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COMPARISION OF MICRONEEDLING AND MESONEEDLING FOR THE EVALUATION OF MELASMA IN ADULTS

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Abstract

Background: Melasma is a common acquired hyperpigmentation disorder characterized by symmetrical brown to gray-brown patches, predominantly affecting sun-exposed areas of the face in adults. It is more prevalent among women and individuals with darker skin types and is influenced by factors such as ultraviolet exposure, hormonal changes, and genetic predisposition. Although benign, melasma has a chronic and recurrent course and can significantly impact psychological well-being and quality of life, making effective and safe management a persistent clinical challenge.

Objective: The objective of this study was to evaluate microneedling and mesoneedling for the management of melasma in adults.

Methods: This randomized control trial was conducted in Lahore at the Chaudhry Muhammad Akram Teaching and Research Hospital over a duration of four months after approval of the synopsis. A total sample size of 46 participants (23 in each group after adding 20% dropout) were recruited using purposive sampling technique. Adults aged 18–50 years of both genders with Fitzpatrick skin types III–V and clinically diagnosed epidermal melasma confirmed by Wood's lamp

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examination were included, while pregnant or lactating females, patients on hormonal therapy, those with active infection, systemic illness, recent depigmenting treatment, or known allergies will be excluded. After screening and written informed consent, participants were randomly allocated into Group A (microneedling) and Group B (mesoneedling) using lottery technique. Each group received one session per month for four months. Prior to each session, topical anesthesia (2.5% lidocaine and 2.5% prilocaine) was applied, and a 1.5 mm automated microneedling device was used. Group A received microneedling alone, while Group B received mesoneedling with a depigmenting solution containing tranexamic acid, N-acetyl glucosamine, vitamin C, and idebenone. All participants were advised to use broad-spectrum sunscreen (SPF ≥ 50). Outcome measures including modified Melasma Area and Severity Index (mMASI) and Investigator's Global Assessment (IGA) were assessed at baseline and after four months. Data analysis was performed using IBM SPSS version 26, with appropriate parametric or non-parametric tests applied, and p value < 0.05 considered statistically significant.

Results: Shapiro-wilk test showed that most variables were non-normally distributed except mMASI. A total of 38 participants (mean age 30.12 ± 3.36 years; 68.4% females) were included with comparable demographics. Baseline mMASI was slightly higher in Group B (p = 0.027), while IGA was similar (p = 0.334). Post-intervention, both groups improved, but Group B showed significantly greater reduction in mMASI and better IGA outcomes (p = 0.001), with 100% participants almost clear. Within-group analysis also showed significant improvements in both mMASI and IGA (p = 0.001), indicating superior effectiveness in Group B.

Conclusion: Microneedling and mesoneedling are both effective, safe, and minimally invasive treatments for melasma, showing significant clinical improvement. However, mesoneedling demonstrated superior outcomes, likely due to enhanced transdermal delivery of depigmenting agents along with dermal remodeling. Both methods are cost-effective and clinically practical, with mesoneedling offering greater overall benefit.

CHAPTER 1
INTRODUCTION

Human melanogenesis malfunction, or melasma, causes skin hypermelanosis that is localized and chronic. It primarily affects women in menacme and appears symmetrically on body parts exposed to the sun. (1) Melasma alludes to its brownish clinical appearance and comes from the Greek word "melas," which meaning black. Although the term "chloasma" (derived from the Latin chérios and the Greek cloazein: greenish) is still used in the medical literature, the terms "mask of pregnancy," liver spots, uterine chloasma, chloasma gravidarum, as well as chloasma virginum do not either fully characterize the disease or are semantically appropriate (1-4).

The medical literature contains accounts of diseases dating back to Hippocrates' (470–360 BC) writings. The phrase was used to describe a number of cutaneous melanization events, and it was noted that sun exposure, fire heat, cold, and skin inflammations could exacerbate the condition.

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Many years later, Joseph Plenck named seven types of melasma the Ephelis (from the Greek: little patch) in his book "Doctrine of Morbis cutaneis": solaris, ignealis, vesticario, gravidarum, hepatica, dismenorrhoealis, and haemorrhoidalis (5).

One common dyschromia that frequently prompts people to seek dermatological therapy is melasma. Skin phototype, sun exposure intensity, and ethnic mix all affect its population prevalence.

A population-based study conducted in 2010 surveyed 1500 adults from several states in Brazil. twenty-four percent of men and twenty-nine percent of women stated that pigmentation issues were the primary reason they sought dermatological care (6).

Melanodermias, including melasma, constituted the third largest group of disorders in dermatological practice, making up more than eight percent of all complaints, according to a 2006 survey of 57,343 diagnoses made at dermatological consultations in Brazil by the Brazilian Society of Dermatology (BSD). In the various parts of the nation, this prevalence ranged from 5.9% to 9.1% (7).

