

# Comparison of Blue Light Blocking Effects of Tips and Tinted Lenses for Dental Light Curing Machines

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## Abstract

**Background/Objectives:** This study aimed to examine the blue-light blocking effect according to the curing light tip and the color of the protective eyeglass lens for the operator's eye protection.

**Method/Statistical Analysis:** The transmittance of light with a wavelength between 200 and 900 nm was measured three times at 1.8 nm intervals using a UV-vis spectrophotometer (LAMBDA 265, Perkinelmer, Inc.). Then the average values obtained were compared for analysis. The visible- and blue-light transmittances of all the tips and tinted lenses were examined, and the ratios of blue light in the transmitted visible light were analyzed to compare the blue-light blocking effects.

**Findings:** The transmittance of visible light with a wavelength between 380 and 750 nm was highest in the yellow lens (60.58%), followed by company B's tip (55.23%), company A's tip (51.46%), the orange lens (47.48%), company C's tip (41.53%), and the red lens (41.00%). The blue-light transmittance was 0.14% in company A's tip for the curing light gun, 0.75% in company B's tip, and 0.12% in company C's tip, which were all very low. Among the tinted lenses, the orange lens had the lowest blue-light transmittance (0.20%), the red lens had a blue-light transmittance of 6.59%, and the yellow lens had the highest blue-light transmittance (12.53%). For the analysis results of the ratio of blue light in the transmitted visible light, it was 0.27% for company A's tip, the best blue-light blocking rate, and 20.68% for the yellow lens, the worst blue-light blocking rate. The ratios of blue light in the transmitted visible light for companies B and C's tips were 1.35 and 0.29%, respectively, showing that they have a good blue-light blocking effect.

**Improvements/Applications:** The curing light tips and orange lens used for the analyses in this study showed a blue-light blocking effect. In the case of blue-light blocking by tinted lenses, further studies are required because the blocking rate may vary depending on the lens tint concentration.

**Keywords:** *Curing light tip, tinting, lens, blue light, blocking.*

## Introduction

Humans need light to identify the natures, shapes, directions, and locations of objects as well as the distances between them, and to perceive space and the objects they

want to know. Light is divided into two types: natural light obtained from the sun, including that from visible light that can be perceived by the human eye as well as infrared to ultraviolet light; and artificial light made for convenient use according to human needs<sup>[1,2]</sup>. In the case of natural light obtained from the sun, the available time for human use is limited to daytime, the bright time of day. The artificial light made to address this limitation can help people perform activities in places where things are invisible due to darkness, or at various time zones, which greatly helps expand the range of human activities and the convenience of life.<sup>1</sup>

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Artificial light not only provides convenience in daily life but also utilizes a different wavelength of light. As it has various transmittances to and interactions with materials according to its wavelength, it is used for the diagnosis and treatment of various diseases, such as gamma rays applied to cancer cells, X-ray used to diagnose and treat diseases by checking the inside of the human body, and treatment using infrared rays. Its effects were confirmed by the results of various studies<sup>[3-7]</sup>.

In the field of dentistry, X-ray, which is artificial light necessary for panoramic, standard, bitewing, and occlusal imaging, is used to accurately determine the conditions of the patient's periodontal tissue, dental components, and jaw bone, where the teeth are situated. In addition to X-ray, light is also utilized for the composite resins used to repair the teeth during dental treatment. The use of a light curing gun that irradiates blue light to cure plastic composite resins is also a therapeutic process using light<sup>[8-10]</sup>.

As such, the utilization of artificial light in various medical fields has spurred the development of many technologies, but to see the therapeutic effect of the light irradiated for treatment, a large amount of light should be irradiated for a short time. It also causes side effects as well as the action for treatment<sup>[7,11]</sup>.

In particular, during the light irradiation process, the practitioners and assistants who have to treat patients while checking the treatment site are exposed to a large amount of light irradiated by the light curing gun for a short time. The risk exposure is even likely to be higher when there are many patients who need to be treated using the light curing gun. Wearing appropriate safety glasses to block the light during the treatment process will minimize the exposure to the side effects, although the light is not completely blocked<sup>[12,13]</sup>. This study aimed to investigate the color and transmittance of the most effective lens that maximizes light blocking and minimizes the risk of exposure to light while using the light curing gun among the various lights used in dentistry.

