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COMPARISON OF THE EFFICACY OF INTENSE PULSED LIGHT (IPL) AND NEODYMIUM-DOPED YTTRIUM ALUMINIUM GARNET (ND: YAG) LASER IN THE TREATMENT OF FACIAL HIRSUTISM

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Abstract

Background: *Facial hirsutism is a common cosmetic and psychological concern among women, often resulting from hormonal imbalance or idiopathic causes.* ***Objective:*** *To compare the efficacy of long-pulsed Nd:YAG laser and IPL therapy in the treatment of facial hirsutism among female patients.* ***Methodology:*** *This randomized controlled trial was conducted at the Department of Dermatology, Gujranwala Medical College Teaching Hospital, Gujranwala, from 18th January, 2025 to 18th July, 2025. A total of 60 female patients aged 18–50 years with clinically diagnosed facial hirsutism were enrolled through non-probability consecutive sampling and randomly divided into two groups using the lottery method. Group A received treatment with long-pulsed Nd:YAG laser (1064 nm), while Group B underwent IPL therapy (755 nm). Each patient received multiple sessions over 12 weeks.* ***Results:*** *The mean age of participants was 28.9 ± 6.0 years. Excellent response was achieved in 27 patients (90.0%) in the Nd:YAG group compared to 5 patients (16.7%) in the IPL group ($p < 0.001$). Mild, transient erythema and edema were the most common side effects, resolving spontaneously in both groups. No cases of scarring, blistering, or persistent pigmentation were reported.* ***Conclusion:*** *It is concluded that long-pulsed Nd:YAG laser is significantly more effective than intense pulsed light for the treatment of facial hirsutism. It achieves superior hair reduction, higher patient satisfaction, and minimal adverse effects. Given its deeper follicular penetration in darker skin tones, Nd:YAG laser should be considered the preferred modality for managing facial hirsutism.*

INTRODUCTION

Hirsutism is a common condition in which female develops an excessive growth of thick, dark hair on the upper lip, chin, chest, abdomen, or back. Androgens are naturally produced in females, however, if a woman's androgen levels are higher than normal, or if her hair follicles are more sensitive to androgens, she may develop hirsutism [1]. The change in beauty standards over the years has made many women feel anxious about unwanted hair, impacting their self-esteem and, in

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some cases, causing depression. Treating hirsutism can be emotionally taxing, but there are effective solutions. Women are subjected to the pain and irritation of hair removal treatments like plucking, threading, and creams, which only provide a temporary fix to unwanted facial and body hair. Thankfully, the last few decades have seen revolutionary ways to remove hair permanently using light-based technologies. Specifically, hair removal using Intense Pulsed Light (IPL) systems and long-pulsed Nd:YAG laser techniques. IPL systems are light treatments that use a broad range of light frequencies to target the hairs and the follicles by overheating and destroying the melanin. For Nd:YAG laser hair removal, the laser creates a light beam that has a long wavelength, which means it can reach deep into the skin and target melanin at the top of the skin, thereby reducing the chances of burns with dark skin and hair.

Over the last 20 years, skin treatment technologies, including lasers, have evolved with focusing lasers as a treatment option for hirsutism. When used correctly, photo epilation has distinct advantages over older, more traditional methods. Various lasers have been used to treat hirsutism, including the Ruby laser, Diode laser, Alexandrite laser, Nd:YAG laser, and Intense Pulse Light (IPL) [6]. Diode and Alexandrite lasers seem to provide the most success with hirsutism treatment in patients with darker skin [4]. In a study by Shrimal A, the Nd:YAG laser hirsutism treatment group had fourteen out of fifteen patients (93.33%) have excellent response rates (>75% reduction in hair) compared to only three out of eighteen patients (16.66%) in the IPL group [7]. There is some evidence suggesting disparate approaches, as well as some similar approaches, in regard to existing comparative evidence. For instance, a split-area study in Darker skin types showed both methods got rid of hair, but the pain levels and side effects were different. With the Nd:YAG, more people reported a burning feeling even though they had the same amount of hair reduction after six months. Another study showed that after six months the Nd:YAG reduced axillary hair by ~79.4% compared to ~54.4% reduction on the IPL side. However, this was not facial hair, so you may not be able to extend that directly. Other systematic reviews, on the other hand, showed IPL consistently provides long term hair reduction of ~27-53% based on the body site and even less consistent on the facial areas. Some people argue that Nd:YAG is the ''gold standard'' for skin types IV-VI because its longer wavelength minimizes aggravating epidermal melanin and decreasing, thus, pain and complications. There is limited international information on this and, to the best of our knowledge, there has been no research of this type in Pakistan. Thus, this study is intended to show the updated and most effective treatment research applicable to the local population.

