A Comparative Study of the Accuracy of a Modified LED Penlight vs. Regular Incandescent Penlight in Measuring Pupil size under Direct Light Protocols in the Drug Evaluation and Classification Program

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Completed : September 14, 2018

Abstract_____

Background: The Drug Evaluation and Classification (DEC) program evlautaes pupil size in direct light as one of its important protocol. For years, the use of incandescent penlights has been used as the standardized method of illumination based on the original pupil size studies.

Newer technology has evolved where there are more efficient lights, e.g., Light emitting diodes (LEDs) lights, available. However, they quite often appear and may also be much brighter and can influence the results of the standardized pupil size and impact the final impairment decision.

In general, saturated colors, like those produced by LEDs, appear brighter than less saturated lights, like those produced by incandescent sources. Even though Light emitting diodes (LEDs) are frequently perceived as brighter than those using incandescent sources, this perception still persists even when the LED and Incandescent bulbs are measured to be at same intensity.

Purpose: With the use of an LED light in a Drug Evaluation Classification (DEC), does this perceived brightness modify the pupillary size on direct light examination or does an LED light and incandescent at the same intensity yield an equivalent pupil size?

The purposes of this study was to :

(1)To create a modified LED penlight that had the same intensity as the standard incandescent penlight during the DRE evaluation.

(2) To compare the two penlights for brightness and pupillary sizes during direct light testing outcomes on a series on normal non-impaired subjects using the specific DEC program protocols for pupil testing that could generate comparable direct pupil sizes.

Methods: Thirty non impaired subjects (24 men;6 women; average age 27 +/- 5 yrs) were tested using each Trained DRE officers measured pupil sizes using a standard incandescent penlight (Fig 1) and a standard LED that was a modified LED penlight since it was too bright and intense (Fig 2 A,B). The LED penlight was modified with a translucent diffuser to reduce the luminance to match the level of the standard incandescent penlight to approximately 65 foot-candles for each penlight.

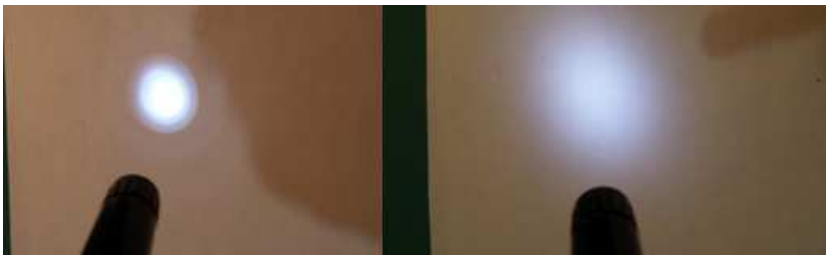


Figure 1 Figure 2 A (No Filter), Figure 2B (Filter)

Each subject had the right and left pupil tested under the two lighting conditions in direct light for 15 seconds and was photographed with a DRE pupillometer in the photo at a distance of 6 inches. This would act as a reference to establish the pupil size under the two different penlight conditions. Each photo was examined to determine the pupil size and recorded to the nearest 0.10 mm. (Fig 3) based on photographic analysis..

Fig 3 A LED Modified Penlight

Fig 3 B Incandescent

Results: The results are shown in the following Table 1.

LEFT EYE	LEFT EYE	RIGHT EYE	RIGHT EYE
Penlight	**LED Light**	**Penlight**	**LED Light**
3.6mm	**3.5mm**	**3.6mm**	**3.5mm**
0.24mm	**0.18mm**	**0.33mm**	**0.31mm**

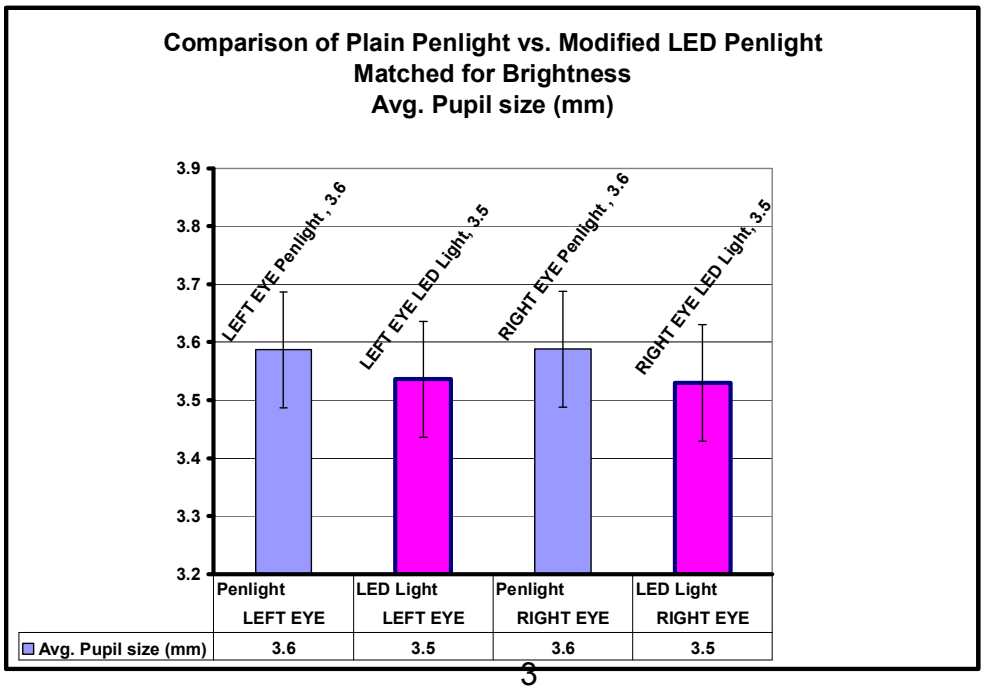
Table 1

Pearson's correlation coefficient measures the strength and direction of the relationship between two sets of pupil sizes. The value of R is 0.8634. This indicates a strong positive correlation and association between the pupil sizes using a standard penlight scores and with the modified LED scores (and vice versa). The value of R^2, the coefficient of determination, is 0.7455.

Though highly correlated, a Paired *t* test was conducted to see if these pupil sizes were significantly different. The results indicated that the two-tailed P value equals 0.1153. Therefore, this difference is considered to not be statistically significant and the pupil sizes were comparable under both pupillometer lighting conditions. Though the LED may have been perceived to be brighter, these results indicates that the two lights yielded equivalent pupil sizes and were not significantly different and were comparable for testing purposes. (Confidence interval: The mean of Incandescent minus LED Modified equals 0.0469 with a 95% confidence interval of this difference: From -0.0121 to 0.1059)

Figure 4 illustrates the comparison between the two methods

Figure 4



Conclusions: This study determined that the modified LED penlight (Bernell Corporation, Mishawaka IN) can serve as an effective substitute option for the use a standard regular incandescent penlight in assessing the Direct Light function during the DRE evaluation.

Acknowledgements:

I would like to express my appreciation to Bernell Corporation, Mishawaka IN, for their support in developing and providing the modified instruments and materials for this study. I want to thank the 30 Plymouth Police Academy recruit class students who contributed their personal time to complete the evaluations. Their efforts are greatly appreciated. I also thank Shankaran Ramaswamy, OD, PhD, FAAO, Associate Professor of Optometry for his comments on a draft of this study.