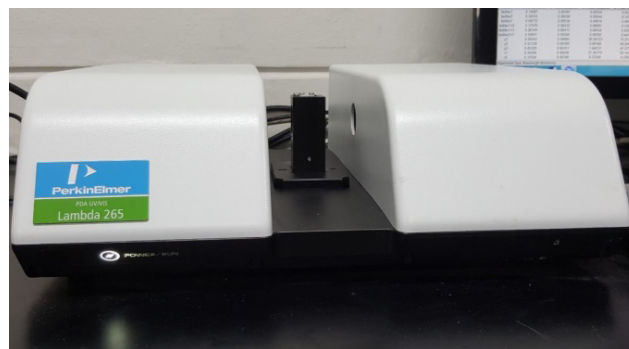
### Method

For curing the plastic composite resins used for tooth restoration, artificial blue light is irradiated using a light curing gun. The light is irradiated for a short time, but a large amount of light is irradiated, directly or indirectly stimulating the operator's eyes. To minimize

this stimulation of the light curing gun operator's eyes by the blue light, the manufacturers of light curing guns sell these with tips. This study intended to find an efficient method of blocking light by measuring the light transmittances of these tips and of eyeglass lenses tinted with red, yellow, and orange dyes that are expected to block blue light.

The transmittances of light with a wavelength between 200 and 900 nm were measured at 1.8 nm intervals using a UV-vis spectrophotometer (LAMBDA 265, PerkinElmer, Inc.) [Figure 1]. The transmittances of the curing light tips and eyeglass lenses were measured three times, respectively, and then the average values were compared for analysis.

The transmittances of the visible and blue light of all the curing light tips and tinted eyeglass lenses were examined [Figure 2,3], and the ratios of blue light in the transmitted visible light were analyzed to compare the blue-light blocking effects. Based on the regulations of ANSI Z80.3 1986, visible light was classified as light between 380 and 750 nm, and blue light as light between 380 and 500 nm.



**Figure 1. UV-vis spectrophotometer (LAMBDA 265, PerkinElmer, Inc.)**



**Figure 2. Curing light tips and eyeglass lenses tinted with red, yellow, and orange dyes.**

### Result and Discussion

Using a UV-vis spectrophotometer, the light transmittances of three companies' curing light tips and eyeglass lenses tinted with red, yellow, and orange dyes within the 200-900 nm wavelength range were measured [Figure 4]. In the visible-light region (380-750 nm), the curing light tips and tinted eyeglass lenses showed different light transmittance spectra according to the wavelength, which indicates that the light transmittance is different depending on the curing light tip and eyeglass lens color concentration.

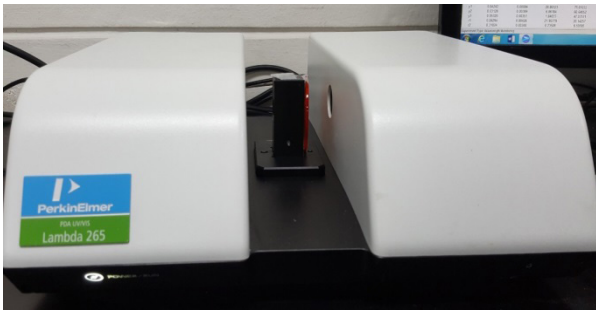


Figure 3. Light transmission process after mounting the UV-vis spectrophotometer (LAMBDA 265, Perkinelmer, Inc.) and lens.