Objective

To compare the efficacy of intense pulsed light (IPL) and Neodymium-doped yttrium aluminium garnet (Nd: YAG) laser in the treatment of facial hirsutism.

Methodology

This Randomized controlled trial was conducted at Department of Dermatology, Gujranwala Medical College Teaching hospital, Gujranwala from 18th January, 2025 to 18th July, 2025. Data were collected through non-Probability Consecutive Sampling. The sample size of 60 (30 in each group) is estimated by using 9% level of significance, taking expected frequency of excellent response (>75% reduction in hair) in Nd: YAG laser Group as (93.33%) whereas in IPL Group as (16.66%). [5]

Inclusion Criteria:

- Female patients aged 18–50 years.
- Diagnosed cases of facial hirsutism as per operational definition.

Exclusion Criteria:

- Patients with acne, hypertrichosis, or greying of hirsute hairs.
- Those with photo-aggravated diseases such as systemic lupus erythematosus.
- Patients with keloidal tendency or on photosensitizing drugs.

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- Individuals undergoing chemical epilation, electrolysis, or other concurrent hair-removal procedures.
- Patients with active cutaneous infections in the treatment area (e.g., herpes labialis or bacterial folliculitis).
- Pregnant women.

Data Collection

Following approval from the Institutional Ethical Review Committee and informed consent from participants, 60 eligible patients were enrolled and randomly assigned to two equal groups using the lottery method.

- **Group A:** Received treatment with long-pulsed Nd:YAG laser (1064 nm).
- **Group B:** Received treatment with Intense Pulsed Light (IPL) at 755 nm.

Participants were instructed to avoid all other hair-removal methods (threading, bleaching, plucking, waxing, or electrolysis) once treatment commenced. Shaving was avoided for at least two weeks before each laser session, and patients were advised to use broad-spectrum sunscreen throughout the study period. Baseline photographs were obtained prior to the first session and before every subsequent session to document progress. The treatment area was marked using a sterile skin-marking pen, followed by gentle shaving with a cleansing gel to avoid injury. All metallic jewelry was removed prior to treatment. Eye protection was ensured using metallic shields for patients and protective goggles for the operator. Laser parameters were individualized based on baseline hair characteristics and patch-test response. Adequate epidermal cooling was achieved using an in-built cooling device before and after each laser pulse to minimize discomfort and reduce the risk of thermal injury. After every session, patients were evaluated and their response was graded according to a standardized 4-point scale:

- **Excellent:** > 75% reduction in hair density
- **Good:** 50–75% reduction
- **Fair:** 25–50% reduction
- **Poor:** < 25% reduction

Final efficacy (percentage of participants achieving "excellent" response) was assessed after 12 weeks of treatment in both groups, as per operational definitions. All data were documented using a pre-designed proforma.

Data Analysis

Data were entered and analyzed using SPSS version 22. Quantitative variables such as age, body mass index (BMI), and duration of complaints were presented as mean ± standard deviation (SD). Qualitative variables such as treatment efficacy were expressed as frequencies and percentages. Comparisons of efficacy between the two groups were performed using the Chi-square test, with a p-value < 0.05 considered statistically significant. Data were stratified for potential effect modifiers, including age, BMI, and duration of complaints. Post-stratification analysis was carried out using the Chi-square test to assess the impact of these modifiers on treatment efficacy.