Melasma is known to affect people of all racial and ethnic backgrounds. However, individuals with darker pigmented phenotypes, such as East Asians (Japanese, Korean, and Chinese), Indians, Pakistanis, Middle Easterners, and Mediterranean-Africans, have higher prevalence, according to epidemiological studies. It is prevalent in the Americas among Brazilians and Hispanic Americans who reside in intertropical regions where ultraviolet radiation (UVR) exposure is higher (8-10).

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In certain communities, up to 30% of pregnant women suffer from this hyperpigmentary condition. The clinical pattern is defined by symmetrical disposition, asymmetrical boundaries, and asymptomatic light to dark brown hyperpigmentation. One of the characteristics of this ailment is an almost continual deterioration of the condition during the summer. According to Wood's lamp examination, melasma was classified into three categories: epidermal, dermal, or mixed in early research. Studies employing laser confocal microscopy have revealed that all melasma are mixed, indicating a common pathophysiology, even though Wood's lamp examination is still helpful in determining whether the majority of the pigmentation is in the dermis or the epidermis (and thus should respond better to topical depigmenting agents) (11).

Although the precise causes of melasma are unknown, a number of triggering factors have been identified, including sun exposure, pregnancy, the use of oral contraceptives and other steroids, the consumption of specific foods, ovarian tumors, intestinal parasites, hepatopathies, hormone replacement therapy, the use of cosmetics and photosensitizing medications, procedures and skin inflammatory processes, and stressful events. This implies that melasma formation is impacted by a variety of causes and is dependent on the combination of hormonal and environmental factors with a genetic substrate that is vulnerable (1, 12-14).

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Melasma pigmentation typically becomes better in the winter and gets worse in the summer (or right after prolonged exposure to the sun). Furthermore, its population incidence is higher in intertropical areas. (15, 16) Using high-protection-factor sunscreen decreases the disease's intensity by 50% and its occurrence during pregnancy by over 90% (17, 18).

Melanogenesis is primarily induced by UVA and UVB light. The melanogenic potential of visible light and infrared radiation is much lower. It's unclear how it contributes to the onset and maintenance of melasma. However, the authors found that professionals exposed to intense light, such as dentists, and overnight workers subjected to oven heat, such as bakers, reported worsening their melasma after being exposed to their respective working conditions (19, 20).

Brownish macules with uneven shapes and distinct boundaries are the hallmark of melasma. It manifests in sun-exposed areas, particularly the face and cervical region; the arms and sternal region are less frequently affected. Centrofacial and peripheral are the two forms of facial melasma lesions based on their clinical distribution. The glabellar, frontal, nasal, zygomatic, upper lip, and chin regions of the face are where lesions are most common in the centrofacial form. The preauricular, mandibular, and fronto-temporal branch areas are impacted in the peripheral kind (12).

A novel treatment called microneedling therapy, sometimes referred to as percutaneous collagen induction therapy, uses mechanical or physical techniques to promote the development of collagen tissue in the skin. This treatment promotes collagen regeneration by making micropunctures on the skin using a device that has numerous tiny needles. This method maintains the integrity of the epidermis and significantly enhances the percutaneous absorption of therapeutic medications, yielding favorable clinical outcomes (21). Orentreich et al. created microneedle therapy, originally referred to as "incision," for the treatment of wrinkles and scars.

However, it is not suitable for treating small body parts or for substantial facial rejuvenation (22).

The study aims that melasma affects adults, particularly women posing a significant psychological, cosmetic and quality of life concerns. The findings of this study will benefit patients as it will identify an effective minimally invasive option that will improve their skin appearance and on turn promote psychological well-being. Health-care professionals will also be benefited as they will be able to make and rely their clinical-decision making on an evidence-based, cost-effective intervention in turn optimizing treatment protocols and reducing the burden of recurrent melasma.

CHAPTER 2
LITERATURE REVIEW

Fatima et. al. in 2025 evaulated the efficacy of topical Tranexamic Acid (TA) administered by microneedling against intradermal TA by mesotherapy in the treatment of melasma. One hundred patients were split into two equal groups for this prospective comparison study. Group B received the same concentration of TA via microneedling utilizing the Dr. PEN A6 device, while Group A received intradermal injections of TA (100 mg/mL). Three treatments were administered to each group at intervals of two weeks. The Melasma Area and Severity Index (MASI) along with standardized clinical photography were used to evaluate the results at Weeks 4, 8, 12, 16, and 20.

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Repeated ANOVA measurements were used for statistical analysis. The average age was thirty-seven years. At Week 4, Group B's MASI scores improved more than Group A's, decreasing by 32.5% as opposed to 18.4%. At Weeks 12, 16, and 20, Group B continuously shown statistically significant improvement, and by Week 8, there was a strong trend. There were no documented adverse events. In conclusion, TA is a successful melasma treatment. Its effectiveness is significantly increased by microneedling, which reduces pigmentation more quickly and with fewer adverse effects (23).

