Use of Intense Pulsed Light (IPL) in Indian Skin Types

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Introduction

Unwanted hair, benign pigmented lesions and acne are major cosmetic problems in Indian skin types. It is usually assumed that many lasers and IPL devices are not suitable for dark skinned patients. These assumptions fail to recognise that the contrast between skin and hair (or lesion) colour remains largely constant or even increases with darker skin.

Numerous previous studies have reported the effectiveness of both Q-switched and microsecond pulsed lasers in the removal of epidermal benign pigmented lesions and acne in light skin types (Fitzpatrick I – III) [1-7]. Other studies have shown intense pulsed light (IPL) to be successful in the treatment of unwanted body and facial hair in both Caucasian and East Asian skin types [8-14]. Early studies by Sherwood et al [15] and Anderson et al [16] exposed pigskin to different wavelengths to establish ideal wavelength for the treatment of pigmented lesions. These studies variously found 504 nm and 532 nm to achieve ideal pigment clearance thus demonstrating a need for a compromise between a high absorption in melanin and optimum penetration depth for specific lesion clearance. Other studies have shown efficacy in the use of Q-switched lasers in Caucasian and Asian skin types including lesions with a significant dermal component [17-20]. Subsequently, other investigators have shown efficacy in the removal of pigmented lesions using IPL wavelengths concentrated in this range [21-23]. However, relatively few studies have focused on treating darker skin types, particularly those found typically on the tropical and sub-tropical Indian Sub-Continent. In an unpublished study in 1999 of 170 patients of skin types III-V, R. Shah MD (Baroda, India) reported a total of 360 ruby laser treatments with a normal incidence of treatment-related skin reactions with few real side effects, particularly when efficient air-cooling of the skin was used.

This study describes the early results of the incidence of side effects and treatment-related problems in dark Indian skin types (Fitzpatrick 4 & 5) using a novel constant spectrum IPL source (iPulse, CyDen Ltd., Swansea, UK) and its efficacy in hair removal and the treatment of benign pigmented lesions and acne.
Methods

The cases reviewed in this study were selected amongst ordinary patients attending the private dermatology clinic of Dr Maya Vedmurthy in Chennai. If subjects presented with any of the conditions suitable for IPL, they were offered the treatment. Whilst the manufacturer’s recommended treatment parameters and application techniques for dark skin types were used, fixed intervals between treatments were not maintained easily because of poor patient compliance arising out of lack of familiarity with routine attendance for cosmetic medical treatment.

No Ethics Committee approval was required as the study was conducted in a private dermatology clinic in Chennai. All subjects had the purpose of the trial explained to them, and each subject gave written informed consent both to participate in the trial and for the subsequent use of their clinical photography.

Treatment sites & numbers

Standardized patient data collection forms were used to record gender, age, ethnicnicity, skin type, treatment parameters, side effects, pain, treatment outcomes and other observations.

The study included a total of 147 subjects with an average age of 31.2 yrs (range, 25-40 years). 100 subjects belonged to Fitzpatrick skin type IV and 47 to skin type V.

130 female and 17 male patients with dark Indian skin types were treated up to 7 times for hirsutism and cosmetic hair removal in other body areas, up to 10 times for mild to moderate inflammatory acne vulgaris and up to 6 times for benign epidermal pigmentation including freckles, PIH, melasma and other benign pigmented lesions.

<table>
<thead>
<tr>
<th>Treatment type:</th>
<th>Hair Reduction</th>
<th>Acne</th>
<th>Pigment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of patients (total 147)</td>
<td>53</td>
<td>35</td>
<td>59</td>
</tr>
<tr>
<td>Av. age (yrs)</td>
<td>29.7</td>
<td>28.4</td>
<td>34.3</td>
</tr>
<tr>
<td>Av. treatment grading scores</td>
<td>0.9</td>
<td>1.1</td>
<td>0.7</td>
</tr>
<tr>
<td>1 treatment</td>
<td>0.2 (n = 23)</td>
<td>0.4 (n = 18)</td>
<td>0.1 (n = 30)</td>
</tr>
<tr>
<td>2-4 treatments</td>
<td>1.30 (n = 24)</td>
<td>1.42 (n = 14)</td>
<td>1.29 (n = 25)</td>
</tr>
<tr>
<td>5+ treatments</td>
<td>2.32 (n = 6)</td>
<td>3.0 (n = 3)</td>
<td>1.5 (n = 4)</td>
</tr>
<tr>
<td>Av. no. treatments</td>
<td>2.4</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Av. pain level (0% = no pain at all, 100% = worst pain imaginable)</td>
<td>49.1%</td>
<td>44.5%</td>
<td>44.7%</td>
</tr>
<tr>
<td>No. patients with normal skin reactions</td>
<td>12 (22.6%)</td>
<td>5 (14.3%)</td>
<td>20 (33.9%)</td>
</tr>
<tr>
<td>No. patients with true side effects</td>
<td>3 (5.7%)</td>
<td>0 (0%)</td>
<td>2 (3.4%)</td>
</tr>
</tbody>
</table>

