has been marketed as a substitute to conventional curing light (CCL) units for quick, safe, and effective polymerizing of composite resins[7]

The argon laser (AL) can polymerize a light-cured orthodontic adhesive 4 times faster with the same or even higher bond strength[6] and with a fewer incidence of enamel fracture at debonding than with the CCL[7]. Besides, at suggested curing times, in-vitro pulp chamber temperature increases from the laser units were considerably lower than those of the CCL. Therefore, the AL should not pose a serious thermal risk to the pulp if used at the recommended energies[4]

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Light-cured adhesives are highly sensitive to light in the blue region of the visible light spectrum and has a peak area of absorption at 470 nm, the light output characteristics of normally used visible-light-curing units have been found to be inconsistent (bandwidth between 400 nm and 520 nm). However, argon laser operates at the bandwidth between 454 nm and 496 nm which has been shown to improve the physical properties of composite resins by achieving a more thorough cure with up to 75% shorter exposure time compared with conventional light-curing units.[7]

There is very brief amount of data present in this particular aspect, present data indicates that there is difference in shear bond strength between composite cured with argon laser and conventional curing light. Thus, it was necessary to compare their bonding strength.

MATERIALS AND METHODS

60 extracted premolars divided into two groups in which one was group cured with conventional light and another was cured with argon laser to compare the bond strength after the curing. The curing was done in a standard way for both the curing lights and shear force was applied on bracket which was measured with universal testing machine.

The teeth will be divided into 2 group			
Sr no	Groups	Type of curing light	Types of groups
1	Group A	Conventional curinglight	Control (n=30)
2	Group B	Argon laser	Experimental (n=30)

Material Used in the Study

- Transbond XT primer (3M UniteK)
- Transbond XT adhesive(3M UniteK)
- Orthodontic bracket (0.022"x0.028" slot, gemini MBT,3M uniteK)
- Light Curing unit (wavelength 400 nm to 520 nm)
- Argon laser unit (AL,250 mW/cm^2, 2.5 J/cm^2 when used for 10 seconds, wavelength 454 to 496 nm)
- Universal testing machine (UTM)

Bonding of brackets using conventional light curing unit

Buccal surface of the teeth was etched with 37% of phosphoric acid for 30 seconds, then rinsed and air dried. A light cured bonding agent (Transbond XT,3M Unitek) was applied to both the tooth surface and the bracket base. The bracket was then placed on the tooth surface with firm pressure and excess material was removed. Curing was accomplished with a light curing unit for 30 sec with an intensity of 450-480nm.

Bonding of bracket using argon laser

Buccal surface preparation was done same as control group and curing was done using argon laser for 10 sec holding light source 3 mm away from the bracket at 45^0 angle

Shear bond strength testing

All the 60 Samples was mounted over acrylic block vertically, the test was performed with universal testing machine at a crosshead speed of 0.5mm/min, the shear force was applied over the bracket till it gets detached from the tooth and shear force was recorded automatically by universal testing machine. Results obtained were expressed in Mpa.

Statistical analysis and methods

Comparison of mean and SD between two groups was done by using unpaired t test toassess whether the mean difference between groups is significant or not. Descriptive statistics of each variable was presented in terms of Mean, standard deviation, standard error of mean. A p value <0.05 of was considered as statistically significant whereas a p value 0.001 was considered as highly significant.

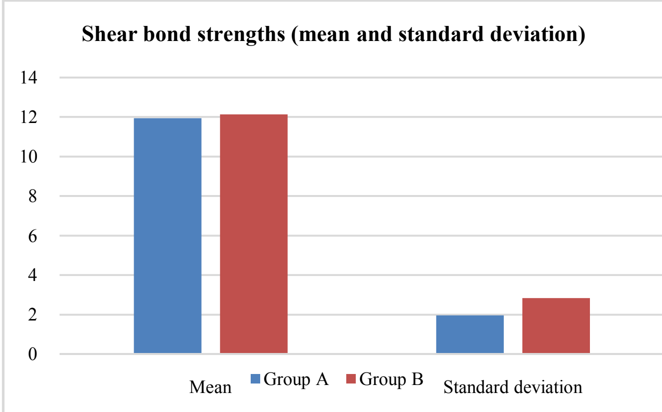
RESULTS

Mean value and standard deviation of shear bond strength on orthodontic bracket cured with conventional curing light (11.94 ± 1.96) was compared with mean value and standard deviation of shear bond strength on orthodontic bracket cured with Argon laser (12.14 ± 2.84).

The p value was found to be 0.37 which was statistically non-significant.