Mohamed et. al. in 2023 compared the efficacy of microneedling alone versus microneedling with glutathione for the treatment of melasma. Twenty-nine females with epidermal type melasma participated in this study (verified by Wood's light examination) were registered. Dermapen was used to microneedle the afflicted area, and then only the right side was treated with glutathione solution. For three months, this program was conducted every two weeks (each patient receives six sessions). The therapeutic response was assessed using modified the melasma area and severity index (m MASI) was computed on both sides of the face (Hemi-m MASI) before to therapy. The results showed that both sides of the face showed a statistically significant decrease in the mean Hemi-m MASI score over the course of the sessions; however, the right side (microneedling plus glutathione) had a greater reduction and a sooner response to the therapy than the left side (microneedling alone). The Hemi-m MASI score was statistically significant on the left side and on the right side. There was a statistically significant difference between the percent of progress on the left side and the percentage on the right side. Overall, combining microneedling with glutathione, a whitening agent, boosts and expedites the effectiveness of this promising treatment for melasma. Therefore, while treating facial melasma, combination therapy is favored than monotherapy (24).

Elhoshy et. al. did a randomized control trial in 2022 with the aim to figure out whether microneedling is safe and effective for treating localized acquired hypomelanosis. The lesions of twenty patients who were at least eighteen years old were randomly assigned to receive either no therapy or one treatment session of microneedling using 1.5-mm needles. Peripheral tanning, patient satisfaction, vitiligo extent score for a target area (VESTA), surface tanning grade of improvement, and participant and physician global assessment of improvement (GAI) were all assessed three months later. Eighty percent of lesions in the microneedling arm and eighty-five percent in the no-treatment arm had median peripheral tanning. In contrast, the median physician GAI was 33.33% and 37.5%. The median VESTA was 37.5% as opposed to 29%. Fifty percent was the median patient GAI in both arms. Both arms showed a median improvement of +3 grades after surface tanning. Overall, for localized developed hypomelanosis in normal-texture and scarred skin, medium-depth microneedling is a useful therapeutic method. To get increased coverage, the authors recommend repeating sessions every one to two months. Interestingly, more research is need to determine whether microneedling has a systemic effect (25).

Farshi et. al. did a pilot trial in 2020 with the objective to compare the effectiveness of normal microneedling with meso-depigmentation solution microneedling over a 4-month treatment period. Twenty participants underwent mesoneedling on one side of their faces and microneedling on the other as part of this pilot trial. For four months, the treatment was repeated once a month.

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Dermacatch® colorimetry, the modified Melasma Area and Severity (mMASI) score calculation, the Investigator's Global Assessment (IGA), and patient questionnaires were used to determine therapy efficacy. All evaluations were carried out at baseline and after two and four months of treatment. The results showed that the average difference between colored and normal skin, as determined by Dermacatch®, was 43.7 ± 20.12 for microneedling sides and 44.6 ± 20.72 for mesoneedling sides prior to treatments. These values decreased to 34.5 ± 16.26 and 28.05 ± 13.79 on the microneedling side and 29.75 ± 15.07 and 20.45 ± 10.58 on the mesoneedling side after two and four sessions. At both time points, there were statistically significant differences between the microneedling and mesoneedling treatments (P =.0001, P =.0001). Both the microneedling and mesoneedling sides had significantly reduced mMASI scores after treatment. Both therapies were successful in treating melasma without causing any significant side effects or problems, according to the IGA and the patients' self-assessment scores. Overall, melanin concentration in epidermal melasma lesions can be reduced with both microneedling and mesoneedling (26).

Bailey et al. (2022) carried out a systematic review to estimate the efficacy of microneedling as a topical therapy adjunct in melasma treatment. The review involved examination of twelve clinical studies that contained over 450 subjects across nations. The findings indicated that microneedling had a significant positive effect on penetration and efficacy of topical depigmenting agents, and thus a higher reduction in Melasma Area and Severity Index (MASI) scores was achieved in comparison to the topical therapy itself. The authors came to the conclusion that microneedling is an open treatment modality treatment with a positive safety profile when combined with topical agents (27).

A clinical study by Pazyar et al. (2023) that was conducted recently, assessed the efficacy of microneedling with tranexamic acid versus those who underwent microneedling with vitamin C in patients with melasma. This is a potential single-blind clinical trial that showed that there were significant changes in the MASI scores of the two treatment groups that were improved following several treatment sessions. But the group using tranexamic acid had a slight tendency of improvement in pigmentation reduction. The study pointed out that microneedling is a good method of drug delivery system, which enhances penetration of active depigmenting agents into skin layers (28).

A clinical trial study done in Pakistan by Gul et al. (2023) examined the effectiveness of topical ascorbic acid with microneedling in the treatment of melasma. The participants in the study were sixty female participants having Fitzpatrick skin type III and IV. Respondents had the microneedling processes and vitamin C solution of 20 percent applied. The outcomes showed that modified MASI scores significantly decreased during the treatment, which proves that both microneedling and topical vitamin C could be successfully used to enhance pigmentation and the general look of the skin (29).

