CURING LIGHT DEVELOPMENT
LED ADVANCES

Tony Beale looks at the development and advantages of LED curing lights in practice

Curing lights have now become a familiar and much used instrument in all dental practices, and have now been around for over 40 years. During this period many types and brands have come and gone, but technological advances have allowed their continual development, resulting in ever more efficient lights becoming available to the clinician.

Each stage of these developments has seen the application of differing energy light sources, with halogen curing lights displacing the earlier blue short wave UV lights by the 1980s, and eventually becoming the most used type into the 1990s. Whilst these lights were found to be effective, they are now being superseded by LED (light emitting diode) curing lights, and it is now generally recognised that an LED light source offers the practitioner the best way to cure bonding agents, composites and other resin-based dental materials.

Gordon Christensen has expressed the view that, 'Currently manufactured LED curing lights, classed as high powered, are now capable of curing all composites, and may even surpass the light output of plasma arc curing lights.'

Plasma arc technology was once seen as the ultimate power source for a dental curing light, but it failed to answer the needs of the market, mainly due to the high purchase price and costly maintenance. LEDs have certainly overcome the major problems that were apparent with both halogen and plasma arc curing lights.

Halogen curing lights are UV powered, but are prone to problems, and these have exhibited themselves as frequent bulb replacements, due mainly to their fragility, and relatively short working life. The bulbs are also expensive to replace and the lights demand regular maintenance and calibration. They also generate considerable heat, and require a built-in fan for cooling which added size and weight to the unit. Their light tips are also subject to damage and can restrict access to hard-to-reach mouth areas.

Virtually all commercially available composite resins and bonding agents will contain camphor quinone. As this chemical acts as a photo initiator to promote complete polymerisation, it is essential that curing lights must be capable of delivering complete curing to all these materials, and most LED powered lights are now capable of this.

ESSENTIAL DESIGN FEATURES

Advances in technology have enabled manufacturers to introduce curing lights that have promised increased performance levels, with each generation being seen as an improvement over previous models. Any improvement in performance has usually been measured by increased power output. However, power output should not be the main criteria that practitioners should consider when looking to buy a curing light. It is important for practitioners to understand what other design features and user benefits might need to be considered. Broadly speaking, these can be summarised as follows:

- **Power density and power variation:** Power density is measured and shown as mW/cm^2 (milliwatts per centimetre squared). Many manufacturers insist in promoting high power density levels as being essential for effective curing, but this can be somewhat misleading. There is an optimal power density level to which an effective curing light should conform. Simply squeezing the same amount of power into a smaller area can increase irradiance or light density, but will not deliver more power. Instead it simply focuses the power over a smaller area. Therefore, a curing light that delivers a very bright centre spot may show an artificially high level of brightness or power density. The power density levels delivered by a curing light must also be variable, so that the requirements for individual curing procedures can be accommodated. Those lights that can only provide a single level of power will not be suitable for all applications.
- **Angulation of light tip:** In a formal paper, the Canadian Dental Association notes, 'To achieve effective curing, the wand tip of the curing unit should always be parallel to the restoration surface to achieve maximal light intensity at the surface. As the wand is tipped, the circular shape changes to an ellipse (greater surface area), and this decreases the light intensity as energy is spread over a greater area.'[1] This emphasises the need for the light tip to be capable of being absolutely parallel to the surface to be cured, as well as being close. Any angulation of the tip may mean a loss of light

The Valo curing light is available in both corded and cordless options

intensity, resulting in incomplete curing.

• **Distance of tip from RBC (resin based composites) surface:** Insufficient exposure to a curing light beam will result in ineffective polymerisation of material, so it is essential that an optimal distance between the tip and the surface to be cured be utilised. To ensure a complete cure, the light beam must always be held at the correct distance from the surface that is to be cured.

