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Original Article

Microneedling with topical ascorbic acid in the treatment of melasma

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Abstract

Objective To assess the outcome of microneedling with topical ascorbic acid (Vitamin C) in the treatment of melasma.

Methods In this non- randomized, pre-post interventional study,60 females with age range of 20 -45 years, fulfilling the inclusion and exclusion criteria, were enrolled. The study was carried out in the department of Dermatology, Mayo Hospital/ King Edward Medical University, during the six month period from 21/09/2021 to 20/03/2022. Topical application of 20% ascorbic acid aqueous solution was done on affected area after microneedling with dermaroller. Patients were instructed to follow strict photo-protective measures. Follow-up was done every 2 weeks for a total of six sessions and then follow up visit, after 1 month of last session. SPSS 23 was used for analysing data.

Results Mean age of the patients was 33.5±4.3 years. Mean duration of melasma was 2.9±1.1 years. Percentage reduction in mMASI score observed was 38.3±8.2, with means of pre-treatment and post-treatment mMASI score of 13.17±1.09 and 8.10±1.11, respectively, (p-value=0.004). Melasma types were as follows: Epidermal 42 (70%), dermal 4 (6.7%) and mixed 14 (23.3%).Out of 60 women, 7 patients (11.7%) were having Fitzpatrick skin type III and 53 patients (88.3%) were having type IV.

Conclusion In conclusion, microneedling with topical vitamin C is an effective treatment option for melasma in Fitzpatrick skin phototypes III-IV. It is a safe treatment modality with minimal and transient side effects.

Key words
Melasma; Microneedling; Topical ascorbic acid.

Introduction

Melasma is a pigmentary condition that typically affects the face. It is mostly attributed to hormonal factors and ultraviolet (UV) exposure.[1] Melasma is typically diagnosed clinically by symmetric, well delineated hypermelanosis in the mandibular, malar, and centro-facial patterns. The forehead, nose, and upper lip are affected in 50-80% of instances, whereas the philtrum, cheeks, and chin are spared. All skin types can experience it, while it is known to afflict darker skin types (Fitzpatrick types III–V) more frequently.[2] Melasma prevalence ranges from 1.5% to 33.3% depending on the ethnic group.[1]

The pathogenesis of melasma is complicated by a number of factors, including genetic susceptibility, hormonal impacts, pregnancy, UV radiation, thyroid disorders, and medications including oral contraceptives and phenytoin.[3] Melasma significantly lowers patients' sense of

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self-worth and quality of life.[4]

In the past, melasma was classified as epidermal, dermal, or mixed depending on where the melanosomes were found. Modern imaging techniques, however, have demonstrated that the distribution of melanophages is heterogeneous, indicating that every melasma is "mixed" with the dermis frequently displaying solar elastosis and increased vascularity as well. Therefore, it is now thought that melasma is the result of a complicated interplay involving keratinocytes, dermal fibroblasts, epidermal melanocytes, and vascular endothelial cells. This process is influenced by hormones, genetics, and UV exposure, as well as by its diversity, dynamic nature, and resistance.[5,6]

Many treatment options are available for melasma such as chemical peeling, light-based therapies (laser or intense pulse light), and topical agents, which are more effective in the epidermal type of melasma. Topical agents include hydroquinone, azelaic acid, kojic acid, retinoids, fluocinolone acetonide in combination with tretinoin and hydroquinone, vitamin C (ascorbic acid), alpha-tocopheryl ferulate, flavonoids, niacinamide, licquorice derivatives, and n-acetyl-4-S-cysteaminylphenol, however, there is no universally effective therapy for this disease.[2,5,6.] One of the new topical agents is vitamin C which decreases oxidation of dopaquinone and 5,6-dihydroxyindole-2-carboxylic acid, inhibits tyrosinase activity, reduces dermal damage, promotes collagen synthesis and has antioxidant and photoprotective effects, thus decreasing hyperpigmentation.[6]

A recent minimally invasive approach of drug delivery to the skin is microneedling technology. The micro-wounds induced by microneedling stimulates the release of growth factors and promotes collagen production, leaving epidermis relatively intact and undamaged, thus, limiting adverse events. Microneedling offers a valuable safety profile, as it stimulates fibroblast and upper dermal collagen synthesis. Thus, it can restore upper dermal collagen and basement membrane. This reduces contact between epidermal melanocytes and dermal-released growth factors like endothelin, stem cell factor and hepatocyte factor, thereby decreasing the melanogenic stimuli.[7]

A few clinical trials have reported efficacy and safety of microneedling combined with topical vitamin C in treatment of melasma. Ismail *et al*. enrolled 30 females having epidermal melasma who underwent six sessions of microneedling with vitamin C 20%, each 2 weeks apart and reported a reduction in mean MASI score from baseline of 8.61±4.45 to 5.75±4.16 after last session with a p-value of < 0.0001.[8] Goel B, in a clinical trial including 30 females, using microneedling as an adjunct to vitamin C therapy reported a 37% reduction in mean MASI score of 8.33±4.52 from baseline to 5.20±3.93 after last session.[9] However, in a study published by Menon A *et al*., topical vitamin C 20% with microneedling showed a reduction in mean MASI score from 8.6±1.42 at baseline to 7.83±1.46. However, the p-value in this case was >0.05.[1] Unfortunately, very little data is available in Pakistan regarding the efficacy and safety of topical ascorbate with adjunctive microneedling.