Feng et al. (2024) conducted a systematic review and meta-analysis to determine the efficacy and safety of the treatment of melasma using microneedling with topical tranexamic acid. Tranexamic acid is also another depigmenting agent that has been extensively researched in the treatment of melasma. These trials involved randomized controlled trials and comparative clinical studies. The

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results showed that a combination therapy had much higher pigmentation improvement than traditional treatment. Moreover, the procedure proved with the least side effects, which is why it is a safe and effective method of melasma treatment (30).

In a recent study by Hasan et al. (2024), mesotherapy methods have been considered for treatment. Researchers compared the therapeutic effectiveness of microneedling-assisted mesotherapy with ascorbic acid and tranexamic acid in the management of melasma in this comparative clinical study. The research showed that the two treatment modalities led to a tremendous pigmentation and patient satisfaction. Nonetheless, the mesotherapy of tranexamic acid demonstrated a little bit of better results in decreasing the melanin deposits and the overall skin color. The authors have highlighted that mesotherapy enables the depigmenting agents to be administered specifically in the dermis and thus enhances the treatment outcomes (31).

A randomized controlled trial by Al-Mohammady et al. (2025) compared the use of microneedling to deliver metformin and tranexamic acid in treating melasma. The outcomes disclosed that both the treatments had a significant positive effect on the scores of MASI and pigmentation degree after several sessions. Nevertheless, tranexamic acid showed a little better clinical result as compared with metformin. The authors concluded that microneedling-assisted drug delivery is a promising approach to the management of melasma (32).

A recent randomized clinical trial by dos Santos et al. (2025) evaluated the effect of microneedling with 2% kojic acid serum on patients with melasma. The researchers discovered that dermaroller-based and dermapen-based forms of microneedling enhanced the quality-of-life measures and reduced melasma severity among the participants significantly. Even though there were some minor side effects including erythema and mild discomfort, the treatment was widely tolerated. The authors found that microneedling with kojic acid may be regarded as one of the safe and effective treatment methods to reduce the pigmentation and enhance skin image in patients with melasma (33).

In a prospective split-face clinical trial conducted by dos Anjos et al. (2025), the relative efficacy of azelaic acid peeling versus microneedling with tranexamic acid in the treatment of melasma among patients was compared. Microneedling was used in this study on one side of the face using tranexamic acid, 4 mg/mL, whereas on the other side of the face 30% azelaic acid peeling was used. This was done in five treatment sessions with a treatment interval of 15 days between sessions. The outcomes of treatment were evaluated by the recording of photographs and Melasma Area and Severity Index (MASI). The results revealed a significant change in pigmentation on both sides of the face which means that both modes of treatment were effective to eliminate severity of melasma. Nevertheless, azelaic acid peeling was clinically improved earlier especially following the fourth treatment session, indicating its expedient depigmenting effect over microneedling with tranexamic acid. The study suggested that the research should be followed by other studies employing more randomized samples to confirm these results (34).

An interventional comparison study was carried out at the Shifa International Hospital by A. Batool et al. (2025) comparing the use of microneedling along with tranexamic acid and vitamin C to the 15% trichloroacetic acid chemical peeling with respect to its efficacy and safety in the prevention of

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melasma in patients having moderate to severe melasma. The participants were 120 in number and were separated into two equal groups in the study. The results of the treatment were measured based on the Melasma Area and Severity Index (MASI) and physician and patient global assessments after 12 weeks. There was a substantial improvement in pigmentation in both of the treatment groups, but the microneedling group had more significant reduction in the scores of MASI and higher scores in rates of clinical improvement over the TCA peeling group. There were also cases of adverse effects, including temporary redness, which dominated in patients who were getting TCA peels. It was indicated (in the findings) that microneedling, when used with tranexamic acid and vitamin C, might offer increased pigment removal, increased satisfaction in patients, and reduced side effects, which would make it a safer, more effective procedure to manage melasma (35).

In a recent systematic review by Nobari et al. (2023), the effectiveness of micro-needling and meso-needling methods was compared to ablative fractional lasers of carbon dioxide and erbium-YAG was evaluated on the management of atrophic and hypertrophic scars. Ten studies that fulfilled the inclusion criteria were included in the review comprising of different study designs including randomized split-face trials, controlled nonrandomized trials, controlled randomized phase three clinical trials, prospective trials, and randomized comparative trials with three studies not specifying the design. The Endnote X8 was used to extract and organize the data. In the reviewed articles, micro-needling and meso-needling had similar clinical effects with most of the studies demonstrating no statistically significant difference between the two interventions. Both needling methods showed significant changes in scar appearance with seventy percent improvement to full response and few studies showed statistically significant benefits of either laser or needling. All in all, the evidence shows that micro-needling and meso-needling are effective, well-tolerated and safe methods to laser therapy as an option in managing scar (36).

