

Diode laser in physiological lip hyperpigmentation: A pilot study

ABSTRACT

Context: Lip hyperpigmentation poses a significant concern for many patients due to its impact on aesthetics and cosmetic appearance. It remains a challenging condition to address, with limited treatment options available, each varying in efficacy. **Aims:** The aim of this study was to assess the effectiveness of diode laser technology in treating lip hyperpigmentation. **Methods and Material:** Patients with physiological lip hyperpigmentation, who had previously shown no response to other treatment modalities, were recruited for the study. **Statistical Analysis Used:** The Statistical Package for the Social Sciences (SPSS) software program was used. The grades of pigmentation before and after treatment were subjected to the Wilcoxon signed ranks test. A value of $p < 0.05$ was considered statistically significant. **Results:** Twelve patients participated in the study. A diode laser session was planned at baseline and then at every 2-month interval. Monthly follow-ups through serial photography were done, and the response was evaluated by a reduction in darkness and pigmentation by a special grading system at baseline and at the end of 6 months. More than 90% of the patients had a good to excellent response at the end of 6 months with a significant p -value (< 0.05). **Conclusions:** Diode laser therapy can be considered a safe and efficacious option for managing lip hyperpigmentation, which is unresponsive to traditional treatments.

keywords: lip pigmentation, diode, laser

Key Messages: Physiological lip pigmentation is a poorly responding condition that often causes great cosmetic concern to patients. Treatment options are often limited with variable results. In the current study, a diode laser was used for lip hyperpigmentation, and the results were promising.

INTRODUCTION

Lip hyperpigmentation is a prevalent condition with diverse underlying causes, such as physiological changes, genodermatoses, inflammatory conditions, hormonal imbalances, medications, and environmental factors. Physiological hyperpigmentation of lips remains one of the most common causes, which generally requires no treatment at all but causes a lot of cosmetic concern to the patients; hence, management is mainly aimed at cosmetic correction of hyperpigmentation.^[1] Available options include pharmaceutical interventions, chemical peels,^[2] and Q-switched Nd Yag laser therapy.^[3]

Pharmaceutical approaches have shown limited efficacy, while chemical peels, including glycolic acid, lactic acid, and retinol, produce varying outcomes.^[2,5] Q-switched Nd

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Figure 1: Clinical image of incidental finding of hypopigmentation of lips after diode laser therapy in our first patient.

Yag laser treatments have demonstrated some success, albeit with inconsistent results, often necessitating multiple sessions.^[3,4] Due to the shortcomings of existing treatments, there has been a quest for innovative therapeutic approaches for lip hyperpigmentation. The concept of using a diode laser for lip hyperpigmentation stemmed from an incidental discovery where one of our patients undergoing upper lip hair reduction experienced burning of a portion of her lip, resulting in hypopigmentation [Figure 1]. Following this chance observation, we initiated a pilot study with a limited number of patients as, in the past, no studies are there in the literature which has used diode lasers for lip hyperpigmentation.

SUBJECTS AND METHODS

The study was conducted over a period of 6 months at a clinic in the South Gujarat region. Patients suffering from physiological hyperpigmentation of lips were included in the study. Lip hyperpigmentation secondary to known causes was excluded from the study. Other exclusion criteria were pregnancy, keloidal tendency, immunosuppression, and patients with unrealistic expectations.

A diode laser session was planned at every 2 months, and clinical response was evaluated at monthly intervals. US-FDA-certified Lumenis Light Sheer Diode was used in the study.

Patients were counseled regarding the benefits, side effects, and limitations of the treatment modality used. An informed

written consent was then obtained after explaining the procedure.

Postprocedure, the treated area was cooled with ice packs and topical steroid-antibiotic ointment. No other topical treatment/systemic treatment was given during the study.

Method of Assessment

Evaluation was done by assessing the degree of clearance of pigmentation and the level of patient satisfaction, as shown in Table 1. Clinical response was evaluated by using photographs taken before treatment and at each follow-up visit. Photographs of patients were taken in the same location with constant illumination and distance at baseline, before and after each therapy session.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) software program was used. The grades of pigmentation before and after treatment were subjected to the Wilcoxon signed ranks test. A value of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 12 patients were included in the study. The diode laser was done at a 2-month interval. Most of the patients belonged to Fitz Patrick skin types 4,5,6. Patients were evaluated at the end of each month for clinical assessment. After 2 months, if required, a repeat session was planned for residual pigmentation. Sessions were continued till satisfactory clearance. The total follow-up period was 6 months.