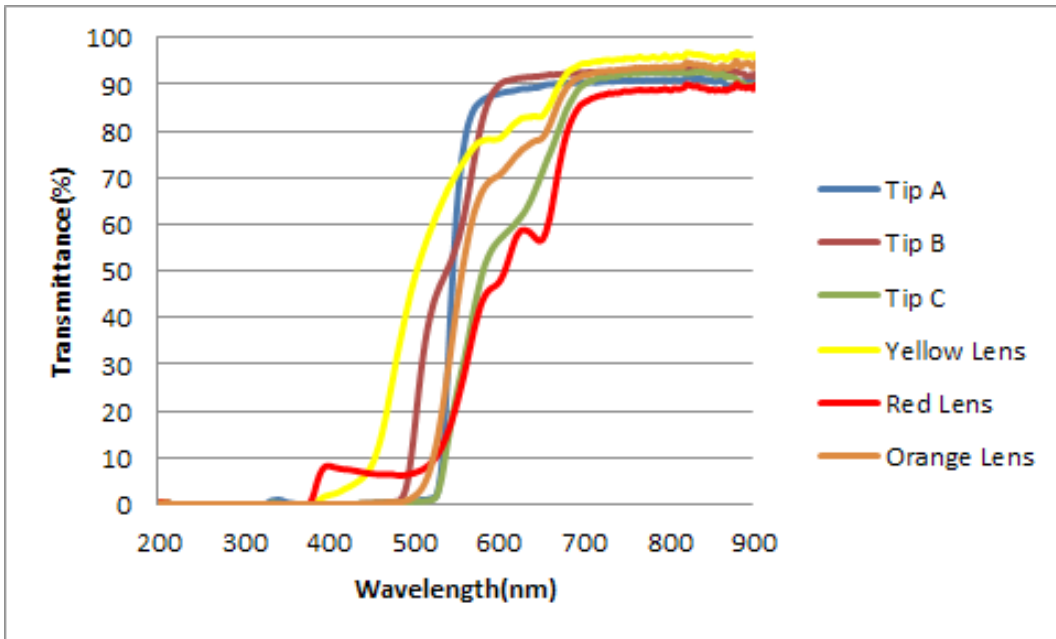


Figure 4. Spectral transmittance curves of dental curing light tips for blue-light blocking and tinted eyeglass lenses.

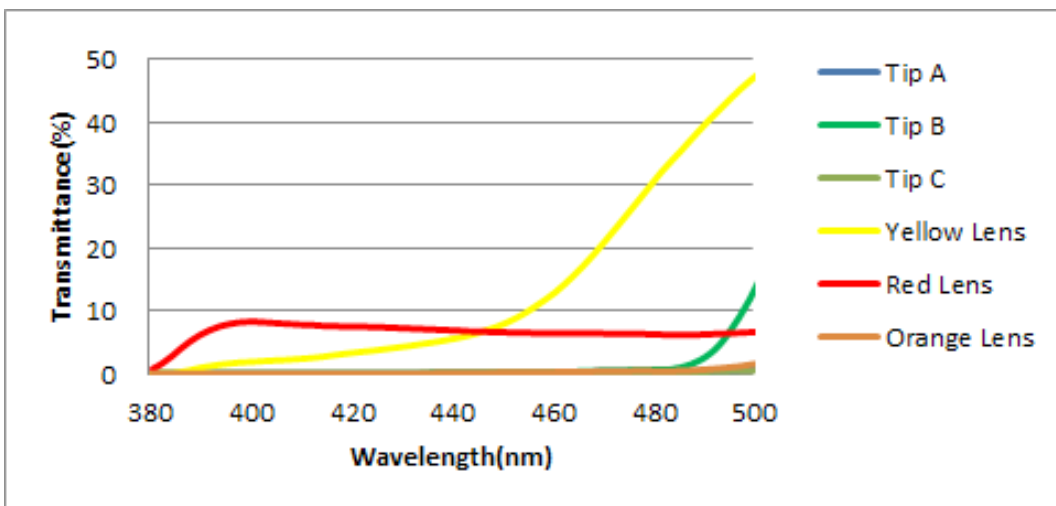


Figure 5. Spectral transmittance curves of dental curing light tips and tinted eyeglass lenses in the blue-light (380-500nm) region

The spectral distribution of only the blue-light region within the 380-500 nm wavelength range is shown in Figure 5. Among the three companies' curing light tips, those of companies A and C showed almost similar spectra, and there was no difference in the distribution of the spectrum. Only company B's curing light tip showed a slight difference near the 500 nm wavelength. Among the tinted eyeglass lenses, the red lens showed a nearly constant transmittance spectral curve in the blue-light region while the yellow lens showed increased light transmittance near the 450 nm wavelength. The orange lens showed a spectral distribution with almost no blue-light transmission, like companies A and C's curing light tips.

Among the light transmittances within the 380-750 nm wavelength measured using a UV-vis spectrophotometer (LAMBDA 265, Perkinelmer, Inc.) [Table 1], the visible-light transmittance was highest (60.58%) for the yellow lens, followed by 55.23% for company B's curing light tip, 51.46% for company A's curing light tip, 47.48% for the orange lens, 41.53% for

company C's curing light tip, and 41.00% for the red lens. The blue-light transmittance within the 380-500 nm wavelength region was 0.14% for company A's curing light tip, 0.75% for company B's curing light tip, and 0.12% for company C's curing light tip, which were all very low (less than 1%). Among the tinted eyeglass lenses, the orange lens had the lowest blue-light transmittance (0.20%), the red lens had 6.59% blue-light transmittance, and the yellow lens had the highest blue-light transmittance (12.53%). For the analysis results of the ratio of blue light in the transmitted visible light, it was 0.27% for company A's curing light tip, the lowest, indicating that such curing light tip has the best blue-light blocking rate. The ratio of blue light was 20.68% for the yellow lens, showing that such lens has the worst blue-light blocking rate. Companies B and C's curing light tips both had a good blue-light blocking effect, with the ratios of blue light out of the visible light being 1.35 and 0.29%, respectively. On the other hand, the red lens had a low blue-light blocking effect, similar to the yellow lens (16.07%).

