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A PREP Panel, Practice-Based, Evaluation of the Handling of the *Kerr Demi-Ultra* Light Curing Unit

Abstract: This paper describes the handling evaluation (by a group of practice-based researchers, the PREP Panel) of a recently introduced Light Curing Unit (LCU), the *Kerr Demi-Ultra*, which possesses a number of novel features such as its ultracapacitor power source, and the Light Emitting Diodes (LEDs) which provide the light output being placed close to the tip of the light guide.

CPD/Clinical Relevance: Testing of new devices and materials with respect to their handling is of importance, given that an easy to handle device should produce better clinical results than one which is difficult to use.

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Practice-based research

The importance of practice-based research has been emphasized by Mandel, who considered that 'research is not only the silent partner in dental practice, it is the very scaffolding on which we build and sustain a practice'.¹

A wide variety of research projects may be considered to be appropriate to general dental practice including, assessment of materials, devices and techniques,

clinical trials of materials, assessment of treatment trends, and patient satisfaction with treatment.² In this regard, the volume of clinical material seen in general dental practice makes dental practice an area of central importance in the assessment of new techniques, devices and materials, as success of a material, device or technique could be considered to be its performance in everyday use in a particular dentist's office.

Central to good performance of dental materials are, not only their physical properties, but also their ease of use, since it could be suggested that a device or material which handles easily will be more likely to produce an optimally performing restoration than one which is difficult to use. The assessment of the handling of a new device, in this case a Light Curing Unit (LCU) with novel features, is therefore of importance.

The performance of a material or device by one operator is necessarily subjective but, when practitioners band together to form a group in order to assess the handling of new materials in dental practice, the results are likely to be more

objective and open to generalization. All of this is possible when practitioner-based research groups are teamed with the expertise available in academic institutions. A UK-based group of practice-based researchers is the PREP (**P**roduct **R**esearch and **E**valuation by **P**ractitioners) Panel. This group was established in 1993 with 6 general dental practitioners, and has grown to contain 33 dental practitioners located across the UK, with one in mainland Europe.³ The group have completed over 70 projects, 'handling' evaluations of materials and techniques and, more recently, clinical evaluations (n = 8) of restorations placed under general dental practice conditions, with the restorations being followed for periods of one to five years.

Light Curing Units (LCUs)

The derivation of light curing chemistry from the UK paint industry into dentistry heralded the introduction of so-called *command set* resin-based materials in the early 1980s and the concordant development of resin composite materials to the sophisticated aesthetic materials that

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Figure 1. The Kerr Demi-Ultra light curing unit.

we know today. Early LCUs were bulky and unreliable, but later versions proved to be reliable, albeit with the potential problems of reducing light output with time as the light source degraded. However, the introduction of LCUs utilizing an LED as the light source in the late 1990s proved to be a worthwhile innovation, since these used less power and could therefore be battery operated, resulting in more versatile LCUs as a power cable was not needed to connect the LCU to a dental unit. Early LED LCUs did not have the light output of gold standard LCUs, such as the *Demetron 500* and, indeed, some needed up to 21 separate LEDs to provide sufficient light intensity to cure a resin composite restoration. As with computer technology, these deficiencies were quickly overcome and today's LED LCUs have more than adequate light curing potential, all through one LED. Advantages of LED light units include a constant output which does not degrade with time, their low power needs and ease of use, but they require a light guide to transmit the light from the LEDs which are housed within the body of the LCU. This problem has been overcome by the introduction of the *Kerr Demi-Ultra* LCU, in which the LEDs providing the light output are placed close to the tip of the light guide. This LCU also uses an innovative power source. The question therefore is 'What will a group of general dental practitioners think of

this innovation?'

It is therefore the aim of this project to evaluate the in-practice handling and use of Kerr's *Demi-Ultra* LCU (Figure 1).

Methods

Selection of participants

All 33 members of the practice-based research group, the PREP Panel, were sent an email communication asking if they would be prepared to be involved in the 'handling' evaluation of a new LCU, also ascertaining that they placed sufficient light cured restorations to make their participation worthwhile. Of those who agreed to participate, 15 were selected at random.