A research conducted by Agnieszka (2025) aimed at comparing the efficacy of needle based and microneedle based mesotherapy in treating aging skin on the face. The ageing skin is normally characterized by the loss of skin firmness and elasticity, wrinkling, and different pigment alterations. Twenty female participants aged thirty-five to sixty years participated in the study and the split-face design was used, where one side of the face was treated to needle mesotherapy and the other one to microneedle mesotherapy. All the subjects were given four sessions of treatment with a mixture of hyaluronic acid fragments, glutathione, stabilized vitamin C and amino acid complex. Measurements were taken on skin parameters, hydration, pH, sebum level, erythema and pigmentation, and photographed, as well as self-evaluation by the participants and pain rating. The findings of the results revealed that both methods resulted in substantial changes in the overall skin condition in a positive way. Microneedle mesotherapy proved to be more effective in hydration, sebum and pH regulation and was equally better in pain tolerance as compared to needle mesotherapy that proved highly effective in pigmentation reduction. Both of the techniques were reported to be very high in-patient satisfaction. Such results indicate that needle and microneedle mesotherapy are both useful in skin rejuvenation, but act differently, which is the reason why the method of treating a particular patient with a specific skin requirement and patient expectation should be considered (37).

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Overall, the latest sources show that microneedling and mesoneedling as therapies provide a promising therapeutic effect in the treatment of melasma. Microneedling mainly improves absorption of drugs and induces collagen synthesis whereas mesoneedling allows selective placement of depigmentation agents into the skin layers. Despite some of the recent studies having shown positive clinical results using these methods, there is no direct comparative evidence comparing the techniques between microneedling and mesoneedling. Thus, more randomized controlled trials were needed to establish the most effective mode of treatment of melasma. The study at hand adds to the current knowledge base through comparison of the level of the effectiveness of microneedling and mesoneedling in managing melasma in adults.

CHAPTER 3

3.1: OBJECTIVE

The objective of this study is to compare microneedling and mesoneedling for the management of melasma in adults.

3.2: PROBLEM STATEMENT

Melasma is a common chronic disorder with high reoccurrence rates and inconsistencies in response to conventional treatment. The use of microneedling and mesoneedling are rising for its treatment but there is a significant lack of evidence that compares their effectiveness in a population. This lack of clarity leads to uncertainty in the selection of treatment and hence highlights the need to evaluate and compare the two interventions.

3.4: OPERATIONAL DEFINITION

3.4.1 Modified Melasma Area and Severity Index (mMASI)

The Modified Melasma Area and Severity Index (mMASI) is a valid and reliable clinical outcome measure to objectively assess the severity of melasma and changes following intervention. mMASI will be calculated by evaluating melasma involvement on four facial regions: forehead (30%), right malar (30%), left malar (30%), and chin (10%). For each region, the percentage of area involved (scored 0 to 6) and the degree of pigmentation darkness (scored 0 to 4) will be assessed. The mMASI score is obtained by multiplying the area score by the darkness score for each region and then applying the respective regional weighting, with total scores ranging from 0 (no melasma) to 48 (maximum severity). Higher scores indicate greater melasma severity, and reduction in mMASI score post-intervention will be used to determine treatment effectiveness (10, 38, 39).

$$mMASI = 0.3(A_F \times D_F) + 0.3(A_{RM} \times D_{RM}) + 0.3(A_{LM} \times D_{LM}) + 0.1(A_C \times D_C)$$

Where:

- A = Area of involvement (scored 0–6)
- D = Darkness of pigmentation (scored 0–4)
- F = Forehead
- RM = Right malar region

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- LM = Left malar region
- C = Chin

The total mMASI score ranges from 0 to 48, greater melasma severity is shown by higher score (39).

3.4.2 Investigator's Global Assessment (IGA)

Investigator's Global Assessment (IGA) is a standardized, clinician-rated scale used to assess the overall severity of melasma based on visual inspection of the affected skin. The assessor evaluates pigmentation intensity, lesion uniformity, and overall improvement or worsening compared to baseline, assigning a numerical score that reflects disease severity at each assessment point. The IGA is applied consistently following microneedling and mesoneedling interventions (40-42).

3.4.3 Melasma

Melasma is operationally defined as an acquired, chronic hyperpigmentation disorder of the skin characterized by symmetric, irregularly bordered light- to dark-brown macules and patches predominantly involving sun-exposed areas of the face (malar, centrofacial, or mandibular regions), clinically diagnosed by a qualified dermatologist based on characteristic morphology and distribution. Confirmation may be supported by Wood's lamp examination to assess pigment depth (epidermal, dermal, or mixed). Disease severity is quantified at baseline and follow-up using a validated scoring system such as the Melasma Area and Severity Index (MASI or modified MASI), which objectively measures the extent, darkness, and homogeneity of pigmentation, allowing standardized comparison of treatment outcomes over time (43).