Table I Comparison of Shear bond strength between Group A and B

	Group	N	Mean	Std. Deviation	t	p	Inference
Shear bond strength (Mpa)	Group A	30	11.94	1.96	1.67	0.37	Not significant
	Group B	30	12.14	2.84			



Graph I Comparison of maximum shear bond strength between Group A and Group B

DISCUSSION

Evolution of bonding had been happening from long era but, little has been reported on the clinical performance of Argon Laser for orthodontic bracket bonding. The ideal orthodontic bracket bonding method should be fast, provide adequate bond strengths to retain orthodontic brackets and prevent or reduce the amount of demineralization during treatment. For these reasons, the argon laser has received much attention. The argon laser has the ability to cure composite resins quickly[16]

Because laser light is coherent, collimated and monochromatic, it was thought that it might be a better source of light for curing, VLC unit consists of white light with unwanted wavelengths filtered out and produce a polychromatic spectrum of blue light.[29] Those units emit wide bandwidths of 120 nm, resulting in a broad spectrum of wavelengths that overlap and are said to be incoherent.[30] Two photons of incoherent light can cancel each other (when those two photons are 180 degrees out of phase) so that the curing power decrease as well as the polymerization of the composite resin. Another problem encountered with VLC units is that they produce a divergent beam of light resulting in a loss of energy (40% if 6 mm far from the curing surface).[11]

In contrast, argon laser emits a narrow, focused and non-divergent beam focusing on a specific target resulting in a more consistent power density over distance.[20,31,32,33] Consequences should be greater composite resin polymerization (thoroughness, depth) with less unpolymerized monomer. This thoroughness results in the enhancement of certain physical properties of the argon polymerized resin compressive strength, diametral tensile strength, transverse flexural strength, and flexural modulus.[22] In terms of shear bond strength consequence of those properties, the literature shows some contradictions.

In present study, shear bond strength of adhesive cured using conventional curing light is compared to that cured with argon laser which apparently shows similar shear bond strength and also argon laser can polymerize the adhesive 4-8 times faster than conventional curing light[4]

Hildebrand N K S[4] compared shear bond strength of adhesive cured with conventional curing light to argon laser both in in-vivo and in-vitro medium. The bond strength of adhesive cured with conventional curing light showed shear bond strength of (8.96 ± 2.80) and (12.10 ± 2.26) where as in our study we compared only in in-vitro medium which showed shear bond strength of (11.94 ± 1.96) which was similar to our study

The bond strength of adhesive cured with argon laser showed shear bond strength of (10.43 ± 2.71) and (12.45 ± 3.46) where as in our study we compared only in in-vitro medium which showed shear bond strength of (12.14 ± 2.84) which was similar to our study

Argon lasers have been found to cause no damage to pulp or enamel at energy levels of 1.6 to 6 watts.[37] research is currently being conducted on the possibility of increased caries resistance from exposure to low levels of argon laser energy. Study done by Kurchak[13] demonstrates that 10 seconds of curing with the argon laser produces bond strengths comparable to those achieved with 20 to 40 seconds of curing with a conventional high-intensity light. The time savings involved in bonding a full arch would be significant. In addition, the .5mm-diameter fiberoptic tip of the laser is easy to manipulate and provides ready access to posterior teeth. Moreover, increased tip distance does not affect degree of conversion when cured with argon laser[38]

The finding that we got in our study is not in correspondence with the findings obtained by Lalani *et al*[7] in which their study concluded that bond strength values of brackets cured with conventional curing light were more as compared to argon laser.

The finding that we got in our study is not in correspondence with the findings obtained by Ibrahim M. Hammouda[11] in which their study concluded that bond strength values of brackets cured with visible light are comparatively less as compared to the argon laser cured brackets and the time of curing was not very significant for the given sample

Our current study when shear bond strength of brackets cured with argon laser were compared with brackets cured with conventional curing light, there was no statistical difference found in shear bond strength between these brackets, these findings were in accordance with the findings of Glaucio Serra[12], who conducted study to evaluate effect of argon laser curing on the shear bond strength using metal brackets bonded with light-cured glass ionomer cement and also the laser group had more adhesion between the ionomer and the enamel than the control group, among all methods, argon laser produces a filtered wavelength of 457-514 nanometers and a peak of 488 nanometers Moreover, the argon laser's waves are coherent; in other words, the photons are in phase with one another and do not collide, as they do in conventional light-curing units[13].

The finding that we got in our study is not in correspondence with the findings obtained by James JW[10] in which their study concluded that bond strength values of brackets cured with argon laser are comparatively less than that of conventional light cured brackets and the difference was insignificant but the curing time was comparatively less for argon laser.

In present study shear bond strength of the brackets cured with argon laser was (12.14 ± 2.84), this value is in contrast with the study done by Talbot TQ[6] which showed relatively higher shear bond strength value of (14.55 ± 4.52) when similar type laser unit is used.

CONCLUSION

Under the experimental condition of the present work, following conclusion are drawn,

- The shear bond strength obtained by argon laser was equivalent to conventional curing light
- Difference in bond strength obtained from comparing conventional curing light to argon laser is not statistically significant
- Argon laser are as effective as conventional curing light for curing adhesive though having advantage of less curing time
- Overall chair-side time for curing adhesive can be reduced with argon laser with almost similar strength and enamel damage

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