Complication and Approach to Safe Laser Hair Removal in Skin Type Fitzpatrick VI: A Case Report

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Abstract

Laser hair removal is one of the most popular aesthetic treatments that is considered safe and effective. Comparatively, it is more effective than shaving, waxing, plucking, and epilation in terms of pain, speed and accuracy. Nevertheless, the complication of laser hair treatment for darker skin can be of concern. Treatment parameters must be adjusted to patient skin type and chromophore. Longer wavelengths and cooling are safer for patients with darker skin types. Hair removal with intense pulse light (IPL) sources is not recommended for hair removal in skin type Fitzpatrick 5 and 6 due to the high risk of hyperpigmentation. This paper addresses the complications and approach to safe laser hair removal in skin type Fitzpatrick 5 and 6.

Keywords: Laser, Hair, Removal, Fitzpatrick, Complications

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Unwanted facial and body hair is a common presentation among patients, for instance, females with hirsutism (1). This issue could be tackled using the latest developing technology in laser and light. The hair is successfully reduced by selective photo-thermolysis. Thermal damage to adjacent stem cells responsible for hair regrowth done by targeting melanin in the hair follicle. The damage will occur when adequate fluence at a wavelength, preferentially absorbed by that target, delivered during a time (pulse duration) equal to or less than the thermal relaxation time of the target (2). Based on this principle, some types of hair removal systems available in the market including ruby laser(694nm), alexandrite laser (755nm), diode laser (800nm), intense pulsed light source (590 to 1200nm) and the neodymium: yttrium aluminium-garnet (Nd:YAG) laser (1064nm), with or without the application of carbon suspension (2).

Looking into the subset of skin type, predominantly in dark skin (Fitzpatrick skin types (FST) IV VI), there will be epidermal melanin interference whereby light is absorbed in the epidermis and converted to heat rather than reaching the target melanin in the hair shaft. This could lead to higher rates of thermally induced side effects such as hypo- or hyperpigmentation, blisters and crust appearance leading to poorer outcome (1). Longer wavelengths, longer pulse durations, conser-vative fluences and more efficient cooling systems could reduce these complications (3). Nd-YAG is an example of longer wavelength lasers which are absorbed less efficiently by epidermal melanin which causes lesser damage. Nd-YAG has shown lowest incidence of adverse events, therefore preferred in darker skin populations (4).

Case Presentation

A 41-year-old female presented to our clinic with a keen desire for facial hair removal. Written consent was provided, by which the patient agreed to the use and analysis of her data. She has underlying polycystic kidney disease diagnosed in our center and has expressed desire for removal of facial hair. She has gone to multiple centers however was denied therapy as risk of complication was higher in view of her skin type. With patient fully understanding the risks, she has given written and verbal consent for laser hair removal in our center.

The patient has only experienced facial hair removal using wax in beauty centers. She has never undergone any non-invasive or invasive procedures such as fillers, injectables or laser therapy on her facial area.

Patient's overall facial skin was normal with no significantly enlarged pores or acne. Her concern was mainly coarse facial hair around her upper lip and chin.

She had undergone facial laser hair removal using a high range Nd:YAG multimodal laser. She required no local analgesia for the procedure. The laser hair removal was done in about 15 minutes. Immediate post procedure, all of the facial hair at the concerned areas was not visible. She had some erythema however overall had no obvious visible burns (Figure 1).

On follow up at Day 1, she experienced some burning sensation hence reported to our center. However, on follow- up Day 2, she experienced burns on her chin with hyper-pigmented spots around her chin (Figure 2), and noticeable erythema on her forehead with hyperpigmented spots has appeared on her forehead at Day 3 (Figure 3).

Local steroid application has been prescribed to reduce inflammation and after Day 7, the obvious burns have recovered well. Patient was generally satisfied with her hairless face however she had to face some unwanted burns and hyperpigmentation which subsequently improved overtime.

Upon further history, patient admitted

Figure 1: Immediate post procedure

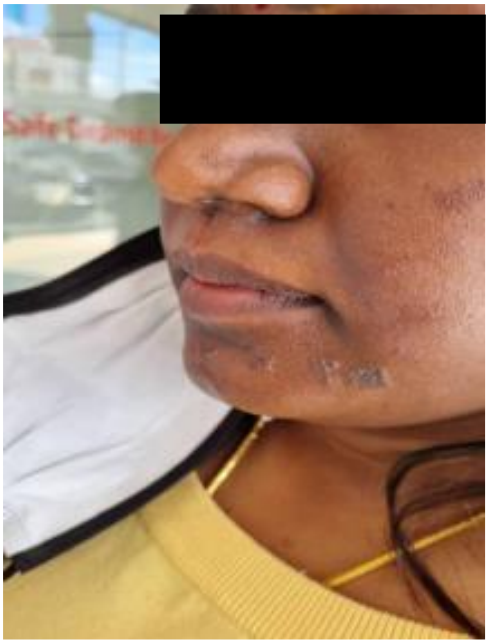

Figure 2: Day 2 Post procedure

Figure 3: Day 3 Post Procedure

to performing face hair bleaching a week prior to laser hair removal. Post procedure, she was compliant with sunscreen application, however,

sun exposure was not limited in view of work commitments, thus increased her risk for developing hyperpigmentation especially considering Malaysia has a tropical climate.

