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20 YEARS

The best in orthodontic light cure is in reach
An engineer's approach

Introduction

At a recent plenary meeting of the American Association of Orthodontists, Mr. Paul Gange, President of Reliance Orthodontic Products and a respected expert on orthodontic bonding, has asked the audience if they use for bonding either two part systems or photo-cured ones. The hands raised showed an almost unanimity for the last method as it enables the practitioner to take as much time as needed to carefully place the bracket on the patient's tooth and to shift it as desired.

The curing light intensity has to be sufficient to maintain the adhesive's light sensitive agent in its excited state: only then it will react with a reduction agent to form free radicals and initiate the resin's polymerization. As it depends on the mass of adhesive, on the shape of the attachment and on other specific conditions, the International Organization for Standardization has recommended for clinical purposes power densities of at least 300 mW/cm^2.

The procedure involves specific adhesives, attachments and instruments: after a short review of their status (strength and weakness), we will attempt to foresee their near future.

The adhesives

Strength. While some half-a-century old, Rafael Bowen's original formula, 75/25 bis-GMA/TEGDMA, is still used in a world where half of the products made ten years ago have being replaced or withdrawn. Manufacturers do not want to invest and prefer the *status quo.*

Weakness. A thorough study using today's most modern means[1] of the light cure of this resin which was made by the Department of Chemical Engineering, University of Colorado, Boulder, CO, shows major problems. Its importance can be stressed only by showing that it was supported by the National Science Foundation, the Department of Education and the Sloan Foundation...

The study shows that at room/body temperature, this resin "*exhibits incomplete double bond conversion (typically 55-75%) and the physical properties vary as a function of curing condition or clinical application*". Furthermore, that "*Increasing the degree of cure in dental resins leads to higher Knoop hardness values, greater flexural strength, modulus, fracture toughness, and increased diametral tensile strength... Therefore, the final double bond conversion can have critical importance on both the mechanical properties and longevity of the restoration*"...

Other significant tidbits from this study showed that "*Conventional dental resins never reach complete conversion when cured in the oral environment... When the co-monomer mixture is cured at room (20°C) or body (37°C) temperature, the final conversions reaches a plateau at 50-55% conversion.... Curing the samples at 70°C and storing them at 20°C suppresses the need for post-cure (i.e., additional consumption of monomer during storage) significantly*."

Another study[2] found that only 62% of the resin-based composites tested are adequately cured, and even when the recommended irradiation times were doubled, only ninety percent of the composites was found cured.

Not mentioned in these studies is that the unreacted monomer and the non polymer-entrapped ingredients are harmful to the patient (some additives are listed as poisons, and Bis GMA has been described as toxic, cytotoxic, oestrogenic and mutagenic).[3]

Related to post-curing, in the last issue of this newsletter[4], it was shown that to eliminate/reduce incomplete cure we had to use heat (microwaves). The in vitro yield increase in polymer by using heat[5-7] is not new, some turning to microwaves,[8] as we did. Heat post-cure has been tried even in vivo, the metal bracket's temperature being raised by induction.[9-10]

Future. Fast changes are unlikely. The already half-a-century old basic recipe has only been superficially improved. The promise of the researchers at the *Southwest Research Institute* (San Antonio, TX) to deliver composites *"far superior to anything which currently exists"* didn't yet materialize, despite a $3.4 million grant received years ago from the *National Institute of Dental Research* (NIH/NIDR).[11]

The photo-initiators

Strength. As the higly active but equally harmful UV radiations have been replaced with the little lower in energy blue ones, a choice of adequate initiators have been found among which camphor quinone (CQ). As electron-donor (reducing agents), activators which enhance curing, there are at least as many suitable tertiary aromatic amines.

Weakness. The plethora of photo-initiators has led to many adhesives, each one responding to a certain wavelength. As a result, all too many light-curing devices have been launched, some even responding to two or more irradiations. **Future.** Recommended and used by major orthodontic products manufacturers, such as Unitek/3M and Reliance Orthodontic Products, etc., camphor quinone, gains ground. As its peak light absorption matches the radiation of the easy to get indium-gallium nitride (InGaN) light-emitting diodes (LED), this trend is unlikely to change.

The attachment.

As long as these will be made of metals, the photo-cure of the adhesive laying under will be plagued by a soft core, i.e. monomer containing additives. Even the powerful laser light-emitting diodes (LD) can leave uncured specs: their beams are narrow and not enough capable to oppose the unsought "wall effect" which absorbs the energy of the free radicals generated at the interface bracket base-enamel rods.

Strength. While translucent brackets made of ceramic, polymers and composites are ideal matches for the photo-cure of adhesives, attempts were made to render acceptable for photo-curing even the metallic ones. However, a bracket having a central opening in the base to allow the passage of light[12], did not receive yet a noticeable acceptance.

