

# Laser Treatment of Pseudofolliculitis Barbae

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PSEUDOFOLLICULITIS BARBAE (PFB) is a chronic foreign body inflammatory reaction to the hair shaft, predominantly seen in individuals with coarse, curled hair who shave regularly. Black persons are genetically predisposed to curly hair and curved hair follicles which confer a much higher risk of PFB. An additional genetic risk factor has been identified as an Ala12Thr polymorphism in the 1A alpha-helical segment of keratin K6hf.<sup>1</sup> The prevalence rates of PFB in the United States range from 10% to 83% (Table 1).

No. of patients/patient population	Percentage (%) of total cases
87 Black patients	52%
38 Black patients	59% <sup>2</sup>
	10% <sup>3</sup>
112 Black US army patients	83% <sup>4</sup>
50 Black US army patients	45% <sup>5</sup>
African Americans who shave	50% <sup>6</sup>

**Table 1:**  
Prevalence of Pseudofolliculitis Barbae in the United States

The main pathogenic mechanism appears to be extra-follicular penetration of the shaved tip of the hair shaft into the skin which gives rise to a foreign body reaction.<sup>7</sup> The second mechanism is by trans-follicular penetration where the growing hair within the follicle pierces the follicular wall and enters the dermis.<sup>2</sup> Shaving against the grain (the direction that hairs point), close shaving, multiple blade razors, and stretching the skin while shaving allows for retraction of sharp-edged hairs back into the follicle.<sup>2,8</sup> There is a greater tendency for the

creation of a sharp tip if the hair is dry.<sup>6</sup> Plucking the hairs with tweezers and electrolysis may break the hair at mid-shaft thereby encouraging trans-follicular penetration.<sup>9</sup>

The clinical appearance can range from mild cases with few papules to severe disease with numerous papules, pustules and widespread inflammation. It is often associated with secondary infection, post-inflammatory hyperpigmentation, scarring and occasionally keloid formation. PFB most commonly presents on the bearded area

of the face and neck. However, it can also occur on the pubic area,<sup>10</sup> scalp,<sup>11</sup> legs<sup>12</sup> and axilla. The diagnosis is primarily clinical and usually straightforward whereas treatment tends to be challenging.

Treatment should be individualized and emphasis should be placed on disease prevention by either growing a beard<sup>5,7,13</sup> (if acceptable), or advice on safe methods of hair removal. Growing a beard may not be acceptable to many patients. For instance, female patients with facial hirsutism regard these hairs as a burdensome interference



*Right anterior neck of patient showing papules and ingrown hairs of pseudofolliculitis barbae.*

with personal and work activities and hence may find a beard intolerable.<sup>14</sup> Many male patients may also find a beard unattractive or unhygienic, though this is also influenced by culture and trends in fashion. In a study of 22 black men, only two (9%) preferred a beard to shaving.<sup>15</sup> In addition, some patients have jobs which forbid growing a beard. In the same study, eight of the men (36%) said that growing a beard would affect their employment.

### Various Methods of Hair Removal

Available methods of hair removal can be classified into temporary and permanent types. Permanent hair removal can be achieved if the follicle in particular the hair bulb and bulge are destroyed.<sup>16</sup> Temporary methods include shaving, plucking, waxing, threading and chemical depilatories. These methods are all problematic to many patients in that they either exacerbate PFB or cause irritation and post-inflammatory hyperpigmentation. Surgical, electrosurgical (electrolysis) and laser assisted hair removal are methods of permanent hair removal.<sup>17</sup> Surgical depilation can lead to scarring which may be cosmetically unacceptable

and unsuitable for susceptible black patients.<sup>9</sup> Electrolysis is highly operator dependent and many treatments are usually required. It may also be impractical, painful and may lead to PFB, post-inflammatory hyperpigmentation and scarring.<sup>18</sup> Laser hair removal has revolutionized the management of PFB.<sup>19</sup>

