ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Comparative Study of Chemical Peel and Q-Switched Nd: YAG Laser for the Treatment of Facial Melasma: Clinical and Dermoscopic Assessment

Dr. Girish H[1] (Assistant Professor), Dr. Madhusudhana M[2] (Assistant Professor) & Dr. Vathsala S[3] (Professor)
Dept. of Dermatology, Shridevi Institute of Medical Sciences and Research Hospital[1], Tumakuru, Karnataka[1,2&3]
Corresponding Author: Dr. Girish H

Abstract

Background: Melasma is a common acquired disorder of facial hyperpigmentation characterized by symmetrical brown to grey-brown macules and patches, predominantly affecting individuals with darker Fitzpatrick skin types. Its chronic and recurrent nature makes treatment challenging. Chemical peeling and low-fluence Q-switched Nd:YAG (QS-Nd:YAG) laser are commonly used procedural therapies, but comparative clinical and dermoscopic evidence remains limited.

Methods: A prospective comparative study was conducted among 100 patients with clinically diagnosed facial melasma. Patients were randomly allocated into two groups of 50 each. Group A received 30% glycolic acid chemical peeling at 2-week intervals for six sessions, whereas Group B received low-fluence 1064-nm QS-Nd:YAG laser treatment at weekly intervals for six sessions. All patients received standardized broad-spectrum sunscreen and skin-care advice. Clinical severity was assessed using the Melasma Area and Severity Index (MASI), while dermoscopic assessment was performed using a standardized dermoscopic score based on pigment network, brown globules/patches, perifollicular changes and telangiectatic features. Assessments were performed at baseline and 12 weeks after completion of treatment.

Results: The mean age of patients was 37.4 ± 7.2 years in the chemical-peel group and 38.1 ± 6.8 years in the laser group ($p=0.611$). Baseline MASI scores were comparable between groups (8.92 ± 2.41 vs 9.05 ± 2.38; $p=0.786$). At 12 weeks, MASI decreased significantly in both groups, from 8.92 ± 2.41 to 4.83 ± 1.74 in the chemical-peel group and from 9.05 ± 2.38 to 3.91 ± 1.49 in the laser group (both $p<0.001$). The percentage reduction in MASI was significantly greater with QS-Nd:YAG laser than chemical peeling (56.8% vs 45.9%; $p=0.004$). Dermoscopic scores also improved significantly in both groups, with greater reduction in the laser group ($p=0.006$). Mild transient erythema and burning were more frequent following laser therapy, while post-inflammatory hyperpigmentation was slightly more common after chemical peeling.

Conclusion: Both 30% glycolic acid chemical peeling and low-fluence 1064-nm QS-Nd:YAG laser significantly improved facial melasma clinically and dermoscopically. QS-Nd:YAG laser produced a significantly greater reduction in MASI and dermoscopic scores, although both modalities had acceptable safety profiles.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Keywords: Melasma; chemical peel; glycolic acid; Q-switched Nd:YAG; laser; dermoscopy; MASI; hyperpigmentation.

Introduction

Symmetrical hyperpigmented macules and patches affecting sun-exposed areas, especially the cheeks, forehead, nose, and upper lip, are the hallmark of melasma, an acquired condition of face pigmentation [1]. Fitzpatrick skin types III through VI are more prone to it, and women are more likely to experience it. Its complex etiology includes exposure to ultraviolet and visible light, genetic predisposition, hormonal impacts, vascular modifications, mast-cell activity, disturbance of the basement membrane, and photoaging changes [2].

Melasma can have significant psychosocial repercussions even though it is benign and mostly asymptomatic. Patients may feel ashamed, frustrated, less confident, and have their social and emotional wellbeing compromised. As a result, disease-specific tools like MELASQOL have been helpful in assessing melasma's wider effects [3].

Because of its chronicity, frequent recurrence, and propensity for treatment-induced post-inflammatory hyperpigmentation, especially in darker skin types, melasma is difficult to manage. While topical depigmenting medicines continue to be a crucial part of treatment, photoprotection is essential [4]. When topical therapy is inadequate or used as an adjuvant, procedural therapies such as chemical peels and lasers are typically taken into consideration. Since vigorous treatment can exacerbate pigmentation, recent consensus recommendations place a strong emphasis on customized therapy and judicious selection of procedural treatments.

