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**Original Article**

# A successful attenuation of Postherpetic neuralgia using low-level laser therapy: A retrospective study

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## Abstract

***Objective*** This study aims to determine the efficacy of Low-level laser therapy (LLLT) in PHN patients.

***Methods*** A retrospective study from January 2019 – December 2021. Thirty-four patients with Postherpetic neuralgia were included in this study. This study used a 660-nm wavelength LLLT HLA-2000 (HANIL, Korea), an aluminium-gallium-arsenide (AlGaAs) diode laser in a continuous wave scanning setting with a 15-mW power and applied for 15 minutes for each area. All patients were given 16 sessions for eight weeks. Pain score was obtained using a numerical pain rating scale (NPRS).

***Results*** All patients in this study experienced significant pain reduction after therapy. The mean starting NPRS was 8.26±1.31, by the fourth week NPRS was reduced to 4.65±0.98, and the eighth week NPRS was at 1.74±1.33.

***Conclusion*** Postherpetic neuralgia poses a challenge for both the patient and physician due to its refractory and chronic nature. LLLT is an effective, low-cost, and safe alternative treatment for patients with Postherpetic neuralgia, especially those with contraindications or who have used multiple medications.

***Key words***
Herpes Zoster; Postherpetic Neuralgia; Low-Level Laser Therapy.

## Introduction

Postherpetic neuralgia (PHN) is a painful sensation most commonly found as a complication of herpes zoster.[1] It is defined as pain that persists for ≥30-90 days after the initial rash onset.[2-4] Post-Herpetic Neuralgia may present as a burning, stabbing, and highly severe pain along the affected nerve with reports of hyperalgesia and allodynia.[5] This condition is incredibly challenging for patients and physicians alike; the pain may be debilitating and persist for months and even years. Peripheral afferent nerve fibers to the spinal cord experience necrosis, fibrosis, and destruction as a result of neuritic inflammation on the back dorsal root, which causes these pain sensation.[6] Tricyclic antidepressants, anti-convulsant, opioids, physiotherapy, and serotonin reuptake inhibitors used alone or in combination have been a cornerstone in alleviating pain in PHN; other novel therapies include the use of botulinum toxin A or low-level laser therapy (LLLT).[4,7]

Low-level laser therapy has gained prominence in treating neuropathic pain, including PHN. It

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showed a significant reduction in pain with minimal side effects and a wide therapeutic window.[7] Low-level laser therapy has exhibited anti-inflammatory properties, analgesic effects, angiogenesis, muscle and nerve regeneration, and increased cartilage and collagen production.[8] Low-level laser therapy uses a device that emits various wavelengths from red to near-infrared wavelengths with low energy to reduce inflammation, diminish pain, and promote nerve regeneration in patients with PHN.[8,9] This retrospective study explores the efficacy of LLLT in conjunction with other medications. It may be helpful to be used as an adjunct therapy or monotherapy in patients who are contraindicated to non-steroidal anti-inflammatory drugs (NSAIDs) or other neuropathic medications.

## Methods

This retrospective cohort study was carried out on 34 patients diagnosed with PHN with a study period from January 2019 to December 2021. All patients fully consented to the study. The institutional review board of Universitas Udayana Faculty of Medicine approved this study (1355/UN14.2.2.VII.14/LT/2022) on 25th May 2022. Inclusion criteria included at least one month to one year of PHN. The presenting complaint mainly was agonizing and debilitating neurologic pain, such as tickling, burning, and stabbing sensations. Those who were pregnant and with active herpes lesions were excluded.

This study used a 660-nm wavelength LLLT HLA-2000 (HANIL, Korea), an aluminum-gallium-arsenide (AlGaAs) diode laser in a continuous wave scanning setting with a 15-mW power, with a 1cm diameter aperture, with the scanning area set at 10x10cm. Laser was applied for 15 minutes in each irradiated area. All patients were treated twice weekly for eight weeks for a total of 16 sessions. Pain score measurements were taken before, during, and after irradiation using a numerical pain rating scale (NPRS). The pain was graded using NPRS on a scale of 0 to 10, with 0 being no pain at all and 10 being the worst pain imaginable. Patient characteristics, including affected dermatomes and systemic medications, are summarized in **Tables 1 and 2**. All patients in this case series were also given Gabapentin 300 mg PO qDay, Vitamin B1 50 mg, B6 10 mg, and B12 500 mcg PO qDay.