Adjunctive treatments in the management of PFB include emollients containing 10% urea cream and lactic acid,<sup>9</sup> topical retinoids,<sup>20</sup> topical steroids<sup>21</sup> and/or alpha hydroxyl acids<sup>22</sup> for mild disease. In addition, topical antibiotics (e.g. clindamycin),<sup>23</sup> benzoyl peroxide/topical clindamycin combinations,<sup>24</sup> intra-lesional steroids, systemic antibiotics (e.g. tetracycline 500mg bd, doxycycline 50mg to 100mg bd or minocycline 50mg to 100mg bd),<sup>25</sup> short courses of systemic corticosteroids (prednisone 40mg to 60mg per day for five to 10 days<sup>26</sup>) and incision and drainage can be used for moderate to severe forms. These treatments are not curative but can attenuate the disorder. Complications such as post-inflammatory hyperpigmentation, scarring and keloids should also be treated.

### Laser Hair Removal to Treat PFB

Laser hair removal has been the most effective modality to date in controlling and in instances, eliminating PFB. Laser light can be reflected, transmitted, scattered or absorbed when it comes into contact with skin.<sup>27</sup> Chromophores are pigmented molecules that absorb light of a particular wavelength. When a chromophore absorbs light, a reaction occurs producing heat which, if sufficient, can destroy the chromophore and diffuse to surrounding tissue. According to the theory of selective photothermolysis,<sup>27</sup> the chromophore can be selectively damaged while sparing the surrounding tissue by choosing the appropriate wavelength, fluence (energy density J/cm<sup>2</sup>) and a pulse duration (exposure time) less than or equal to its thermal relaxation time (TRT - time taken for the target to cool down to 50% of its original temperature).

In laser hair removal, the endogenous chromophore is melanin in the hair matrix and hair shaft. Dark hair with large amounts of eumelanin is most susceptible to laser induced damage. Alternatively, an exogenous

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chromophore used for epilation by Q-switched Nd:YAG lasers is topically applied carbon massaged into hair follicles. It is advantageous in being safer in darker skin types and allowing treatment of fairer hairs.<sup>28</sup> However, only temporary hair removal has been achieved by this method.<sup>29</sup>

To selectively damage the hair follicle, it was thought that the pulse duration should be less than or equal to the TRT of the hair follicle which is about 10ms to 100ms depending on the follicular diameter.<sup>30</sup> It has been shown that follicular stem cells in the bulb as well as the bulge must be destroyed to achieve permanent hair reduction.<sup>31</sup> However follicular stem cells do not contain significant melanin and may be distant from pigmented targets.<sup>30</sup> It was therefore felt that longer pulse durations may be needed to allow conduction of laser energy to destroy the entire follicular unit. Hence the extended theory of selective photothermolysis was developed which proposes that the target is destroyed by heat diffusion from the pigmented area rather than by direct heating.<sup>32</sup>

Compared to fairer skin types, darker skin has greater amounts of epidermal melanin which can absorb laser light as it passes through the epidermis to intended dermal chromophores. This can possibly result in blistering, dyspigmentation and scarring.<sup>33,34</sup> It is fortunate that even in skin type VI, the melanin content in hair is greater than that in the epidermis; therefore, selective thermal injury can still be

achieved. The adverse effects can be decreased while maintaining efficacy with the following measures:<sup>19</sup>

- Longer wavelengths - allow deeper penetration of light with less epidermal absorption.
- Longer pulse durations - allow slower heating up and more efficient cooling of the epidermis.
- Lowest possible fluence to treat darker skin.
- Epidermal cooling e.g. saffire cooled tip, cryogen spray, ice.

Melanin is the primary light absorber between 600nm and 1100nm.<sup>27</sup> Laser systems used for hair removal include the Alexandrite (755nm), diode (800nm) and Nd:YAG (1064nm). Intense pulsed light (500nm to 1200nm) systems can also be used for hair removal; however, they are not safe for darker skin types.<sup>21</sup> The Nd:YAG laser is

pulse durations for hair removal, a novel short pulsed 0.65ms portable Nd:YAG laser has been found to be safe and effective for hair removal.<sup>38</sup> In addition, it carries the added benefit of gentler yet efficacious treatment,<sup>39</sup> requiring no gels, no skin contact with the laser, no anesthesia and often no cooling.

There have been a number of studies on the efficacy of various laser systems for hair removal and PFB treatment. Some studies suffer from small sample sizes and follow-up is at times inadequate. Most studies use mean lesion count and percentage hair reduction as their measure of outcome.