'Ideally, the tip should be within 3mm of the RBC to be effective.'[2]

• **Light beam:** Failure to concentrate the light beam within close proximity to the surface of a restoration will almost certainly result in an inadequate cure. 'A light beam has maximal intensity near the restoration surface; as it becomes scattered and reflected within the RBC material it loses its integrity.'[3]

• **Curing time and effect on tooth structure:** It must be remembered that curing through natural tooth structures, will require a longer cure time. Belvedere states, 'As the light passes through tooth structure (enamel or dentine), it is absorbed and scattered, resulting in incomplete curing of RBC material, especially in areas such as proximal boxes,'[4] In several clinical papers it is also recognised that darker shade composite resin materials may require longer cure times, both Malhotra et al,[3] and Strassler,[5] also consider that curing of darker composites should be carried out at 1mm distance from the cure surface.

DEVELOPING THE VALO CURING LIGHT

In seeking to produce a versatile dental curing light that would fully satisfy the requirements detailed above, Ultradent embarked on an in-depth project which resulted in the introduction of the Valo curing light. The Ultradent company was founded by Dr Dan Fischer, an American dental practitioner who has dedicated much of his life to the production of highly innovative dental materials, many of which are now used worldwide by thousands of dental professionals. Ultradent gained considerable experience in the production of many dental materials over a period of 30 years and had previously produced a highly successful LED curing light which had shown the practical advantages and resultant benefits in utilising LEDs. Through continual development Ultradent introduced the improved Valo curing light in 2009.

Within 12 months the Valo light had gained a five-star rating from Reality, the internationally recognised dental products evaluation board. Other accolades followed, including a 2010 Bronze International Design Excellence award, a Top 50 Technology Products award from *Dentistry Today*, and a Top 100 Dental Products award from *Dental Products Report*. A cordless version of the Valo light is also now available.

THE VALO CORDLESS

The original Valo curing light is able to cure almost all composite resins and associated bonding materials, and is even capable of penetrating porcelain. By harnessing the latest broadband technology, LEDs of three wavelengths were incorporated into the head of the light, capable of not only polymerising camphor quinones efficiently, but all proprietary photo-inhibitors. The Valo cordless is small and very lightweight, with an ergonomic 'wand-like' body. The design allows the tip to access difficult to reach areas in the mouth while still permitting correct parallel positioning to tooth surfaces at the ideal distance without excessive strain being imposed on the patient's TMJ. The light's aluminium body is also very durable and effectively dissipates any generated heat, and its specially designed lens provides a consistent and concentrated cure.

The Valo curing light head, showing the arrangement of the LEDs

Three user-friendly modes of power - standard (1,000 mW/cm^2), high power (1,400mW/cm^2) and extra power (3,200mW/cm^2) - allow variable applications, according to material requirements, and its collimated beam succeeds in maintaining power density and uniform curing over different surfaces.

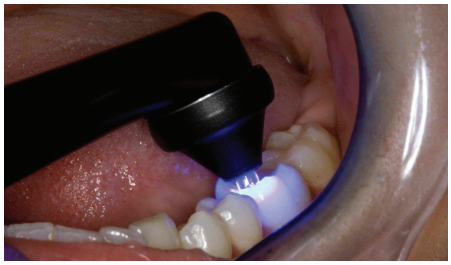
The Valo light satisfies the requirements of dental professionals for the successful and consistent curing of all composites and associated bonding materials. In comparison to the dental curing lights of five to 10 years ago, it clearly manages to incorporate the significant technological advances that have taken place over that period, and can provide the clinician with a safe, reliable and highly versatile light that requires minimal maintenance.

The Valo curing light is available in the UK from Optident Ltd:
Tel: 01943 605050
sales@optident.co.uk
www.optident.co.uk

FMC Events is hosting a one-day seminar by **Dr Dan Fischer** on the 'Future of dentistry'. The event is taking place at the Royal College of Physicians in London on 17 September, 2012, and will show how the use of modern materials and techniques can prove to be of great benefit to both dentists and patients. 7hrs verifiable CPD. To book your place call **0800 371652** or visit **www.fmc.co.uk/events**

For a full list of references or to ask a question/comment on this article, please send an email to: comments@ppdentistry.com

The Valo curing light, showing how its low profile allows easy access to posterior areas



The Valo's collimated beam maintains power density and uniform curing over different surfaces