



The efficiency and benefit of using, the halogen light source used for bleaching of teeth, in bonding of orthodontic brackets (an in vivo study)

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Abstract

Background: The property of the bleaching light sources is the wide and curved (the negative of the mouth curve) head of exposure. The aim of this study was to, test the efficiency of this devise to bond orthodontic brackets, via unique exposure for the whole teeth, by comparing the rate of the brackets failure with the traditional led light source used in orthodontic brackets bonding which utilizes light exposure for every tooth separately, and evaluating the benefit of time saving through contrasting the time required for bonding with the ordinary led and halogen light sources.

Materials and methods: 856Roth 0.22 stainless steel brackets were bonded to 39 patients by using one of the two light sources in the form of three groups; bleaching light group (13 patients / 225 brackets) , ordinary led light group (13 patients /237 brackets), split mouth group(by using combination of the two sources, 13patients / 229 brackets).

Results: There is no statistically significant difference between the light source used for bleaching and traditional led light source in bracket failure rates, and the time required for bonding by the bleaching light source is 22% and 5% of that required by ordinary led light and ordinary halogen light respectively.

Conclusion: the light sources used for bleaching can be used effectively in bonding of orthodontic brackets with given advantage of saving time and effort.

Key words: halogen bleaching light, led light, brackets bonding

Introduction

In fixed-appliance treatment, one of the most important requirements is correct bracket positioning¹.The advantage of a light-cured adhesive system is that it gives the clinician the ideal working time to position the bracket, reduces the risk of contamination, and helps in easy removal of excess material after bonding². The use of light-cured bonding systems has become popular since photo activated materials were

developed^{3,4,5} Such bonding systems have been widely accepted among orthodontist because of their ease of use and the extended time available to obtain proper bracket position before polymerization is initiated.

Most visible light-cured resins use camphoroquinone, which is sensitive to light in the blue region of the visible light spectrum, with peak absorption at approximately 470 nm, Free radicals

are produced and initiate the polymerization^{6,7}.

Tungsten-quartz halogen curing units (TQH) have been conventionally used as the source of visible light. The disadvantages of conventional halogen units are, the prolonged curing time with halogen bulbs, which can be uncomfortable to the patient, impractical with children, and inconvenient for the clinician^{8,9}. These units deliver 400–900 mW/cm², emit white light, which is filtered to produce blue light with a wavelength of 400–500 nm¹⁰ and a 40-second light curing time per site is recommended to gain an adequate polymerization^{11,12}. The total light curing time thus approaches 15 minutes, which is too long for both the orthodontists and the patients. To resolve these disadvantages, modifications have been performed that increase the light intensity by the use of improved light guides, such as a tapered light guide^{13,14,15}.

Light curing units with gallium nitride blue light-emitting diodes (LED) have also been developed, The spectral output of LED falls within the absorptive region of camphoroquinone, so the LED requires no filters to produce blue light, they produce between 410 and 500 nm. Although the LED shows 70% of the irradiance produced by the TQH, the depth of cure produced by the LED was greater than that by the TQH¹⁶.

However, Banerjee and Sable found recently that the LED provides similar bond Strength and depth of cure when compared to halogen curing units in a shorter period of time while providing other benefits like a longer lifetime and being user-friendly¹⁷.

Materials and methods

The present study included 39 patients (12 male and 27 female) were from attendance seeking orthodontic

treatment in the private clinic, with age ranged between (12-39 years).

All the subjects were treated with upper and lower fixed appliances and met the criteria of having sound facial surfaces of teeth (teeth free from caries, reconstructions or enamel disorders) and no undesirable antagonistic contact between teeth and brackets .A total of a 856 Roth 0.22 stainless steel brackets from (ortho classic) were bonded using light cure bonding system from (ortho technology).

