

Effect of Intense Pulsed Light Versus Intradermal Tranexamic Acid for the Management of Melasma

Sadaf Ahmed Asim, Tayyaba Iqbal, Madiha Sajid and Sadia Bhatti

Department of Dermatology, Dow International Medical College, Dow University of Health Sciences, Karachi, Pakistan

ABSTRACT

Objective: To compare the effectiveness of intense pulsed light (IPL) and intradermal tranexamic acid (TXA) in treating melasma.

Study Design: A cross-sectional analytical study.

Place and Duration of the Study: Department of Dermatology, Dow International Medical College, Dow University Hospital, Karachi, Pakistan, from 15th January to 15th July 2023.

Methodology: A total of 62 patients with melasma, aged 20-50 years, were divided into two groups. Group A (32 patients) received IPL (560 nm filter was used) treatment, and Group B (30 patients) received intradermal TXA. Each group underwent four treatment sessions with varying intervals. Melasma area and severity index (MASI) scores were used to compare the effects of treatment.

Results: After a 3-month treatment period, both groups showed reduced mMASI scores compared to baseline with a significant initial difference between Group A (8.6 ± 4.2) and Group B (5.4 ± 2.7 , $p < 0.001$). However, post-treatment, there was no significant difference in mMASI scores (Group A: 3.8 ± 2.6 ; Group B: 3.2 ± 2.0 , $p = 0.29$). IPL treatment (Group A) demonstrated a significant reduction in mMASI scores (57.1 ± 19.7) compared to intradermal TXA treatment (Group B, 42.2 ± 18.8 , $p = 0.0034$).

Conclusion: Both IPL and intradermal TXA treatments effectively reduced melasma, with IPL exhibiting superior results. However, post-treatment outcomes converged, emphasising the need for personalised approaches considering the unique characteristics of South East Asian skin.

Key Words: Intense pulsed light, Melasma, Intradermal tranexamic acid.

How to cite this article: Asim SA, Iqbal T, Sajid M, Bhatti S. Effect of Intense Pulsed Light Versus Intradermal Tranexamic Acid for the Management of Melasma. *J Coll Physicians Surg Pak* 2024; **34(05)**:522-526.

INTRODUCTION

Melasma is a multifaceted dermatological condition characterised by hyperpigmented patches predominantly affecting the facial area. Its prevalence is significantly higher among women, especially those within the reproductive age group of 20 to 40 years.¹ The condition shows a marked preference for Fitzpatrick skin types III and IV.^{2,3} Melasma's aetiology is believed to be multifactorial, with genetic predispositions, ultraviolet (UV) radiation, hormonal variations, and cosmetic use cited as potential contributors to its development.^{4,6}

The clinical presentation of melasma allows its classification into epidermal, dermal, or mixed types, based on the depth of melanin deposition.⁷ This stratification is crucial for guiding treatment strategies, which, to date, present considerable challenges in terms of efficacy and long-term outcomes.^{8,9} Traditional treatments have ranged from topical depigmenting agents to procedural interventions like chemical peels and laser therapy, each demonstrating variable success rates.^{10,11}

Among newer technologies, intense pulsed light (IPL) has gained attention for its targeted approach, though its efficacy varies and is dependent upon specific patient characteristics.¹²

The exploration of tranexamic acid (TXA), both in topical and injectable forms, represents a significant advancement in melasma management. TXA has been shown to address the pigmentation and vascular components of melasma effectively, potentially offering a dual-action approach to the treatment.^{13,14} Despite these advancements, the management of melasma remains a subject of ongoing research, with studies exploring novel agents and methodologies to improve treatment outcomes and patient satisfaction.¹⁵⁻¹⁷

This research aimed to evaluate the comparative effectiveness of IPL treatment versus localised TXA injections in the management of melasma in South East Asian patients, utilising the modified melasma area and severity index (mMASI) for assessment.¹⁸ The study's findings were anticipated to contribute valuable insights into cost-effective and efficient treatment modalities for this pervasive and often recalcitrant skin condition.¹⁹

METHODOLOGY

This study was conducted at the Department of Dermatology, Dow International Medical College, Dow University Hospital, Karachi, Pakistan, involving two distinct groups. The number of subjects per group was set at 30, determined through calculations with PASS version 15 software. This determination was based on two independent sample proportions, aiming for a 95% confidence

Correspondence to: Dr. Sadaf Ahmed Asim, Department of Dermatology, Dow International Medical College, Dow University of Health Sciences, Karachi, Pakistan
E-mail: doc.sadaf.ahmed@gmail.com