Table 1—Summary of results

Treatment parameters in respect of pulse duration and energy density (fluence) were determined individually according to manufacturer’s recommendations, precise skin typing and reaction to test patch treatments. In view of the dark skin types prevalent in South East India, triple sub-pulses were used with total pulse durations in the range of 35-45 ms with intra-pulse off-times of 5-10 ms to facilitate epidermal cooling whilst ensuring follicular or pigmentary coagulation. The pulse fluence used of 10-14 J/cm² using an 8.9 cm² skin contact spot size and twin parallel xenon lamp configuration was found to be sufficient to produce normal erythema, peri-follicular oedema or darkening of epidermal pigmented lesions.

The incidence of side effects and the treatment outcomes were evaluated by direct assessment, a patient questionnaire to record pain response and the level of patient satisfaction and by expert medical review of patient before/after photographs.
Intense Pulsed Light Device

An iPulse™ i200 (CyDen Ltd., Swansea, United Kingdom) intense pulsed light device was used for all treatments. This novel IPL was chosen because of its constant spectral output profile and it was hypothesized that the time-resolved constant spectrum output between 530 nm and 1200 nm for the entire pulse duration claimed by the manufacturer would ensure efficient and stable delivery of energy to the dark Indian skin types in the study and reduce the side effects often associated with conventional, free-discharge IPL devices when used to treat dark skins [24].

Treatment procedure

Pre- and post-treatment photography was used. The treatment area was shaved and cleaned and the area covered with chilled ultrasound gel. The IPL treatment program and fluence was chosen based on skin condition, skin type and reaction to initial test patch treatments. After treatment, cooling gel packs were applied to the area. Aloe vera cream was gently rubbed into the treated area when the treatment session was completed. No other creams or preparations were used except in cases of melasma where hydroquinone (2%) cream was used as an adjunctive treatment. Those who were satisfied with results at follow-up or did not wish to continue received no further treatment. Patients who were not satisfied could receive further treatment sessions with the same protocol as above, until the final assessment point when the patient and dermatologist felt satisfied with the result, or agreed that no further improvement could be seen.
Results & Discussion

The groups comprised hair removal: n=53; acne: n=35 and pigmentation: n=59. The overall average fluence used was 11.6, 10.5 and 12.3 J/cm$^2$ respectively.

The study was conducted in Chennai city in Southern India where the normal range of skin types of patients seeking treatment is Fitzpatrick IV-V and the sunny climate is constantly hot and humid with an average ambient temperature even in air-conditioned rooms above 25°C. These climatic conditions increase treatment-related problems and increase the incidence of post-treatment side effects aggravated by sun exposure to skin areas exposed to intense pulsed light or laser wavelengths.

It is reasonable to assume that certain pigmented lesions may be diagnosed accurately by an expert dermatologist as benign without the benefit of histological validation (impossible where the treatment with light therapy is entirely non-invasive and no tissue is removed during the procedure).

The generally poor response after only one or two treatments confirms the importance of completing a course of IPL treatments at regular intervals. Patients who failed to attend sufficient treatment sessions, showed reduced effectiveness as assessed by the expert clinician. Where more treatment sessions were given, in most cases better results were observed.

In common with other anecdotally reported experience with laser and IPL devices in India, a conservative approach is generally taken to choosing treatment parameters and it is generally found that numbers of treatments needed to achieve satisfactory results are greater than in countries with lighter skin types and even where treatment energy levels are similar, more treatments appear to be necessary.

Efficacy

Treatment outcomes were only assessed and recorded at the end of a treatment or course of treatments when the patient and/or dermatologist were satisfied that no further improvement could be achieved, where the patient did not wish to continue or where the patient simply failed to appear for further scheduled treatments. The standard descriptions of efficacy used in this study by the expert clinical assessor were graded and assessed as follows:

Hair Reduction:

Grade 0 = No reduction (<10%),
Grade 1 = Some Reduction (>25%),
Grade 2 = Moderate Reduction (>50%),
Grade 3 = Good Reduction (>70%).

