RESEARCH PAPER

Intralesional polidocanol sclerotherapy versus pulsed dye laser in the treatment of plantar warts

Dalia A.M. Bassiouny[1], Ahmad K.S. Abdel-Hameed[2], Neveen B. Hassan[3], Yara Mohamed Mohamed El-Okeely[4*]

[1] Professor of Dermatology, Kasr El-Ainy, Cairo University, Egypt

[2] Assistant Professor of Dermatology, Venereology and Andrology, Al-Azhar University, Egypt

[3] Lecturer of Dermatology, Venereology, Faculty of Medicine, October 6 University, Egypt

[4*] Dermatology Resident, October 6 University Hospital, Egypt. Email: yaraelokeely@gmail.com (Corresponding Author)

Received: 2nd Mar, 2026 | **Revised:** 14th Mar, 2026 | **Accepted:** 4th Apr, 2026 | **Available Online:** 20th Apr, 2026

Abstract

Background: Plantar warts are common benign skin growths caused by human papillomavirus, mainly affecting weight-bearing areas of the foot and causing pain. Polidocanol and pulsed dye laser (PDL) emerging effective therapies, possibly acting through vascular destruction.

Keywords: Plantar Warts, Human Papilloma Virus, Polidocanol, Pulsed Dye Laser

How to cite this article: Bassiouny DAM, Abdel-Hameed AKS, Hassan NB, El-Okeely YMM. Intralesional polidocanol sclerotherapy versus pulsed dye laser in the treatment of plantar warts. Int J Drug Deliv Technol. 2026;16(33s):911. DOI: 10.25258/ijddt.16.33s.109

Source of support: Nil.

Conflict of interest: The authors declare no conflict of interest.

Introduction:

Warts are widely occurring benign skin tumors that may develop in both genders and at any age [1]. It is caused by human papilloma virus (HPV) which infects the superficial layers of the skin [2]. Plantar warts, or verrucae plantaris as a type of cutaneous warts, lesions occur on the bottom of the foot [3].

After a plantar wart develops, HPV is released through shed epithelial cells, allowing the virus to spread and infect other areas or individuals. [3].

They are commonly associated with HPV types 1, 2, 4, 10, 27, and 57 [4]. Finding out which type of virus causes warts doesn't change how they are treated [3].

Plantar warts exhibit an annual incidence of 14%. Certain populations , like people with weakened immune systems, are more likely to get plantar warts [5]. They can cause pain during standing or walking, which is mainly attributed to their presence on weight-bearing areas of the foot. Therefore, successful treatment of plantar warts may lead to an improvement in patients' quality of life [6].

An increase in dermal blood vessels is a characteristic feature of warts, while their regression is often related to vascular thrombosis [7].

Although multiple treatment approaches exist for plantar warts, they are often difficult to manage because of their tendency to recur and inconsistent treatment outcomes [8].

Polidocanol is a widely used, safe, non-ionic detergent sclerosant that has been approved by the FDA for the sclerotherapy of incompetent saphenous veins [9].

Previous studies have demonstrated that 3% polidocanol is both effective and safe in the treatment of various dermatological conditions, including hemangiomas, acne cysts, pyogenic granuloma, lymphangioma circumscriptum, and plantar warts [10].

PDL (Pulsed dye laser) has been used in the last decade for verrucae treatment, particularly treatment of recalcitrant warts [11].

While the mechanism of PDL in managing warts is not completely established, it is believed to exert its effect by selectively damaging the dilated vascular structures of the wart. [12].

Review of litrature :

This article provides a narrative review comparing intralesional polidocanol and pulsed dye laser in the treatment of plantar warts.

Intralesional polidocanol sclerotherapy versus pulsed dye laser in the treatment of plantar warts

Plantar warts are benign hyperkeratotic lesions secondry to infection with human papillomaviruses (HPVs), typically presenting on weight-bearing plantar surfaces and producing pain with pressure and ambulation [3].

Epidemiology and Prevelence :

Human papillomavirus (HPV) infection is highly prevalent worldwide, with approximately 440 million new cases reported annually [9]. Plantar warts have an estimated yearly incidence of about 14% and are most frequently seen in children and young individuals, while being uncommon in infants. Some differences are observed between sexes, and activity levels, hygiene practicesand footwear habits likely influence their development [3].with higher rates among swimmers, athletes, and populations exposed to communal wet surfaces where maceration and microtrauma facilitate inoculation [1].

Clinical picture :

Clinically, these lesions present as solitary, rough-surfaced hyperkeratotic papules that may range in color from flesh-toned to yellow or gray-brown. They can also appear as thickened, cobblestone-like plaques known as mosaic warts, which result from the fusion of multiple plantar wart papules with interruption of skin lines, black dots representing thrombosed capillaries, and tenderness with lateral compression, distinguishing them from corns and calluses [10].

The burden extends beyond pain to activity limitation and psychosocial distress, particularly in occupations requiring prolonged standing and in competitive sport where barefoot facilities are common [1].