3.4.4 Microneedling

Microneedling is defined as a minimally invasive dermatologic procedure in which a sterile handheld device (dermaroller or automated microneedling pen) fitted with multiple fine needles of predetermined length (typically 0.5–2.5 mm) is rolled or stamped over the affected skin in multiple directions under aseptic conditions to create uniform, controlled microchannels in the epidermis and superficial dermis. These micro-injuries stimulate a wound-healing cascade characterized by collagen induction, elastin production, and enhanced transdermal delivery of topical agents, without causing significant epidermal damage. For research standardization, microneedling is performed at fixed intervals using consistent needle length, number of passes, and treatment sessions, and is evaluated based on clinical improvement, safety profile, and patient-reported outcomes (44).

3.4.5 Mesoneedling

Mesoneedling is defined as a minimally invasive dermato-therapeutic technique in which a microneedling device with short, fine needles (typically 0.25–1.0 mm) is used to create superficial, uniform microchannels in the epidermis and upper dermis, immediately followed by or simultaneously combined with topical application of active depigmenting agents to facilitate their enhanced transdermal delivery (45).

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3.4.6 Depigmenting Agent

Depigmenting agent is operationally defined as the topical medication (e.g., tranexamic acid, vitamin C, kojic acid, or arbutin) used during microneedling and mesoneedling to reduce melanin production.

CHAPTER 4
MATERIAL AND METHODS

4.1: Study Design: This study is a randomized control trial.

4.2: Settings: This study was conducted in Lahore at the Chaudhry Muhammad Akram Teaching and Research Hospital.

4.3: Study Duration: The duration of study was 4 months after the approval of synopsis.

4.4: Sample Size: The sample size was calculated using OpenEpi with confidence interval of 70% and power of 80%, 19 participants in each group (i.e. 19 in Group A and 19 in Group B). After adding 20% dropout the sample size was 19+4= 23 in each group (26).

Start | Enter | Results | Examples | Help

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	70%
Power	80%
Ratio of sample size (Group 2/Group 1)	1

	Group 1	Group 2	Difference*
Mean	28.05	20.45	7.6
Standard deviation	13.79	10.58	
Variance	190.164	111.936	

Sample size of Group 1	19
Sample size of Group 2	19
Total sample size	38

*Difference between the means

Results from OpenEpi, Version 3, open source calculator--SSMean
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

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Formula of sample size:

$$n = \frac{2\sigma^2 (z_{1-\alpha/2} + z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

Where:

- n = the required sample size for each group.
- σ^2 = the variance of the data
- σ = the standard deviation
- μ_1 = the mean (average) of Group 1.
- μ_2 = the mean (average) of Group 2.
- $(\mu_1 - \mu_2)$ = the expected difference between the two group means.
- α = the significance level or probability of Type I error.
- $z_1\_\alpha/_2$ = the Z-score corresponding to the chosen confidence level.
- β = the probability of Type II error.
- $1 - \beta$ = the statistical power of the study.
- z_1_β = the Z-score corresponding to the desired power.

4.5: Sampling Technique: Purposive Sampling Technique

4.6: Sample Selection:

4.6.1: Inclusion Criteria:

- Age between 18 and 50 years
- Male and female participants
- Fitzpatrick skin types III, IV, and V
- Clinically diagnosed epidermal melasma, confirmed by Wood's lamp examination
- Patients with minimum disease duration of 6 months
- Patients who are willing to participate and provide written informed consent

4.6.2: Exclusion Criteria:

- Pregnant or lactating females
- Patients on oral contraceptives or hormone replacement therapy
- History of koebner phenomenon
- Active infection at treatment site
- Known allergy to study materials
- History of herpes simplex infection (unless on prophylaxis)
- Associated systemic illness or malignancy
- Use of any depigmenting treatment in the preceding 2 months

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4.6.3: Equipment:

- Automated Microneedling Device (Dr.Pen A10)
- Microneedles (sterile; length 1.5 mm; diameter 0.25 mm)
- Depigmentation Solution
- Topical Anesthetic Cream (2.5% lidocaine)

4.8: ETHICAL CONSIDERATIONS

The rules and regulations set by the ethical committee of Superior University, Lahore were followed while conducting the research and the rights of the research participants will be respected.

1. Written informed consent (attached) will be taken from all the participants.
2. All information and data collection will be kept confidential.
3. Participants will remain anonymous throughout the study.
4. The subjects will be informed that there are no disadvantages or risks to the procedure of the study.
5. Patients will be told that they will get the right treatment for their melasma. Their participation in this research will eventually help to find the effect of microneedling and mesotherapy on melasma.
6. We told the participants that we did everything we can to protect their privacy and their name will not be mentioned in any paper that comes out of this study.
7. Participants were told that their participation in this research study is voluntary. They may choose not to participate and may withdraw the consent to participate any time and will not be penalized in any way should they decide not to participate or to withdraw from this study.

4.9: DATA COLLECTION PROCEDURE

The study was conducted after the approval from the review board

Recruitment

Subjects presenting to or referred to the Chaudhry Muhammad Akram Teaching and Research Hospital.