The split mouth design was used for 13 patients of the total, for whom 117 brackets using the light source used for bleaching from (BeyondTM Dental and Health; wave length 480-520 nm, light filtered through 12000fibers with total length of 1mile through an optical lens coated with more than 30 protective layers, completely removing infrared and ultraviolet light), in which one upper and one lower sides were exposed first for forty seconds and 112 brackets were bonded using the ordinary led light source (wood pecker led type from Guilin wood pecker medical instruments, wave length 480 nm). The overall brackets failure rate was registered regardless of the type of the light source used, and so, it is considered as a control group with which other groups were compared. For other 13 patients, 237 brackets were bonded using only the ordinary led light (wood pecker), and 225 brackets were bonded to the other 13 patients using only the light source specially designed for bleaching of teeth (Beyond).

The procedure and steps of etching and bonding are uniform for all groups excluding the time and source of light exposure. Polishing of teeth with non fluoridated pomus followed by etching with 37% phosphoric acid (resilience) liquid etchant from Ortho technology,

for 30 seconds, then the teeth washed by water spray for 10 seconds and dried, then a thin layer of primer (resilience) was applied over the etched surface and a light cured bracket adhesive (resilience) was applied to the base of the bracket, attached to the tooth surface and pressed firmly and the excess resin is removed. Then the polymerization is done; for the ordinary led light, 20 seconds application of light on each bracket (10 seconds on mesial side and 10 seconds on distal side of the bracket). For the bleaching light source; after placement of all brackets with the bond on the teeth, a single 40 seconds exposure of the light by putting the curved head of the device close to the mouth (the same as in the bleaching procedure according to manufacturer recommendation). Then the initial arch wire was placed (0.014 NiTi, svenska orthocut) to be replaced later by the corresponding sequence of arches.

Bracket bond failure was recorded for the first time failure only, and the observation period was 9 month. Failure rates were analyzed using χ^2 test statistics at $\alpha=0.5$ level of significance.

Results

Table 1 shows the number and rate of brackets failure for the three groups. the chi squared test showed no significant difference ($p=0.100$) between the control group (split mouth type) and any of the groups of either the ordinary led light source or the halogen light used in bleaching of teeth, figure(1).

The time required per patient to bond the average number of brackets used during upper and lower fixed appliance treatment (18 brackets) for three types of light sources; ordinary led light(10 seconds per tooth),

ordinary halogen light (40 seconds per tooth) and halogen light used for bleaching(40 seconds per patient), is calculated and shown in table (2). We notice that the rate of reduction in time required for bonding by using bleaching light source in contrast to the traditionally used light sources(ordinary led light and ordinary halogen light) is 11% and 5% respectively, figure(2).

Discussion

One of the short comings of halogen light of the ordinary light guns used in orthodontics and conservative dentistry is the long exposure time required to set the composite. On the other hand, the recognized feature of the light sources used in bleaching of teeth is the capability of directing the light to a broad area thus exposing multiple teeth (approximately 20 teeth) which is returned to the intended design of the apparatus, so, it is theoretically possible to cure the composite under all the brackets with the same proposed efficiency by applying the bleaching light source for a single time exposure. Hence this study aimed to investigate the reliability of the light sources used for bleaching to be used in bonding of brackets by comparing the brackets failure rate with most popular source of light used nowadays(LED light source), and calculating and comparing the time required for all types.

In most researches, the split mouth design is used to save the time and to reduce the number of the subjects required, in this study it was used as a control since the patient was compared with himself or herself regarding all oral conditions in response to the type of light used, hence the total number of the brackets failed was counted regardless of the type of the light used, and compared with a pure groups of

either the led light type or the bleaching halogen light type, which will increase the validity of the results.

In this study it was found that the rate of brackets bond failure was the lowest for the group of ordinary led light but the difference was not statistically significant indicating that the light used for bleaching procedures can be efficiently used for bonding of orthodontic brackets with a total exposure time of only 40 seconds for the whole brackets.

The bracket failure rates obtained by Sunna and Rock¹⁸ and Linklater and Gordon¹⁹ which correspond to the average rate of bracket failure in clinical practice with the conventional technique, were 6.6% and 6.34% respectively, which is close to the rate of our study (5.2%), suggesting that the use of the two types of the light gives results similar to the average. While the result of the bond failure for the light cured with ordinary led light source and the light cured with the halogen bleaching light source were 3.7%, 5.7% respectively which differ from that obtained by Koupis et al²⁰ who found it 5.00% , 3.33% respectively.