Dermoscopy :

Dermoscopy serves as a valuable diagnostic tool for these lesions as their clinical presentation often resembles that of other cutaneous conditions such as corns and calluses [11] . Clinically, corns appear as small, round lesions that are often painful on pressure with a central keratin core, while calluses present as wider, thickened plaques over pressure areas that are usually painless. Dermoscopically, corns show a translucent central core with preserved skin lines, whereas calluses show an opaque yellowish area with preserved skin lines and no prominent vessels [12].

Dermoscopic examination of plantar warts typically reveals uniform black to red dots and globular structures, specific vascular patterns (dotted and linear vessels) , disruption of normal skin lines , frogspawn-like appearance (multiple closely spaced dots) [12].

Accurate diagnosis plays a crucial role in guiding appropriate patient care, dermoscopy and non-invasive methods can improve differentiation from corns and calluses, reducing unnecessary destructive procedures [4,10].

Treatment modalities :

Despite many therapeutic approaches, no single modality provides uniformly durable clearance. Treatment selection is often individualized based on lesion morphology, number, patient comorbidities, and clinician expertise [6]. This therapeutic heterogeneity underscores the need to synthesize evidence on mechanisms and outcomes [13].

The recalcitrant nature of many plantar warts reflects the complex interplay between viral persistence in keratinocytes and variable host immunity with spontaneous clearance possible but unpredictable. Recalcitrant lesions are more common in immunocompromised hosts, yet even immunocompetent patients may experience chronic lesions, suggesting that localized immune dysregulation and biomechamical factors contribute to persistence [3]. Device-based heating and laser coagulation may exploit these vulnerabilities [14] .

The main goals of treating warts are: (i) to get rid of the wart and prevent it from coming back (ii) to make sure there are no scars left and (iii) to help the body develop immunity that lasts a lifetime [15].

A. Intralesional injections :

1. Intralesional polidocanol sclerotherapy

Polidocanol is a type of surfactant that is non ionic and is used to block blood vessels. It works by damaging the membranes of the cells that line blood vessels, causing them to break down right away and leading to the collapse of the vessel walls [16].

When the inner layer under the endothelium becomes exposed, it causes platelets to stick and form a clot in a specific area, which blocks the small blood vessels around the lesion [17]. Occlusion of nutritive capillaries produces ischemia within the targeted tissue; in warts, this deprives HPV-infected keratinocytes of blood supply and promotes necrosis of the papillomatous core [18].

The lack of oxygen and nutrients in an area with reduced blood flow helps release antigens and allows the immune system to recognize them, which might help clear the

infection from areas beyond where the injection was made [16]. When compared to thermal methods, polidocanol's chemical ablation targets the endothelium and surrounding blood vessel structures more precisely, which helps reduce damage to nearby tissues when the right amount is used [19].

Polidocanol also has a mild local anesthetic effect, which reduces injection pain and helps patients tolerate intralesional procedures on weight-bearing skin [16].

A 2024 pilot on intralesional polidocanol for plantar warts reported high rates of clinical clearance with favorable tolerability, supporting its role as a minimally invasive option in recalcitrant disease. In this study of 20 patients, complete response was achieved in 60% of patients after 1–5 sessions, with partial response in 25% and 15% showing no response .Additional regional data showed successful wart control using polidocanol alone and in combination protocols, suggesting adaptability across practice settings [18].

2. Bleomycin

Intralesional bleomycin was used to treat plantar warts by injecting a harmful substance directly into the wart.which inhibits DNA synthesis in infected keratinocytes. Clinical studies report complete clearance rates of 74–87% after one or more injections, making bleomycin a promising option for resistant or difficult-to-treat plantar warts [20]. Alternatively, microneedling-assisted topical bleomycin can be applied to enhance drug penetration through the thick plantar epidermis and achieved approximately 80% clearance , offering a less invasive approach with comparable efficacy and reduced pain [21].

3. Fluorouracil (5-FU)

The approach functions as an immunotherapeutic antineoplastic antimetabolite that suppresses DNA and RNA synthesis, leading to inhibition of cell replication and proliferation. [22]. Intralesional 5-FU was studied for treating warts and found that 80% of the patients had a complete response showing that 5-FU is an effective and safe treatment for plantar warts [23]. Recent studies using network meta-analyses are looking again at 5-FU and immune modifiers, showing they may be better than some older treatments in patients with plantar warts [24].

4. Candida antigen

Intralesional Candida albicans has shown effective results in treating plantar warts, in achieving full clearance in about 80% of patients [25]. Another study found that about 70% of plantar warts were completely removed, confirming its safety and effectiveness.[26]. The treatment is usually easy , safe, and associated with minimal recurrence.