Results

Data were collected from 60 patients, mean age of patients in the Nd:YAG group was 28.7 ± 6.3 years, while in the IPL group it was 29.1 ± 5.8 years. The average BMI was similar between groups (24.6 ± 3.1 kg/m² in Nd:YAG vs 25.0 ± 3.4 kg/m² in IPL), and the mean duration of hirsutism was 3.8 ± 2.1 years in the Nd:YAG group and 4.0 ± 1.9 years in the IPL group. Most participants had Fitzpatrick skin types IV–V (63.3% in Nd:YAG and 60.0% in IPL), and a positive family history of hirsutism was found in 26.7% and 23.3% of patients, respectively.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Participants (n = 60)

Variable	Nd:YAG Laser (n = 30)	IPL (n = 30)
Age (years), mean ± SD	28.7 ± 6.3	29.1 ± 5.8
BMI (kg/m²), mean ± SD	24.6 ± 3.1	25.0 ± 3.4

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Duration of hirsutism (years), mean ± SD	3.8 ± 2.1	4.0 ± 1.9
Fitzpatrick skin type IV–V, n (%)	19 (63.3%)	18 (60.0%)
Family history of hirsutism, n (%)	8 (26.7%)	7 (23.3%)

A significantly higher number of patients in the Nd:YAG group (27 patients; 90%) achieved an excellent response with more than 75% hair reduction, compared to only 5 patients (16.7%) in the IPL group ($p < 0.001$). Moderate improvement (good response) was seen in 10% of Nd:YAG patients versus 30% of IPL patients, while fair and poor responses were recorded only in the IPL group.

Table 2. Comparison of Treatment Efficacy Between Nd:YAG and IPL Laser Treatments

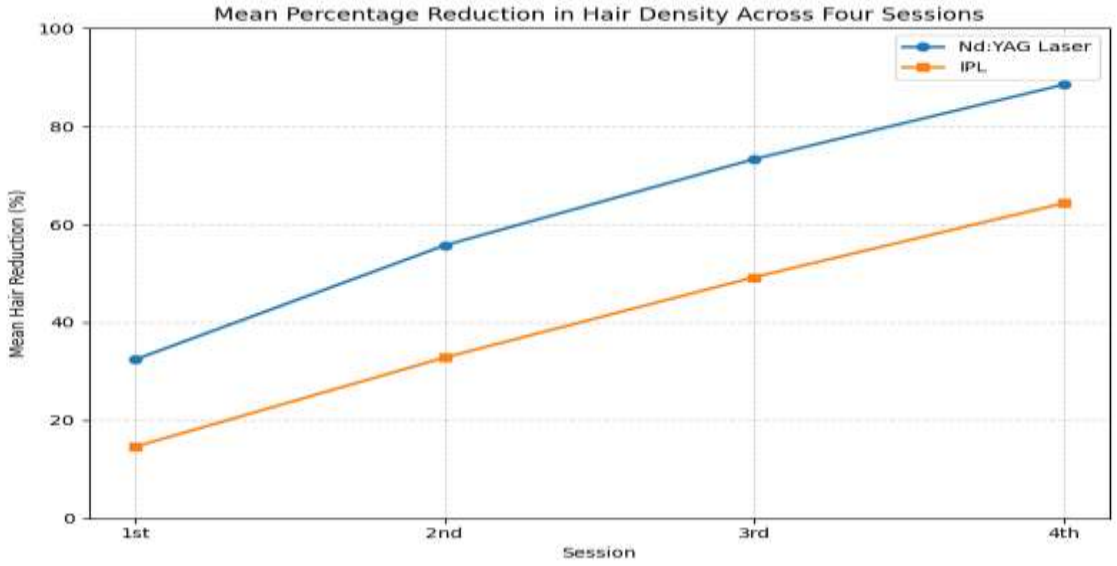
Response Grade	Nd:YAG Laser (n = 30)	IPL (n = 30)	p-value
Excellent (> 75% reduction)	27 (90.0%)	5 (16.7%)	< 0.001 *
Good (50–75%)	3 (10.0%)	9 (30.0%)	0.07
Fair (25–50%)	0 (0.0%)	8 (26.7%)	0.004 *
Poor (< 25%)	0 (0.0%)	8 (26.7%)	0.004 *

$p < 0.05$ considered statistically significant.