The results of this study indicate that the total time required for the bleaching light source to bond an average number of brackets used in upper and lower fixed orthodontic treatment (n=18) is 40 seconds, in contrast with 720 seconds needed with ordinary halogen light and 360 seconds with ordinary LED light sources, which represent 5%, 11% of the time required for the later two types respectively. this reduction in the time required may offer the orthodontist, the comfort , easiness and time saving by overcoming the disadvantage of elongated total time required by the ordinary halogen light and even shortening the time required by the ordinary led light source. So it will be

the fastest way to bond orthodontic brackets.

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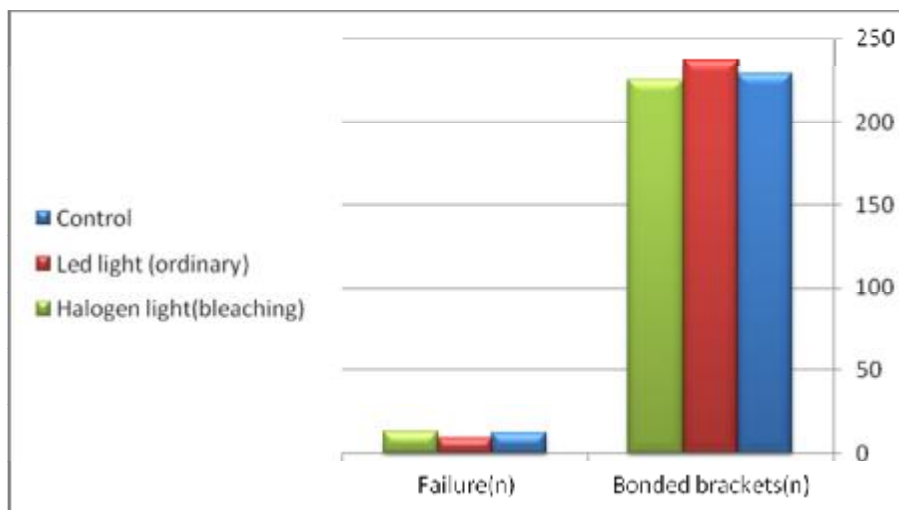
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Table (1): Number and rate of brackets bond failure.

Group	Bonded brackets(n)	Failure(n)	Failure rate(%)
Control	229	12	5.2
Led light (ordinary)	237	9	3.7
Halogen light (bleaching)	225	13	5.7

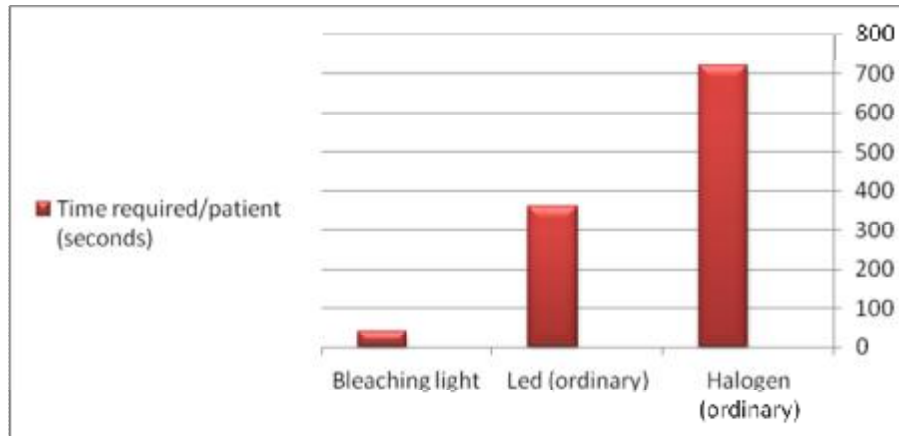
The chi-squared test found no significant difference in bracket failure rates between the groups ($p=0.1$).



Figure(1)

Table(2): Time required per patient for bonding of brackets.

Light source	Average number of brackets bonded/patient	Time required/patient (seconds)
Halogen (ordinary)	18	720
Led (ordinary)		360
Halogen (for bleaching)		40



Figure(2)