The energy parameters used were 24/auto, where 24 was the fluence and in "auto" is the automatic calibration of pulse width by the machine. Immediately after the procedure, there was transient erythema in all the patients; 10 patients noticed mild swelling, while two patients noticed moderate swelling. Erythema was followed by crusting over the lips in the next 3 days, which settled over a period of 1–2 weeks.

Table 1: Objective and Subjective Assessment Methods.

Objective and subjective assessment		
Objective assessment		subjective assessment [4]
Level of darkness and pigmentation [5]	Grading of clinical response [4]	0-not satisfied1- Satisfied2-Extremely satisfied
Grade 0 – No Pigmentation	Grade 0: no response	
Grade 1 – Light Brown	Grade 1: mild response (1%–25%)	
Grade 2- Brown	Grade 2: moderate response (26%- 50%)	
Grade 3- Dark brown	Grade 3: good response (51%–75%)	
Grade 4- Black	Grade 4: excellent response (> 75%)	

Table 2: Energy Parameters Used.

TOTAL PATIENTS	12
Energy	24 J
Fluence (Pulse width)	Auto calibration by machine
Downtime	1 to 2 weeks
Changes observed post laser session	En;-thema, swelling and crusting

Total downtime was 7 days in five patients, 10 days in four patients, and 14 days in three patients [Table 2].

Lip pigmentation was graded by the color chart given by Shariq *et al.*^[5]. Out of 12 patients, eight patients had Grade 3 pigmentation, two patients had Grade 2 pigmentation, one patient had Grade 1 pigmentation, and one patient had Grade 4 pigmentation [Table 3].

At the end of 6 months, six patient has an excellent response (>75% clinical response), five patient had good response (51%–75% clinical response) and one patient had moderate response (25%–50% response) [Table 4] [Figure 1–10]. More than 90% of the patients had a good to excellent response, and at the end of 6 months, and *p*-value was significant (<0.05).

At the end of 6 months, 10 patients were satisfied, while two patients were extremely satisfied [Table 5].

In most of the patients single session was sufficient with complete recovery. Very few patients required a second session scheduled at an interval of 2 months for the residual patchy hyperpigmentation. Almost all the patients are in follow-up now with no recurrence. The side effects were minimal to absent in all the patients. The crusting and swelling that occurred in patients subsided in 5–7 days in the majority of patients.

Table 3: Grading the Number of Patients According to the Color Chart.

Grade of Pigmentation [5]		
Grade	Total Patients At Baseline	Percentage
1 – Light Brown	1	8.3%
2 – Brown	2	16.7%
3 – Dark Brown	8	66.7%
4 – Black	1	8.3%

Table 4: Grading of Clinical Response.

Grading of clinical response	No of patients	Percentage
Excellent response	6	50%
Good response	5	41.7%
Extremely satisfied	1	8.3%

**Figure 2: Baseline picture of patient 1.****Figure 3: Improvement after undergoing two sessions of diode laser at the end of 6 months.**

DISCUSSION

Physiological hyperpigmentation of lips is a common problem in Fitz Patrick skin types 4,5, 6. The concentration of melanocytes is more on lips with a higher melanocytes:keratinocytes ratio, giving a darker appearance to the lips. In the epidermis, melanocyte density varies according to the body site. The highest concentrations of melanocytes are found in the genitalia and face. The basal epidermis of facial skin features one melanocyte per four keratinocytes.^[6] Within the lips, the melanocyte: keratinocyte ratio is 1:10–15.^[7] Melanocyte density does not differ among individuals of different ethnic backgrounds. Instead, variations in pigmentation among races are caused by differences in pigment production by melanocytes and the proportion of mature melanosomes and their transfer within keratinocytes.^[7]

**Figure 4: Baseline picture of patient 2.**



Figure 5: Improvement after undergoing two sessions of diode laser after 4 months of diode laser.



