Original Article

# Evaluation of Therapeutic Outcomes of Microneedling assisted Tranexamic Acid + Vtamin C versus Platelet Rich Plasma in the Management of Melasma: A Prospective Comparative study

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## Abstract

**Background:** Melasma is a chronic acquired hyperpigmentary disorder that predominantly affects women and has a significant psychosocial impact. Conventional therapies often yield incomplete responses and are associated with frequent recurrences. Microneedling enhances transdermal drug delivery and may improve the efficacy of topical therapeutic agents such as tranexamic acid and vitamin C. Platelet-rich plasma (PRP), through its regenerative and anti-inflammatory properties, has also emerged as a promising treatment modality. The objective is to compare the efficacy and safety of microneedling-assisted tranexamic acid plus vitamin C with microneedling-assisted platelet-rich plasma in the treatment of melasma. **Material and Methods:** This prospective randomized comparative study included 60 patients with clinically diagnosed melasma who were allocated into two groups of 30 patients each using computer-generated randomization. Group A received microneedling-assisted tranexamic acid and vitamin C, while Group B received microneedling-assisted PRP. Treatment sessions were performed at 21-day intervals for 3–4 sessions. Clinical response was assessed using the Melasma Area and Severity Index (MASI), Physician Global Assessment (PGA), patient satisfaction scores, and standardized photographic documentation at baseline, 4, 8, and 12 weeks. **Results:** Both treatment modalities resulted in clinical improvement. Group A demonstrated a greater reduction in MASI scores from 12.8 ± 3.2 at baseline to 6.2 ± 1.8 at week 12, whereas Group B improved from 13.1 ± 3.5 to 8.3 ± 2.3 (p=0.001). Marked improvement (>50% reduction in MASI) was observed in 66.7% of patients in Group A compared with 36.7% in Group B. Patient satisfaction scores were significantly higher in Group A (8.1 ± 1.2) than in Group B (7.2 ± 1.4; p=0.02). Both treatments were well tolerated, with only mild and transient adverse effects. **Conclusion:** Microneedling-assistedtranexamic acid plus vitamin C was more effective than microneedling-assisted PRP in reducing melasma severity and achieving higher patient satisfaction. Both modalities were safe and well tolerated; however, tranexamic acid plus vitamin C demonstrated superior overall clinical outcomes.

**Keywords:** Melasma; Microneedling; Tranexamic acid; Platelet-rich plasma; Vitamin C; MASI.

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## Introduction

Melasma is a common acquired hyperpigmentary disorder characterized by symmetrical brown macules and patches over sun-exposed areas of the face. It predominantly affects women and individuals with darker skin phototypes, particularly Fitzpatrick skin types III–V. Although benign, melasma can significantly impair quality of life because of its chronic, recurrent nature and cosmetic disfigurement.[1]

The pathogenesis of melasma is multifactorial and involves ultraviolet radiation, hormonal influences, genetic predisposition, oxidative stress, vascular changes, and dermal inflammation.[2-4] Owing to the complex nature of the disease, conventional treatment modalities such as hydroquinone, retinoids, chemical peels, and lasers often provide incomplete improvement and are associated with recurrence.[5]

Tranexamic acid (TXA) has emerged as a promising therapeutic option for melasma. It inhibits the plasminogen–plasmin pathway, thereby reducing melanocyte activation and melanogenesis.[6] Vitamin C acts as an antioxidant and depigmenting agent through inhibition of tyrosinase activity and reduction of oxidative stress.[7] However, the efficacy of topical agents may be limited by poor penetration through the stratum corneum.

Microneedling enhances transdermal drug delivery by creating microchannels in the skin, thereby improving penetration of topical agents while also stimulating dermal remodeling.[8] Previous studies have demonstrated favorable outcomes with microneedling-assisted tranexamic acid in melasma.[9]

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Platelet-rich plasma (PRP), an autologous concentrate of platelets and growth factorsincluding PDGF, TGF-β, VEGF, IGF-1, and EGF, has also been investigated as a treatmentmodality for melasma because of its regenerative, anti-inflammatory, and melanocyte-modulating effects.[10] However, evidence comparing microneedling-assisted TXA plus vitamin C with microneedling-assisted PRP remains limited.

Therefore, the present study was undertaken to compare the efficacy and safety of microneedling-assisted tranexamic acid plus vitamin C versus microneedling-assisted platelet-rich.