As expected, where multiple treatments were given the greatest degree of hair reduction was achieved. In general, there was little reduction in regrowth of hair follicles after a single treatment, a moderate reduction only after 3-4 treatments and in two cases of thick, facial hair, a good reduction after 7 treatments. Table 2 indicates better results in fewer treatments for cosmetic hair removal versus hirsutism. Intervals between treatments needed to be 3-4 weeks and the trial subjects did not always follow this.

There were fewer cases of cosmetic hair removal on body areas than might be seen in comparable studies in lighter skin types. This is probably explained by cultural preferences and traditional Indian garment design.

Figure 3—Hirsutism: Female, age 20 yrs, skin type V, 50% reduction with regrowth of finer lighter hair. 6 treatments at irregular intervals over 10 months using a fluence of 11-13 J/cm$^2$, triple sub-pulses: 14 ms on, 7 ms off.

Figure 4—Hair Removal: Graph showing patient satisfaction, with progressively better results with increasing numbers of treatments in both hirsutism and purely cosmetic hair removal cases.
Acne Improvement:

0 = No reduction (<10% clearance of acne spots),
1 = Some Reduction (>25%),
2 = Moderate Reduction (>50%),
3 = Significant Reduction (>70%).

The improvement in results with increasing numbers of treatments was best shown in acne improvement grades with some reduction achieved in only two treatments.

Pigmented Lesions:

0 = No Lightening (<10%),
1 = Some Lightening (>25%),
2 = Moderate Lightening (>50%),
3 = Good Lightening (>70%),
4 = Complete Clearance (>90%).

Clinically assessed improvement (lightening) of pigmented lesions ranged from “no lightening” at all to “complete clearance”. Where multiple treatments were undertaken the greatest degree of lightening was achieved. With freckles, melasma and post-inflammatory hyperpigmentation (PIH), multiple treatments were needed to produce satisfactory results.

Café au lait did not respond even after 3 treatments.

Table 2—Hair removal

Average treatment grading scores with different numbers of treatments for hirsutism and cosmetic facial hair removal. 0 = No reduction (<10%), 1 = Some Reduction (>25%), 2 = Moderate Reduction (>50%), 3 = Good Reduction (>70%).

Table 3—Acne

Average treatment grading scores for facial acne. 0 = No reduction (<10% clearance of acne spots), 1 = Some Reduction (>25%), 2 = Moderate Reduction (>50%), 3 = Significant Reduction (>70%).
Becker’s Naevus – Single treatments were completely ineffective, multiple treatments on the thigh of one patient were similarly ineffective and one case showed darkening of the naevus at 4 weeks post treatment. This was probably due to the deep location of the pigment.

<table>
<thead>
<tr>
<th>No. treatments</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Becker’s</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(n = 2)</td>
<td></td>
<td></td>
<td></td>
<td>(n = 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freckles</td>
<td>0.3</td>
<td>1.2</td>
<td>2.0</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(n = 7)</td>
<td>(n = 5)</td>
<td>(n = 1)</td>
<td>(n = 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melasma</td>
<td>0.1</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(n = 7)</td>
<td>(n = 1)</td>
<td>(n = 1)</td>
<td>(n = 1)</td>
<td>(n = 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigment</td>
<td>0.1</td>
<td>1.0</td>
<td>0.8</td>
<td>2.2</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>(n = 12)</td>
<td>(n = 4)</td>
<td>(n = 4)</td>
<td>(n = 5)</td>
<td></td>
<td>(n = 1)</td>
<td></td>
</tr>
<tr>
<td>PIH</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.0</td>
<td>-</td>
</tr>
<tr>
<td>(n = 0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(n = 2)</td>
<td></td>
</tr>
<tr>
<td>Total scores</td>
<td>0.1</td>
<td>1.1</td>
<td>1.0</td>
<td>1.7</td>
<td>2.0</td>
<td>0.0</td>
</tr>
<tr>
<td>(n = 30)</td>
<td>(n = 10)</td>
<td>(n = 6)</td>
<td>(n = 9)</td>
<td>(n = 3)</td>
<td>(n = 1)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4—Pigmentation
Average treatment grading scores for pigmentation: 0 = No Lightening (<10%), 1 = Some Lightening (>25%), 2 = Moderate Lightening (>50%), 3 = Good Lightening (>70%) 4 = Complete Clearance (>90%).
Side Effects & Treatment-related Problems

Side effects and treatment-related problems were assessed to range from “none” to “severe superficial burns” across all treatment types included in the study. Treatment-related problems are considered to be normal in IPL treatments and in this study included skin reactions following treatment up to and including severe erythema in hair removal, mild to normal erythema in acne cases and darkening of pigmented areas or temporary crusting. In the case of pigmentation treatments, temporary crusting of epidermal lesions, which sloughs off within 7-10 days during normal washing was distinguished from transient hyperpigmentation that lasted several weeks to several months and was considered a true side effect.

