

White hair removal with electro-optical device in Pakistani population

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Abstract *Objective* To evaluate the synergistic effect of intense pulsed light (IPL) and bipolar radiofrequency (RF) [Electro-optical device] on white hair in Pakistani population.

Patients and methods Twenty eight women with white hair (skin phenotypes III-V) were included in the study. The chin and upper lip were treated with six treatment sessions over 5-6 months. The level of RF energy was 15-20 J/cm², while optical fluences varied from 26 to 38 J/cm². Hair counts and photographic evaluation were obtained at baseline, 4 months and one month after final session.

Results An average hair removal of 63% was observed after sixth session.

Conclusion In lighter coloured hair, combined effect of the two types of energy, radiofrequency and intense pulse light technology offer a promising solution.

Key words

Intense pulse light, radiofrequency.

Introduction

Intense pulse light (IPL) is a method of permanent hair removal involving the use of a specially constructed xenon flash lamp and focusing optics.^{1,2} It is not a real laser because its light is noncoherent. The light is actually diffused through coloured filters.³ Intensity may be adjusted to treat any skin type. When the light strikes the dark-coloured melanin, the light is converted to heat energy.⁴ The shaft of the hair then transmits this heat down to the growing part of the hair, the hair follicle.⁵ Once the hair follicle is heated to a certain level, it is permanently destroyed.^{6,7} As all these machines use melanin as a target chromophores, white and

blond hair escape the photoepilation.⁸ A new technology called electro optical synergy (ELOS) is being offered as a solution for this difficult to treat hair removal.^{9,10} It utilizes bipolar radiofrequency (RF) and IPL energies together.^{11,12,13} RF produces heat when the tissue's electrical resistance converts the electric current to thermal energy deeper within the hair.¹⁴ When RF waves are combined with the light energy of the laser/IPL, RF is attracted to this heated area and heats it further. This increases the effectiveness of permanent hair reduction while reducing the risk of any undesirable light-associated side effects.¹⁵ IPL photo energy can penetrate skin up to 2.5 mm deep while RF up to 4mm.^{16,17,18}

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Patients and methods

Twenty eight women with white facial hair (aged 35-63 years; mean age 49 years) and skin

phenotypes III-V were included in the study. 30 sites were selected; 22 sites were on the chin and eight sites were on the upper lip. Subjects who were pregnant, had scarring tendencies, or taking drugs known to induce photosensitivity, anticoagulation medication or isotretinoin use within the past 6 months prior to the start of the study were excluded. The study participants were instructed to stop all methods of hair removal prior to the first treatment to allow the hair cycle to return to normal.

Informed consent from all participants was obtained and the facial site to be treated was identified and photographed. Digital photographs using identical lighting, patient positioning and camera equipment (Canon IXY digital 5 mega pixel, Tokyo, Japan) were obtained in all. Manual hair count in a 2.5 x 2.5 cm² area was performed prior to each treatment session. Anatomical landmarks were used to maintain uniformity of results: lip (mid-philtrum), chin (midmandibular notch).

Following the hair count and photography, the hair was shaved off. No topical anesthetic agent was applied to the treated body areas. 1-2 mm thick layer of cold gel was applied to the designated area in order to improve coupling of the light to the skin and reduce the skin's temperature during the procedure. Additional cooling was given by Zimmer Cryo 5 as radiofrequency device makes treatment slightly painful.

The IPL-RF system used was the HS-620 (Shanghai Apollo medical technology). The optical energy component emitted light at wavelengths of 400-1200nm. The system provided simultaneous application of optical and RF energy. The hand piece used for delivery of the energy had contact cooling set at -4°C for all treatments, and provided a spot size of

12mmx35mm. Settings of IPL and RF was done according to skin type and hair density. Light pressure was applied via the applicator to the treatment site in order to ensure good coupling of electrodes on the skin surface. The level of RF energy was set at 15-20 J/cm² in all study patients. The range of fluences used for IPL was 26-38 J/cm², depending upon skin phenotype. Test pulses were carried out on an area adjacent to the study site to determine the level of optical energy suitable for each patient. Pulses were placed in an adjacent minimally overlapping pattern over the entire study site. Multiple passes were carried out to a maximum of three passes unless there was persistent erythema that lasted more than a few minutes. Subjects were evaluated after the treatment for immediate adverse effects such as blister formation, epidermal changes, edema and/or erythema around the hair follicles. Erythema in perifollicular pattern was considered a normal immediate response indicative of the effectiveness of the administered treatment. All patients were given a sunblock of SPF 50 for regular use and 1% hydrocortisone cream for two days.

In most of the patients hair regrowth was rapid, therefore, first 4 sessions were done after every 3 weeks. Remaining sessions were done according to patient's hair growth roughly 3 to 6 weeks apart.

Percentage hair reduction was defined as the average number of terminal hairs present at each session compared with the average number of terminal hairs at baseline. Hair counts were taken after each treatment session. Subjective patient reports and adverse effects were also recorded at each follow-up visit. A patient satisfaction scale was used at the last visit. The following scale was utilized: grade I – no improvement; grade II – mild improvement;

Table 1 Average hair count at each session (n=28).