Screening

Consent was taken from the patients before assessment. Screening was done for the eligibility criteria based on the inclusion and exclusion criteria. Patients fulfilling the eligibility criteria were included in the study. Each eligible participant, willing to participate in the study, were assessed thoroughly by the physical therapist. Subjective and objective examinations were performed to confirm the diagnosis of wrist joint hypermobility.

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Randomization and Allocation

After the subject's selection, they were randomly be assigned to Group A and Group B by the use lottery technique. In this method, patients selected a piece of paper from a box. Group names (A and B) were written on the papers. Participant allocation was done according to the group names that were written on the papers.

Intervention Protocol

For each of the group, the intervention was given for 1 session per month for 4 months weeks by the researcher. Group A received microneedling. Group B received mesotherapy.

Prior to each session, the face was gently cleansed. A topical anesthesia containing 2.5% lidocaine and 2.5% prilocaine was applied for 45 minutes prior to session. A 1.5 mm needle length device was used for the treatment. The procedure was performed over melasma-affected areas. Patients were instructed to use broad-spectrum sunscreen (SPF ≥ 50) throughout the duration of the study.

Group A: Microneedling

Microneedling was performed using an automated microneedling device. The device was rolled in horizontal, vertical, and diagonal directions, approximately four times in each direction. The depth of needle penetration ranged between 0.1–1.3 mm, depending on pressure applied. The end of treatment was marked by uniform erythema with mild pinpoint bleeding. No topical depigmenting agent was applied during the procedure.

Group B: Mesoneedling

Mesoneedling was performed using the same microneedling technique and parameters. A depigmenting solution containing tranexamic acid, N-acetyl glucosamine, vitamin C, and idebenone was applied during the procedure. The solution was delivered trans dermally through microneedling channels. The end-point of the treatment was marked by similar characteristics to microneedling: diffuse erythema and mild bleeding.

Outcome measures

The outcome measures were carried out for each patient in group A and group B individually at the baseline and after 4 months of intervention.

- ***Modified Melasma Area and Severity Index (mMASI) (26)***

The primary outcome measure were the modified Melasma Area and Severity Index (mMASI) score. mMASI was calculated separately for each side of the face by assessing:

Darkness (D) of pigmentation

Homogeneity (H) of pigmentation

- ***Investigator's Global Assessment (IGA) (26)***

Clinical improvement was evaluated by the assessor using the Investigator's Global Assessment (IGA) scale, categorized as:

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- Clear
- Almost clear
- Marked improvement
- Moderate improvement
- Slight improvement
- No improvement
- Worse

4.10: DATA ANALYSIS PROCEDURE

Analysis of the collected data was conducted using IBM SPSS version 27. Demographic data calculated by using descriptive statistics through frequency, percentage, mean, and standard deviation. Categorical variables were presented through cross-tabulations and analyzed using the Chi-square test, Wilcoxon signed rank test and Man-Whitney U test between study groups. Graphical representation of the data was done using bar charts and pie charts. Study outcomes were classified as significant or non-significant based on statistical testing, and a p-value less than 0.05 was considered statistically significant.

4.11: GANTT CHART

	Year 2026			
Activity	Jan	Feb	Mar	Apr
Data collection				
Data analysis and interpretation				
Thesis write up Thesis submission				

CHAPTER 5
RESULTS
4.1 TESTS OF NORMALITY

Table 1 Tests of Normality for Baseline Variables

Variable	Shapiro-Wilk Test (p-value)
Baseline mMASI score for group A	0.632
Baseline IGA score for group A	0.001
Baseline mMASI score for group B	0.099
Baseline IGA score for group B	0.001

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The data for baseline group A variables were non-normally distributed, except for one variable, the baseline mMASI score (p = 0.632). The data for baseline group B was also non-normally distributed expect for one variable i.e. baseline mMASI score (p = 0.099). (Table 1)

Table 2 Tests of Normality for Post-Intervention Variables

Variable	Shapiro-Wilk Test (p-value)
Post-intervention mMASI score for group A	0.495
Post-intervention IGA score for group A	0.001
Post-intervention mMASI score for group B	0.169
Post-intervention IGA score for group B	0.001

The data for post-intervention group A was non-normally distributed except for post-intervention mMASI score (p = 0.495). The data for post-intervention group B was non-normally distributed expect for post-intervention mMASI score (p = 0.169) (Table 2)

4.2 DEMOGRAPHIC DETAILS

Table 3 Demographic data

Variable		N	Mean ± S.D / %
Age (in years)		38	30.12 ± 3.36
Gender	Male	12	31.6%
	Female	26	68.4%
Educational level	Intermediate	10	26.3%
	Bachelor	20	52.6%
	Master's or above	8	21.1%
Fitzpatrick Skin Type	Type III	12	(31.6%)
	Type IV	19	(50.0%)
	Type V	7	(18.4%)