Questionnaire design

A questionnaire was designed by the PREP Panel co-ordinators and representatives of the sponsors in order to provide background information on the ease of use of LCUs used previously by the participating practitioners and to compare the ease of use of these with the ease of use of the *Kerr Demi-Ultra* LCU. The majority of answers were made on visual analogue scales (VAS).

Instructions to evaluators

Explanatory letters, questionnaires and a *Kerr Demi-Ultra* LCU were sent to the evaluators in April 2014, along with the instructions for use. The practitioners were asked to use the *Demi-Ultra* LCU where and as indicated, and return the questionnaire after six weeks' use. The data from the returned questionnaires were collated as below.

Results

Of the 15 evaluators from the PREP panel, four were female and the average time since graduation was 29 years, with a range of 11–46 years.

Background information based on the evaluators' existing LCU

The number of LCUs currently in use in the evaluators' practices varied from 2 (5 evaluators), to 3–5 (9 evaluators), while one evaluator had 6 LCUs. Five evaluators had a halogen LCU, two had a corded LED and all 15 had cordless LEDs. Reasons given for their choice of LCU included:

Halogen:

- 'Original light and still used' (4 similar);
- 'Original Kerr Optilux (10+ years old) and still second brightest in the practice'.

Corded LED:

- 'Built into Kavo chair'.

Cordless LED:

- 'Ease of use, ease of charging, relatively cheap';
- 'Changed to this on assumption they give correct wavelength and intensity';
- 'Power and flexibility';
- 'Lightweight, easy to position, good price for multiple purchase' (2 similar);
- 'Lightweight, free with large order, 360° head turning, good battery life';
- 'Free with composite kit order' (3 similar).

The evaluators were asked how often they charged the battery if they used a cordless LCU, with the results being as follows:

(a) After every patient	6 evaluators
(b) After multiple patients	2 evaluators
(c) Once during the day	1 evaluator
(d) Charge a spare battery separate to the light	1 evaluator
(e) At the end of the day/overnight	2 evaluators
(f) Other: 'always kept on charge', 'once a week'	

When the evaluators were asked what they considered the life of an LCU to be, the result was as follows:

(a) 2 years or less	2 evaluators
(b) 3–4 years	2 evaluators
(c) 5–6 years	6 evaluators
(d) 7–10 years	3 evaluators
(e) More than 10 years	2 evaluators

Regarding the sizes of curing tips used by evaluators, none used 2 mm or larger than 10 mm, while two used 4 mm, ten used 8 mm and four used 10 mm.

The reasons given for the size of tip that the evaluator used were:

- 'Size it came with' (7 similar);
- 'Good coverage and spread of light' (3 similar);

- '2 mm too small';
- 'Came with 8 mm and I wouldn't want a larger size.'

Evaluators used a wide variety of different LCUs. The reasons given for the choice of light included:

- Ease of use (7 evaluators);
- Cost (6 evaluators);
- Ergonomics (6 evaluators);
- Powerful output (5 evaluators);
- Reliability (4 evaluators); and
- Lightweight (4 evaluators).

The ease of use of the LCU used by evaluators prior to the present study was rated (on a VAS where 1 = difficult to use and 5 = easy to use) as follows:



With regard to a stated preference of LED or conventional LCUs, 13 evaluators stated that they preferred LEDs, giving reasons for their choice, such as:

- 'Quieter' (3);
- 'Bright, lightweight, no heat, cordless' (2 similar);
- 'Cooler to use' (2 similar);
- 'Smaller – therefore easier to handle. No fan – quieter and good output' (2 similar);
- 'No cord to hang over patient in a badly designed surgery'.

However, one dentist commented that his 'halogen light still gives one of the brightest readings in the practice'. When the evaluators were asked if they were prepared to pay extra for an LED LCU compared with a conventional LCU, 80% (n = 12) stated they were.

Regarding testing the irradiance of the evaluators' current light, this was carried out by an in-built light meter by 7 evaluators, a separate light meter by 5 evaluators, while 4 evaluators used a test composite depth of cure device, with one evaluator commenting that 'The old Ivoclar gadget is still simple and reliable'. All the evaluators (100%) stated that an in-built light meter was an advantage. The irradiance of the light was tested once a week by 4 evaluators, once a month by 4 evaluators, once every 6 months by 5 evaluators and once per year by one evaluator. No evaluator tested his/her LCU on a daily basis.