Received: November 22, 2023; Revised: April 02, 2024;

Accepted: April 22, 2024

DOI: <https://doi.org/10.29271/jcpsp.2024.05.522>

interval and a 91% test power, taking into account treatment improvements of 49.4% for IPL and 86.3% for TXA.¹¹

Group A received treatment with IPL, utilising a 560 nm filter, while Group B underwent treatment with intradermal injections of TXA for melasma. Prior to inclusion, participants were required to have ceased all forms of topical, oral, or injectable medications for at least three months. Following a detailed explanation of the procedures involved, informed written consent was obtained from each participant. The type of melasma, affecting any facial area, was determined through clinical assessment and, where necessary, wood lamp examination. Prior to each treatment session, participants were instructed to cleanse the affected area with soap and water.

For those in the IPL group (Group A), the procedure entailed drying the face, applying a cooling gel, and using a filter appropriate for the skin type. Both the participant and the practitioner wore protective eyewear, and IPL pulses were administered according to a predetermined schedule. Post-session, participants were advised to apply sunscreen.

For those in the group receiving intradermal TXA injections (Group B), the process included drying the face, cleansing with an alcohol swab, and applying a topical numbing cream for a minimum of 30 minutes before the injection. TXA was administered undiluted, using an insulin syringe, directly into the affected area. Following the injection, a topical antibiotic ointment was applied, and sunscreen use was recommended.

The duration of the study was six months from 15th January to 15th July 2023 with the IPL group receiving sessions every three weeks and the TXA group every two weeks, totalling four sessions. The study aimed to enroll 30 participants of any gender in each group, aged between 20 and 50 years.

Eligible participants included individuals of any gender diagnosed with melasma on any part of the face, who had abstained from any topical, oral, or injectable medications for three months preceding the study, and who had no other active skin lesions. Exclusion criteria encompassed individuals with hyperpigmentation from secondary causes, pregnant or lactating individuals, and those with known photosensitivity or hypersensitivity to TXA. Efficacy of treatment was assessed by the reduction in mMASI score before and after the treatment results according to a four-point scale (no change, mild, moderate, or significant improvement). No change represented that mMASI reduction is less than and equal to 25%. Mild improvement represented the reduction in mMASI scores by 25-50%. Moderate improvement represented the reduction in mMASI by 50-75%, and significant improvement represented by above 75%. Data collection was facilitated through a questionnaire-based form, capturing all pertinent details of each participant's visit. The SPSS software version 21.0 was employed for data entry and analysis, summarising clinical characteristics in terms of frequencies and percentages for various variables (gender, duration of pigmentation, and age), and calculating the mean of the mMASI scores obtained.

Data analyses were carried out using the latest version of SPSS, STATA version 16, and MS Excel, with categorical variables presented as frequencies and percentages. Continuous data were

expressed as means \pm standard deviations. A two-sample t-test was utilised to compare the efficacy and satisfaction scores between the IPL and intradermal tranexamic treatments, with p-values <0.05 deemed indicative of statistical significance.

RESULTS

The study analysed data from 62 participants diagnosed with melasma, who were randomly divided into two treatment groups. Group A, consisting of 32 participants, received IPL therapy, whereas Group B, comprising 30 participants, was treated with intradermal injections of TXA. The average age of participants was documented at 34.8 ± 7.0 years, and a predominant female participation was observed. In terms of melasma types, within Group A, half of the participants (50%) had mixed melasma, whereas in Group B, a larger proportion, 22 participants (73%), presented with epidermal melasma.

Following a 3-month period of treatment, a decrease in mMASI scores was noted for both groups from their baseline figures. Initially, Group A exhibited a mean mMASI score of 8.6 ± 4.2 , and Group B recorded a score of 5.4 ± 2.7 , with this difference being statistically significant ($p < 0.001$). Post-treatment analysis revealed that the mMASI scores adjusted to 3.8 ± 2.6 for Group A and 3.2 ± 2.0 for Group B, with no significant statistical difference observed between the treatment outcomes of the two groups ($p = 0.29$). Notably, a significant reduction in mMASI scores was more pronounced in Group A with a mean reduction of 57.1 ± 19.7 compared to the Group B, with a mean reduction of 42.2 ± 18.8 , yielding a p-value of 0.0034. These findings are illustrated in Figure 1.