Weakness. As light doesn't penetrate metals, the larger the metal attachment's bonding surface, the lower the chances to fully cure the adhesive. As brackets have approached their peak of miniaturization, there are little chances that an improved design could help.

The use of larger bases, such as these complementing molar tubes (which will, sooner or later, replace bands), raise problems. While recommended to be used to bond bands, the action of light emitters to cure such cements (e.g. Ultra Band Lok™ by Reliance Orthodontic Products) is limited only to a momentary fixation rather than to bonding: the compomer's glass-ionomer component takes over in time.

Future. A sizeable replacement of the current steel attachments is still remote, as their nonmetal counterparts are not yet strong enough. It is, however, quite likely that today's polycarbonate, polysulfone or polyurethane attachments will be replaced by stronger, more advanced polymers and the "tin mouths" will be forgotten.

The curing lights

Today, there are four distinct categories of light emitters used to cure orthodontic adhesives: based upon a tungsten filament in a halogen atmosphere (QTH), on light emitting diodes (LED), on lasers (LD) and on plasma-arc (PAC) lights, each operating within a certain light wavelength, Fig. 1

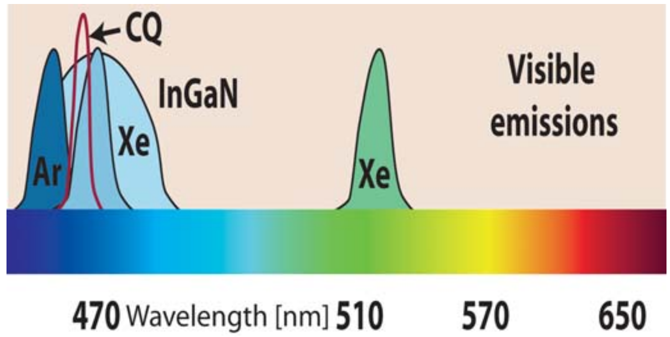

Fig. 1. QTH, PAC: Visible emissions (before filter). PAC: XE (xenon); Luxeon Dental: InGaN; CQ: camphor quinone; LED Lasers: Ar (argon)

Laser curing units are large: while the LaserMed's AccuCure 3000™ (Salt Lake City, UT) are relatively smaller, other have to have even wheels (see Korea Medical Industry's Argon Dentcure[13]). For orthodontic purposes, a blue laser module which delivers 200 mW is sold for $ 2200.

The plasma-arc devices such as PowerPAC (American Dental Technologies, Corpus Christi, TX), or Rembrandt Sapphire (Den-Mat, Santa Maria, CA), can be accommodated only on a desktop. The devices raise plasma to several thousand degrees and most of the energy is given off as heat: only less than 1% is given off as light. Such units are sold for $ 1750 (Ortho Source, North Hollywood, CA 91605). PAC bulbs should last around 1000 hours and cost around $700 to replace.

While both LD and PAC reduce the chair time and please the anxious patients, these will not be discussed here as being expensive, bulky and requiring a tight control to prevent excessive tissue heating.

Strength. In the average sized office in the US, the curing light devices are either QTH or LED: in the firsts, the curing is activated by a bulb filled with halogen (iodine or bromine) and contains a tungsten filament. When connected to an electric current, the filament glows and produces a powerful white light which has to be filtered to provide its blue component (400-500 nm).

In the past, the light emitting diodes emitting a blue light were difficult to obtain. In 1993, S. Nakamura found a way to mass produce indium-gallium nitride blue light emitting diodes, and in 1995, J. Kennedy matched their radiation to the dentists' need for an efficient curing tool. LED lights can be cordless, small and lightweight. As these emanate in the photo-inhibitors light absorption, the energy needed is smaller. Using batteries instead of the office's power source, these are handy, do not generate too much heat and are quiet and long-lasting. Light guides, liquidbased or made of optical fibers are in most cases unnecessary.

Weakness. The light penetrating a composite is in part back-reflected, scattered and inefficiently absorbed by the filler and the substrates (bracket's undercuts and enamel's rods). As illumination's intensity decreases with the square of its distance from the source, the radiation delivered by a source has to be quite high. As already shown[2], to effectively cure most composites within the manufacturers' recommended times, curing light have to deliver an intensity of at least 300 mW/cm^2. This is why the QTH lamps are larger and must be plugged into the house's power supply. Despite of being dissipated with a fan, the heat released degrades over time the device's components and decreases its curing ability. The use of light guides is compulsory.