With regard to disinfecting their LCUs, wipes were used by 14 evaluators, spray by 2 evaluators and a barrier by

14 evaluators. One evaluator used an autoclave, given that he had a halogen unit with an autoclavable light tip. Typically, a combination of barrier bag and wipes was used.

The ease of cleaning of the evaluators' current LCUs was rated as follows (on a VAS where 1 = difficult to clean and 5 = easy to clean):



When asked the design of their current LCUs, the results were as follows:

- Regarding weight, this was stated to be satisfactory by 93% (n = 14).
- All 100% (n = 15) stated that their current light was comfortable to hold.
- When the evaluators were asked how easy their current light was to place below an occlusal restoration in an UL7 in order to cure the restoration fully the result was as follows (on a VAS where 1 = difficult to place and 5 = easy to place).



Comments: 'Depends on inter-arch space' (3 evaluators).

Results after familiarization with the Kerr Demi-Ultra LCU

The presentation of the Kerr Demi-Ultra LCU was rated (on a VAS where 1 = poor and 5 = excellent) by the evaluators as follows:



Comments:

- 'Very smart looking';
- 'Very nice – on a par with Apple iPad and iPhone!';
- 'Excellent presentation and packaging'.

The evaluators rated the instructions (on a VAS where 1 = poor and 5 = excellent) as follows:



Comments:

- 'Very thick and only a few pages in English';

- 'Little mention of the 40-second re-energizing feature – Kerr should make more of that'.

When the evaluators were asked if the Demi-Ultra LCU was comfortable to hold, 80% (n = 12) stated that it was. Comments included:

- 'Heavier than current LCU but comfortable';
- 'Felt a little slippery' (2);
- 'Good balance'.

The evaluators were asked to rate the ease of cleaning of the Demi-Ultra LCU (on a VAS where 1 = poor and 5 = excellent) with the following result:



Comments:

- 'It seemed sturdy and difficult to knock the light out of the base when recharging'.

Replies following clinical use of the Kerr Demi-Ultra LCU

The total number of light cured direct placement restorations placed during the evaluation was 1013, comprising 190 Class I, 252 Class II, 165 Class III, 188 Class IV and 218 Class V. The Demi-Ultra LCU was used for 11 indirect restorations, treatment of dental hypersensitivity (6 evaluators), repair of fractured porcelain (3 evaluators), bonding amalgams (4 evaluators), and placing orthodontic brackets (4 evaluators).

Regarding the performance of the Demi-Ultra LCU in clinical use, 93% (n = 14) of the evaluators stated that the controls worked satisfactorily.

Comments included:

- 'Buttons too close together and were the same colour (black) therefore hard to distinguish. Manufacturer may not have realized that the controls will be covered with a sheath which doesn't help visibility, One button should be different in some way';
- 'Put the control buttons on the other side as well'.

The weight of the Demi-Ultra LCU was stated to be satisfactory by 9 evaluators (60%). Nine (60%) of the evaluators stated that the power source/capacitor life was sufficient. Comments from the remainder were:

- 'If doing a lot of orthodontic bond ups one after another it died on me twice, ie 20

seconds x 24' (2 evaluators);

- 'Would need to be tested for longer, say 18 months, for battery life comparison'

When the evaluators and their dental nurses were asked to rate the ease of use of the *Demi-Ultra* LCU (on a VAS where 1 = difficult to use and 5 = easy to use) the result was as follows:



The evaluators were asked if they considered any changes essential to the acceptability of the *Demi-Ultra* LCU, with the following results:

- 'Light shield design poor';
- 'Less slippery';
- 'May be too heavy';
- 'Change button colour of ONE button';
- 'Cost'.

When the evaluators were asked what they liked most about the *Demi-Ultra* LCU, evaluators made the following comments:

- 'Ease of use, quiet, simple. Brightness';
- '5 second cure for A3 and pulsed action of light';
- 'Cordless and good shape to fit palm of hand, excellent power';
- 'Powerful and bright – set composite quickly';
- 'Beautifully made and nice design BUT recharge is really impressive';
- 'Ergonomics' (2 similar);
- 'Presentation';
- 'Aesthetically pleasing' (3 similar);
- 'LEDs on tip';
- 'Balance and design. Less heat'.