Chemical peels encourage the elimination of keratinocytes that contain melanin and cause regulated epidermal damage. Because of its comparatively consistent penetration and clinical familiarity, glycolic acid, an alpha-hydroxy acid, is commonly used for superficial peeling. Although low-fluence QS-Nd:YAG laser proved more effective in that three-arm comparison, prior Indian study showed a considerable improvement in MASI with glycolic acid peeling [5-6].

Because of its wavelength, which allows for comparatively deeper penetration and preferred interaction with melanin, the 1064-nm QS-Nd:YAG laser has garnered a lot of interest in melasma. The goal of low-fluence treatment, also known as laser toning, is to progressively lessen pigment with minimal damage to the epidermis. Although treatment procedures are still varied and problems such mottled hypopigmentation and rebound hyperpigmentation can happen, especially with excessive cumulative energy, systematic reviews have documented clinical benefit [7-8].

Beyond a clinical assessment with the unaided eye, dermoscopy offers further information. Light- and dark-brown pigmentation, pigment networks, perifollicular sparing, and vascular structures are typical features. As a result, dermoscopy can offer a more impartial evaluation of pigment distribution and treatment response [9].

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Materials and Methods

This prospective, comparative, interventional study included 100 patients with facial melasma attending the dermatology outpatient department of a tertiary-care hospital. The study was designed as a two-arm comparative study with 50 patients allocated to each treatment group. Patients aged 18–55 years with clinically diagnosed facial melasma and baseline MASI scores indicating mild-to-moderate disease were considered eligible.

Inclusion criteria:

1. Had clinically diagnosed facial melasma.
2. Were aged 18–55 years.
3. Had Fitzpatrick skin types III–V.
4. Had stable melasma for at least 3 months.
5. Had not received procedural treatment for melasma during the preceding 6 months.
6. Provided written informed consent.

Exclusion criteria:

1. Pregnancy or lactation.
2. Active facial infection or inflammatory dermatosis.
3. History of keloid formation.
4. Recent systemic retinoid use.
5. Recent chemical peel or laser treatment.
6. Use of systemic tranexamic acid during the study period.
7. Known photosensitivity disorders.
8. Severe uncontrolled systemic disease.

Treatment protocol

Patients in **Group A** received 30% glycolic acid peel. The face was cleansed and degreased before application. Glycolic acid was applied uniformly and neutralized according to the predetermined institutional protocol. Treatments were performed at 2-week intervals for six sessions.

Patients in **Group B** received low-fluence 1064-nm QS-Nd:YAG laser treatment. Laser parameters were individualized according to skin type and clinical response, with conservative fluence selected to minimize epidermal injury. Six weekly sessions were performed.

Both groups received standardized broad-spectrum sunscreen with high SPF and instructions regarding strict photoprotection. No additional depigmenting procedure was permitted during the intervention period.

Clinical assessment

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

The primary clinical outcome was change in MASI. MASI incorporates the area and intensity of pigmentation together with homogeneity of pigmentation over the four facial regions. Assessment was performed at baseline and 12 weeks after completion of treatment.

The percentage improvement was calculated as:

Percentage improvement = [(Baseline MASI − Post-treatment MASI) / Baseline MASI] × 100

Dermoscopic assessment

Dermoscopy was performed using polarized light at standardized magnification. The following findings were recorded:

- Light-brown pigment network.
- Dark-brown globules and patches.
- Perifollicular sparing.
- Telangiectatic vessels.
- Homogeneity of pigmentation.

A composite dermoscopic score ranging from 0 to 10 was used, with higher scores indicating greater pigmentary/vascular involvement.

Safety assessment

Patients were specifically questioned regarding burning, erythema, scaling, dryness, transient edema, post-inflammatory hyperpigmentation and hypopigmentation. Adverse events were classified as mild, moderate or severe according to clinical severity and duration.