In contrast, according to G. Christensen,[14] LED lights offer a relatively low intensity but cost more than the conventional halogen lights. A recent listing of the QTH and LED lights (September 2008)[15] shows prices ranging between $279 and $695, with the LED lamps being more expensive. Another similar listing, same date, counts as the most expensive the LED lights, at $880, the least being a QTH for $226.[16]

Future. PAC, LD and QTH lights are high energy consumers. The light systems energy efficiency is for QTH 0.7%, for PAC 0.2%, for LD 0.02% and for LED 13%.[17] High energy consumption supposes larger and less handier devicce bodies.

This may not be important finacially, but it can be, if not frustrating, at least inconvenient: parts have to be replaced requiring the subsequent let down time. QTH lights are considered too slow for curing, while the LED-based ones show a continuous improvement.

Aside the LED lights, the preferred curing devices of tomorrow may be these based upon blue lasers. If today's LD for dental purposes cost thousands of dollars, it is very likely that the current advances in technology will change this. Indeed, the Blu-Ray™ disc (a next-generation optical format jointly developed by a group of the world's leading consumer electronics, personal computer and media manufacturers) will use a blue-violet laser (405 nm).

BlueTrack Technology's new mouses (Explorer and Explorer Mini) may have an impact on decreasing the heat accompanying the illumination as it replaces lasers with an arrangement blue LED - mirrors (such mouses should be available at BestBuy.com and Best Buy stores starting November 2008 for the estimated retail price of $99.95 and $79.95, respectively). Another advance that may have repercusions are the pen-size blue lasers (473 nm, 10mW-30mW). Sold by Optotronics,[17] their prices start at $669.

Conclusions

In orthodontics, the advantages of light cure have left behind the so called "chemical", or "two part" systems. As the composites used as adhesives have not sensibly changed within half-a-century, there are few chances to have them replaced in the near future. Metallic attachments would still be around for quite a while, either because these cannot be easily substituted, or because of the clinicians' inertia.

In contrast, the situation changes when it comes to curing lights: the handy and least expensive devices that would still do the job will be preferred by most orthodontists. With the exception of the possibility of laser- type devices becoming all too popular due to the recent advances in optics, the LED based lights will be in the future the profession's work horse.

References

1. Lovell LG, Berchtold KA, Elliott JE, Lu H, Bowman CN, Understanding the Kinetics and Network Formation of Dimethacrylate Dental Resins. Polym. Adv. Technol. 2001; 12: 335-345
2. Fan PL, Schumacher RM, Azzolin K, Geary R, Eichmiller FC, Curing-light intensity and depth of cure of resin-based composites tested according to international standards, J Am Dent Assoc, 2002; 133 (4): 429-434.
3. Matasa CG, Orthodontic polymers: aworrisome present? Chapter, in: Graber TM, Eliades T, Athanasiou AE (eds). Risk Management in Orthodontics: Expert's guide to malpractice. Quintessence, Chicago, 2004.
4. Matasa CG, Wanted: a grid of bracket's strengths and weakneses. An engineer's approach. Orthod. Mat. Insider 2008; 20(2): 1-8
5. Araújo PHH, Sayer C, Poço JGR, Giudici R. Techniques for reducing residual monomer content in polymers: a review. Polymer Engineering and Science. 2002; 42(7): 1442-1468.
6. Rueggeberg FA, Dlugokinski M, Ergle JW, Minimizing patient's exposure to uncured components in a dental sealant. J Am Dent Assoc. 1999; 130 (12), 1751-1757
7. Bagis YH, Rueggeberg FA. The effect of post-cure heating on residual, unreacted monomer in a commercial resin composite. Dental Materials. 2000; 16(4):244-247
8. Blagojevic V, Murphy VM. Microwave polymerization of denture base materials. A comparative study. J.Oral Rehabilitation. 1999; 26(10): 804-808.
9. Mizrahi E, Cleaton-Jones PE, Landy C. Tooth surfaces and pulp chamber temperatures developed during electro-thermal bonding. Am. J. Orthod Dentofac Orthop. 1996; 109: 506-514.
10. Ward GJ, Mizrahi E, Cleaton-Jones PE. Electro-thermal bonding: Shear bond strength of orthodontic brackets after two weeks. Brit.J Orthod. 1998; 25: 123-126
11. Matasa CG, Resin-based composites: Tomorrow. Orthod. Mat. Insider 2005; 17(3); 3
12. Jordan RA, Binder OM, Georgiakis EG, Puttler OL, (Ormco), US Patent 6,482,002' 2002
13. http://kormedical.en.ec21.com
14. Christensen GJ, The curing light dilemma. J Am Dent Assoc, 2002; 133 (6): 761-763
15. http://zapmedicalonline.com (Curing lights)
16. www.med1online.com/c-248-dental.aspx/ (Dental curing lights)
17. Ernst C P. Clinical aspects of photopolymerization. Transact Acad Dent Mater 2004; 18: 105-117.
18. www.optotronics.com (Portable blue lasers)

A do-it-yourself, personalized powerful LED light for less than $50?

