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Successful treatment of recalcitrant plantar warts with pulsed dye laser

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Abstract

Introduction: Plantar warts caused by human papillomavirus (HPV) are often resistant to standard treatments, significantly affecting patients' quality of life. Pulsed dye laser (PDL) therapy has emerged as a promising alternative for refractory cases.
Methods: Four patients (three males, one female; ages 15 to 45) with recalcitrant plantar warts unresponsive to cryotherapy, curettage, and topical agents were treated with PDL. Each underwent three sessions spaced 3 weeks apart, using a fluence of 13.50 J/cm² and a pulse duration of 1.5 ms. Outcomes assessed included lesion resolution, recurrence rates, and adverse effects.
Results: All patients achieved complete wart resolution after three PDL sessions. By the second session, vascular coagulation was evident, leading to significant lesion reduction. No adverse effects such as scarring or pigmentation changes were reported, and no recurrences were observed during a 3-month follow-up.
Conclusions: Among laser therapies, PDL demonstrates excellent outcomes with minimal adverse effects in treating refractory plantar warts. Further studies are warranted to validate these findings in larger populations.

Keywords: human papillomavirus, treatment, plantar warts, pulsed dye laser, refractory warts

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Introduction

Cutaneous warts are proliferative diseases resulting from human papillomavirus (HPV) infection of keratinocytes. They are common, affecting approximately 7% to 12% of the population (1, 2). HPV is a double-stranded DNA virus with more than 200 types identified. HPVs can be categorized into high-risk and low-risk types based on their carcinogenic potential. The life cycle of HPV is closely associated with the proliferation and differentiation of epithelial cells. Cutaneous HPV infection commonly manifests as warts, including flat warts (verruca plana, on the hands and face), common warts (verruca vulgaris), plantar warts (verruca plantaris, on the soles), and condyloma acuminatum (anogenital warts, on the genitalia, anus, or perianal area) (3). Most cutaneous HPV infections lead to benign proliferative lesions but rarely progress into cutaneous cancers such as squamous cell carcinoma (4). Effective prevention, diagnosis, treatment, and long-term management of cutaneous HPV infection are critical for dermatologists, pediatricians, urologists, gynecologists, and general practitioners.

Although several major guidelines exist for cutaneous warts (1, 2), a comprehensive and systematically produced guidance for managing cutaneous HPV infections, including flat warts, common warts, plantar warts, and anogenital warts, is lacking.

Plantar warts are common lesions induced by HPV that frequently resist conventional therapies, including cryotherapy, curettage, and topical agents. Recalcitrant warts can significantly impair mobility and quality of life (1, 2). PDL therapy has demonstrated high clearance rates with minimal adverse effects, making it a promising option for difficult-to-treat cases (3).

Studies have reported varying clearance rates for PDL therapy. One study of 120 wart patients showed a 49.5% clearance rate, with plantar warts at 47.6% (5). A review of 35 clinical trials confirmed that PDL achieves response rates between 47% and 100%, with fewer adverse effects than CO_2 and Nd:YAG lasers (6).

Methods

Four patients with recalcitrant plantar warts, unresponsive to prior treatments, were selected for PDL therapy. Each patient had a history of multiple unsuccessful treatment attempts, including cryotherapy, topical agents, and electrocoagulation, before being enrolled in this study. The patient profiles were as follows. Patient A is a 43-year-old immunocompetent male with a single painful plantar wart on the heel. He had the wart for 2 years and had previously attempted self-medication with salicylic acid and three sessions of cryotherapy without success. Diagnosis was made using dermoscopy (Fig. 1). Patient B is a 39-year-old immunocompetent male with a solitary plantar wart on the left foot. He had the wart for 1 year and had undergone two sessions of cryotherapy with no improvement. Diagnosis was made using dermoscopy (Fig. 2). Patient C is a 45-year-old male with diabetes (immunocompromised) and extensive mosaic plantar warts on the ball of the foot. He had the warts for 3 years and had previously tried topical treatments and electrocoagulation without success. Diagnosis was made using dermoscopy (Fig. 3). Patient D is a 15-year-old immunocompetent female with mosaic plantar warts affecting the ball of the foot. She had the warts for 1.5 years and had undergone prior cryotherapy and topical treatments with no improvement. Diagnosis was made using dermoscopy (Fig. 4).

All patients reported persistent pain and continued lesion growth despite multiple prior treatments. The treatment was administered using the Vbeam Perfecta PDL system (Candela Medical, Marlborough, MA, USA). Each patient underwent three treatment sessions, spaced three weeks apart. The laser parameters were set to a fluence of 13.50 J/cm² and a pulse duration of 1.5 milliseconds. During each session, the laser was applied directly to the wart lesions.

Post-treatment, patients were monitored for lesion resolution, recurrence, and any adverse effects, such as scarring or pigmen-

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tation changes. Follow-up assessments were conducted over a 3-month period to evaluate long-term efficacy and recurrence rates.

Results

By the second session, vascular coagulation was observed, confirming treatment efficacy. All patients experienced complete wart resolution by the third session. No adverse effects such as scarring or pigmentation changes were reported. A 3-month follow-up confirmed no recurrences.