Management And Outcome

Treatment considerations for skin types Fitzpatrick V and VI:

1. Wavelength - consider chromophore (especially risk of absorption by epidermal melanin); longer wavelengths associated with less epidermal absorption and therefore greater safety in patients with higher skin type.
2. Treatment parameters – employ settings that minimize extent of epidermal and dermal injury (typically more conservative than in skin type

Fitzpatrick I–III, often requiring a greater number of sessions), e.g., lower fluences and longer pulse durations for laser hair removal; lower treatment densities (microthermal zones cm−2) for fractional laser resurfacing

3. Pre-and post-treatment sun protection (sun-protective behaviours, broad-spectrum sunscreen SPF ≥ 30)
4. Consider pre- (≥ 2 weeks prior) and post-treatment bleaching agents (e.g., hydroquinone 4% cream)
5. Judicious epidermal cooling, e.g., slower treatment speeds when using lasers with contact cooling; pausing between passes of resurfacing lasers to reduce bulk heating; icepacks post-procedure
6. Consider topical corticosteroids post-treatment (to reduce inflammation), especially when significant post-procedure erythema or oedema noted.

In addition to the removal of unwanted hair for cosmetic reasons, laser-assisted hair removal is also employed as a primary or adjunctive treatment of several hair disorders that are disproportionately prevalent in individuals of African ancestry -pseudo-folliculitis barbae, acne keloidalis nuchae, dissecting cellulitis of the scalp, and folliculitis decalvans. When performing laser hair removal in individuals with richly pigmented skin, epidermal melanin acts as a competing chromophore and, therefore, the risk of adverse events from epidermal injury is greater than in lighter skin types. Key strategies to minimize the risk of epidermal injury in skin of colour include employing longer wavelength lasers, longer pulse durations and judicious epidermal cooling techniques.

Longer wavelength lasers are associated with deeper penetration and therefore, the ratio of the temperature of the hair bulb to the temperature of the epidermis is increased, allowing for follicular destruction with relative sparing of the epidermis. The safest wavelengths for skin type Fitzpatrick IV-VI are those in the near infrared range: the 800–810-nm diode and the 1064- nm neodymium-doped yttrium aluminium garnet (Nd:YAG) lasers. The lowest incidence of adverse events associated with laser hair removal in darker skin types has been shown with the long pulsed 1064-nm Nd:YAG and therefore, this is the preferred wavelength for patients with skin type Fitzpatrick VI (among whom the risk of complications from laser hair removal is highest). Thermal injuries resulting in hypopigmentation can occur when the 800–810-nm diode laser is used in skin type Fitzpatrick V and VI, and, therefore, test spots are strongly advised.

Higher fluences are associated with an increased risk for epidermal injury in darker skin types. A study by Ross et al. found the highest tolerated fluences in darkly pigmented skin to be 100 J cm $^{-2}$ for skin type Fitzpatrick IV and V, and 50 J cm^{-2} for skin type Fitzpatrick VI. Therefore, lower fluences are recommended for higher skin type to minimize excessive thermal injury to the epidermis, which can be associated with disfiguring pigmentary alterations.

Long pulse durations facilitate efficient epidermal cooling and are therefore associated with fewer adverse events in dark skin types (5). Examples of long pulse durations that are considered safe for laser hair removal in skin type Fitzpatrick IV-VI include, 400 ms for the 810-nm diode and 30 ms for the 1064-nm Nd:YAG with contact cooling.

Cooling of the epidermis pre- and postoperatively is paramount when performing laser hair removal in darkly pigmented skin (6) as thermal injuries can cause pigmentary abnormalities that may last for several months. Epidermal cooling during laser hair removal is achieved by one of two mechanisms – contact or cryogen spray cooling. In the former type, a

chilled copper plate or sapphire window is used to cool the epidermis on contact before the laser pulse is delivered. In the latter, a cryogen is applied for 20–100 ms prior to the pulse of laser energy. For post- cooling, the chilled surface of the laser hand piece can be reapplied to the treated area, or the cryogen spray can be administered up to 100 ms after the laser pulse. Other epidermal cooling strategies include application of refrigerated gels prior to treatment (for contact cooling devices) and ice packs for 5–10 min post-procedure. While either contact or cryogen spray cooling laser hand pieces can safely be used in darker skin types, dyspigmentation has been reported when suboptimal cryogen settings and/or poor operator technique have been employed.