## Materials and Methods

This prospective randomized comparative study was conducted in the Department of Dermatology, Venereology and Leprosy of a tertiary care hospital over a period of one year. Sixty patients with clinically diagnosed melasma were enrolled after obtaining written informed consent. Patients aged 18–50 years with untreated or treatment-free melasma for at least four weeks were included in the study. Pregnant and lactating women, patients with active facial infections, bleeding disorders, keloidal tendency, systemic illness, and those receiving treatment for melasma within the preceding four weeks were excluded.

Participants were randomly allocated into two groups of 30 patients each using a computer-generated randomization sequence. Group A received microneedling-assisted tranexamic acid (TXA) and vitamin C(Vit C), while Group B received microneedling-assisted platelet-rich plasma (PRP).

Before each procedure, a topical anesthetic cream containing lignocaine and prilocaine was applied under occlusion for 30–45 minutes. Microneedling was performed using a dermapen fitted with a 36-needle cartridge. Multiple passes were made in horizontal, vertical, and diagonal directions until uniform erythema with pinpoint bleeding was achieved. The technique was based on the principles of percutaneous collagen induction therapy described by Austetal.[8]

In Group A, tranexamic acid and vitamin C were mixed in a 1:1 ratio immediately before application. The preparation consisted of 100 mg tranexamic acid obtained from a 500 mg/5 mL formulation and 250 mg vitamin C obtained from a 500 mg/2 mL formulation. The solution was applied topically over the microneedled skin. The rationale for the use of tranexamic acid and vitamin C in melasma has been describedpreviously.[6,7]

In Group B, autologous PRP was prepared from venous blood by centrifugation at 3500 rpm for 20 minutes and applied immediately following microneedling. The therapeutic role of PRP in pigmentary disorders has been reported in previous studies.[10]

Treatment sessions were performed at 21-day intervals for a total of 3–4 sessions. All participants were advised strict photoprotection and prescribed a broad-spectrum sunscreen (SPF 50+) throughout the study period.

Clinical assessment was performed at baseline and at 4, 8, and 12 weeks. Efficacy was evaluated using the Melasma Area and Severity Index (MASI), a validated scoring system for assessment of melasmaseverity.[11] Physician Global Assessment (PGA), patient satisfaction scores, and standardized clinical photographs were also recorded. Dermoscopic evaluation was performed in selected cases.

Adverse effects including erythema, burning sensation, edema, pain, post-inflammatory hyperpigmentation, and infection were documented during each follow-up visit.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Quantitative variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Intergroup comparisons were performed using the independent t-test and chi-square test. A p-value <0.05 was considered statistically significant.

## Results

[Table 1] Section: Clinico-dermographic Profile of Study Population

A total of 60 patients with melasma were enrolled and completed the study. Thirty patients were allocated to Group A (Microneedling + Tranexamic Acid + Vitamin C) and thirty to Group B (Microneedling + PRP).The majority of patients belonged to the 31–40 years age group in both treatment groups, with no significant difference(p = 0.63) in age distribution.Females constitutedthe majority of the study population, reflecting the known epidemiological pattern of melasma.The distribution was statistically comparable (p > 0.05).

**Table 1: Clinico-dermographic Profile**

| Variables | Group A (n =30)(TXA + VIT C) | Group B (n = 30)(PRP) | Total n (%) |
|---|---|---|---|
| Age(years), Mean ± SD | 36.4 ± 6.2 | 37.1 ± 5.9 | ----- |
| Gender (Female/Male) | 27 (90%)/26 (86.7%) | 3 (10%)/4 (13.3%) | 53 (88.3%)/7 (11.7%) |
| Epidermal Melasma | 12 (40%) | 11 (36.7%) | 23 (38.3%) |
| Dermal Melasma | 6 (20%) | 7 (23.3%) | 13 (21.7%) |
| Mixed | 12 (40%) | 12 (40%) | 24 (40%) |

Both groups showed similar distribution of melasma types, with mixed melasma being most common (40% each). The similarity in baseline classification ensures that disease severity type did not bias outcomes, allowing valid comparison between TXA+Vit C and PRP interventions.

[Table 2]Section:MASI Score Changes Over Time

Baseline MASI scores were statistically similar between the groups. Group A had a mean MASI of 12.8 ± 3.2 while Group B had 13.1 ± 3.5 (p = 0.71). Both groups improved over time, but Group A demonstrated significantly faster and greater MASI reduction at all follow-ups. By week 12, Group A reached 6.2 ± 1.8 versus 8.3 ± 2.3 in Group B (p =

0.001), confirming superior pigment clearance with TXA+Vit C microneedling.