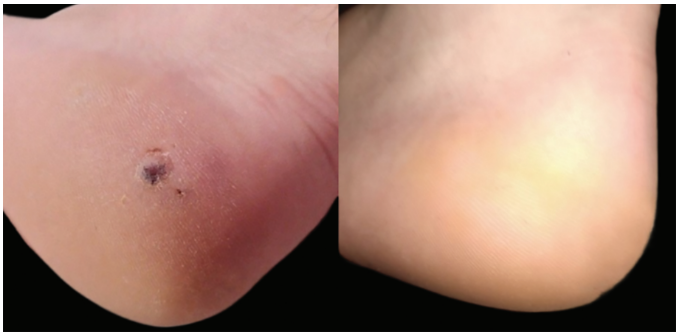

Figure 1 | Patient A, before and after three sessions.

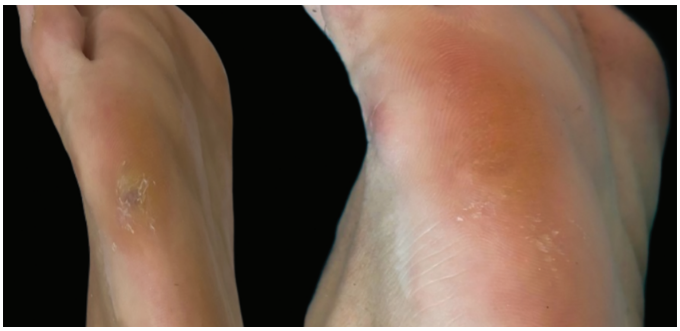

Figure 2 | Patient B, before second session and after three sessions.

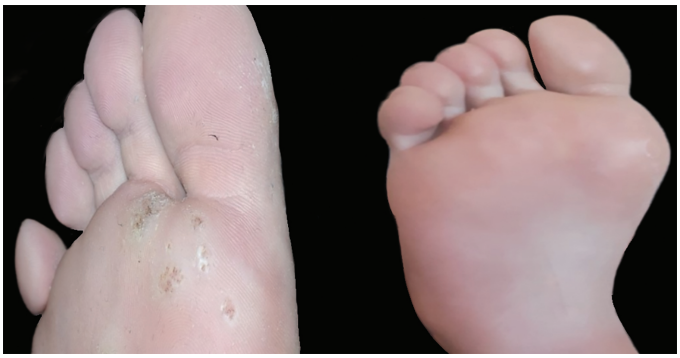

Figure 3 | Patient C, after first session and final result after three sessions.

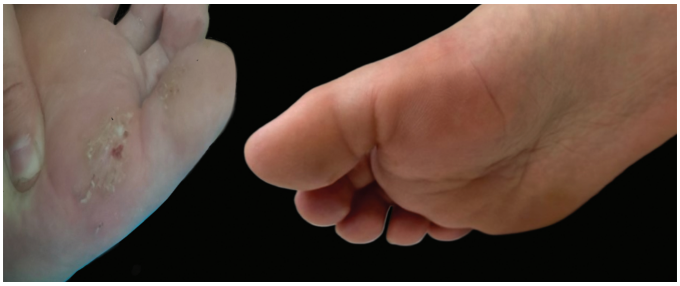

Figure 4 | Patient D, before treatment and after three sessions.

Discussion

Recent studies highlight the effectiveness of PDL in treating warts, particularly in cases resistant to conventional therapies (2, 4). It is now considered a viable alternative for managing persistent plantar warts, given its minimal adverse effects and high clearance rates compared to cryotherapy and CO_2 laser treatments (6, 8). Meta-analyses comparing PDL to other laser modalities suggest its superiority in targeting vascular structures while minimizing collateral tissue damage (6).

PDL therapy selectively targets oxyhemoglobin in the vascular supply of warts, inducing ischemia and necrosis of infected keratinocytes (2, 3). Thus, PDL therapy utilizes selective photothermolysis to disrupt wart vasculature while minimizing collateral tissue damage. In addition, it stimulates immune responses, further enhancing its therapeutic effect. A comprehensive review of laser applications in dermatology confirmed PDL as a safe and effective treatment for refractory plantar warts, emphasizing its role in addressing recalcitrant cases with minimal risks (8, 9). Studies suggest that this technique plays a crucial role in treatment efficacy. A report analyzing 142 patients with 703 recalcitrant warts found a 93% clearance rate with PDL (9). Furthermore, optimized treatment protocols, such as stacked pulse techniques and fluences of 8 to 9.5 J/cm², significantly improve clearance rates (10).

A randomized controlled trial comparing PDL to cryotherapy and cantharidin reported similar clearance rates between modalities (11). However, in cases of long-standing recalcitrant lesions, PDL appears to offer superior results when optimized treatment parameters are used. In addition, PDL therapy enhances the immune response by exposing wart antigens, thereby potentially reducing recurrence rates. Although some studies report a recurrence rate of up to 30%, this is still lower than traditional modalities such as cryotherapy and salicylic acid treatment (5, 9). Moreover, patient satisfaction with PDL remains high due to its relatively pain-free application and minimal downtime.

Despite these benefits, limitations exist. PDL is not universally available and may be cost-prohibitive for some patients. Moreover, treatment efficacy may vary depending on lesion size, duration, and anatomical location. Future studies should focus on refining treatment protocols, identifying predictive factors for successful outcomes, and exploring combination therapies to further improve efficacy.

This case series supports PDL as a safe non-invasive option for recalcitrant plantar warts, particularly in cases resistant to conventional therapies.

Conclusions

PDL therapy is an effective and safe alternative for recalcitrant plantar warts. In our patients, it achieved complete resolution in all cases. Although it is not readily available in all settings, its minimal adverse effects and non-invasive nature make it a preferred choice for clinicians managing treatment-resistant plantar warts. Further studies with larger populations are necessary to confirm these findings.

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