Introduction

Dental LED lights cost in the hundreds of dollars and are widely used, from teeth whitening and filling cure to the detection of tooth-related problems. Their prices vary between $4-500, some being sold for more than $1000 when added with accessories like timers, audible signals, pulsating modules and illumination testers. Thus, 3M/ESPE's Elipar FreeLight 2 is sold through the chain Patterson Dental[1] for $1329.

It is our opinion that an orthodontic light has to be efficient, simple and inexpensive. It has to cures fast while being handy and it has to release little heat while allowing the clinician a good visibility of the area of interest.

The essential components of such lights are readily available, and any hobbyist should be able to put them together as we did.

Reasons for a simpler orthodontic curing light

- Some of the accessories with which the expensive lights are provided to please dentists are either seldom needed in an orthodontic practice, or can be easily replaced (see below, later):

- A timer limits exposures to several seconds, providing a latent period during which the light cannot be activated. This prevents the excessive tissue heating which can occur with over-exposure.

-A trigger that produces a series of pulses at a predetermined frequency: it reduces the heat that may irritate or harm the patient, or overheat the composite.

-A built-in illumination tester that indicates if the recommended light-curing dosage is provided: it signals the need to replace aging lamps.

In orthodontics, which uses illuminations that last less than a 30 sec. per tooth, the need of a timer and an audible signal is questionable. Precautions regarding a too high heat, as released by a powerful LED, are taken by the manufacturer first to protect the device rather than the dental pulp.

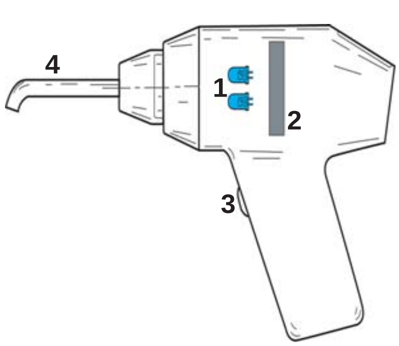

Fig. 1. Pistol-shaped light.
1. LEDs, 2. Fan. 3. Switch, 4. Light guide.

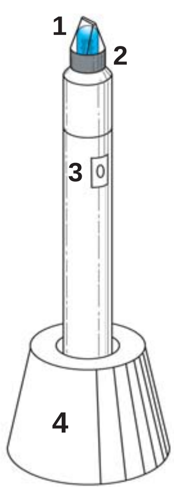

Fig 2. Pen-shaped light
1. LED, 2. Heat sink, 3. Switch, 4. Charging stand

Basically, the shapes of the devices are either pistol, or pen-shaped, as shown in Fig. 1[2] and 2[3]. The pistol shape, typical for the quartz-tungsten halogen (QTH) lights, was selected to protect the patient from the heat released by its couple of powerful LEDs.[1] The pen-shaped lightd dissipate the LED's heat with the help of heat sinks.

High intensity blue LEDs, such as Cree's Research XL7090 blue[4] or Phillips's Luxeon V (Dental, DS35)[5] can be found in commerce[6], while mini-fans and heat sinks are available through electronics distributors such as Radio Shack[7].

Multiple LED arrangements having as purpose to speed both teeth coating and cavity filling have already been suggested, as shown in Fig. 3.[8] The success in orthodontics of such a device is debatable, as if high intensity LEDs (which need sizeable heat sinks) are used, these will obstruct vision.

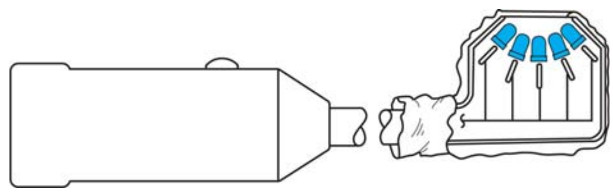

Fig. 3. Curing light exhibiting a multitude of LEDS inwardly converging toward a focal point

Materials and method

Putting the required parts together requires little skill, and the ways to do it are based either on common sense or patents over 20 years old, i.e. expired. Any hobbyist knowledgeable in electricity can do it, the danger of shock being nil.

A first purpose was to build a pen-shaped light using a high intensity blue LED, in this case the Luxeon's Dental LED DS35[9], using common alkaline bateries instead of rechargeable ones. A 7"aluminum spike used for gutters (from Home Depot, made by Amerimax, Lancaster, PA 17603) was at the same time a support and a heat sink. The basic materials are shown in Fig. 4.