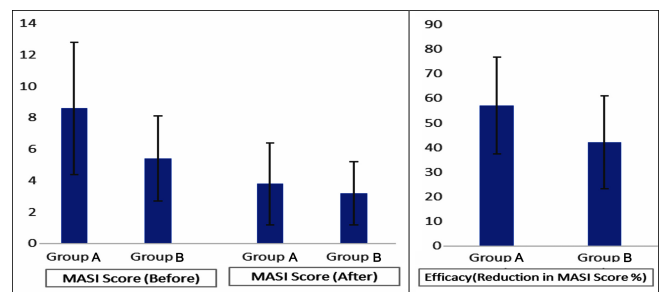


Figure 1: Changes in mMASI scores at baseline and after treatment.

Furthermore, efficacy of treatment assesses by the reduction in mMASI score before and after the treatment results according to a four-point scale (no change, mild, moderate, or significant improvement). Where no change represents that mMASI reduction is less than equal to 25%, Mild improvement represents the reduction in mMASI scores by 25-50%, Moderate improvement represents the reduction in mMASI by 50-75% and above 75% will represent significant improvement.

Figure 2 represents that efficacy of IPL treatment (Group A) was better, as 22 (68.8%) had shown moderate to significant improvement, whereas in Group B, 16 (53.3%) had shown only mild improvement and no significant improvement.

The impact of IPL and intradermal TXA treatment was measured by calculating the efficacy (reduction in mMASI score %), which was the difference between mMASI scores before and after the treatment.

Shapiro-Wilk test ($p = 0.064$) was used to analyse the normality of the efficacy variable. Measured data were expressed as mean \pm standard deviation for both groups (Table I). Where it was clearly noticed that there was a statistically significant difference between both treatments ($p < 0.05$), especially when the type of melasma was dermal and epidermal. However, there was no significant difference identified between treatments when the type of melasma was mixed.

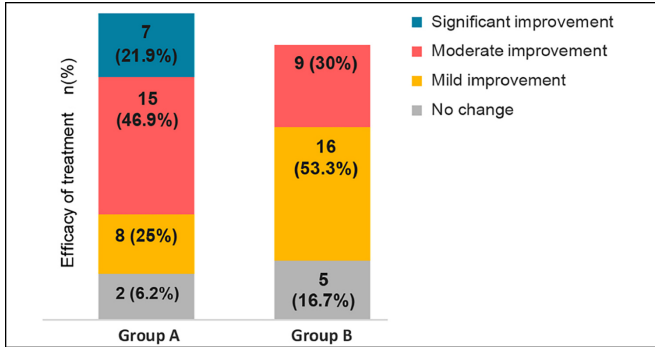


Figure 2: Efficacy of treatment (reduction in mMASI score). Gray bar = no change (efficacy $\leq 25\%$); yellow bar = mild improvement (efficacy 25-50%); pink bar = moderate improvement (efficacy 50-75%); blue bar = significant improvement (efficacy $> 75\%$) where Group A received IPL treatment and Group B received intradermal TXA treatment.

Table I: Modified MASI efficacy outcomes of both groups.

Efficacy	Group A (n = 32)	Group B (n = 30)	Overall (n = 62)	p-value
Overall*	57.1 \pm 19.7	42.2 \pm 18.8	49.9 \pm 20.5	0.0034**
Dermal*	52.5 \pm 12.1	13.9 \pm 5.1	40.7 \pm 21.2	0.0001**
Epidermal*	67.5 \pm 18.8	49.2 \pm 15.9	53.6 \pm 18.1	0.0171**
Mixed*	55.1 \pm 22.6	31.6 \pm 7.2	50.4 \pm 22.5	0.0604

*Two sample t-test of mean difference was used for comparison. **Statistically significant.

Table II: Group-wise demographics, percentage reduction in mMASI score, efficacy of treatment, and side effects.

	Total n = 62	Group A n = 32	Group B n = 30	p-value
Age years*	34.8 \pm 7.0	35.9 \pm 6.8	33.6 \pm 7.1	0.20
Gender				0.092
Male	14 (23%)	10 (31%)	4 (13%)	
Female	48 (77%)	22 (69%)	26 (87%)	
Marital status				0.021**
Married	43 (69%)	18 (56%)	25 (83%)	
Single	19 (31%)	14 (44%)	5 (17%)	
Type of melasma				<0.001**
Dermal	13 (21%)	9 (28%)	4 (13%)	
Epidermal	29 (47%)	7 (22%)	22 (73%)	
Mixed	20 (32%)	16 (50%)	4 (13%)	
Side effects overall				<0.001
No side effects	19 (31%)	19 (59%)	0 (0%)	
Localised bumps, redness, pain	18 (29%)	0 (0%)	18 (60%)	
Redness	8 (13%)	8 (25%)	0 (0%)	
Itching	3 (5%)	3 (9%)	0 (0%)	
Burning, localised bumps, pain	3 (5%)	0 (0%)	3 (10%)	
Burning, localised bumps, pain, redness	5 (8%)	0 (0%)	5 (17%)	
Burning	1 (2%)	1 (3%)	0 (0%)	
Burning, localised bumps, redness	1 (2%)	0 (%)	1 (3%)	
Localised bumps, pain	1 (2%)	0 (0%)	1 (3%)	
Localised bumps, redness	1 (2%)	0 (0%)	1 (3%)	
Irritation	1 (2%)	1 (3%)	0 (0%)	
Redness, pain	1 (2%)	0 (0%)	1 (3%)	