**Table 1** An overview of the Post-Herpetic Neuralgia patients treated with low-level laser therapy (LLLT).

| | |
|---|---|
| Age | |
| Mean | 59.8 |
| Median (Min, Max) | 64 (24,80) |
| Gender | |
| Male | 13 |
| Female | 21 |

**Table 2** Improvement of pain scores before, during, and after irradiation.

| | *N=34* | *P-Value* |
|---|---|---|
| NPRS improvement | | |
| Mean Week 0 | 8.26 ± 1.31 | <0.001 |
| Mean Week 4 | 4.65 ± 0.98 | <0.001 |
| Mean Week 8 | 1.74 ± 1.33 | <0.001 |

Statistical analysis was done using the Shapiro-Wilk normality test and paired t-test afterward using IBM SPSS 26. A p-value of less than 0.05 was considered significant.

## Results

Thirty-four patients met the inclusion and exclusion criteria and were enrolled in the study; among them were 21 females and 13 males, with a mean age of 59.8±15.2 (range 24-80). The pain affected various dermatomes, with the chest and back being the most common area. The patient's characteristics, including affected dermatomes and systemic medications, are summarized in **Tables 1 and 2**.

***Treatment Response*** The outcomes of all the patients after eight weeks (16 sessions) were favorable and are shown in **Figure 1**. Nearly all

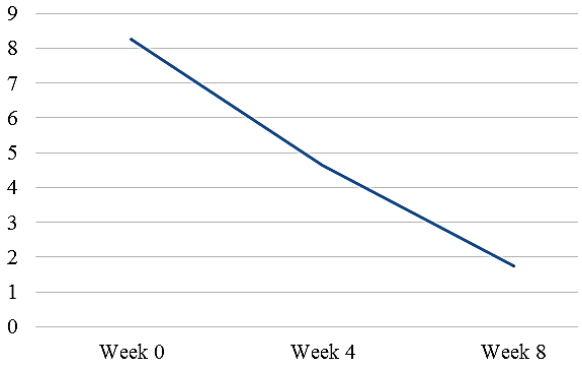


**Figure 1** Efficacy of low-level laser therapy on Postherpetic neuralgia as measured by NPRS.

patients reported zero to mild pain (NPRS 1-4) at the end of the study, with six patients reporting no pain (NPRS 0) and one patient reporting moderate pain (NPRS 5). The mean initial NPRS was 8.26±1.31, the fourth-week NPRS was 4.65±0.98, and the eighth-week NPRS was 1.74±1.33. The pain level subsided significantly and could be seen as early as four weeks. This result was sustained until the end of the study and with the discontinuation of anti-neuropathic pain medication. This decrease in NPRS is consistent with previous studies using LLLT for herpetic neuralgia. Noted in this study is that improvement in sleep quality was the first to be significantly affected even before the fourth week. No adverse effects were recorded throughout the treatment period.

In nearly all cases, gradual improvements were seen throughout the week, with oral therapies tapered off after eight weeks when their subjective pain rating scale was considerably lower. Some patients also reported immediate analgesic effects, although this might be attributed to the placebo effect.

## Discussion

Varicella-zoster virus reactivation induces inflammation of the dorsal root, leading to major nociceptive pathways alteration, which causes spontaneous electric discharge and lowers nerve thresholds.[1,10] Nerves become hypersensitive to even faint mechanical stimulation, leading to allodynia or inappropriate severe pain. Neuropathic pain continues to be an elusive and challenging clinical problem to solve. Postherpetic Neuralgia disproportionately affects elderly individuals, who are at a higher risk for drug interaction and adverse effects; hence, therapeutic options are often limited.[9]

Low-level laser therapy utilizes Gallium-Aluminium-Arsenide (GaAlAs) laser with a wavelength of 660 nm and 15mW power (Hanil HLA-2000). LLLT is a non-invasive, painless, and safe procedure requiring no hospitalization or anesthesia. This effective modality is underused, as evidenced by the limited publications available and primarily written in Japan. Significant improvements were observed, as evident by the decline in the pain rating scale **(Table 1)**. No adverse effects were observed during this study as well as during the 8-week follow-up period. The downside is that the procedure is time-consuming and requires significant equipment investment.