**Table 2: MASI Score Comparison Over Time**

| Time Point | Group A (Mean ± SD) | Group B (Mean ± SD) | p-value |
|---|---|---|---|
| Baseline | 12.8 ± 3.2 | 13.1 ± 3.5 | 0.71 |
| Week 4 | 9.4 ± 2.6 | 11.2 ± 2.9 | 0.01* |
| Week 8 | 7.3 ± 2.1 | 9.4 ± 2.4 | 0.003* |
| Week 12 | 6.2 ± 1.8 | 8.3 ± 2.3 | 0.001* |

[Table 3] SECTION: Percentage Improvement in MASI at Week 12
Significant improvement (>50%) was seen in 66.7% of Group A compared to 36.7% of Group B patients. This demonstrates that TXA+Vitamin C microneedling yields higher clinical response rates and more noticeable pigment reduction than PRP by the study end.

**Table 3: Percentage Improvement in MASI**

| Improvement (%) | Group A n (%) | Group B n (%) |
|---|---|---|
| <25% | 2 (6.7%) | 6 (20%) |
| 25–50% | 8 (26.7%) | 13 (43.3%) |
| 50–75% | 14 (46.7%) | 9 (30%) |
| >75% | 6 (20%) | 2 (6.7%) |

[Table 4] Section: Patient Satisfaction Score (0–10)
Patient satisfaction was significantly higher in Group A at week 12, likely due to faster visible pigment reduction. Group A had a satisfaction score of 8.1 ± 1.2 versus 7.2 ± 1.4 in Group B, highlighting perceived superiority of TXA+Vit C treatment.

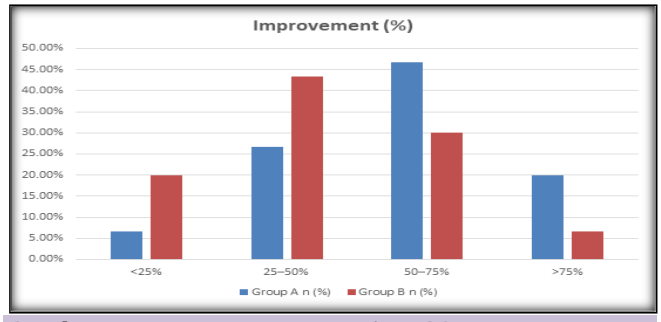
**Table 4: Patient Satisfaction Score**

| Parameter | Group A Mean ± SD | Group B Mean ± SD | p-value |
|---|---|---|---|
| Week 12 Satisfaction Score | 8.1 ± 1.2 | 7.2 ± 1.4 | 0.02* |

[Table 5] Section: Side Effects Profile
Both treatments were well tolerated. Erythema was the most common side effect in both groups. PIH was slightly higher in the PRP group. No severe complications occurred, demonstrating good safety profiles for both modalities.

**Table 5: Adverse Effects**

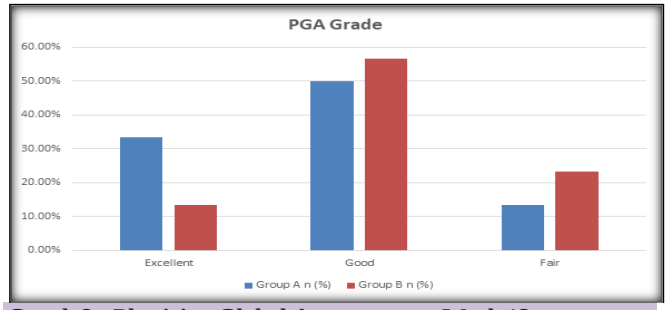
| Side Effect | Group A n (%) | Group B n (%) | p-value |
|---|---|---|---|
| Erythema | 20 (66.7%) | 18 (60%) | 0.57 |
| Burning | 12 (40%) | 8 (26.7%) | 0.27 |
| Edema | 4 (13.3%) | 6 (20%) | 0.49 |
| PIH | 2 (6.7%) | 4 (13.3%) | 0.39 |




**Graph 1: Percentage Improvement in MASI**

Before Left sideAfter Left side Before Right side After Right side

**Image 1-Before and after microneedling with TXA + vit C**




**Graph 2: Physician Global Assessment at Week 12**

**Image 2-Dermoscopic pictures for TXA and vit C**

**Image 3-Before and After picture for microneedling with PRP**

## Discussion

Melasma is a chronic pigmentary disorder with a significant psychosocial impact and remains therapeutically challenging because of its multifactorial pathogenesis and tendency to recur. The present study compared the efficacy and safety of microneedling-assisted tranexamic acid (TXA) plus vitamin C with microneedling-assisted platelet-rich plasma (PRP) in patients with melasma.

