JOURNAL OF DENTISTRY 39 (2011) 309–315

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/jden

# Effects of light attenuation by fibre posts on polymerization of a dual-cured resin cement and microleakage of post-restored teeth

Yi-Ching Ho [a,d], Yu-Lin Lai [b], I-Chiang Chou [a,c], Shue-Fen Yang [b], Shyh-Yuan Lee [a,b,c,*]

[a] School of Dentistry, National Yang-Ming University, Taipei, Taiwan
[b] Department of Stomatology, Taipei Veterans General Hospital, Taipei, Taiwan
[c] Department of Dentistry, Taipei City Hospital, Taipei, Taiwan
[d] Department of Dentistry, National Yang-Ming University Hospital, I-Lan, Taiwan

ARTICLE INFO

*Article history:*
Received 19 November 2010
Received in revised form
25 January 2011
Accepted 25 January 2011

*Keywords:*
Fibre post
Light attenuation
Polymerization
Dual-cured resin cement
Microleakage

SUMMARY

*Objectives:* The influence of light transmitting ability of different fibre posts on the polymerization of a dual-cured resin cement, and the further microleakage of the post-restored endodontically treated teeth were examined.
*Methods:* An LED curing light was used as light source and the measurements of 470 nm irradiances were made at 1 mm intervals along the posts (P-Lux, P-White, and P-Steel). The polymerization of a dual-cured resin cement surrounding the posts at five depths (0, 2, 5, 8, and 10 mm) from the top was evaluated using micro-Raman spectra after 40 s light-curing. Meanwhile, 36 human single-rooted endodontically treated teeth were randomly divided into three groups and restored with these posts and the cement according to the manufacturers' instructions. Microleakages of the post-restored teeth were compared using an electrochemical measurement system on three consecutive days, and statistically analysed using nonparametric tests.
*Results:* Light transmission through fibre posts was exponentially reduced as the depth increased ($p < 0.05$, $R^2 > 0.95$), and the polymerization of the resin cement beyond the depth of 5 mm significantly declined for all specimens ($p < 0.05$). Fibre posts displayed higher value of light transmission, exhibited a higher polymerization rate of surrounding resin cement, and also demonstrated less microleakage; whilst P-Steel posts had the lowest polymerization rate and produced higher microleakage ($p < 0.017$).
*Conclusions:* The effective radiance along the post was diminished exponentially, which features the insufficient polymerization of a dual-cured resin cement surrounding the posts at apical region and might therefore influence the microleakage of post-restored teeth.


## 1. Introduction

The endodontically treated teeth with extensive loss of coronal structure often require posts and cores for retention of final restorations.[1] Due to the demand for aesthetics and the development of all-ceramic crown, the use of non-metallic posts has recently increased in popularity.[2] The aesthetic posts exhibit not only aesthetic results, but also good mechanical properties justifying their clinical usage.[3]

* *Corresponding author at*: School of Dentistry, National Yang-Ming University, No. 115, Sec. 2, Li-Nong St., Taipei 112, Taiwan. Tel.: +886 2 28267235; fax: +886 2 28264053.
E-mail address: sylee@ym.edu.tw (S.-Y. Lee).
0300-5712/$ – see front matter 
doi:10.1016/j.jdent.2011.01.009

Basically aesthetic fibre posts contain a high volume percentage of continuous unidirectional fibres embedded in a polymer matrix.[4–6] These fibres reinforce the composite posts and allow more light transmission into the root canals. dos Santos Alves Morgan et al.[4] measured the quantity of luminous energy transmitted to the apical terminal of post, and found that the transmitted light significantly decreased as the post length increased. However, Goracci et al.[5] claimed that the ability of the post to transmit the light radially is rather critical than transversely for cement polymerization. They measured the quantities of photons at three different levels (coronal, middle, and apical) along the posts, and proposed a linear negative correlation of photon counts amongst different levels.Resinous cements are thought to be more effective for post cementation owing to recent improvements in dental adhesives, which not only retain the post but also reinforce the tooth.[7] However, the use of self-cured resin can be a problem due to the insufficient working time. Light-curing resin cements possess better handling properties, but light transmission through the bulk of intraradicularly resin can be limited.[8,9] Recently, dual-cured resin cement has been widely used in cementation of aesthetic posts.[10,11] It was developed to overcome unfavourable characteristics of self-cured and light-cured resin cements. Nevertheless, when dual-cured resin is not exposed to light or light is attenuated, it had been shown to decrease the degree of conversion (DC).[12–16]