Fig. 4. Basic materials for a high intensity LED light.
1. LED, 2. AAA alkaline batteries, 3. Aluminum spike

A second purpose was to speed cure by providing several LEDs without impairing the vision of the area of interest. Today, the orthodontist has to rotate the curing device light around the attachment: if the light would be emitted simultaneously from several directions, both time and effort would be spared.

A third and final purpose was to "personalize" the device, i.e. to enable the clinician to arrange the multiple lights according to his needs.

I. For the first purpose, preliminary tests have been made with common blue LEDs (470 nm, Radio Shack's #276-316 probably made by Nichia in Japan), and then with similar others having 3, 5 and 10 mm diameter[10], Fig. 5, inexpensively purchased from China*.

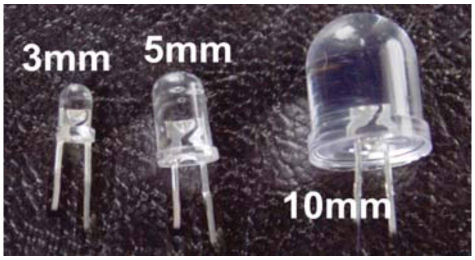

Fig. 5 Common blue light emitting LEDs

LEDs used. These low intensity LEDs were substituted then with the high intensity ones, Luxeon Dental, LXHL-PRD5** (see Fig. 6) from Philips, cost $35 each. These were promptly distributed along with instructions by Future Electronics[5], (Pointe-Claire, Quebec H9R 5C7, Canada).

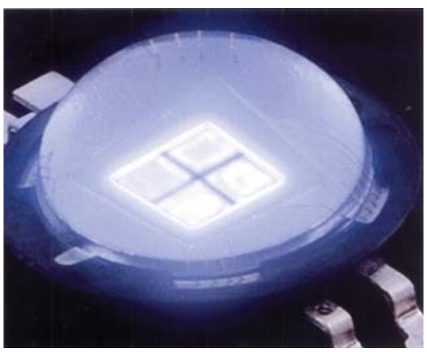

Fig. 6. The high intensity Luxeon Dental LED seen through filters

LED arangements. The key to any successful design using a high intensity LED is the ability to transfer away as much heat as possible. For this purpose, the high intensity LEDs have been tightly pressed against the aluminum spike used as heat sink and kept this way with the same acrylic adhesive it had to cure. The common procedure is to use "pin fin" heat sinks (www.Coolinnovations.com) and highly conductive, Ag-based adhesives (www.Arcticsilver.com).

I. Each new connection was stepwise checked for both the voltage of the sources and the current. The latter was kept at its highest value acceptable by the manufacturer by using resistors connected either in series or in parallel.

Fig. 7. Mounted LEDs: Observe the aluminum spike used as both heat sink and support

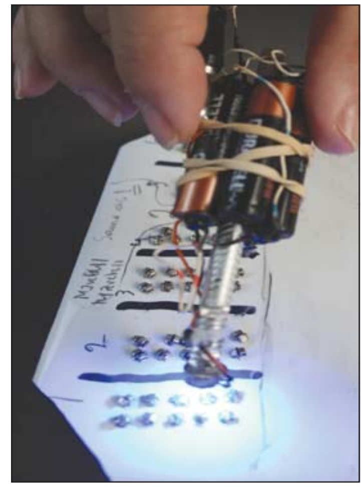

Fig. 8. Bonding with the help of a high intensityLED powered by 5 AAA batteries

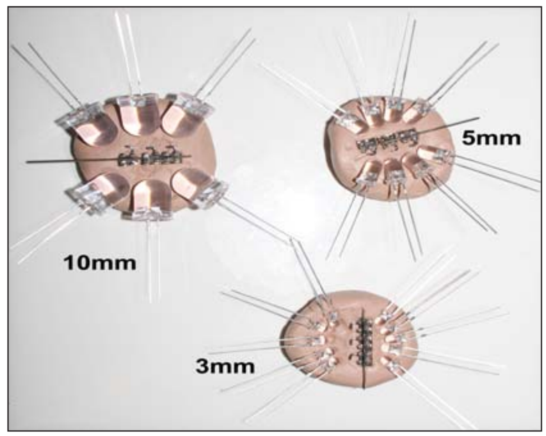

Fig. 9. Common LEDs arrangements respecting steric hindrance during cure

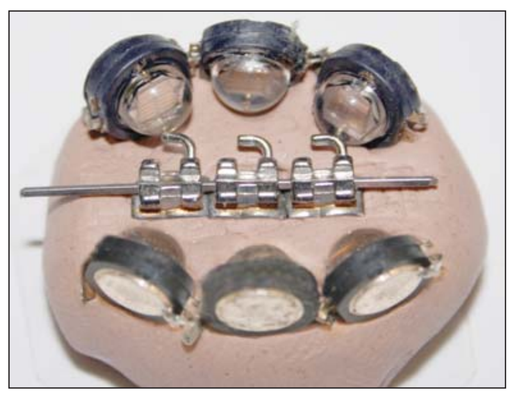

Fig. 10. Preferred arrangement for high power LEDs

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*) Peak Wave Length (nm) : 465 ~ 470
Forward Voltage (V) : 3.2 ~ 3.8
Luminous Intensity: 6000 mcd (millicandles) (photopic units)
Max Continuous Forward Current : 30mA
Max Peak Forward Current : 75mA
Life Rating : 100,000 Hours