Figure 8: Baseline picture of patient 4.



Figure 6: Baseline picture of patient 3.



Figure 9: Picture showing typical crusting of lips on day 5 of diode laser.

Melanin is produced by specialized cells called melanocytes situated in the basal layer of the epidermis as well as oral epithelium. Melanin is transported to neighboring cells through melanosome (an ovoid granule-like cell organelle, 400–800 nm) into a superficial layer of keratinocytes in the stratum spinosus, which is 0.027–0.15 mm thick.^[8]

Some conditions involve not only the lips but also other intraoral structures, other mucosal sites, skin, hair, nails, or other organs. Thus, the evaluation of patients with lip hyperpigmentation requires a systematic approach that includes a complete medical history, family history, history of cosmetic and medication use, and evaluation of systemic symptoms.^[1]

Physiological hyperpigmentation of lips ideally does not need treatment. The primary indication is when patients want a cosmetic correction in the appearance of lips. Multiple treatment options have been tried in the past with variable results. Various depigmenting creams containing Hydroquinone, azelaic acid, kojic acid, and glycolic acid have been tried with limited efficacy.^[9] Chemical Peels has been tried as an adjuvant therapy for hyperpigmentation of lips.^[2] Various peels that have been tried include Glycolic acid peel, Kojic acid peel, trichloroacetic acid peels, and recently, ferulic acid peels have been tried, but the results have been inconsistent, leading to poor patient compliance. Recently, Q-switched Nd Yag Lasers has been introduced to treat



Figure 7: At the end of 6 months.



Figure 10: Improvement at the end of 6 months.

hyperpigmentation of lips with variable results.^[3,4] Q-switched laser uses a 1064-nm wavelength to target melanin in the lips; a low fluence with multiple passes is recommended to get results. However, the treatment requires multiple sittings, which increases the burden of cost on the patient.

Anderson and Parrish's principle of selective photothermolysis explains the mechanism behind such light-based therapies.^[10] Lasers emit light onto the skin surface that is reflected, scattered, transmitted, or absorbed. At specific peak wavelengths in the red to near-infrared range of electromagnetic radiation (600–1100 nm), absorbed light energy heats the target chromophore in the skin. The most common chromophores are melanin, oxyhemoglobin, tattoo pigment, water, and collagen. Selective tissue destruction occurs when optimal parameters of wavelength, fluence, and pulse duration confine heating and subsequent injury to the desired chromophore without dissipation to surrounding tissues. Wavelengths of 600–1100 nm favor absorption by melanin in the hair matrix. Epidermal melanin competitively absorbs the same wavelengths used for hair removal. In darker-skinned individuals, the greater epidermal melanin content competes with the hair follicle for light absorption, increasing the risk of thermal blisters and postinflammatory changes. There have been case reports of diode laser causing postinflammatory hypopigmentation on the skin in patients undergoing treatment for hair removal.^[11] Apart from the action on melanocytes by a diode wavelength, its tendency to cause postinflammatory hypopigmentation over lips encouraged us to do a pilot study with a limited number of patients. Encouragingly, the results were satisfactory. In comparison to other available modalities, diode laser therapy for lip pigmentation required fewer treatment sessions, demonstrating its potential as an efficient treatment option. We also observed that blackish, dark brown, or bronze-colored lips responded well as compared to less dark lips. A large-scale study in the future will definitely validate the results and efficacy of diode in lip hyperpigmentation.

CONCLUSION

In conclusion, our study suggests that diode laser therapy (808 nm) holds significant promise as an effective treatment

for hyperpigmentation of the lips. The results demonstrate its potential to offer a safe and efficient solution, particularly for cases resistant to traditional treatment modalities. With its ability to achieve satisfactory outcomes in a relatively short timeframe and with a single session compared to existing options, diode laser therapy emerges as a valuable addition to the armamentarium for managing lip hyperpigmentation. The findings of this study indicate a promising future for diode laser therapy in addressing this common cosmetic concern.

LIMITATION

A large-scale study will be required to validate the result of our study as the number of patients enrolled was less. Further research and clinical trials are warranted to validate and refine its use.

Conflict of interest

There are no conflicts of interest.

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