

# Laser therapy for the treatment of pearly penile papules

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**Abstract** Pearly penile papules (PPP) present as dome-shaped papules of no more than 3 mm in diameter that line the base of the glans of the penis. These benign lesions affect between 14.3 and 48 % of men. While often asymptomatic, PPP can cause a great deal of psychological distress that may warrant treatment. Current treatment options include cryotherapy, electrodesiccation, and curettage (ED&C). However, these modalities may have considerable adverse cosmetic effects, including scarring, pain, and pigmentary changes. Laser modalities offer clear potential for improved cosmetic outcome in PPP treatment, but is not routinely used. Thus, a systematic review of available literature using the National Library of Medicine database PubMed was completed to find articles relevant to the treatment of PPP with laser and light therapy. The systematic search and screening of articles resulted in inclusion of eight articles discussing a total of 55 patients with PPP treated by laser therapy. The present systematic review found that erbium:yttrium-aluminum-garnet (Er:YAG) and CO<sub>2</sub> laser were the most commonly reported ( $n = 45$  and  $7$ , respectively). Furthermore, the use

of CO<sub>2</sub>, Er:YAG, pulsed dye laser, and fractional photothermolysis therapies demonstrated complete clearance of PPP in all cases with minimal complications and discomfort. Thus, based on the currently available evidence, laser therapy is a well-tolerated and efficacious method for treating PPP with minimal long-term adverse effects and a cosmetically desirable outcome. Although the included studies are limited in power, this systematic review offers clinically relevant insight into the potential for laser therapy.

**Keywords** Pearly penile papules · Hirsutoid papillomas · Treatment · Laser therapy · Systematic review

## Introduction

Pearly penile papules (PPP) are papular anatomical variants of a white or “pearly” appearance lining the base of the glans penis. These lesions were first described by Littre and Morgani [1] in 1700 and named “pearly penile papules” by Johnson and Baxter [2] in 1964. This benign lesion is seen in approximately 14.3 to 48 % of men, with an increased prevalence in African-American patients [3, 4]. The papules rarely appear before puberty and are most commonly seen in patients between 20 and 40 years of age [5]. PPP often become less prominent with age and occur less frequently in patients who have been circumcised, possibly due to increased exposure to normal friction and abrasive forces over time [6]. While the etiology remains unknown, PPP have been hypothesized to be vestigial remnants of penile spines, as observed in other mammals [7].

This condition generally presents as dome-shaped papules of no more than 3 mm in diameter lining the glans of the penis

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in a “cobblestone” pattern. Lesions are asymptomatic and often discovered incidentally. Histological evaluation demonstrates characteristics of angiofibroma, including ectatic vessels in the dermis, increased collagen fibers, and elongated rete ridges. The papules also exhibit orthokeratosis and acanthosis [8]. Under dermatoscopic evaluation, PPP appear in rows, with each papule exhibiting a central comma-shaped or dotted vessel [8]. PPP are often mistaken for a sexually transmitted infection such as condyloma accuminata. However, PPP is neither infectious nor contagious, and there has no known association with comorbid HPV infection [9]. PPP carry no known increased risk of malignancy.

### Current treatment options

Current treatment options include cryotherapy, electrodesiccation, and curettage (ED&C), and various laser therapies. However, it should be noted that PPP are benign and do not require any treatment beyond reassurance [10]. Any therapy should be reserved for patients who are highly distressed by the appearance of this common and benign finding [11].

Cryotherapy is an efficient, in-office method performed under local anesthesia. Liquid nitrogen is used to separate the epidermis from the warmer, vascularized dermis causing tissue necrosis of the upper layer. Ablative cryotherapy has been shown to be effective at removing PPP in 80–90 % of patients after two sessions [10]. However, the risks of scarring and hyper- or hypo-pigmentation at the application site limit its use [10]. Considering the higher incidence of PPP in African-American men, these risks may be especially unacceptable because pigment changes may appear more prominently than in other skin types. Another side effect of cryotherapy includes pain at the treatment site both during and after the procedure. Topical anesthetics may be used prior to the procedure to decrease pain, but carry their own risks including methemoglobinemia [12–14]. Other common side effects of ablative cryosurgery include edema, blister formation, and erythema.

ED&C is a common removal strategy for pearly penile papules. ED&C involves use of an electrosurgical device such as a hyfrecator to cauterize the tissue. The cauterized cells are then removed via curette. ED&C offers a quick and economical option for PPP removal as the necessary equipment is commonplace and inexpensive. However, this technique has an increased risk of scarring and disfigurement, which may be cosmetically unacceptable to patients [11, 12]. Similarly to cryotherapy, patients may experience pain and discomfort during the procedure or administration of local anesthetic.