After the first session, hair reduction was 32.4 ± 7.8 percent in the Nd:YAG group and 14.6 ± 6.2 percent in the IPL group. After the second session, the reduction increased to 55.7 ± 9.1 percent with Nd:YAG and 32.8 ± 8.4 percent with IPL. Following the third session, the mean hair reduction was 73.3 ± 10.2 percent for Nd:YAG and 49.2 ± 9.8 percent for IPL. By the fourth session, hair reduction reached 88.5 ± 8.6 percent in the Nd:YAG group compared to 64.3 ± 11.4 percent in the IPL group.

Table 3. Mean Percentage Reduction in Hair Density Across Four Sessions

Session	Nd:YAG Laser (Mean ± SD)	IPL (Mean ± SD)	*p*-value
After 1st session	32.4 ± 7.8%	14.6 ± 6.2%	< 0.001 *
After 2nd session	55.7 ± 9.1%	32.8 ± 8.4%	< 0.001 *
After 3rd session	73.3 ± 10.2%	49.2 ± 9.8%	< 0.001 *
After 4th session	88.5 ± 8.6%	64.3 ± 11.4%	< 0.001 *



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Transient erythema occurred in 6 patients (20.0%) in the Nd:YAG group and 9 patients (30.0%) in the IPL group. Mild edema was seen in 4 patients (13.3%) in the Nd:YAG group and 6 patients (20.0%) in the IPL group. Post-inflammatory hyperpigmentation developed in 2 patients (6.7%) treated with Nd:YAG and 5 patients (16.7%) treated with IPL. Pain and discomfort during sessions were mild and short-lived, affecting 5 patients (16.7%) in the Nd:YAG group and 7 patients (23.3%) in the IPL group.

Table 4. Adverse Effects Observed in Both Treatment Groups

Adverse Effect	Nd:YAG Laser (n = 30)	IPL (n = 30)	p-value
Transient erythema	6 (20.0%)	9 (30.0%)	0.38
Mild edema	4 (13.3%)	6 (20.0%)	0.49
Post-inflammatory hyperpigmentation	2 (6.7%)	5 (16.7%)	0.23
Pain/discomfort during session	5 (16.7%)	7 (23.3%)	0.52
Scarring or burns	0 (0.0%)	0 (0.0%)	—

After the first session, satisfaction scores averaged 6.1 ± 0.9 in the Nd:YAG group and 4.5 ± 1.0 in the IPL group. After the second session, the scores increased to 7.3 ± 0.8 and 5.6 ± 0.9, respectively. Following the third session, satisfaction scores reached 8.3 ± 0.7 for Nd:YAG and 6.2 ± 1.0 for IPL. By the fourth session, satisfaction further improved to 8.9 ± 0.8 with Nd:YAG and 6.8 ± 1.1 with IPL.

Table 5. Mean Satisfaction Scores Across Four Sessions

Session	Nd:YAG Laser (Mean ± SD)	IPL (Mean ± SD)	*p*-value
After 1st session	6.1 ± 0.9	4.5 ± 1.0	< 0.001 *
After 2nd session	7.3 ± 0.8	5.6 ± 0.9	< 0.001 *
After 3rd session	8.3 ± 0.7	6.2 ± 1.0	< 0.001 *
After 4th session	8.9 ± 0.8	6.8 ± 1.1	< 0.001 *