Regarding the durability/reliability of the *Kerr Demi-Ultra* LCU, 9 evaluators rated it as 'very', and 2 as 'good/average', although 2 evaluators commented that 'the evaluation was too short to comment on long-term durability'. Ten (67%) of the evaluators found the 40-second re-energizing a useful feature, but two commented that they 'Didn't know about it'.

The curing time of the *Demi-Ultra* LCU (25 x 10 seconds on full charge) was rated as 'plenty' by 10 evaluators and 'adequate' by one evaluator, with 4 stating that it was 'not enough, especially for orthodontic cases'.

Regarding heat generated by the *Demi-Ultra* LCU, 7 evaluators considered this to be 'much less' or 'less', with 7 evaluators

noting 'no difference'.

Regarding the overall rating of the *Demi-Ultra* LCU, 8 evaluators rated this as 'excellent', 3 as 'good', with 2 rating it as 'below average' and one as 'poor'.

The evaluators were asked to rate particular features of the *Demi-Ultra* LCU in terms of importance (where 5 = most important and 1 = least important) with the following results:

Feature	Average Score	Range
Swivelling head rotation to 360°	3.1	1–5
40-second charge	3.7	1–5
Low heat emission	3.3	2–5
Easy use	3.1	1–5

Ten (67%) of the evaluators stated that they would purchase the *Demi-Ultra* LCU for use in their practice if available at an average price. Nine (60%) of the evaluators would recommend the *Demi-Ultra* to a colleague to use in their practice.

Final comments were:

- 'Nice light but cost needs to be competitive';
- 'After using its predecessor for over 10 years (Optilux halogen) I was reluctant to switch to LED. The *Demi-Ultra* is a worthy successor and I would like to continue to use in my practice' [Subsequent purchaser];
- 'Overall this is a winner. When I need to buy this is the leading contender. The nurses grew to like it';
- 'The technology is impressive and overall a nice piece of kit';
- 'I would purchase this unit if I was looking for another LCU. Excellent product and a pleasure to use';
- 'Many good features. The *Kerr* sheaths were a good fit – this is important';
- 'Poor battery life' (2).

Discussion

Light Emitting Diode (LED) LCUs use a semiconductor material system based upon gallium nitride to generate blue light of selected wavelengths of between 400

and 500 nm without needing to use filters.⁴

This has been considered to be a much more efficient means of converting electric energy into light compared with halogen light technology.⁵ Advances in LED technology have been considered to make it possible, today, to produce LED LCUs which provide an equivalent energy to high intensity halogen or plasma arc LCUs,⁴ and these new LED LCUs have become available without the need for cooling fans. In addition, the majority of LED LCUs can be battery powered because of their low power consumption.⁴ Indeed, Pelissier and colleagues, in 2011,⁶ considered that energy-efficient blue LED lights are rapidly replacing their halogen lamp predecessors as the standard light source in clinical dentistry.

From these comments, it could be concluded that LED LCUs are now state-of-the-art for the curing of resin-based restoratives in dental practice. It was therefore deemed appropriate to carry out a 'handling' evaluation of a recently introduced LED LCU, the *Kerr Demi-Ultra*, which possesses a number of novel features, such as its 40-second re-energizing feature, its ultracapacitor and the LEDs being positioned at the tip of the light, rather than the light being transmitted by a light guide. The *Kerr Demi-Ultra* Curing Light has therefore been subjected to an extensive evaluation by 15 members of the PREP panel in which 1013 light cured restorations were placed.

The presentation of the Unit scored very highly (4.8 on a VAS where 1 = poor and 5 = excellent) and, though the instructions scored well, comments were made that they were too voluminous and that users' attention should have been drawn more to the 40-second re-energizing feature, this being emphasized by the fact that two evaluators stated they were not aware of this feature. Also with regard to design, the aesthetically pleasing design of the *Kerr Demi-Ultra* Curing Light was commented on by several evaluators. However, one comment could be considered to sum up most aspects of the *Demi-Ultra*, namely that it was considered to be a worthy successor to the *Optilux Demetron* light, for many years considered to be the gold standard.