The rationale of this study is to assess the outcome of topical application of 20% aqueous solution of ascorbic acid along with microneedling in reducing the hyperpigmentation associated with melasma, by calculating the mean reduction in mMASI score. It is a relatively new therapy that has shown promising results in international studies, is operationally convenient and is well tolerated by the patients.

Methods

The present study was a non-randomized, pre-post interventional study carried out in the Department of Dermatology unit II, Mayo Hospital, Lahore from 21-09-2021 to 20-03-2022. After approval from hospital ethical committee, 60 female patients of age 20-45 years with clinical diagnosis of melasma (all types epidermal, dermal, mixed), with mMASI score ≥5, regardless of marital status or disease duration were included in the study. Pregnant, lactating females precluded from the study. Patients with a history of any other depigmenting treatment in the past 3 months and/ or on Hormone Replacement Therapy (HRT) or oral contraceptives were omitted too. Patients with a history of bleeding disorder, keloid formation, active infection at melasma site, known allergy to vitamin C, medical illness (renal, hepatic or endocrine disorders) and patients with acute flare of facial acne were also not enrolled.

Demographic data including age at admission, marital status, number of pregnancies, occupation (indoor/ outdoor), predisposing factors (daily duration of sun exposure, pregnancy, use of oral contraceptive pills), family history of melasma, duration of melasma in years, type of melasma and Fitzpatrick skin type were collected. The patients were then assessed and their affected areas were noted, Wood's lamp examination was done and photographs were taken at enrolment and final session; modified Melasma Area and Severity Index (mMASI) score calculation was done at enrolment and at each visit, every 2 weeks, for a total of six sessions and then at follow up visit, after 1 month of last session.

In each treatment session the patient's affected skin was wiped clean with alcohol swab and topical anesthetic cream (EMLA®- lidocaine 2.5%, prilocaine 2.5%) was applied for 30 minutes followed by microneedling with a dermaroller (in horizontal, vertical and diagonal direction) on a stretched skin until mild erythema was noted and icepack was applied. Topical application of 20% ascorbic acid was done on affected area thereafter. Patients were instructed to follow strict photo-protective measures, subsequently: avoidance of sun exposure and use of sunscreen with sun protection factor (SPF) 50. The procedure and data collection on a predesigned proforma. Outcome was measured by percentage reduction in mMASI score from the patient's own baseline values using the following formula:

(Patient`s mMASI score at baseline – Patient`s mMASI score after completion of therapy) X100/Patient`s mMASI score at baseline

mMASI is a reliable and validated index used to quantify the severity of melasma and changes observed during therapy. According to the mMASI score, the face is divided into four areas: the forehead, the right malar, the left malar, and the chin, which correspond to 30, 30, 30, and 10% of the total face area, respectively. The melasma in each of these areas is graded on two variables: percentage of total area involved, on a scale of 0 (no involvement) to 6 (90%-100% involvement) and darkness, on a scale of 0 (absent) to 4 (severe). The mMASI score ranges from 0-24 and is calculated using the following equation:

mMASI = 0.3 (DF) AF + 0.3 (DMR) AMR + 0.3 (DML) AML + 0.1 (DC) AC

Where D is darkness, A is area, F is forehead, MR is right malar, ML is left malar, C is chin, and the values 0.3, 0.3, 0.3, and 0.1 are the percentages of the respective facial areas.

Data were analyzed using Statistical Program for

Table 1 Demographic and clinical characteristics of the patients.