No. of Sessions	Average hair in 2.5x2.5 cm ² area	Hair density
1	19	No change
2	19	Mild decrease
3	15	Moderate decrease
4	12	Fine
5	10	Very fine
6	7	Vellus type hair

Table 2 Patient satisfaction scale (n=28).

Grade	Results
Grade I (no improvement)	2
Grade II (mild improvement)	5
Grade III (good improvement)	18
Grade IV (excellent improvement)	3

grade III – good improvement; and grade IV - excellent improvement.

Results

In all patients treatment was well tolerated with little pain. Perifollicular edema and erythema occurred immediately after the procedure which was considered normal response. Four of the 28 patients had transient mild scaliness and crusting after first treatment. There were no adverse events seen at 30 and 90 days post treatment. During first session patients did not observe significant reduction. Maximum reduction in hair counts was observed from third sessions onwards (**Table 1**).

Hair density decreased from treatment to treatment as noted by both patients (**Table and 2**) and investigators (**Figures 1 and 2**). An average clearance of 63% was observed after 6 months. Upper lip and chin sites had comparable hair removal efficiency. Two patients had no response, for which there was no evident reason. A total of 75% of patients graded their improvement as good (grade III) or excellent (grade IV). Hair count showed 63% reduction from the base line. No permanent side effect was noted in this study.



Figure 1 Hair density before treatment.



Figure 2 Significant reduction after six months, final session.

Results showed no significant dependence on skin color, as lighter and darker skin types responded similarly to treatment.

Discussion

Removal of unwanted hair is one of the most commonly done cosmetic treatments. Traditional methods, such as shaving, depilatories, tweezing and waxing result in only temporary hair removal, and thus require extensive maintenance.¹ Long-term hair removal via electrolysis is generally unsatisfactory due to its time-consuming, painful nature and the associated risk of scarring or pigmentary changes.

The more modern approach to long-term hair removal involves laser and IPL treatment modalities. These technologies are based on the scientific principle of selective photothermolysis – during treatment, the emitted light energy is absorbed by the hair's pigment (melanin) and is then converted into heat. This leads to destruction of the follicle and disruption of the hair growth mechanism, while leaving the surrounding skin undamaged. Both laser and IPL devices have been proven successful in inducing long-term reduction of hair density, as well as delayed hair growth, while causing minimal discomfort and complications. The IPL technology differs from lasers in various physical aspects. The main difference is that while lasers emit light at a distinct wavelength, IPL delivers a wide range of wavelengths, allowing greater flexibility in adjusting to various skin types and body areas, which may differ in terms of hair depth and density.

Radiofrequency energy is chromophore-independent; therefore, patients with darker skin types can be safely treated with RF. The addition of RF energy allows for lower optical energy fluences in order to achieve hair loss. The cooled epidermis has higher impedance than the target that was preheated by the light pulse, and with the epidermis conducting a low current and less heat transfer there is a lower risk of adverse effects. The optical energy is chromophore-sensitive: by heating the hair structure it increases the temperature of the tissue which in turn decreases the resistance or impedance. The lower impedance in the follicle allows for greater RF energy being deposited. The distribution of RF current is based on the geometry of the electrodes and the distance between them. The depth of penetration is half the distance between the electrodes. Under ideal circumstances in the absence of cooling and

preheating, the depth of penetration of RF current is 4mm (distance between the electrodes is 8 mm). This depth allows for heat generation around the hair follicles. The keratin within the hair shaft is not conductive and has high impedance. RF current flows around the hair

With any pulse width, optical energy targets melanin and heating of the hair follicle occurs from the inside and proceeds outwards. In contrast, RF energy heats the hair follicle from the outside in and requires no chromophore. For gray or white hair where there is little or no melanin, so the optical component of the electromagnetic pulse plays a minor role. It is hypothesized that there is non-specific preheating of the follicle acting as a macroscopic structure absorbing light. The preheating reduces the impedance and facilitates the concentration of RF current within the outer layers of the follicle. This progression of outward to inward heat transfer is likely responsible for the injury ensuing to the germinative area of the hair follicle which results in effective hair removal.

The results of this study indicate that combined RF and optical energy is an effective method of photoepilation for white hair. It is generally accepted that white hair is unresponsive to lasers and IPL. Other techniques used to target white hair include photodynamic therapy utilizing a photosensitizer such as 5 amino-levulinic acid, which also leads to non-chromophore targeting of pilosebaceous structures. Melanin encapsulated liposomes (Meladyne) have also been studied as an exogenously introduced target for non-pigmented white, grey and light blond hair.

The 63% hair removal efficiency observed after 6 months in present study population suggests that combined RF and optical energy offers a

favorable alternative to this previously difficult to treat patient management subgroup.

Conclusions

Integrated radiofrequency and optical energy technology represents a new effective photoepilatory technique for the long-term removal of white hair. Although results may not be quite as efficient as with chromophore-targeting primarily light-based technologies, it does offer a new approach to this previously refractory group of photoepilatory individuals. Further studies focusing on long term effect of this technique on removal of white hair is recommended.

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