An insufficient DC of a resin may lead to unfavourable mechanical properties and biocompatibility.[17–20] Consequently the solubility and permeability of resin cement layer to water can be challenged, which shall then alter the microleakage of the post-restored root canals. The purposes of this study were, therefore, to examine the light attenuation through post systems, and investigate its effect on the DC of a dual-cured resin cement surrounding the posts and the microleakage of post-restored teeth. We hypothesized that the light attenuation by aesthetic posts can retard the DC of dual-cured resin cements and subsequently increase leakage potential of post-restored teeth.

## 2. Materials and methods

Three post systems with different light-transmission properties were selected for this study, namely Parapost Fiber Lux (P-Lux), Parapost Fiber White (P-White), and conventional metal Parapost (P-Steel) (Table 1). All of these posts were from the same company (Coltène/Whaledent, Cuyahoga, OH, USA) and had the same diameter (1.25 mm).

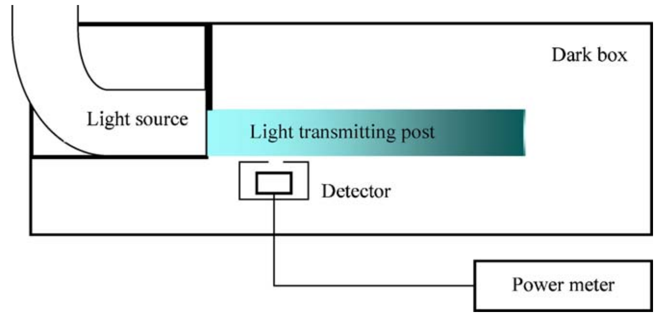


**Fig. 1 – Schematic illustration of radiance measurements along the post using a power metre. The light curing unit was attached to the top of the post in such a way that the post was the only path through which light could pass into the dark box.**

### 2.1. *Effective radiance surrounding the posts*

Ten posts of each group were cut to 10 mm in length to obtain a uniform parallel shape. A post was placed into a custom-made black plastic box to measure the light transmitted through it (Fig. 1). The box had an upper and lower chamber, and the upper chamber had two compartments. The post was inserted into the right compartment and secured with black silicon and adhesive to ensure that the post was the only path for illumination to pass through from the left chamber. An LED light-curing unit (Elipar™ Freelight 2, 3M ESPE, St. Paul, MN, USA) which served as the light source was placed in the left compartment and contacted the top of the post.

The light irradiance through the post was measured by a power metre (1930-C, Newport, Irvine, CA, USA) and a light detector (918-UV, 190–1110 nm, Newport). The power metre was set to a wavelength of 470 nm, and the light detector was covered by a black mount with an aperture window of 1.25 mm in diameter. To standardize the light source, a brand new light-curing unit was used. During the experiment, a 20-s exposure of the curing unit was used, and the power density value at 10 s was recorded.

Radiance was measured at 1-mm intervals along the posts, from top to bottom. Meanwhile, the radiance at the apical limit, after the light had passed through the entire post (10 mm), was recorded as well. To calculate the light intensity of the irradiance ($\mu W/cm^2$), the optical power value ($\mu W$) measured with a power metre was divided by the aperture area. The output intensity of the LED light-curing unit was constantly monitored (1023 $mW/cm^2$) throughout the experiment.

**Table 1 – Post systems and the dual-cured resin cement used in the study.**

| Material | Code | Composition | Manufacturer | Lot. no. |
|---|---|---|---|---|
| Parapost Fiber Lux | P-Lux | 60% Glass fibre, 40% resin | Coltène/Whaledent, Cuyahoga, OH, USA | MT-40890 |
| Parapost Fiber White | P-White | 42% Glass fibre, 29% resin, 29% filler | Coltène/Whaledent, Cuyahoga, OH, USA | MT-53081 |
| Parapost | P-Steel | Stainless steel | Coltène/Whaledent, Cuyahoga, OH, USA | MT-25887 |
| Duolink (translucent) | Duolink | Monomer: Bis-GMA | Bisco, Schaumburg, IL, USA | 0700003787 |