**) Peak Wave Length (nm) : 450- 470
Forward Voltage (V) : 5.43 -7.83
Luminous Intensity: 5- 600 mW (radiometric units)
Max Continuous Forward Current : 700 mA
Life Rating : 100,000 hours

In agreement with the initial purpose, both common LEDs and the high intensity ones were connected in series with common flash light type batteries, Fig. 7 and 8.

II. Prior to the simultaneous use of several LEDs to cure adhesives, their steric hindrance (space limitations) were examined, as these have to focus just on one attachment which is placed close and between others, as shown in Fig. 9. Similar arrangements have been tried with the high power LEDs used in this research, Fig. 10. In all cases, the arrangement of the LEDs and the attachments took care of the spatial interference, and the need for proximity to the attachment/ enamel interface. In all cases, the arrangement of the LEDs and the attachments took care of the spatial interference, and the need for proximity to the attachment/enamel interface, Fig. 11.

Based upon the above, LEDs of different sizes of the common or low intensity type were arranged, after their connection to batteries, in star configurations as shown in Fig. 12 a & b. As it can be seen in both images, the area of interest could be watched through the center, left without obstruction.

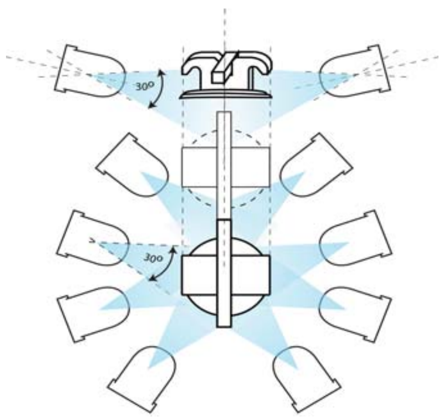

Fig. 11. Planned star-like distribution of common LEDs, profile and bird view

Noticing that just one of the high intensity LEDs provides enough energy to achieve a good bonding, the star-like arrangement of the latter was abandoned in favor of using just two converging ones, Fig. 13.

Fig. 12. Common LEDs arranged in a star-type configuration. a. Eight 3mm LEDs, glued; b. Six 10mm LEDs, free on wires.

III. As different situations may need different configurations which should change at will, another purpose of this study was to provide a way to repeatedly modify the LEDs arrangement while always providing a solid support.

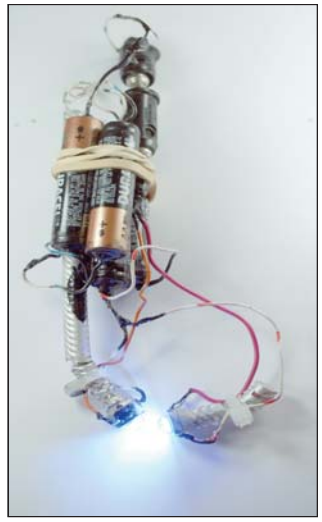

Fig. 13. The convergence of two high intensity LEDs provides enough energy

Fig. 14. ShapeLock allows any desired shape which can be quickly immobilized

This was made possible with the help of a polymer that can be mold and remold indefinitely at acceptable temperatures, ShapeLock™ (Sunnyvale, CA 94085). When its granules are heated at 150^{o}F (in a microwave oven, or, when in contact with the system, with a hair blower), these agglomerate and form a soft mass that can be fashioned at will. Applied on the LED/wire arrangements, it cn be made into the shape desired to minute details, Fig. 14s. When cooled, it becomes solid, conserving the shape and providing a strong support for the arrangement. The polymer is though, machinable & paintable.

Bond strength and cure testing. To test the impact of the proposed LEDs arrangements, sets of ten Ormco Mini Diamond™ upper lateral brackets each were subjected to tension. The time of exposure was limited to half a minute per bracket (five minutes for the set of ten) (although the same support was used, the sets were cured while avoiding a super-exposure from the other's curing).

Both the support (a HF- etched ceramic plate) and the debonding device used in tension mode were described earlier[11, 12]. The adhesives used throughout the experiments were Light Bond™ and Quick Cure™ from Reliance Orthodontic Products (Itasca, IL 60143).

