A Clinical Comparison of LED and Halogen Curing Units

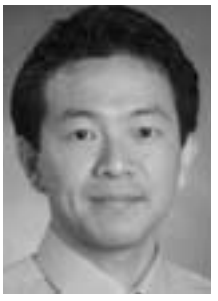
WILLIAM LAYMAN, DMD
TATSUKI KOYAMA, PHD

Light-cured adhesives, introduced by Newman in 1964,[1] are now the most popular means of bonding orthodontic brackets. These composite resins contain camphorquinones[2]—photoiniators that, when activated by blue light in the spectrum of 400-500 nanometers, cause polymerization of the adhesive.[3]

The first dependable light-curing unit used in orthodontics was the halogen bulb, which gives off light as a side effect of the heat generated by energy passing through a tungsten filament.[2,4-6] Although orthodontic halogen units initially produce a wavelength of 470 nanometers, the average life span of a halogen bulb is only 100 hours, and the wavelength drops below an effective range during this period.[7] A survey of 122 dental offices by Barghi and colleagues showed that 45% of halogen curing lights had outputs of less than 300mW/cm^2.[8] In a study by Fan and colleagues, more than 60% of the resin composites cured at a power of 300mW/cm^2 were incompletely polymerized.[9]

To overcome the disadvantages of halogen curing lights, Mills and colleagues proposed a light-emitting diode (LED) curing unit in 1995.[2]

Dr. Layman



Dr. Koyama

Dr. Layman is a resident, Vanderbilt Orthodontic Center, and Dr. Koyama is an Assistant Professor, Department of Biostatistics, Vanderbilt University, 1500 21st Ave. S., Suite 3400, Nashville, TN 37212. E-mail Dr. Layman at wlayman113@aol.com.

Fig. 1 Ortholux XT halogen curing light.

These devices use junctions of doped semiconductors to generate light.[10] Because their light is not derived from heat, LEDs have a lifetime of more than 10,000 hours with little degradation in output over time. LED curing units are also more compact and easier to utilize in a busy practice.

Bishara and colleagues[11] and Dunn and Taloumis[12] have reported acceptable shear bond strengths of brackets bonded with LED curing units in vitro. The present study was designed to compare a conventional halogen curing light with a relatively new LED unit in a clinical situation.

Materials and Methods

The sample consisted of 12 consecutive patients who presented to our clinic for orthodontic treatment. These patients had no restorations on the buccal surfaces of the teeth to be bonded. All teeth were prepared with Transbond* Self-Etching Primer and direct-bonded with Transbond adhesive.

Standard metal brackets were placed in each patient's upper and lower right quadrants using the Ortholux XT* halogen light (Fig. 1), with each bracket exposed for 10 seconds per side, according to the manufacturer's instructions. An equal number of brackets were bonded in the patients' left quadrants with the Ultra-Lume LED 2** light (Fig. 2), curing each bracket for 10 seconds as instructed.

Bond failures were recorded over a three-month period. A Wilcoxon matched-pairs signed-rank test was used to evaluate the statistical significance of the difference between the two groups.

Results

Of the 103 brackets cured with the halogen light, five debonded, for a failure rate of 4.8% (Fig. 3). In the group cured with the LED unit, only two debonded (1.9%). All failures occurred at the bracket-adhesive interface. The difference between the two groups was not statistically significant.

Discussion

This comparison shows clinically acceptable results for both curing units, corroborating the findings of Bishara and colleagues.[11] The LED device would normally require 200 seconds to bond 20 brackets, however, whereas the halogen light would take 400 seconds. If an orthodontist started treatment on 300 patients in a year, the time saved annually by using an LED unit would amount to about 16 hours.

The LED unit is also a smaller device, the size of a handpiece. It has a larger head than the halogen light, making it difficult to access posterior teeth in some patients with limited mouth opening, but this problem is easily overcome with experience in positioning the unit and the patient's jaw. In addition, the LED does not require both sides of the bracket to be exposed, and activation is easy.

Fig. 2 Ultra-Lume LED 2.

Conclusion

In a clinical setting, the LED curing unit produces bonds as strong as those produced by a conventional halogen light, and is faster and more convenient.

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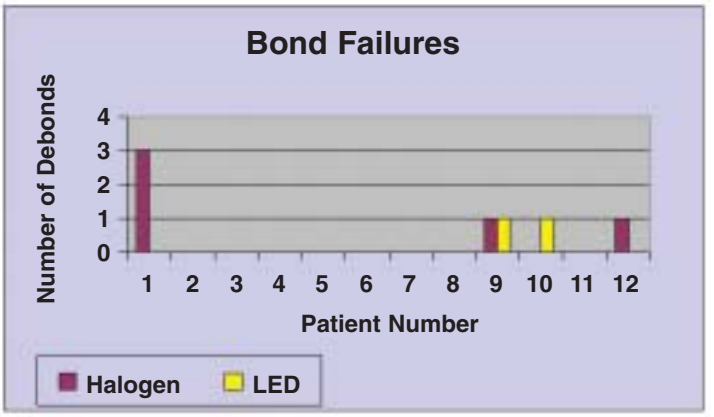

Fig. 3 Bond failures by patient for halogen and LED curing units.

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