Laser therapy is another modality that may be considered in PPP treatment to improve the cosmetic outcome and to minimize procedural side effects. Fractional photothermolysis

(FP) uses mid-infrared lasers to create microscopic columns of thermal injury to treat both epidermal and dermal skin disorders [15]. The fractionated carbon dioxide (CO<sub>2</sub>) laser is an important therapeutic option due to its suitability for use with darker skin types [16], as it generally does not affect pigmentation. Increased risk of infection is associated with CO<sub>2</sub> laser therapy, but may be minimized with proper wound care [17]. The erbium:yttrium-aluminum-garnet (Er:YAG) laser is another laser modality. The laser is strongly absorbed by water in the tissue and effectively remodels collagen. Its low penetration of only a few micrometers minimizes thermal injury, thereby reducing the risk of scarring and patient discomfort [18]. The pulsed dye laser (PDL) primarily targets blood vessels and may be an attractive modality for PPP lesions, which are highly vascularized. Additionally, the low risk of scarring and infection with PDL [17] make this modality highly favorable for PPP therapy.

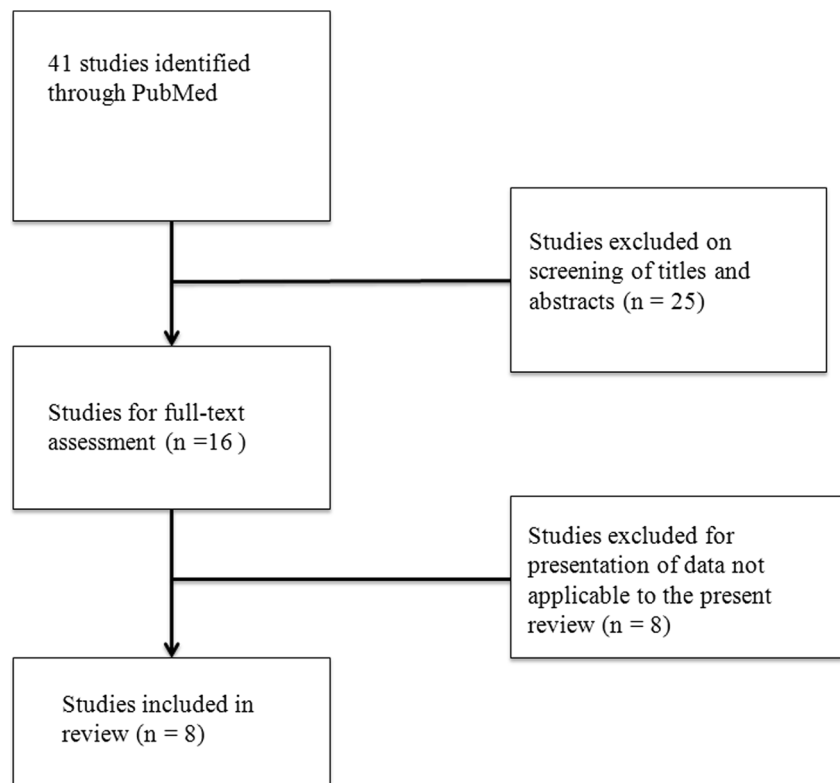
While laser therapy offers clear potential for this condition, it is not a routinely used modality for PPP treatment. Additionally, to date, no large-scale randomized controlled trials have been performed to validate the efficacy of laser therapy.

The purpose of the present study is to systematically review the available literature to evaluate laser treatments for PPP. The laser modalities discussed are CO<sub>2</sub>, YAG, PDL, and FP. The efficacy of these therapeutic modalities will be critically evaluated, and the clinical implications for treatment of PPP will be discussed.

### Methods

A systematic review of available literature (Fig. 1) through September 2015 using the National Library of Medicine database PubMed was completed to find articles relevant to the treatment of PPP with laser and light therapy. A broad search was employed using the search phrases “pearly penile papules,” “hirsutoid papillomas,” and “Hirsutoid papillomas of coronal margia of glans penis” individually. The search returned 41 articles. Only articles written in English were included for further review. The titles and abstracts of the articles were reviewed for relevance to the treatment of pearly penile papules by two authors for suitability for background information, clinical presentation, epidemiology, and treatments. A total of eight articles on laser and light therapies were included. Articles were included if they were original, case reports, case series, or independent studies. Articles determined to be irrelevant based on their title or abstract or content of the manuscript were excluded. Book chapters were also excluded. A cross search of the Scopus database did not return additional studies.