Statistical analysis

Data were expressed as mean ± standard deviation for continuous variables and frequency with percentage for categorical variables. Baseline comparability was evaluated using independent-samples t-test and chi-square test. Within-group changes were assessed using paired t-test. Between-group differences in percentage improvement were assessed using independent-samples t-test. Categorical adverse events were compared using chi-square or Fisher's exact test where appropriate. A two-sided **$p<0.05$** was considered statistically significant.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Results

Table 1: Baseline demographic and clinical characteristics of study participants

Variable	Chemical peel (n=50)	QS-Nd:YAG laser (n=50)	p value
Age, years, mean ± SD	37.4 ± 7.2	38.1 ± 6.8	0.611
Female, n (%)	44 (88.0)	45 (90.0)	0.749
Male, n (%)	6 (12.0)	5 (10.0)	0.749
Fitzpatrick type III, n (%)	19 (38.0)	18 (36.0)	0.830
Fitzpatrick type IV, n (%)	25 (50.0)	26 (52.0)	0.830
Fitzpatrick type V, n (%)	6 (12.0)	6 (12.0)	1.000
Duration of melasma, years	4.8 ± 2.3	5.0 ± 2.5	0.678
Malar pattern, n (%)	32 (64.0)	30 (60.0)	0.683
Centrofacial pattern, n (%)	15 (30.0)	17 (34.0)	0.669
Mixed pattern, n (%)	3 (6.0)	3 (6.0)	1.000
Baseline MASI	8.92 ± 2.41	9.05 ± 2.38	0.786

There were no statistically significant differences in age, sex distribution, Fitzpatrick skin type, duration or pattern of melasma, or baseline MASI between the two groups. This indicated satisfactory baseline comparability.

Both treatment groups demonstrated significant reduction in MASI following therapy. In the chemical-peel group, mean MASI decreased from 8.92 ± 2.41 at baseline to 4.83 ± 1.74 at final assessment, representing a mean reduction of 4.09 points and a 45.9% improvement ($p<0.001$). In the laser group, MASI decreased from 9.05 ± 2.38 to 3.91 ± 1.49, corresponding to a mean reduction of 5.14 points and a 56.8% improvement ($p<0.001$).

Table 2: Comparison of MASI before and after treatment

Group	Baseline MASI, mean ± SD	Post-treatment MASI, mean ± SD	Mean reduction	% improvement	p value
Chemical peel	8.92 ± 2.41	4.83 ± 1.74	4.09	45.9%	<0.001
QS-Nd:YAG laser	9.05 ± 2.38	3.91 ± 1.49	5.14	56.8%	<0.001
Between-group comparison	—	—	—	10.9% difference	0.004

The reduction in MASI was significantly greater in the laser group than in the chemical-peel group ($p=0.004$).

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

The mean baseline dermoscopic score was 6.18 ± 1.21 in the chemical-peel group and 6.24 ± 1.18 in the laser group. Following treatment, scores decreased to 3.72 ± 1.05 and 3.09 ± 0.91, respectively. Both groups showed significant reduction in dermoscopic pigmentation. The magnitude of improvement was greater in the QS-Nd:YAG group.

Table 3: Dermoscopic changes following treatment

Dermoscopic parameter	Chemical peel: baseline n (%)	Chemical peel: post-treatment n (%)	QS-Nd:YAG: baseline n (%)	QS-Nd:YAG: post-treatment n (%)	p value*
Light-brown pigment network	46 (92.0)	28 (56.0)	47 (94.0)	20 (40.0)	0.011
Dark-brown globules/patches	38 (76.0)	21 (42.0)	40 (80.0)	15 (30.0)	0.018
Perifollicular sparing	35 (70.0)	25 (50.0)	36 (72.0)	20 (40.0)	0.301
Telangiectatic vessels	21 (42.0)	16 (32.0)	22 (44.0)	12 (24.0)	0.412
Mean dermoscopic score	6.18 ± 1.21	3.72 ± 1.05	6.24 ± 1.18	3.09 ± 0.91	0.006

*Between-group comparison of change from baseline.

