

Finger-shaped Red Light Emitting Diode to Ascertain the Depth of Periungual Wart

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ABSTRACT

Management of periungual wart is a great challenge, especially when there is subungual extension. The major cause of recurrence of wart is improper clinical assessment of its extent and not directing therapy against the entire wart. This difficulty of ascertaining its extent could be overcome with this finger-shaped red light emitting diode device. Red light in the device penetrates the thick palmar skin and dark constitutive skin colour due to its longer wavelength.

KEYWORDS: Periungual, red, wart

INTRODUCTION

Warts are the most common benign nail tumours. Warts around the nail unit are commonly caused by human papillomavirus - 1, 2 and 4. Periungual warts originate from the skin possessing granular layer including hyponychium, proximal and lateral nail folds. They can invade the nail bed and compress the matrix.^[1] The current management options for periungual warts include topical, intra-lesional and systemic drugs, lasers and surgical procedures. The choice of a procedure in a patient depends on skill of the treating physician, location and extent of wart, number of warts, duration of warts, age and immunologic status of the patient.^[2] Nevertheless, periungual warts are known to recur and one of the most common causes of recurrence is inability of treating physician to determine the extent of it. We designed a simple device to ascertain the extent of periungual wart.

DEVICE SPECIFICATIONS

The device is handy with dimensions of 8.5 cm × 5.5 cm × 2.5 cm [Figure 1a]. Power source for

the light emitting diode (LED) device is a 9V battery with a switch adjacent, both fixed at the upper part of the device [Figure 1b]. A row of nine 3.3V, 20 mA red colour LEDs is fixed on a plastic board and is enclosed in a black opaque cover [Figure 1c]. The opaque cover transmits light only to the bottom and there is no dispersion of light through the sides [Figure 1d]. The total cost incurred to design the device is 200 INR [Table 1].

PRINCIPLE

Visible spectrum has a colour range from violet to red, with a wavelength ranging from 400 to 700 nm. The penetration depths of these colours depend on their wavelength.^[3] The light with longer wavelength penetrates deeper. Blue light has a wavelength range of 400–470 nm and can penetrate only up to 1 mm. Red has the longest wavelength (630–700 nm) in the visible spectrum and can penetrate 1–6 mm [Figure 2].

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DISCUSSION

The LED device fits snugly when placed with its bottom on the finger [Figure 3]. As there is no dispersion of light through the sides, when illuminated, the red light passes onto the finger. Wart stands out contrasting as black against a bright red background making it easy for the treating physician to appreciate its extent [Figure 4]. Trans-illumination with white torch light is not sufficient. Limitations of white light are it is ineffective in thicker palmoplantar skin and darker constitutional skin colour.^[4] These limitations could be overcome with this device due to deeper penetrating red light.

Therapies for periungual wart are targeted only to that portion visible to the naked eye. Subungual extension of wart can be missed with the naked eye examination. For subungual extension, most

treatment modalities require a partial nail avulsion before targeting therapy except for those having immunomodulatory action like bleomycin. This device addresses this problem of assessment and delineates the complete extent of the periungual wart with distinct advantages [Table 2].

The red LED device can also be used in injecting sclerotherapy agents for varicose veins and drawing blood in individuals with clinically invisible veins. Knowing the extent of periungual wart is required for

Table 1: Cost of making the device

Components	Cost (INR)
9 red LEDs	45
Plastic board	10
Switch	5
9V battery	30
Wire connections	10
Making charges	100
Total	200

INR: Indian rupee, LEDs: Light emitting diodes

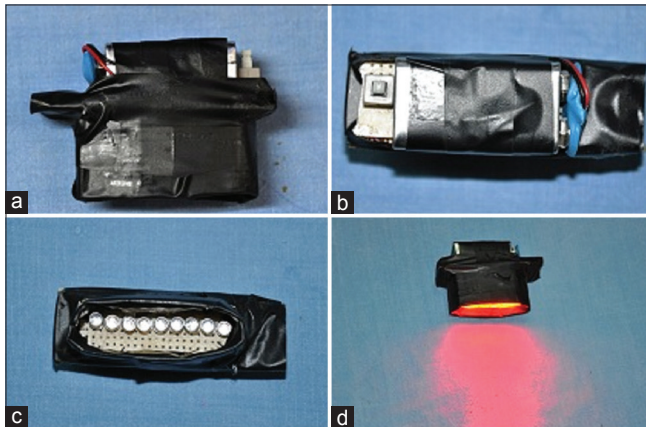


Figure 1: (a) Finger-shaped red light emitting diode device; side view: battery on top, (b) top view: 9V battery power source with a switch adjacent, (c) bottom view: row of nine light emitting diodes on a plastic board, (d) opaque black cover allows light to pass only through bottom

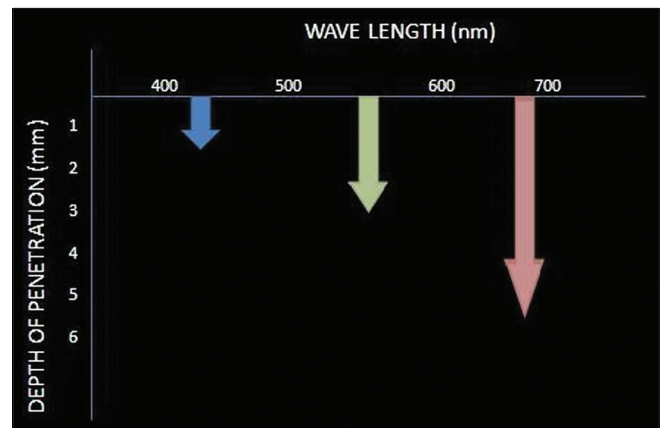


Figure 2: Wavelength of light and depth of penetration : Across the visible spectrum from violet to red, the light penetrates deeper with higher wavelengths



Figure 3: Light emitting diode device fits snugly when placed with its bottom on the finger



Figure 4: Periungual wart stands out black against a bright red background

Table 2: Advantages of the device

Simple
Inexpensive
Lightweight
Handy
Finger-shaped
Non-fragile

successful management of the condition which can be achieved with this LED device.

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Conflicts of interest

There are no conflicts of interest.

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