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Influence of Polymerization with Argon Laser and Led on the Shear Bond Strength of Adhesive Systems

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Introduction:

The efficient polymerization of adhesive materials, decreasing the polymerization shrinkage process, is of paramount importance for the resistance and durability of the substrate / fixing material adhesion, directly influencing the resistance to masticatory efforts and orthodontic mechanics, reflecting on clinical benefits for patients and professionals1.

The most used device for photoactivating adhesive materials is the LED (Light Emitting Diode), which has a long service life and does not cause thermal changes in materials and dental structure. The argon laser is also capable of polymerizing resins. Its use is little studied in the literature, and there is no consensus in relation to a usage protocol, facts that generate doubts regarding its viability and efficiency2,3,4.

In view of the above, the objective of this research is to evaluate the influence of polymerization with Argon laser and LED on the shear bond strength of adhesive systems, conventional and self-etching.

Methods:

An experimental research was carried out, in vitro, with 28 premolars. The studied variables were: light sources (LED - Optilight Max® - Gnatus®; and Argon Laser - Accucure® TM 3000, Laser Med); and adhesive systems: TransbondTM XT and TransbondTM Plus Self Etching Primer. The brackets used were the Mystique @ GAC model.

The teeth were fixed in PVC tubes (Tigre®) and randomly divided into two large groups (n = 14), according to the adhesive system; and subdivided into two more groups (n = 07), according to the type of light. Table 1 describes all groups and subgroups.

Bracket Mystique GAC	GROUP 1 Transbond XTTM Primer + TransbondTM Paste	G1LED: 275mW/ 20s G1LASER: 250mW/ 10s
	GROUP 2 Transbond XTTM Plus Self Etching +TransbondTM Paste	G2LED: 275mW/ 20s G2LASER: 250mW/ 10

TABLE 1. Distribution of groups according to the system and type of light.

Source: Author data.

The specimens were conditioned with phosphoric acid (Condac 37 FGM®), adhesive systems applied and polymerized with the LED and the Argon laser5. The light sources were applied according to the parameters described in table 2.

PARAMETERS	LED	LASER DE ARGON
POWER (mW)	275	250
TIME (s)	20	10
IRRADIANCE (mW/ cm²)	550	892,85
DOSE (J/cm²)	11	8,92

TABLE 2. Distribution of parameters used for light sources. Source: Author data.

The specimens were subjected to 1,000 thermal cycles with 30 seconds in each bath (5 ° C and 55 ° C) (Biopdi® machine). The shear test was performed on the Universal Shimadzu® machine (Model AGX, Japan), at 0.5 mm / min, with a 3kN load cell.

The fractures were classified by the Remaining Adhesive Index (ARI), in the following scores: proposed by Artun and Bergland6:

0 = no adhesive remnant.

1 = less than half of the adhesive remnant.

2 = more than half of the adhesive remnant.

3 = all the adhesive on the tooth.

For statistics, the SPSS Software (Statistical Package for the Social Sciences) version 22 was used; and the tests: F (ANOVA) or Kruskal Wallis; and t - Student or Mann-Whitney.

RESULTS AND DISCUSSION

Table 3 describes the shear bond strength values, in MPa, for all specimens. G1: TransbondTM XT; and G2: TransbondTM Plus Self Etching Primer, and light sources, LED and Argon Laser. All adherence values found were within the acceptable standard for clinical use, corroborating with the literature[7,8].

SPECIMEN	G1LED	G2LED	G2LED	G2LED
CP1	15,75	11,54	36,70	3,89
CP2	12,10	11,04	27,86	4,94
CP3	8,70	5,44	24,00	20,93
CP4	40,02	5,21	20,80	15,80
CP5	4,00	6,64	26,20	4,70
CP6	11,36	11, 01	7,62	8,20
CP7	10,39	6,25	14,50	9,35

TABLE 3 Distribution of force values in MPa, for adhesive systems and light sources. Source: Author data.

Table 4 describes the values of the ARI scores. Most scores were high. According to the literature9, high values of the IRA benefits the enamel, as there is less risk of fracture. The place where most take-offs occurred was at the adhesive / base interface. This region presents a fragile connection, constituting a critical area that is still responsible for a high rupture rate10,11,12.

SPECIMEN	G1LED	G2LED	G2LED	G2LED
CP1	3	1	3	3
CP2	1	3	1	1
CP3	0	3	1	0
CP4	1	3	0	3
CP5	3	3	2	3
CP6	3	0	3	0
CP7	0	2	3	1

TABLE 4 Distribution of IRA scores for adhesive systems and light sources.

Source: Author data.

Table 5 shows the statistical analysis for shear bond strength. The TransbondTM XT adhesive system was statistically superior to the TransbondTM Plus Self Etching. It is believed that the application of acid conditioning positively influenced the adhesion values for both light sources, as stated by studies reported in the literature13,14. This would explain the superiority of the conventional adhesive over the self-etch.

VARIABLE	ADHESIVE SYSTEM	BRACKET MYSTIQUE® Media ± DP (Median)
LED	TransbondTM XT TransbondTM Plus Self Etching Value de p	14,62 ± 11,76 (11,36) 8,16 ± 2,88 (6,64) p = 0,015*
LASER	TransbondTM XT TransbondTM Plus Self Etching Value de p	TransbondTM XT TransbondTM Plus Self Etching p = 0,006*
LED x LASER	Value de p	p = 0,176
LED x LASER	Value de p	p = 0,735

TABLE 5 - Statistical analysis of shear strength. Source: Author data.

Table 4 describes the statistical analysis for the ARI scores. There was no statistically significant difference between the values found for adhesive systems and light sources.

VARIABLE	ADHESIVE SYSTEM	N	BRACKET - MYSTIQUE® (%)
	TOTAL	7	100,0
LED	TransbondTM XT		
	0	2	100,0
	1	2	28,6
	2	-	-
	3	3	100,0
	TransbondTM Plus Self Etching Primer		
	0	1	16,7
	1	1	100,0
	2	1	33,3
	3	4	100,0
LASER	TransbondTM XT		
	0	1	33,3
	1	2	40,0
	2	1	33,3
	3	3	100,0
	TransbondTM Plus Self Etching Primer		
	0	2	40,0
	1	2	33,3
	2	-	-
	3	3	100,0

TABLE 6 - Statistical analysis of shear strength.Source: Author data. p> 0.05, not significant.

Conclusions: The LED and Argon Laser light sources showed similar behavior. The conventional TransbondTM XT adhesive was superior to the TransbondTM Plus Self Etching Primer.

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