*Two-sample t-test of mean difference was used for comparison. **Statistically significant, Chi-square test used for categorical variables.

The majority of patients (19, 59%) who received IPL treatment (Group A) showed no side effects at all, whereas the majority of patients who received intradermal TXA treatment (18, 60%) experienced localised bumps, redness, and pain as side effects (Table II).

DISCUSSION

The research drew an intriguing contrast between the observed efficacy of intradermal TXA treatment in the current study and the findings reported by Shetty *et al.*²⁰ Despite a notable reduction in mMASI score and a fair percentage of patients reporting mild efficacy in the current study, there are disparities when juxtaposed with Shetty *et al.*'s results. These differences hint at underlying factors such as sample size variances, treatment protocols, and participant demographics which could influence outcomes. A deeper dive into these elements promises a richer, more informed comparison, potentially shedding light on the root causes behind the divergent results.

The discussion further explored how regional and demographic factors may impact the effectiveness of intradermal TXA treatment, as illustrated by the comparison with Iqbal *et al.*'s study.²¹

As the current study is focused on a Pakistani demographics, it implies that specific regional or environmental factors may influence treatment outcomes. This segment underscores the necessity of considering demographic nuances in treatment strategies, suggesting that efficacy can vary significantly across different settings. Such exploration can unveil insights into why certain treatments perform well in some regions but not in others.

Adding to this dialogue, it is imperative to discuss this study's findings in light of the study by Saeed *et al.*,²² which involved 50 Asian participants and concluded that IPL treatment yielded non-satisfactory results, with a mere 4% success rate for greater than 50% reduction in mMasi score. Contrasting starkly, this study demonstrated a 57.1% reduction in mMASI scores. This divergence potentially underscores the critical role of skin type, regional factors, and the technique of the procedure. It accentuates the significance of tailoring melasma treatments to specific patient profiles, reaffirming the concept that one-size-fits-all approaches may not be effective across diverse populations. This comparison not only highlights the variability in treatment outcomes based on demographic and regional considerations, but also points towards the necessity for meticulous selection and customisation of treatment modalities.

Moreover, the methodology employed in melasma treatment studies, including treatment duration, follow-up periods, and assessment techniques, invariably affects the research outcomes. By recognising and deliberating on these methodological variations, the discussion enhances the comprehension of why study results may differ. This acknowledgement stresses the importance of methodological context in evaluating and comparing treatment efficacy, further enriching the analysis.

In conclusion the discussion acknowledges the limitations inherent in the study and those referenced, lending credibility to the comparative analysis. By considering factors like sample size constraints, inconsistencies in treatment application, and follow-up durations, the article presents a balanced viewpoint. This not only highlights areas ripe for future research but also ensure a comprehensive understanding of the comparative study results.

Overall, by meticulously addressing these aspects, the discussion section achieves a nuanced comparison of the study results with existing research, enhancing the understanding of IPL and intradermal TXA treatments for melasma. This thorough approach does not just validate the study's conclusions but also adds valuable insights to the melasma management discourse, highlighting the need for tailored treatment strategies across diverse demographic and regional contexts.

CONCLUSION

Both IPL and intradermal TXA treatments effectively reduced melasma, with IPL exhibiting superior results. However, post-

treatment outcomes converged, emphasising the need for personalised approaches considering the unique characteristics of South East Asian skin.

ETHICAL APPROVAL:

The study was conducted after approval from the Ethical Committee of the Dow University of Health Sciences (Approval no. IRB-2758/DUHS/Approval/2022/05, Dated: 5th Jan 2023).

PATIENTS' CONSENT:

Informed written consent was obtained from each participant.

COMPETING INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

SAA: Conception of idea, data collection, drafting of article, and final review.

MS: Critical review of the manuscript.

TI: Drafting the manuscript, data analysis, and interpretation.

SB: Revising for important intellectual content.

All authors approved the final version of the manuscript to be published.

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