**Table 1. Light transmittances of dental curing light tips for blue-light blocking and tinted eyeglass lenses**

Wavelength (nm)	Light Transmittance (%)					
	Company A (Tip A)	Company B (Tip B)	Company C (Tip C)	Yellow Lens	Red Lens	Orange Lens
380-750 (Visible light)	51.46	55.23	41.53	60.58	41.00	47.48
200-380 (Blue-light)	0.14	0.75	0.12	12.53	6.59	0.20
Blue-light/Visible light	0.27	1.36	0.29	20.68	16.07	0.42

**Conclusion**

All the curing light tips that were used in the analysis in this study showed an excellent blue-light blocking effect, and the orange lens showed a similar blue-light blocking effect by the curing light tips. In the case of the yellow and red lenses, the blue-light blocking effect was low. Further experiments are needed to determine whether the yellow and red lenses can produce as much blue-light transmittance as the orange lenses. For this purpose, further research is needed to compare the blue-light transmittances by tint concentration.

**Ethical Clearance:** Not required

**Source of Funding:** Self

**Conflict of Interest:** Nil

**References**

1. Chang MH. Study of Space Expression by Light and Color – Based on my works - [master's thesis]. [Seongbuk-gu (Seoul)]: University of Sungshin Women's; 2013.
2. Chae MS. A Study on the Representation of Formative Arts using Light [master's thesis]. Dong-gu (Gwangju): University of Chosun; 2003.
3. Park YJ. Effects of gamma-ray irradiation on intracellular Ca<sup>2+</sup> regulation in A549 human lung cancer cells [master's thesis]. Michuhol-gu(Incheon): University of Inha; 2008.
4. Hur JM, Kim DH. The Ethanol Extract of Red Ginseng Enhances Anti-Tumor Effects Using Co60 Gamma Irradiation. Applied Biological Chemistry.

- 2011;54(1):15-20. DOI : <http://dx.doi.org/10.3839/jabc.2011.003>
5. Rhim SY, Kim YG, Kim TK, Kim JD, Choi JW, Kim JK. Comparison of the Short-term Effects of Jjimjilbang Therapy and Infrared Therapy on Pain Scale of Patients with Chronic Low Back Pain. 2007; 8(4):417-32.
  6. Kim YG, Kim JD, Kim TK, Lee KH, Han SH, Choi JW, et al. Comparison of the Short-term Effects of Jjimjilbang Therapy and Infrared Therapy on Pain Scale of Patients with Knee Osteoarthritis. Korean journal of clinical geriatrics. 2006;7(4):419-25.
  7. Vanida N, Praewpat P, Siribang-on PK, Bhornsawan T, Thirayost N. A study on light transmittance through red protective shields modified with different window films. *BDJ Open* volume(3). 2017. DOI : <https://doi.org/10.1038/bdjopen.2017.14>
  8. Elvidge CD, Keith DM, Tuttle BT, Baugh KE. Spectral identification of lighting type and character. *Sensors(Basel)*. 2010;10(4):3961-3988. DOI:10.3390/s100403961
  9. Harlow JE, Rueggeberg FA, Labrie D, Sullivan B, Price RB. Transmission of violet and blue light through conventional (layered) and bulk cured resin-based composites. *J Dent*. 2016 Oct;53:44-50. DOI: 10.1016/j.jdent.2016.06.007.
  10. Kim HR, Jeong JH. Optical Evaluation of MR8 Material spectacle Lens with a New Method for the analysis of Blue Light. *Korean Journal of Vision Science*. 2018;20(4), 413-420.
  11. Song KS, Joo SH. Study on the blue light hazard protection rate of blue light coated lenses. *Korean Journal of Vision Science*. 2016;18(4), 525~533.
  12. Carlos JS, Monise de PR, Andomar Bruno FV, Erick René CR, Lorraine BF, et al. Marcelo G, Evaluation of Eye Protection Filters Used with Broad-Spectrum and Conventional LED Curing Lights. *Brazilian Dental Journal*.2017;28(1). <http://dx.doi.org/10.1590/0103-6440201701380>
  13. Seo JM. Change of Contrast Sensitivity Induced by Tinted Spectacle Lens. *Journal of Korean Ophthalmic Optics Society*. 2016;21(1), 47-51.