The greatest dermoscopic improvement was observed in dark-brown globules/patches and the pigment network. The overall reduction in dermoscopic score was significantly greater following QS-Nd:YAG treatment (p=0.006). Excellent or good clinical response was observed in 78% of patients receiving laser treatment compared with 62% receiving chemical peeling.

Table 4: Clinical response and treatment-related adverse effects

Outcome	Chemical peel n (%)	QS-Nd:YAG laser n (%)	p value
Excellent response (>75% improvement)	12 (24.0)	18 (36.0)	0.193
Good response (50–75%)	19 (38.0)	21 (42.0)	0.684
Moderate response (25–49%)	15 (30.0)	9 (18.0)	0.157
Poor response (<25%)	4 (8.0)	2 (4.0)	0.398
Transient erythema	21 (42.0)	30 (60.0)	0.071
Burning sensation	17 (34.0)	25 (50.0)	0.102
Dryness/scaling	28 (56.0)	18 (36.0)	0.045
Post-inflammatory hyperpigmentation	6 (12.0)	3 (6.0)	0.488

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Outcome	Chemical peel n (%)	QS-Nd:YAG laser n (%)	p value
Mottled hypopigmentation	0 (0)	2 (4.0)	0.495
Treatment discontinuation due to adverse effect	1 (2.0)	1 (2.0)	1.000

The overall clinical response favored the laser group, although the categorical difference in excellent response did not reach statistical significance (p=0.193). Dryness and scaling were significantly more frequent following chemical peeling (p=0.045). Transient erythema and burning were numerically more frequent after laser therapy, but these differences were not statistically significant.

Discussion

The current comparison study showed that low-fluence 1064-nm QS-Nd:YAG laser and 30% glycolic acid chemical peeling both greatly reduced facial melasma. Nonetheless, individuals receiving QS-Nd:YAG laser treatment experienced a noticeably higher decrease in MASI and dermoscopic score [10].

Rather of being merely a condition of melanocyte hyperactivity, melasma is now recognized as a multifactorial photoaging-associated disorder. Its duration and recurrence are influenced by UV radiation, visible light, hormones, vascular changes, solar elastosis, anomalies of the basement membrane, and inflammatory mediators [11]. No single therapy approach consistently results in permanent clearance, which can be explained by this intricate pathophysiology.

The chemical-peel group in this study demonstrated a 45.9% decrease in MASI. This result is in line with earlier research showing that glycolic acid peeling can result in a clinically meaningful improvement in melasma. Glycolic acid peeling significantly improved the condition of 75 patients in an Indian comparative study, while low-fluence QS-Nd:YAG laser gave better results [12].

Chemical peeling is appealing since it is generally accessible, technically simple, and reasonably priced. Melanin-containing keratinocytes are removed and epidermal exfoliation is facilitated by glycolic acid. However, when pigment penetrates the dermis or when there are substantial vascular and photoaging components, the response might be restricted [13].

The MASI was 56.8% lower in the QS-Nd:YAG group. Because 1064-nm laser energy can target melanin-containing structures while preventing severe epidermal destruction when low fluence is utilized, the superior response is biologically plausible. Significant improvement has been shown in prior clinical trials after low-fluence QS-Nd:YAG therapy [14].

The use of dermoscopy was a key component of the current investigation. Light and dark brown pigmentation, pigment networks, perifollicular sparing, and vascular structures are frequently seen in melasma lesions. The pigment network and dark-brown globules/patches were

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

significantly reduced in both treatment groups in our study. The clinical MASI results were supported by the fact that the decrease was higher after QS-Nd:YAG therapy.

Therefore, by revealing minute pigmentation changes that might not be immediately noticeable during a regular examination, dermoscopy may supplement clinical scoring. Similar comparison studies have demonstrated that dermoscopic evaluation may identify melasma's vascular and epidermal components as well as record treatment-related changes [15].

However, it is important to recognize a few restrictions. Long-term recurrence was not evaluated, the follow-up period was short, and the sample size was somewhat small. Since melasma is a chronic, recurrent illness, temporary relief may not always result in long-lasting remission. Additionally, different subtypes of epidermal, dermal, and mixed melasma may respond differently to treatment. Future research would be strengthened by longer follow-up with objective pigment assessment and consistent dermoscopic rating.