The performance of the LED arrangements were compared with a QTH light sold by Ortho Source, LA 500. This light chosen as control was found by the US Government[13] to be equivalent with Kerr's OptiLux 501, a good light. Aside this control, the arrangements tested were the common blue LEDs star as shown in Fig. 12a, the single high intensity Luxeon LED as shown in Fig. 8, and two of the same converging, as shown in Fig. 14.

As the illumination obtained using two high intensity LEDs was high enough, no attempts were made to use more in a star configuration (Fig. 12 a & b). Indeed, the heat dissipated may have been too high, causing problems in both the dental pulp and the composite.

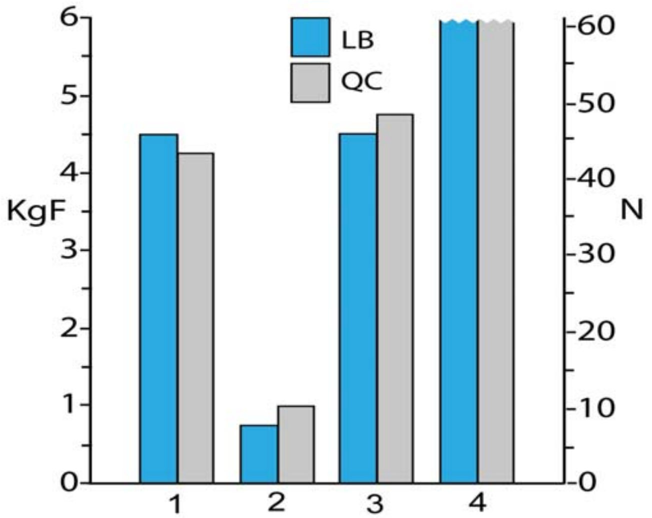

Fig. 15. Average bond strength obtained when curing with several lights arrangements at a 30 sec illumination. Adhesives: LB: Light Bond™; QC: Quick Cure™ Lights 1: QTH Light, LA 500; 2. Star configuration of common LEDs; 3. Single Luxeon Dental; 4. Two converging ones

A related, useful test. Illumination testers/meters or radiometers are useful as these allow the clinician to avoid systematic bond failures due to insufficient light exposure, warning about the need to change the emitter. Instead of buying a curing light with a built-in illumination tester, or a separate specialized device ($265)[1], a simple experiment allows to check the curing power.

This requires just a notebook which should be kept also as a reference for each couple light-adhesive. A speck of the latter is placed on the white portion of a certain page, while the light is applied for always the same time on the corresponding spot of one of the back pages. The number of pages through which the light penetrates enough to harden the adhesive should be marked and referenced for future checking (as the lamp looses power, the number of pages through which the adhesive still cures decreases).

Results

The dependence between the tested lights (QTH as control, along with the three LEDs arrangements) and the generated bond strength is shown in Fig. 15.

The maximum force measurable at the time of the experiments was only 6 KgF (5.88 N). While all the LEDs tested hardened both adhesives, the generated bond strength differed. The ARI index showed an almost even distribution of the adhesive on both substrates. Checking with a needle the adhesive left on the ceramic plate, it was found that the QTH and the LED star arrangement left a soft core.

Discussion

3M/ESPE's Elipar™ FreeLight 2500 is advertised[14] as *"an advanced LED curing light that requires less than 10 percent of the electrical power consumed by conventional halogen curing lights.... The performance of the Elipar FreeLight curing light provides polymerization results and cure times similar to conventional halogen units"*. Its action parallels our arrangement using a single Luxeon Dental LED.

A later version from the same company uses two LEDs instead of one along a light guide: Elipar™ Free Light 2 LED. Its principle was shown in Fig.1[2] According to the its manufacturer, the last light cures "*compatible materials 50% faster than manufacturers recommended cure times*" (the "compatible materials" are composites, compomers, adhesives and glass ionomers), parallels the action of our arrangement comprising two converging Luxeon Dental LEDs.

The performance of a single Luxeon's Dental LED (DS35), as shown in Fig.15, matches the manufacturers' new light, but not its price. Indeed, the $1329[1] for the Elipar™ Free Light 2LED is over 15 times the price of the materials we used to achieve a similar performance, see Fig.4 (two Luxeon Dental LEDs x $35 each; 5 batteries, an aluminum spike, solder, wires, some ShapeLock™, altogether $10).