Personal and clinical data	*No. of patients*
Age (years)	
20-30	15 (25%)
31-45	45 (75%)
Mean±SD	33.5±4.3
Duration of melasma (years)	
1-2	21 (35%)
3-5	39 (65%)
mean±SD	2.9±1.1
Occupation	
Indoor	47 (78.3%)
Outdoor	13 (21.7%)
Marital status	
Married	56 (93.3%)
Unmarried	4 (6.7%)
Melasma type	
Epidermal	42 (70%)
Dermal	4 (6.7%)
Mixed	14 (23.3%)
Fitzpatrick skin type	
II	7 (11.7%)
III-IV	53 (88.3%)

Table 2 Percentage reduction in mMASI score

Reduction	*Number*
≤ 30	9 (15.0%)
≥ 30.1	51 (85.0%)
Total	60 (100%)
Mean ± SD	38.3 ± 8.2

Table 3 Pre-treatment vs. post-treatment mMASI score.

mMASI score	*Mean*	*S.D*	*P value*
Pre-treatment	13.17	1.09	P=0.004
Post-treatment	8.10	1.11	

Social Science (SPSS Inc., Chicago, IL, USA) version 23.0. Mean±SD was calculated for continuous variables including age, mMASI score (baseline and after treatment), reduction in MASI score and melasma duration. Frequency and percentages were calculated for categorical variables including percentage reduction, occupation, Fitzpatrick skin type, melasma type. Data were stratified according to age, melasma types, duration, Fitzpatrick skin type, marital status, parity and occupation. Post-stratification analysis was performed to look for effect on mMASI score reduction. Student's t-test and chi-square tests were used to test for significance pertaining to numerical and categorical variables, respectively. A p-value of ≤0.05 was considered significant.

Results

In this study, mean age of the patients was 33.5±4.3 years. Mean duration of melasma was 2.9±1.1 years. The majority of females belonged to indoor occupation. Married women were 56 (93.3%) while unmarried were 4 (6.7%). Melasma types were as follows: Epidermal 42 (70%), dermal 4 (6.7%) and mixed 14 (23.3%).Out of 60 women, 7 patients (11.7%) were having Fitzpatrick skin type III and 53 patients (88.3%) were having type IV **(Table 1)**. Percentage reduction in mMASI score observed was 38.3±8.2 **(Table 2)**. Pre-treatment mean mMASI score was 13.17±1.09 and post-treatment 8.1.0±1.11, with a significant reduction (p-value=0.004) **(Table 3)**. Stratification for age, melasma type, melasma duration, marital status, Fitzpatrick skin type, parity and occupation was also carried out which, however, failed to show any significant association with reduction in mMASI score. No serious adverse effects were noted except pain and post procedure transient erythema.

Table 4 Stratification for melasma type with regard to percentage reduction of mMASI score.

Melasma Type	*Percentage Reduction in mMASI Score*		*Total*	*Chi Square/P value*
	≤ 30%	≥ 30.1%		
Epidermal	8(19%)	34(81%)	42(100%)	X^2=3.324
Dermal	1(25%)	3(75%)	4(100%)	P=0.190
Mixed	_	14(100%)	14(100%)	
Total	9	51	60	

Discussion

Melasma has a substantial emotional and psychosocial impact on patients. The effect on patients' quality of life is under reported despite it being so prevalent in our population. Its treatment is difficult and often prolonged to maintain the initial response.[9,10]

Our study included sixty females with melasma. They received six sessions of microneedling with ascorbic acid (vitamin C). The majority of cases were of Fitzpatrick skin type III and IV and this was consistent with Susruthi Rajanala *et al.* study.[5]

In the current study reduction of mMASI score was 38.3% which is comparable with a study carried out by Goel (2020).[9] Our results were comparable to a previous study by Menon *et al.* (2019) that compared tranexamic acid with microneedling versus ascorbic acid with microneedling in patients with melasma.[1]

In our study pre-treatment mMASI score was 13.17±1.09 and post-treatment 8.10±1.11, the difference between pre and post-treatment was found to be statistically significant (p=0.004). Yasmina *et al.* (2021) also found vitamin C after microneedling efficacious in melasma similar to our study.[12]

Ismail *et al.* reported mean MASI score in the first session as 8.61±4.45 and there was a gradual decrease in its value till it reached a mean of 5.75±4.16 in the last session (P<0.0001).[8]

In a split face comparative study by Raza *et al.* (2022), using microneedling with vitamin C serum versus tranexamic acid showed a significant improvement in pigmentation with both. Furthermore, use of either solution produced good results while the difference between the two was not clinically significant (P>0.05).[13]

Amal *et al.* in 2022 conduct a split face comparative study evaluating vitamin C versus PRP (platelet rich plasma) with microneedling and found that vitamin C was more efficient in treating mixed melasma than with PRP.[14]

Furthermore, the results of the current study were comparable to those of Tahoun AI *et al.* who used microneedling to enhance the penetration of a vitamin C in the treatment of melasma.[15] In the present study the percentage of improvement of MASI score was not related to patient marital status, melasma type, melasma duration, and Fitzpatrick skin type.

The limitation of study was a small sample size and further studies with a larger sample size and longer follow up are suggested.

Conclusion

In conclusion, microneedling with topical vitamin C is an effective treatment option for melasma in Fitzpatrick skin phototypes III-IV. It is a safe treatment modality with minimal and transient side effects.

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