In a small study using the 0.65ms Nd:YAG laser, one half of each axilla of six female patients was treated and the other side was monitored as a control.<sup>38</sup> The treatment sides were treated with a fluence of either 21J/cm<sup>2</sup> or 36J/cm<sup>2</sup> and a manual hair count was done before treatment and at each follow-up visit. Four months after four monthly treatments, the hair reduction was graded as five (75%-100%



Chin and sub-mental area of female patient with papules, ingrown hairs and post-inflammatory hyperpigmentation before laser treatment.

Chin and sub-mental region of patient showing clinical improvement after three laser treatments with a 650 microsecond 1064nm laser.

Sub-mental area of patient showing ingrown hairs, papules and post-inflammatory hyperpigmentation of pseudofolliculitis barbae.

Side-effect	Nd:YAG (N=35)	Diode (N=32)	Alexandrite (N=33)
Redness	22.8%	68.7%	90%
Superficial burn	14.2%	30.3%	60.6%
Mild scarring	2.2%	6.2%	15.1%
Hyperpigmentation	2.2%	31%	40%
Hypopigmentation	0.0%	5.3%	8.4%

**Table 2:** Side-effects of different lasers in skin types IV, V and VI<sup>35</sup>

safest in dark skin types.<sup>35,36</sup> The diode and Alexandrite lasers have been used in darker skin types<sup>35,37</sup> but carry a higher risk of side effects (Table 2).

Although traditional lasers and light devices use relatively long

reduction) on the high fluence side and four (50%-75% reduction) on the low fluence end by individuals and investigators. On the high fluence side, the average hair count went from 114 to 28 (76% reduction) and in the low fluence areas from 135 to 38 (72% reduction).

The pre-treatment consultation is important to educate patients and assess their suitability for laser hair removal. An endocrine work up should be done in patients with suspected hirsutism. These patients need to be informed that they may require more frequent and ongoing maintenance treatments.

An observational study of 26 patients with PFB refractory to medical therapy resulted in a statistically significant mean papule count of  $30 \pm 19$  and  $12 \pm 6$  on the control and treatment sites respectively one month after treatment with a long pulse Nd:YAG laser (50, 60 and 70 J/cm<sup>2</sup>, 50ms, 5mm spot size).<sup>40</sup> There was a subjective assessment by patients of a 80% to 90% reduction in bump counts in this study. There were a few cases of blistering and dyspigmentation which resolved within a few months.

In another study, a diode laser (10J/cm<sup>2</sup>, 30ms, 9mm spot size) was used to treat eight patients (skin types V and VI), four of whom had PFB.<sup>41</sup> They received seven to ten treatments each, four to six weeks apart resulting in a 75% to 90% hair reduction in each patient and complete PFB resolution in affected patients by the end of the study. Two of the patients experienced blistering then hypopigmentation which resolved within eight weeks and three developed hyperpigmentation which resolved with 4% hydroquinone over a two to four month period.

The pre-treatment consultation is important to educate patients and assess their suitability for laser hair removal. An endocrine work up should be done in patients with suspected hirsutism. These patients need to be informed that they may require more frequent and ongoing maintenance treatments. Patients should be informed that 10%-20%

of hairs are removed with each treatment and that an average of six treatments each four to six weeks apart may be required.<sup>19</sup>

Because the melanin in hair is greatest during anagen, laser therapy is most effective during this phase of hair growth. Treatment is continued until further treatments do not make a reduction in hair volume.<sup>42</sup>



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The patient's hair may be shaved on the day before or immediately pre-treatment. Perifollicular edema and erythema can occur minutes to hours post treatment. Sun protection is important and patients should not pluck, wax or undergo electrolysis between laser treatments but may shave or use chemical depilatories if needed. Contraindications include pregnancy, systemic retinoids in the last six months and recent tanning. A test patch should be done a few days pre-treatment.<sup>21</sup>

Laser hair removal is the most effective treatment for PFB, besides growing a beard. The Nd:YAG, especially the 0.65ms Nd:YAG laser, appears to be the safest laser for treating darker skin types. 

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