Intense pulsed light (IPL) is not recommended for hair removal in skin type Fitzpatrick V and VI due to the high risk of hyperpigmentation (5).

Discussion

Removing unwanted hair procedure has been practiced regularly in our community. The purpose usually due to personal hygiene and desire to be cosmetically improved. Prior to laser hair removal, multiple conventional procedures have been used; ranging from abrasion, threading, plucking, waxing, chemical depilators and shaving. These procedures have non- permanent result and only delay hair growth. Laser hair removal had been introduced as permanent hair removal, but it was originally contraindicated in patients with ethnically dark or sun-tanned skin. As years goes by, the laser hair removal technology had advanced and now itis available to all patients including patients with darker skin type Fitzpatrick V and VI.

For laser hair removal, laser light must pass through the pigmented epidermis to treat the dermal hair target. There will be difficulty in patient with skin type Fitzpatrick V and VI as the melanin in the epidermis compete as chromophore for laser light. The melanin will absorb the laser light and converts it to heat and when heat accumulate, it will create thermal damage and cause epidermal blistering, dyspigmentation and scaring (7). Besides that, it will reduce its efficacy as less laser light will be directed towards dermal hair target (8). For our patient above, she had mild thermal damage at epidermis causing cutaneous side effect which are hyper-pigmentation and mild skin burn, after her laser treatment, as seen in Figure 2 and Figure 3.

Nowadays, new generation laser hair removal devices can provide safe & effective hair removal treatment in patients with skin type Fitzpatrick V and VI (8). Longer wavelengths laser is safer in treating darker skin patient as there is greater depth penetration and less superficial chromophore absorption, hence decrease the melanin absorption and less thermal damage. Longer pulse durations also allow for more efficient cooling of the epidermis. The slower the light energy deposited into the skin; slower pigmented epidermis absorbed lights & heats up. It is more efficient to remove heat from slow- heating object (7).

We had used Nd:YAG laser for our patient's laser hair removal treatment as mentioned above. Nd:YAG (1064nm) laser & Diode(800nm) laser are among the laser frequently used for laser hair removal in patient with darker skin (9). Nd: YAG laser has got the longest wavelength, but the melanin absorption is less. It can be used safely with high energy and the penetration is comparatively less, hence lower incidence of adverse effects in darker skin type Fitzpatrick V and VI (10). Diode laser penetration is not as much as Nd: YAG laser but its penetration is still safe and effective for darker skin (5).

In addition, cooling devices is also important to ensure safe laser hair removal in dark skin patient. It selectively cools the most superficial layers of the skin & ensure the maintenance of a lower temperature at the

epidermal level yet reaching the required higher temperature at the target level. The basic principle is to protect the superficial layers of the skin from collateral thermal damage. It can be achieved by cold air convection, contact cooling or cryogen spray cooling (6).

Furthermore, proper patient selection also needs to be done before treatment. Patient selection and tailoring of the fluence used to the patient's skin type remain the most important factors in efficacious and well tolerated laser treatment (2). Patient selection can be done by thorough history taking, which include medication history, history of herpetic infections, history of keloid or hypertrophic scars and pregnancy status (8).

Test spots are also necessary to be done before the treatment, to determine the appropriate laser parameters later. Test spots should be performed at the similar treatment area to match closely with the skin color, sun exposure and hair density level. The test should start with safest parameters (longer fluence & longer pulse duration). Patient with darker skin will have one to two days delay to show the cutaneous side effects. Thus, we need to wait and monitor more than 48 hours for the cutaneous reaction to be present (8). The cutaneous side effects in our patient were also observed about one to two days after her laser treatment, as seen in Figure2 and Figure 3.

Besides that, the treatment area needs to be closely shaven prior to laser treatment because superficial hair heating will cause skin blistering and discoloration. In the event of any thermal damage-related cutaneous side effects, a topical antibiotic or corticosteroids should be applied and prescribed, as what we had prescribed to our patient above. Subsequently, the cutaneous side effects had resolved with time. Most of cutaneous side effects are generally temporary and reversible (3). If the previous treatment had caused any cutaneous side effects, a thorough history has to be taken, recent sun exposure, new medications, new skin products, and post treatment regimen. More conservative parameters also should be applied on next laser treatment. This is to ensure patient safety.

Conclusions

Laser hair removal is the most efficient method of long-term hair removal. It can be done safely with the new generation laser, regardless of skin type & ethnicity. It is done safely by combining longer wavelengths, longer pulse duration, efficient cooling devices, thorough history (good patient selection), test spots (to determine laser parameters), good pre and post treatment care. Both Nd: YAG laser and Diode laser are safe to be use for laser hair removal for skin type Fitzpatrick V and VI, however, one should select a system that minimizes side-effects (4).

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