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*Original Research Article*

# Effect of Time and Intensity of Curing Unit on Bond Strength of Stainless Steel Orthodontic Brackets (*in vitro* study)

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## Abstract
This in vitro study was aimed to evaluate the shear bond strength of orthodontic brackets that be cured with two types of light emitting diode (LED).Thirty extracted premolar teeth were divided arbitrarily into two groups. Each one of these groups consisted of 15 teeth framed in an acrylic block. After standard enamel etching procedure, each orthodontic brackets were cured on the first group of teeth with low intensity curing unit (1000-1200mW/cm$^2$) for 20 second, the second group with high intensity curing unit (5000-6000 mW/cm$^2$) for 6 second. For each bracket, its strength of shear bond was tested with a universal computerized testing machine. The results showed that brackets cured with low intensity LED produced the highest shear bond strengths (36.6 MPa) while with high intensity show (33 MPa) with no significant difference was found between them. the study can recommend the high intensity LED curing units as this can save time and decrease chair time.

**Key Words:** shear bond, stainless brackets, LEDs.

## الخلاصة
كان الهدف من هذه الدراسة لمختبريه هو لمقارنة قوة اللصق في الحاصرات التقويمية مع نوعيتين مختلفتين من البواعث الضوئية ذات شدة. تم تقسيم ٣٠ سن ضاحك مقلوع وتقسيمها الى مجموعتين. كل مجموعة تتكون من ١٥ سن ثبتت في قوالب منا لاكريليك. بعد اجراء تخريش المينا حامضيا، تم لصق الحواصر التقويمية للمجموعة الاولى بواسطة جهاز باعث للضوء ذو شده منخفضه (١٢٠٠ ملي واط/سم$^2$) ولمده ٢٠ ثانيه، وتم لصق الحواصر التقويمية للمجموعة الثانية بواسطة جهاز باعث للضوء ذو شده (٦٠٠٠ ملي واط/سم٢) ولمده ٦ ثانيه. تم قياس قوه اللاصق باستخدام آلة اختبار عالمية. وأظهرت النتائج أن الحواصر التقويمية التي تم لصقها باستخدام جهاز منخفض الكثافة ولمده ٢٠ثانيهتنتجأعلىقوةلصق (٣٦,٦ ميجاباسكال) بينما أظهرت للمجموعة الثانية بواسطة جهاز باعث للضوء ذو شده عالية ولمده ٦ثانيه (٣٣ ميجاباسكال) مع عدم وجود فرق احصائي بينهما. طبقا لنتائج هذه الدراسة ينصح باستخدام باعث للضوء ذو شده عالية ولمده ٦ ثانية لما فيه من تقليل للوقت والجهد للطبيب والمريض.

**الكلمات المفتاحية:** قوه التلاصق، الحواصر المعدنية، اجهزه باعثة للضوء.

## Introduction
One of the disadvantages of use of composite material is easier in use and give time for precise bracket position, so its use in orthodontic treatment become very popular, but one of its disadvantage is long curing time which consider unsuitable for both orthodontist and patient. For that reason, to decrease chair time there are some methods used like use self-etching primers, brackets precoated and decrease the curing time by device with high intensity of lite to enhance polymerization [1-3].

A new technology used in orthodontic to polymerization the adhesive by light emitting diode (LED). the LED characterized by low generation of heat, and for that reason it is having lifetime over 10000 hrs., with the same constant level of light output, in addition to that the LEDs are cordless so it does not need fan and function noiselessly [4-9].

The promise future of LED come from the

use of these devices with rechargeable batteries because it need low power supply and can be manufactured with cordless, lightweight units and economic design, so it's can be used on operative and orthodontic [10].

The light emitting from LEDs devices should be enhance the polymerization sufficiently as the polymerization is directly related to the power of lights and time exposure. To get high bond strength the resin materials should be polymerized sufficiently [11].

There is a new LEDs generation band characterized by power above 1200 mW/cm$^2$used to curing composite efficiently in half the time of halogen devices [10,11].

The aim of this in vitro study was to contrast the shear union strengths of orthodontic brackets cured with the two modes of LED light, which has different light intensity and curing time.

## Materials and Methods

For this study, previously extracted premolars have been used from patients demanded orthodontic treatment, after extraction each tooth was cleaned and washed to remove blood and remnants of soft tissue and kept in jug with distilled water at room temperature, and to avoid bacterial growth we change the water periodically.

There are some standards put to select the samples, and the sample should be;

-The enamel of buccal surface should be intact.

-Should be don't treated with chemical products (e.g., H2O2),

- Should be caries free.

A total of thirty stainless steel orthodontic brackets **(**STRATUS Bracket Systems**)** the surface area provided by the manufacturer company (Fairfield Orthodontics, USA), the base was directly bonded with Resilience® Light-Activated Orthodontic Bonding Systems (Ortho Technology, Inc, USA).