Of course, our contraptions, which were connected in series with common batteries, can also be assembled using compact battery holders (Radio Shack) as the latter can host rechargeable ones. A less handy alternative is the use of the office's electrical network: thus, if a transformer/converter source of 12 DCV is connected trough a resistance of 8 Ohms to a single high powered LED, the resulting current would be around 600mA (the one we used in most of the experiments described). In this casethe cordless advantage is lost, but the 100,000 hours of the LEDs' continuous life expectancy is preserved (along with the low power consumption, low heat and silent operation).

Conclusions

Some technological advances are difficult to assess, and even more to be put in practice by non-specialists. The light curing devices which can be used in orthodontics are not among these, as these are simple and non-dangerous while providing fast and palpable results. Of course, the contraption made by a hobbyist will not have a sleek design or be under guarantee, but it may work as well.

The financial part is not to be neglected either: there would always be (adventurous or technologically inclined) people who may not be willing to pay a high price for a sophisticated device which they can put it together themselves, no matter how well it is advertised.

References

1. www.pattersondental.com
2. Adam RE, DeBaun BA, Lotte BW (3M) US P 6,419,483 '2002
3. Burtscher P, Plank W, Rohner G (Ivoclar), US P 6835,064 '2004
4. http://www.datasheet4u.com/html/X/L/7/XL7090_CreeResearch.pdf.html
5. http://www.philipslumileds.com/products/line.cfm?lineId=3
6. http://www.futureelectronics.com/home.asp
7. http://www.radioshack.com/home/index.jsp
8. Osterwalder JM, Creamer AA, USP 6,102,696 2000
9. LXHL-PRD5 Lambertian Emitter Luxeon V 700 mA
10. http://www.ledshoppe.com/Product/led/LE1003.htm
11. Matasa CG, Acrylic-solvent: a promising interaction. Orthod. Mat. Insider 2005; 17 (4): 5-8
12. Matasa CG, A simple bond strength device, Orthod. Mat. Insider 2005; 17 (2): 6-8
13. http://www.fda.gov/cdrh/pdf3/K033201.pdf
14. http://www.dentalcompare.com/details/5719/Elipar-FreeLight-Curing-Light.html

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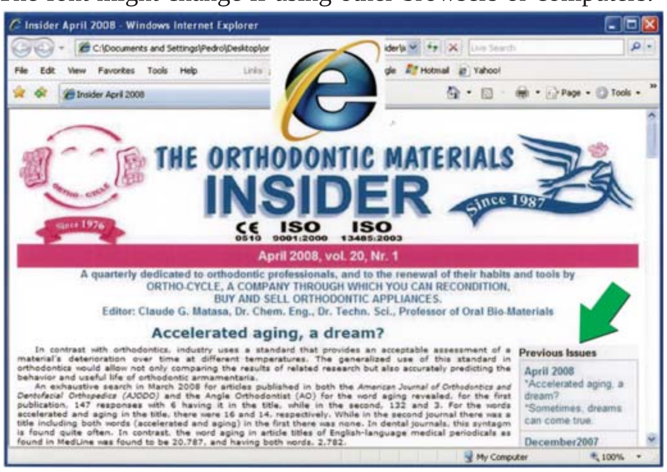

Vatican Penance: Forgive us Our Carbon Output !

The Holy See announced this year that it would become the world's first "carbon neutral" sovereign state by planting trees in a Hungarian national park to offset the carbon-dioxide emissions and energy use of Vatican City. Recently, the Vatican has als sponsored a two-day conference on climate change, and Pope Benedict XVI and other leaders have called for more attention to environmental problems.

Two Professors in Geophysical Sciences at the University of Chicago have prepared a planet-friendly salad lunch. Authorities are trying to help: those from Denver called attention to the fact that every time you recycle one pound of garbage, you reduce your carbon dioxide emissions by one pound. Others recommend measures even for the use of your computer: adjust the settings so that both the computer and monitor go to sleep when inactive for 10 minutes. This step can save approximately 250 pounds of carbon dioxide per year. The above measures may seem extreme, but the average American generates about 7.8 tons of carbon dioxide per year: this is about the weight of two full-grown elephants and works out to about 47 pounds of carbon dioxide a day for every man, woman and child in the country.

Does this affect you? Sooner than we think, we may have to deal with an excess of greenhouse gases that can raise the temperature of a planet to lethal levels, as on Venus, where carbon dioxide contributes to a surface temperature of about 467°C (872 °F). We should not forget that the U.S. greenhouse emissions increase every year with about 1.7%.

As size, the third world producer of carbon dioxide is metallurgy. While massive pieces of steel are recycled, the tiny ones are dumped, as are your attachments. Highly processed stainless steel is known for a high "Carbon intensity", a ratio of carbon dioxide to energy that measures the "greenness" of different products.

If not for the money, concerns for ecology (did you plant ever a tree?) should determine you either to sell, or to recycle your attachments: **Ortho-Cycle will be happy to help!**