LLLT uses a red to near-infrared spectrum with a wavelength of 600 to 1000 nm to irradiate affected body parts. Irradiating affected body parts would displace nitric oxide (NO) from cytochrome c oxidase, thus allowing oxygen utilization, and restoring ATP production. Normal cell metabolism leads to pain improvement. Additionally, low-level laser irradiation modifies subsequent cellular and tissue reactions, enhancing cellular motility, proliferation, growth factors, and anti-inflammatory cytokine production.[11,12] The laser type, power, and wavelength all affect how well LLLT works. Irradiation can be delivered at intervals ranging from once a day to once a week. The selection of laser wavelength is vital and needs to be understood to determine

penetration depth due to scattering and absorption of the corresponding specific wavelength.[9] In this case, a wavelength with low chromophore absorption should be selected to penetrate deeper as adequate depth is needed to irradiate the blood vessel to enhance adenosine triphosphate (ATP) production and ultimately decrease inflammation and reduce pain. The location of the treated area also determines wavelength selection as skin thickness varies between 0.5 mm on the eyelids to 4 mm or more on palms and soles; the average thickness to the dermis is around 2 mm, and beneath those are subcutaneous fats and blood vessels. A wavelength of 660 nm used in this study may penetrate up to 6 mm. The wavelength of the laser is intended to target the hypodermis that contains nerves essential to attenuate pain in PHN.[13] During LLLT, mitochondria produce ATP by oxidative phosphorylation and the electron transport chain from oxygen and other nutrients. In herpes zoster or PHN, cells are stressed due to inhibition of oxygen consumption by NO. This inhibition reduces ATP production and increases ROS leading to oxidative stress and causing even more inflammation and cell death, ultimately leading to pain.[13]

These results indicate that LLLT effectively attenuates neuropathic pain, provides analgesia, and hastens pain reduction. Six patients reported no pain at all (NPRS 0), and 27 patients reported slight pain (NPRS 1-4), with only one patient still reporting moderate pain (NPRS 5) after eight weeks of treatment. This combination of LLLT and Gabapentin provided a significantly faster NPRS reduction than Gabapentin alone and lowered the typical dose of Gabapentin from at least 600 mg qDay to 300 mg qDay with rapid discontinuation.[14] A study by Rowbotham *et al.* comparing the pain reduction capabilities of Gabapentin compared to placebo, found that Gabapentin was able to incur a 33% reduction after eight weeks. Kanodia *et al.* in their study, also mentioned a 26-38% decrease across different dosages.[14,15] Age was also reported as a confounding variable, and inefficacy in patients older than 60 was reported. However, our study does not reflect those findings, with a mean age of 59.8 and median age of 64. Our clinical experience has shown that the use of adjunctive low-level laser therapy (LLLT) can lead to faster pain attenuation compared to oral therapies alone. This finding is consistent with previous literature on the subject. In many cases, we have been able to taper medication use as early as the first week of treatment by incorporating LLLT into the treatment plan.

This study has several limitations due to the small number of patients, lack of long-term follow-up, the potential influence of other medications, and the absence of control groups. Future controlled trials are needed to replicate the result in this study and investigate whether it can be used as primary or adjuvant therapy. Nevertheless, our study highlights the possible role and safety of LLLT in treating Postherpetic neuralgia, especially in patients with polypharmacy.

Previous studies from Mukhtar *et al*. showed a similar favorable effect in which most treated patients showed no pain at the end of the 8-week study.[9] Sasaki *et al*. have also demonstrated a similar favorable impact in mostly elderly patients (67.11±12.67 years old) using an 830 nm diode laser, albeit needing a longer duration of treatment at 3.44±8.78 months and a 60.16-78.26% improvement rate.[12] A systematic review by Bjordal *et al*. in using LLLT for pain attenuation concluded that LLLT has a significantly favorable outcome compared to placebo and a significant relative risk for improvement of 2.7 (CI 95% 1.8-3). However, additional studies are needed to assess different doses or energy densities to modulate pain

attenuation and anti-inflammatory.[16] Another study by Kemmotsu *et al*. from Hokkaido University applied LLLT in 63 PHN patients with an immediate reduction in pain. The average number of treatments was 36±12, with an effective ratio of 90% for immediate and 89% for long-term effects.[17] However, direct comparison between studies is difficult due to the lack of result standardization.

## Conclusion

LLLT significantly reduced NPRS rating in PHN patients, with no adverse effects reported in this retrospective study. LLLT provides a non-invasive and painless therapy method and is especially beneficial for individuals prone to drug interaction, such as elderly individuals, which many are also the at-risk population for PHN.

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