5. Purified Protein Derivative (PPD)

PPD administered intralesionally has been used as an immunostimulatory treatment for plantar warts. In a clinical trial, injections every two weeks for up to three sessions cleared about 55% of patients [27]. Another study found that 56% of the difficult plantar warts were completely cleared, which is a bit less than the result seen with the Candida antigen. The implementation was well-tolerated and safe, with minimal recurrence [25].

6. Measles, Mumps and Rubella (MMR) vaccine

Intralesional administration of the MMR vaccine has been investigated as an immunotherapeutic approach for the management of recalcitrant plantar warts. In the trial, giving injections every 2 to 3 weeks led to complete clearance in approximately 62% of patients, showing higher efficacy than PPD but slightly lower than Candida antigen. The treatment was well-tolerated, safe, and associated with minimal recurrence during follow-up [25].

7. Acyclovir

Recent clinical trials have assessed intralesional acyclovir as a treatment for plantar warts, demonstrating encouraging clearance rates. In a randomized controlled study of 68 patients, acyclovir achieved complete cure in 68.6% of cases. The drug acts by inhibiting viral DNA replication and reducing viral proliferation within the lesion. Compared with cryotherapy, it required slightly more treatment sessions and was associated with greater procedural pain [28].

8. Methotrexate

Intralesional methotrexate (MTX) is a cytotoxic anti-proliferative agent injected directly into plantar warts, inhibiting DNA synthesis in rapidly dividing infected cells. In 20 patients who received intralesional MTX at a concentrations of 25 mg/mL every two weeks for up to six sessions, 35% had complete clearance, 40% showed partial improvement, and 25% had no response. The side effects were generally not severe and included some pain and bruising where the shot was given, and there were no major problems reported [23].

9. Vitamin D_3

Intralesional vitamin D_3 has been evaluated as an immunotherapeutic option for plantar warts, demonstrating encouraging efficacy. In a study included 62 patients with plantar warts treated with injections of vitamin D_3 every three weeks, Most of them, 72.6%, their warts completely cured , with a further 22.5% showing partial response and only 4% non-responders, indicating a favorable therapeutic profile with minimal adverse effects [29].

10. Zinc sulphate

Intralesional zinc sulfate (2%) has been investigated as a way for immune-stimulating to treat plantar warts, with daily intralesional injections resulting in complete clearance in approximately 70% of patients at 3 months follow-up, demonstrating its effectiveness as a therapeutic option [30].

B. Laser therapy :

1. Pulsed dye laser (PDL) (585-595 nm)

PDL focuses thermal energy within wart microvasculature with selective photothermolysis of feeding vessels [31].. Thermal coagulation of capillary loops causes ischemia with HPV-infected keratinocytes starved and papillomatous core involution, while sparing surrounding epidermis when effective parameters are applied [32]. PDL debulks the lesion and causes focal necrosis by collapse of nutritive vessels serving to both decrease the titer of virus in situ as well as expose viral antigens that may secondarily enhance immune recognition and clearance [33]. Shorter pulse durations confine heat to vessel-rich structures, preventing it from diffusing further into surrounding tissue, so reducing the risk of scarring compared with nonspecific thermal ablation [32]. The injury is identical to that of thermal coagulative necrosis within the vessel walls, leading to thrombosis and fibrotic remodelling similar to other PDL vascular targeted effects in treated dermatoses [32]. Vascular edema resulting from shut-down may produce bystander effects, in which neighbouring untreated wart tissue regresses – probably related to disordered perfusion and inflammatory mediators emanating from the treated core [33].

Clinical studies further support its efficacy, In a study of 30 patients, PDL achieved complete clearance in 63.3 % of plantar warts after up to six treatment sessions, with minimal complications [31]. In a larger cohort of 46 patients, PDL produced 73.9 % clearance of plantar warts, confirming its effectiveness and good tolerability [34].

2. Long- pulsed Neodymium: Yttrium/ Aluminum/ Garnet (Nd: YAG) Laser (1064 nm)

Long-pulsed Nd:YAG laser (1064 nm) has been effectively used in the
treatment of resistant plantar warts through selective photothermal destruction
of HPV-infected tissue. Recent clinical studies have reported complete clearance
rates of approximately 66–73% after multiple treatment sessions [32].

3. Erbium: Yttrium/Aluminum/Garnet (Er: YAG) Laser (2940)

Erbium:YAG laser (2940 nm) is an ablative treatment for plantar warts that enables precise removal of HPV-infected hyperkeratotic tissue with minimal thermal damage. However, when used as monotherapy, its efficacy is limited, with complete clearance rates of approximately 23–25% and recurrence rates up to 40–45%, supporting its role as an alternative rather than a first-line treatment [35].

Conclusion

Polidocanol appears to be more effective based on available evidence in comparison to pulsed dye laser in the treatment of plantar warts and is an economically affordable option, simple to use with no requirement for advanced equipment, with no serious side effects reported.. In contrast, pulsed dye laser is associated with higher costs, requires a trained clinician familiar with proper end-point determination, and has limited availability in clinical settings.

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