The sample divided in to two groups according to type of curing;

**Group A**; in this group 15 brackets bonded to tooth surface by orthocomposite and curing mesial and distal surfaces for about 10 seconds (total 20 second) by using light curing device with intensity equal to (1000-1200mW/cm2) by using (Woodpecker® Dental Curing Light LED.C, Guillin Woodpecker Medical Instrument CO., LTD., China).

**Group B**; in this group 15 brackets bonded to tooth surface by orthocomposite and curing mesial and distal surfaces for about 3 seconds (total 6 second) by using light curing device with intensity equal to (5000-6000 mW/cm$^2$), by using (The FlashMax P3 460 4W, CMS Dental A/S Ragnagade 7 DK - 2100 Copenhagen Denmark.

**Preparation the sample;**

Every tooth should be mounted in acrylic block, and for that use aluminum container and the tooth built in this container by using sticky wax and the teeth placed so that the middle third of the buccal surface is positioned to be parallel the container, the container is dyed with a thin coat of separating medium (Vaseline) also to increase retention of tooth in container we made grooves on the roots to enhance retention.

We use self-curing acrylic to mounting the teeth in the container, after mixing the appropriate amount of liquid and powder, the mixture poured around the tooth to the height of the cementoenamel junction [13-15].

After complete setting of acrylic , the samples were removed and coded and stored in distilled water, (Fig1).

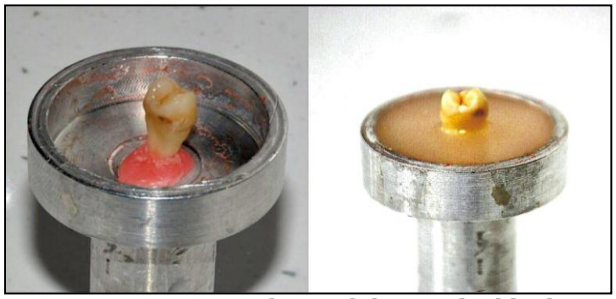

**Figure 1:** mounting the tooth by acrylic block

The buccal surface of each sample of each group before bonding was polished by means of non-fluoridated pumice and water mix with and by using rubber cup attach to a low speed head piece for about 10 seconds. Then each tooth was washed with water spray for 10 seconds then dried by oil free air for 20 seconds [16,17].

Shear bond strength measurement were done with (Microcomputer control Electronic Universal testing machine, model WDW-5, time group INC, china) with a crosshead rate of 0.5 mm/minute [18,19](Fig. 2), the force value were recorded in Newtons. The force was divided by the surface area of the bracket base to obtain the stress value in Mega Pascal units.

The gathered data were statistically analyzed by utilizing Statistical Package for Social Sciences (SPSS) program. The tests used include, Descriptive analysis; minimum, maximum, mean, standard deviation and T-test.

Figure 2: measure the shear bond by universal testing machine

## Results

The table (1) show the descriptive statistics of group **A** and group **B**and the table (2) show t-test. All groups displayed clinically acceptable mean bond strengths (over eight MPa) [20,21] and t-test indicated no significant difference between group **A** and group **B** (P>.05) (Table 2). The group **A** show greatest shear bond strengths (20 seconds and low intensity light cure) 36.6 MPa.

**Table 1:** descriptive statistic for each groups

| **Group** | Mean (MPa) | Sample size | Std. Deviation | Minimum | Maximum | Range |
|---|---|---|---|---|---|---|
| **group A** | **36.6** | **15** | **23.1** | **10.7** | **86** | **75.3** |
| **group B** | **33** | **15** | **18.9** | **4.3** | **65.1** | **60.8** |
| **Total** | **34.8** | **30** | **20.8** | **4.3** | **86** | **81.7** |

| **Table 2:** t test between group. | | | | | | |
|---|---|---|---|---|---|---|
| **Group** | Mean(MPa) | Sample size | Std. Deviation | t-test | P-value | Sig. |
| **group A** | **36.6** | **15** | **23.1** | **0.054** | **0.82** | N.S |
| **group B** | **33** | **15** | **18.9** | | | |
| ***P > .05*** | | | | | | |

## Discussion

In order to improve orthodontic treatment, the high bond strength is recommended during treatment also should be remove the brackets with less or without enamel damage, also time saving during bracket bonding is recommended to decrease chair time [22].

This study found the bond strength of bracket bonded with low intensity and high intensity of LED curing unite is over (8 MPa) [21,22]which is clinically accepted for orthodontic treatment.

Despite the mean of group A is more than the mean of group B there is no significant between them (table 2), this disagree with [3,23,24], may be due to sample material and method of assessment of bond strength.

The study can recommend the high intensity LED curing units as this can save time and decrease chair time.

## Conclusion

We concluded from this study there is no clinical significant between using low with long time and high with short time intensity LED curing unite in bond strength, so we can use both unit in dental work because ite mean over 8 MPa but we recommended to use the high intensity as it saving time and more comfort to patient and orthodontist.

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