**Fig. 1** Systematic search of PubMed returned 41 total studies. After review of titles, abstracts, and full text, eight studies were included in this review



## Results

The systematic search and screening of articles resulted in inclusion of eight articles discussing a total of 57 patients with PPP treated by laser therapy. Five studies describe a total of 7 patients treated with CO<sub>2</sub> laser therapy (summarized in Table 1). One paper describes 45 patients treated with Er:YAG laser, while another described 4 patients treated with PDL. FP was utilized in 2 reports. Patient details for non-CO<sub>2</sub> lasers are summarized in Table 2.

## CO<sub>2</sub> laser

Five studies described the use of CO<sub>2</sub> laser for treating PPP in 7 patients [16, 19–22]. Age ranged from 17 to 38, with majority of men having had the papules since puberty. All papules were 1–2 mm in diameter. Laser parameters varied among studies and are summarized in Table 2. Laser fluence ranged from 100 to 22,000 mJ/cm<sup>2</sup> for 1–2 treatments. All procedures were well tolerated with no complications or significant pain reported. No pigmentation changes or scarring

**Table 1** Reports of CO<sub>2</sub> laser for the treatment of PPP

Study	Number	Mean age, years (range)	Mean duration	Laser type	Laser fluence (mJ/cm <sup>2</sup> )	Laser settings	Treatment period	Follow-up (months)
Gan and Graber [16]	2	22 (24–20)	–	DeepFX handpiece CO <sub>2</sub> laser	100–150	3- or 4-mm square scanner size, frequency of 125 Hz for two–three passes	3 week + 2 month and 2-month intervals	–
Krakowski et al. [19]	1	17	4 months	Macrofractionated 10,600 CO <sub>2</sub> laser	100	10 W, 0.1 s repeat delay, size land density 6-6	1 session	6
Lane et al. [20]	1	38	Since puberty	CO <sub>2</sub> laser with 125-mm handpiece in defused mode	–	10 W, continuous wave, variable spot size, variable pulse	1 session	6
McKinlay et al. [21]	1	23	Since puberty	Short-pulse high energy CO <sub>2</sub> laser	9000–22,000	Pulse duration 0.1–1.0 msec, 175 mJ, 8 Hz, 1 mm spot size	1 session	2
Magid [22]	2	–	Since puberty	CO <sub>2</sub> laser	16,000	0.1 s, 5 W, pulse power density 640–160 W/cm <sup>2</sup>	1 session	–

**Table 2** Non-CO<sub>2</sub> lasers for the treatment of PPP

Study	Number	Mean age, years (range)	Mean duration, years	Laser type	Laser fluence (mJ/cm <sup>2</sup> )	Laser settings	Treatment period	Follow-up (months)
Baumgartner [18]	45	31.5 (22–49)	–	Erbium:yttrium-aluminum-garnet laser	400–500	Spot diameter 1.5–3 mm, repetition rate. 8–10 Hz, energy density 5.8–28.9 J/cm <sup>2</sup>	1–6 times (average 2)	12
Sapra et al. [17]	4	28 (18–43)	3–20	Pulsed dye laser	6000–1000	–	1–3 times	–
Rokhasar et al. [2008]	1	26	5	Fractional photothermolysis laser (Fraxel SR750)	–	1550 nm wavelength, pulse energy 20 mJ, pass density 125, final densities 100–1500 MTZ/cm <sup>2</sup>	Every 2 weeks, total sessions	12

arose from the procedures. All papules treated with ablative laser settings were completely cleared after the first session of therapy (range of follow-up, 5 days–6 months). In the remaining report [16], which utilized a fractional CO<sub>2</sub> laser, complete remission was reported after 2–3 laser treatment sessions.

#### Erbium:yttrium-aluminum-garnet laser

One case series described the use of (Er:YAG) laser for treating PPP [18]. The 45 patients in this report ranged in age from 22 to 49. The laser fluence was 400–500 mJ/cm<sup>2</sup> for an average of 2 treatment sessions (range, 1–6), and the frequency of these sessions was not provided. Other than some slight capillary bleeding that stopped spontaneously in an unspecified number of patients, no severe complications were reported. All 45 patients were followed-up at 1 year with complete clearance reported in all cases.

#### Pulsed dye laser

One case series described the use of PDL for PPP treatment [17]. Four patients (age range, 18–43 years) presented with papules that had been present for 3–20 years due to misdiagnoses and ineffective treatment. All patients were treated with a laser fluence of 6000–1000 mJ/cm<sup>2</sup> for 1–3 treatment sessions. Multiple treatments, when necessary, were completed due to incomplete papule clearance. A single patient reported mild discomfort after the procedure that abated within 1 week. No other complications were reported, and all patients were satisfied with the results.