The effectiveness of the *Demi-Ultra* LCU was marginally higher than the currently used LCU. The ease of use score, though above average at 3.9 (on a VAS where 1 = difficult to use and 5 = easy to

use) was lower than the current LCU which scored 4.6 on the same scale. The ease of use of the control buttons when the barrier bag was in place caused several comments as did the slipperiness of the unit again when the barrier bag was in place. This may be due, in part, to the evaluators needing to use standard barrier bags at the start of the evaluation, rather than the type manufactured by Kerr specifically for their LCU which only became available later in the evaluation. Several suggestions were made to improve the design of the control buttons – these suggestions have been fed back to the manufacturer.

The pricing of the *Kerr Demi-Ultra* curing light would appear to be an important consideration when nearly half the evaluators would pay between £200 and £400 for an LCU of similar quality and the other half would pay a maximum of £800.

The results of the present evaluation may be considered to add to another handling evaluation of the *Kerr Demi-Ultra* carried out in the US, which carried out a comparison of the curing and thermal properties of the *Demi-Ultra* and other LCUs.⁷ These evaluators found that the depth of cure of the *Demi-Ultra* compared favourably with other comparable LCUs and that the maximum temperature at the light tip was the lowest of the lights that they tested.

Finally, Shortall and co-workers⁸ have produced a comprehensive and thereby useful list of the selection criteria for a clinician considering purchase of a new LED LCU. These include:

- Does the unit offer broad spectral coverage to allow curing of all restorative resins?;
- Does the unit offer a good selection of power settings?;
- Does the unit have autoclaveable light guides in a suitable range of diameters?;
- Does the gun or wand holder base unit allow easy unit placement and retrievability?;
- Has the manufacturer a reputation for offering reliable high quality products?;
- Has the unit an in-built 'radiometer' for checking emitted power regularly?;
- Does the unit facilitate compliance with current cross-infection control standards?;
- If a cordless type, are the unit batteries removable or integral to the unit?;
- Does the manufacturer offer a reliable and efficient repair programme?;

- Does the unit have inbuilt thermal cut-out protection for the diode(s)?;
- Does the unit offer a good range of programmable time settings?;
- Is there a corded power back-up option if the battery fails?;
- Is there an audible indication of elapsed irradiation time?;
- Is the unit robust, portable, easy to use and reliable?;
- Is the unit comfortable to hold and not too heavy?;
- Does the light source exit allow 360° rotation?;
- Is the light beam well collimated?;

It would appear that the *Kerr Demi-Ultra* fulfils the majority of these criteria.

Conclusions

The number of evaluators who would purchase the *Kerr Demi-Ultra* curing light (67%) and recommend it to colleagues (60%) indicates the good reception of this LCU. The acceptability of the unit would possibly be further enhanced by modifying the instructions to highlight the 40-second re-energizing feature and also modification of the control button design to differentiate them and make them easier to operate when the barrier sleeve is in place.

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Manufacturer's comments

Kerr UK wish to thank the PREP Panel for their in depth comments regarding our new LCU. Their enthusiastic responses underline what we feel about the light. Several comments were helpful to us, such as those on button design, light shield design, curing time, improving awareness of the 40-second re-energizing feature, and cost. We are already working on those in order to improve what we feel is an LCU which has pushed back the boundaries of light curing still further. We, at Kerr, are in the business of providing dentists with solutions to common everyday challenges, and with *Demi-Ultra* we really feel we've addressed a number of issues that dentists have been dealing with for years. We've brought to market the industry's first and only curing light powered by state-of-the-art ultracapacitor technology. Although ultracapacitors are similar in size and shape to traditional batteries, they work differently, re-energizing in a matter of seconds, and maintaining their energy capacity year after year, lowering operating costs for the customer. In practical terms, the *Demi-Ultra U-40* ultracapacitor enables a full charge in under 40 seconds, for incomparable convenience. The new LED light system also features Kerr's proprietary CURE technology, which rapidly delivers uniform depth of cure with industry-leading low temperatures.

We are very excited to be able to provide technology that genuinely delivers convenience, efficiency and reliability to our dental customers on a whole new level.