In the present study, females constituted the majority of patients and most participants belonged to the third and fourth decades of life. These findings are consistent with previous studies by Handel et al,[2] and Sarkar et al,[5] which reported a higher prevalence of melasma among women of reproductive age. Mixed melasma was the most common clinical subtype observed, a finding comparable to that reported in Indian studies evaluating melasmapatterns.[5]

Both treatment groups demonstrated a progressive reduction in MASI scores during the study period. However, microneedling-assisted TXA plus vitamin C produced a significantly greater reduction in MASI scores compared with microneedling-assisted PRP at 12 weeks. Furthermore, a greater proportion of patients in Group A achieved more than 50% improvement in MASI scores, indicating superior clinical efficacy.

The beneficial effect of TXA in melasma can be attributed to inhibition of the plasminogen-plasmin pathway, resulting in reduced melanocyte activation, decreased inflammatory mediators, and suppression of melanogenesis.[6]

Vitamin C acts synergistically by inhibiting tyrosinase activity and reducing oxidative stress, thereby enhancing depigmenting effects.[7] Microneedling further improves treatment efficacy by facilitating transdermal delivery of topical agents through the formation of epidermal microchannels while simultaneously stimulating dermal remodeling.[8]

Our findings are in agreement with those of Budamakuntlaetal,[9] who reported significant improvement in melasma following microneedling-assisted tranexamic acid therapy. Similarly, Karnet al.[10] demonstrated a substantial reduction in MASI scores with intradermal TXA, highlighting its effectiveness as a therapeutic option for melasma. The superior outcomes observed in the present study further support the role of TXA-based therapies in targeting multiple pathogenic pathways involved inmelasma.

Although PRP also resulted in clinical improvement, the response was less pronounced compared with the TXA-vitamin C combination. PRP contains several growth factors, including platelet-derived growth factor, transforming growth factor-β, and epidermal growth factor, which contribute to tissue regeneration and dermal remodeling.[11] The beneficial effects of PRP in melasma have been reported by Elfar and colleagues, who observed improvement in pigmentation following PRP therapy.[12] However, the magnitude of improvement reported in PRP-based studies has generally been variable, possibly because PRP primarily exerts indirect effects on melanogenesis.

Patient satisfaction scores in the present study also favored Group A. These observations are clinically important because visible improvement is often associated with better treatment adherence and patient confidence. Similar findings have been reportedin previous studies evaluating TXA-based interventions in melasma.[9,10]

Both treatment modalities were well tolerated. The adverse effects observed were mild and transient, with erythema being the most common reaction. No serious adverse events were encountered. These findings are consistent with earlier studies that have demonstrated the safety of microneedling-assisted therapies in patients with melasma.[9,12]

The present study has certain limitations. The sample size was relatively small, the study was conducted at a single center, and the follow-up period was limited to 12 weeks. Therefore, long-term efficacy and recurrencerates could not be evaluated. Further multicentric studies with larger sample sizes and longer follow-up periods are required to validate these findings.

Overall, the results of the present study suggest that both microneedling-assisted TXA plus vitamin C and microneedling-assisted PRP are effective treatment modalities for melasma. However, the TXA-vitamin C combination demonstrated superior clinical improvement, higher patient satisfaction, and better physician-rated outcomes, indicating its potential as a more effective therapeutic option in the management of melasma.

## Conclusion

Both microneedling-assisted tranexamic acid plus vitamin C andmicroneedling-assisted platelet-rich plasma were effective and safe treatment modalities for melasma. However, microneedling-assisted tranexamic acid plus vitamin C demonstrated superior clinical efficacy, with greater reduction in disease severity, higher patient satisfaction. The enhanced response may be attributed to the combined effects oftranexamic acid mediated inhibition of melanogenesis, the antioxidant action of vitamin C, and improved transdermal delivery achieved through microneedling. Both treatments were well tolerated with minimal adverse effects. These findings suggest that microneedling-assisted tranexamic acid plus vitamin C may be considered a more effective minimally invasive therapeutic option for the management of melasma, particularly in patients with darker skinphototypes.

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### Conflicts of interest

There are no conflicts of interest.

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