#### Fractional photothermolysis

One case report of a 26-year-old male described the use of FP for PPP treatment [15]. The patient presented with 1–2 mm papules present for 5 years. FP treatment was administered at a wavelength of 1550 nm for five separate sessions to achieve

complete clearance (follow-up time of 1 year). Apart from mild erythema, no complications arose from this procedure. The patient was satisfied with the results. Another report [16] discussed fractional CO<sub>2</sub> treatment in two cases of PPP affecting patients with Fitzpatrick type I and V skin. The condition was completely resolved in two and three treatment sessions, respectively.

#### Discussion

PPP are asymptomatic, non-infectious lesions located on male genitalia that, in spite of their benign nature and lack of physiological discomfort, do cause psychological distress that warrants their removal. Histologically, these lesions are acral angiofibromas [23]. Oates et al. [24] considered these lesions to represent phylogenetic residua from animal ancestry. PPP are frequently misdiagnosed as genital warts, specifically molluscum contagiosum or condylomata acuminata. According to the literature, prevalence of PPP has ranged from 14.3 to 48 % [4] and presents after puberty, typically during the second and third decades. Higher rates of PPP have been reported in uncircumcised males, and rates seem to be higher in African-Americans [3, 22]. In spite of this moderate prevalence of PPP, the appearance of these lesions can cause significant concern, embarrassment, and anxiety in patients, their partners, and even their physicians. Past therapeutic modalities used to remove PPP include circumcision, podophyllin, ED&C, and cryotherapy. However, these modalities may have considerable adverse cosmetic effects, including scarring and pigmentary changes. As such, finding a form of treatment for this population that is both effective and cosmetically acceptable is vital. Laser therapy (including CO<sub>2</sub>, YAG, PDL, and FP modalities) is a more novel method that provides lasting removal of PPP without any of the adverse cosmetic effects associated with other removal methods.

Of the modalities discussed in the present review, use of the YAG and CO<sub>2</sub> laser were the most commonly reported ( $n = 45$  and 7, respectively). In both modalities, while some cases reportedly responded incompletely to first therapy, complete resolution was attained after a maximum of six or two sessions, respectively. This demonstrated efficacy was coupled with a favorable tolerance by patients. Additionally, cosmetic outcome was excellent, with no cases reporting scarring or depigmentation and majority of patients reporting satisfaction with either form of treatment. PDL and FP were also used in 4 patients and 1 patient, respectively, with complete clearance achieved after multiple sessions (maximum three and five sessions, respectively). Both modalities reported high cosmesis and patient satisfaction with no complications.

While there is clear clinical potential for use of lasers in the treatment of PPP, the included studies are severely limited in design and power, in large part due to the rates of patients reporting this condition. Based on the limited evidence presented herein, laser modalities may provide an efficacious and cosmetically excellent first-line treatment option for PPP. Further high-powered randomized controlled trials are warranted.

## Conclusion

Pearly penile papules (PPP) are benign papular lesions lining the base of the glans penis. Although PPP are harmless, they do cause significant psychosocial distress on the part of the patient and can be misdiagnosed by physicians. These misdiagnoses can lead to incorrect treatment and unwarranted patient behavioral modifications that in turn instigate poor use of medical resources and unnecessary psychological stress, respectively.

Current treatment options, including cryotherapy and electrodesiccation and curettage, carry risks of scarring, hyper- or hypo-pigmentation, and/or disfigurement that cannot be ignored. Laser therapy offers cosmetic outcomes and long-term results superior to non-laser treatment modalities. Therefore, laser therapy must be considered as a viable alternative. The present systematic review found that CO<sub>2</sub>, YAG, PDL, and FP laser therapies could all be used effectively to permanently remove PPP lesions with minimal side effects and little discomfort.

Although this systematic review is based on a small number of published case studies, the results of this review are significant to healthcare providers. The eight articles described here suggest laser therapy (including CO<sub>2</sub>, YAG, PDL, and FP modalities) is superior to previous treatment options for PPP, including cryotherapy and electrodesiccation and curettage. Based on current research, laser therapy is an effective, well-tolerated method of permanently removing

PPP with no long-term adverse effects, including scarring or pigmentary changes.

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**Compliance with ethical standards**

**Informed consent** Not applicable

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**Authors' contributions** Dr. Joaquin J. Jimenez and Eric L. Maranda had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and Design: Maranda, Akintilo, Hundley, Nguyen, Moore, Zullo, and Jimenez. Acquisition, analysis and interpretation of data: Akintilo, Hundley, Nguyen, Moore, Zullo, and Jimenez. Drafting of the manuscript: Akintilo, Hundley, Nguyen, Moore, Zullo, and Jimenez. Critical revision of the manuscript for important intellectual content: Akintilo, Hundley, Nguyen, Moore, Zullo, and Jimenez. Statistical analysis: N/A. Obtained funding: N/A. Administrative, technical or material support: Akintilo, Hundley, Nguyen, Moore, Zullo. Study supervision: Jimenez.

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