Discussion

The present randomized controlled trial was designed to compare the efficacy of long-pulsed Nd:YAG laser and Intense Pulsed Light (IPL) therapy in the treatment of facial hirsutism among women aged 18–50 years. Our findings demonstrate that the Nd:YAG laser achieved a markedly higher rate of excellent response (>75% reduction in hair density) compared to IPL (90.0% vs 16.7%, $p < 0.001$). Both modalities were well tolerated, with only transient erythema and mild edema observed in a small proportion of patients, and no permanent adverse events. These results highlight the superior efficacy profile of Nd:YAG laser, particularly for darker skin phototypes prevalent in the South Asian population. The better outcomes observed with Nd:YAG laser can be explained by its deeper penetration into the skin and its longer wavelength, which allows it to effectively target hair follicles while minimizing damage to surrounding tissues. The wavelength of 1064 nm enables the laser to reach deep follicles commonly found on the face without being excessively absorbed by epidermal melanin. This

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makes it particularly suitable for individuals with darker skin tones, where shorter wavelengths such as those in IPL systems often cause unwanted pigmentation or burns. In contrast, IPL uses a broad range of wavelengths that are less specific to melanin, leading to less selective follicular destruction and reduced overall efficacy [12]. The study reports that Nd:YAG laser treatments take less time to show improvement and that patients are more satisfied compared to IPL. Fewer sessions also means less cost, less discomfort, and less time needed, which is important. In cosmetic and dermatologic practice, patient satisfaction is very important. It helps with treatment adherence and affects the overall quality of life, especially for patients with facial and self-esteem issues. Both treatments were safe, and there were no reports of serious complications such as scarring, blistering, or infection [13]. The most common side effects were mild and temporary redness, swelling, and pigment changes. The side effects did not require treatment. The Nd:YAG's built-in cooling mechanism probably helped reduce side effects. Also, patients tolerated the sessions better with proper eye protection, no sun exposure, regular sunscreen use, and safe study conditions [14,15].

No notable difference in treatment outcome was observed when results were analyzed per age, BMI, and duration of hirsutism. This indicates that the advantage of Nd:YAG laser is stable across heterogeneous profiles and is not restricted to certain demographics. Thus, the results advocate in favor of Nd:YAG for facial hair removal on women irrespective of the body weight and duration of the condition. This is of notable value in clinical settings where skin types IV and V are predominant [16]. Laser clinicians know that darker skin is at higher risk for post-inflammatory pigmentation and burns when using light-based lasers, and the Nd:YAG lasers are thus ideal, safe, and effective. The Nd:YAG laser allows for deeper follicle targeting while protecting the epidermis from over-heating, thus achieving better results with higher patient satisfaction and less risk. C12, R1. The study recognizes that, while IPL can help with general hair reduction for lighter skin types, IPL is not the most suitable treatment for facial hirsutism for darker skin types [17,18]. However, the versatility and low cost of IPL technology is an advantage, but the generality of the spectrum can make it less powerful and predictable for selective follicular damage. This will likely result in patients needing more frequent maintenance, and the treatment results being more inconsistent. This study has several weaknesses, too. The length of the sample and the 12-week follow-up limited the study's ability to assess the recurrence or regrowth of hair over the long term. Also, without hormonal evaluations, it is unclear the extent androgen excess and hair reduction plays on the results. Thus, for more robust studies that have the same findings and better treatment strategies, more extensive, long-term studies incorporating hormonal factors will be necessary.

Conclusion

It is concluded that long-pulsed Nd:YAG laser therapy is more effective and safer than intense pulsed light for the treatment of facial hirsutism. Patients treated with Nd:YAG laser achieved greater hair reduction, faster response, and higher satisfaction levels compared to those treated with IPL. Both modalities were well tolerated, but side effects such as transient erythema and mild hyperpigmentation were less frequent with Nd:YAG. The results suggest that Nd:YAG laser provides deeper follicular penetration and more selective targeting, making it a better option, especially for individuals with darker skin tones. Therefore, Nd:YAG laser should be considered the preferred treatment choice for achieving optimal and sustained results in facial hirsutism.

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