T. Alster reported a significant incidence of side effects [25] in darker skin phototypes following laser treatment and recommended prophylactic application of SPF30+ sun screen initiated at least three to four months before laser surgery to avoid post-inflammatory hyperpigmentation. No such precautions were taken in this study when using IPL therapy.

<table>
<thead>
<tr>
<th>Normal side effects</th>
<th>No. Patients (%)</th>
<th>No. Incidents</th>
<th>Av. pain score</th>
<th>Areas</th>
<th>Side effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acne</td>
<td>5 (14.3)</td>
<td>5</td>
<td>39.8</td>
<td>Face</td>
<td>Mild erythema</td>
</tr>
<tr>
<td>Hair removal</td>
<td>12 (28.8)</td>
<td>17</td>
<td>45.5</td>
<td>Face</td>
<td>Mild erythema</td>
</tr>
<tr>
<td>Pigment</td>
<td>20 (33.9)</td>
<td>21</td>
<td>46.6</td>
<td>Face, thigh (1), chest (1)</td>
<td>Mild erythema</td>
</tr>
</tbody>
</table>

True side effects

| Acne                | 0 (0)            | 0             | n/a            | n/a   | n/a            |
| Hair removal        | 3 (5.7)          | 5             | 47.5           | Face, legs (1) | Burns (1), erythema |
| Pigment             | 2 (3.7)          | 3             | 48.7           | Face  | Burns (1), erythema (2) |

Table 5—Side effects

The standard descriptions of side effects used in this study by the expert clinical assessor were graded as follows:

**Hair Removal:**

0 = None,
1 = Mild Erythema,
2 = Erythema (e.g. Perifollicular Oedema),
3 = Severe Erythema,
4 = Crusting (e.g. including transient hyperpigmentation),
5 = Severe Superficial Burns (e.g. including hypopigmentation).
Acne:
0 = None,
1 = Mild to Normal Erythema,
2 = Hyperpigmentation,
3 = Severe Superficial Burns.

All acne patients showed a reduction in the number of inflamed lesions with no side effects. The reduction of acne spots observed was similar to results reported in the literature for lighter skin types treated with IPL.

Pigment:
0 = None,
1 = Mild to Normal Erythema / darkening of pigmented lesion / crusting,
2 = Hyperpigmentation,
3 = Severe Superficial Burns,
4 = Hypopigmentation.

Normal erythema was only seen in about one third of patients suggesting an over-cautious approach. Side effects were seen with increased fluence. Two cases of post hair removal treatment burns were reported. The consequential hyperpigmentation resolved in both of these cases within 3 months (See figures 7-9).

Pain

Pain experienced by the patients during all of the treatments was graded using a blank visual analogue scale (0 = no pain at all and 10 = worst pain imaginable). Average pain scores for hair removal, acne and pigmentation were 4.5, 4.7 and 4.2 respectively. Most subjects found the level of discomfort easily tolerated and no subjects felt the pain was unbearable as no scores were recorded above 7.0 (See figure 10).
Conclusions

When a sufficient number of treatments were performed, the iPulse constant spectrum IPL was found to be effective in this preliminary study in the treatment of benign pigmented lesions, acne and in the long-term delay of hair regrowth in hirsutism.

Normal treatment related problems including patient assessed pain response and side effects using the iPulse IPL with its constant spectral output, large 8.9 cm$^2$ spot size and relatively low fluence characteristics, were found to be comparable in dark Indian skin to those reported in the literature in lighter skin types with conventional IPL devices. Early indications of efficacy in the treatment of hirsutism, pigmentation and acne were broadly similar to lasers and other IPL systems in lighter skin types.

Both the follow-up period and the number of lesions included in the present study may not be sufficient to fully evaluate the potentials of this treatment modality as well as the true incidence of recurrence of the original condition. Therefore, the results obtained should be confirmed in larger studies.
References