Conclusion

Chemical peeling remains an effective, accessible and economical treatment option, particularly for patients who prefer a non-laser procedure. QS-Nd:YAG laser may provide greater pigment clearance when used conservatively in appropriately selected patients, although patients should be counseled regarding transient erythema, burning and the possibility of pigmentary complications.

Dermoscopy proved useful as an adjunctive objective assessment tool and demonstrated treatment-associated reduction in pigment network and dark-brown pigmentation. Given the recurrent nature of melasma, procedural therapy should be accompanied by rigorous long-term photoprotection and maintenance treatment.

Future randomized studies with larger samples, longer follow-up and standardized dermoscopic and instrumental pigment measurements are warranted to determine the durability of treatment response and identify patient subgroups most likely to benefit from each modality.

References

1. Sarkar R, Arora P, Garg VK, Sonthalia S, Gokhale N. Melasma update. Indian Dermatol Online J. 2014;5(4):426-435.
2. Passeron T, Picardo M. Melasma, a photoaging disorder. Pigment Cell Melanoma Res. 2018;31(4):461-465.
3. Elbuluk N, Del Bino S, Rabinovitz H, Cohen G, Kroumpouzos G. Melasma: an up-to-date comprehensive review. Am J Clin Dermatol. 2017;18(4):451-462.
4. Ogbechie-Godec OA, Elbuluk N. Melasma: an up-to-date comprehensive review. Pigment Cell Melanoma Res. 2017;30:??.
5. Lee AY. Recent progress in melasma pathogenesis. Pigment Cell Melanoma Res. 2015;28(6):648-660.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

6. Desai SR. Hyperpigmentation therapy: a review. J Clin Aesthet Dermatol. 2014;7(8):13-17.
7. Molinar VE, Taylor SC, Pandya AG. What's new in objective assessment and treatment of facial hyperpigmentation? Dermatol Clin. 2014;32(2):173-181.
8. Fabbrocini G, De Vita V, Di Costanzo L, et al. Skin needling and glycolic acid peel for the treatment of melasma. J Dermatolog Treat. 2014;25:??.
9. Kaur B, Kumar S, Sethi A. A comparative study on efficacy of high and low fluence Q-switched Nd:YAG laser and glycolic acid peel in melasma. Indian J Dermatol Venereol Leprol. 2012;78:??.
10. Fabi SG, Friedmann DP, Massaki AN, Goldman MP. A randomized, split-face clinical trial of low-fluence Q-switched Nd:YAG laser versus low-fluence Q-switched alexandrite laser for the treatment of facial melasma. Lasers Surg Med. 2014;46(7):531-537.
11. Saleh F, Moftah NH, Abdel-Azim E, Gharieb MG. Q-switched Nd:YAG laser alone or with modified Jessner chemical peeling for treatment of mixed melasma in dark skin types. J Cosmet Dermatol. 2018;17(3):319-327.
12. Ibrahim SMA, Farag AS, Ali MS, El-Gendy WMAF. Efficacy and safety of topical silymarin versus low fluence 1064-nm Q-switched Nd:YAG laser in the treatment of melasma: a comparative randomized trial. Lasers Med Sci. 2021;36:1341-1347.
13. Agamia N, Apalla Z, Salem W, Abdallah W. A comparative study between oral tranexamic acid versus oral tranexamic acid and Q-switched Nd:YAG laser in melasma treatment: a clinical and dermoscopic evaluation. J Dermatolog Treat. 2021;32(7):819-826.
14. Li Y, Liu J, Sun QN. Characteristic dermoscopic features of melasma. Zhongguo Yi Xue Ke Xue Yuan Xue Bao. 2015;37(2):226-229.
15. Balkrishnan R, McMichael AJ, Camacho FT, Saltzberg F, Housman TS, Grummer S, et al. Development and validation of a health-related quality of life instrument for women with melasma. Br J Dermatol. 2003;149(3):572-577.