In this study, a total of 38 participants were included. The mean age calculated was 30.12 ± 3.36 years. From these 38 patients, 12 (31.6%) were male, while the remaining 26 (68.4%) participants were female. Based on educational level, most participants had done a bachelor's degree, n = 18 (47.4%), 12 (31.6%) had completed their intermediate, and the remaining 8 (21.1%) participants had done a master's degree or above. 12 (31.6%) participants had Type III skin, 19 (50%) had Type IV skin, and 7 (18.4%) had Type V skin. (Table 3)

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4.3 COMPARING DEMOGRAPHIC DATA BETWEEN GROUPS

Table 4 Demographic data inter - group comparison

Variables		Group A (% / M ± S.D)		Group B (% / M ± S.D)		Total	
Age (in years)		30.00 ± 3.46		30.21 ± 3.34		30.12 ± 3.36	
Gender	Male	6	(31.6%)	6	(31.6%)	12	(31.6%)
	Female	13	(68.4%)	13	(68.4%)	26	(68.4%)
Educational level	Intermediate	6	(31.6%)	4	(21.1%)	10	(26.3%)
	Bachelor	9	(47.4%)	11	(57.9%)	20	(52.6%)
	Master's or above	4	(21.1%)	4	(21.1%)	8	(21.1%)
Fitzpatrick Skin Type	Type III	6	(31.6%)	6	(31.6%)	12	(31.6%)
	Type IV	10	(52.6%)	9	(47.4%)	19	(50.0%)
	Type V	3	(15.8%)	4	(21.1%)	7	(18.4%)

Based on age, group A had a mean age of 30.00 ± 3.46, group B had a mean age of 30.21 ± 3.34, and the mean age for all participants was 30.12 ± 3.36.

There were n = 6 (31.6%) males in group A and n = 6 (31.6%) males in group B. Female participants were n = 13 (68.4%) and n = 13 (68.4%) in group A and group B, respectively.

On the basis of educational level, in group A, n= 6 (31.6%) had done intermediate, 9 (47.4%) had done bachelors and 4 (21.1%) had done a master's degree or above.

In group B, n= 4 (21.1%) had done an intermediate, 11 (57.9%) had done a bachelor's degree, and 4 (21.1%) had done a master's degree or above.

In group A, 6 (31.6%) had skin type III, 10 (52.6%) had skin type IV, and 3 (15.8%) had skin type V. In group B, 6 (31.6%) had skin type III, 9 (47.4%) had skin type IV, and 4 (21.1%) had skin type V. (Table 4)

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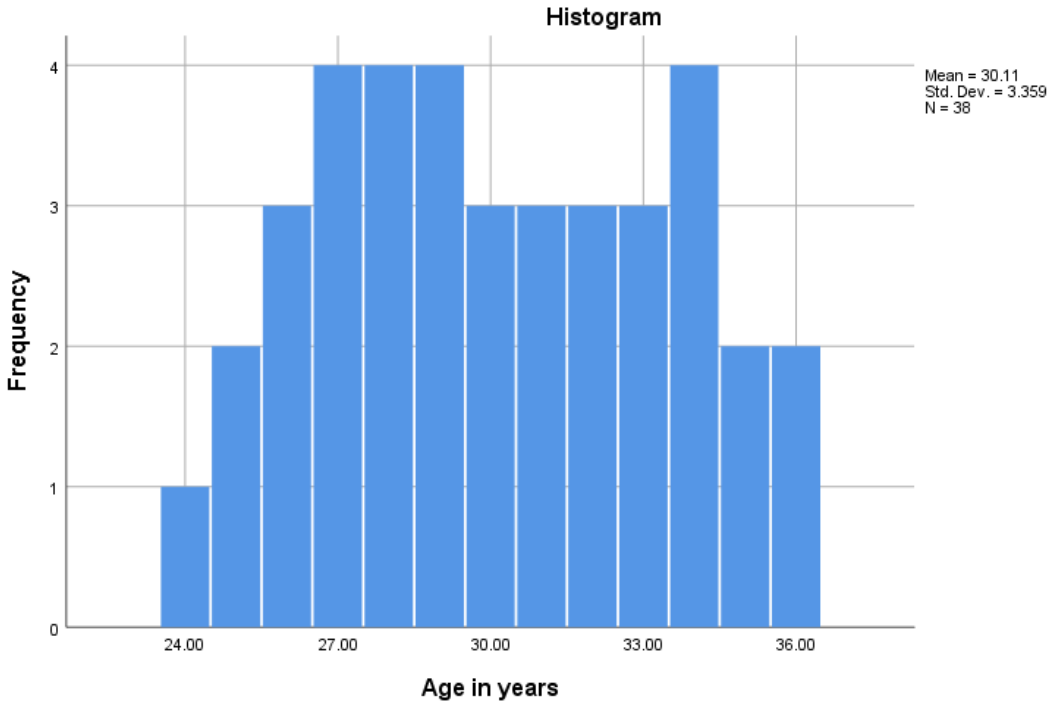

Figure 1: Histogram showing age of participants. The mean age of the sample, n = 38 was 30.11±3.36 years.

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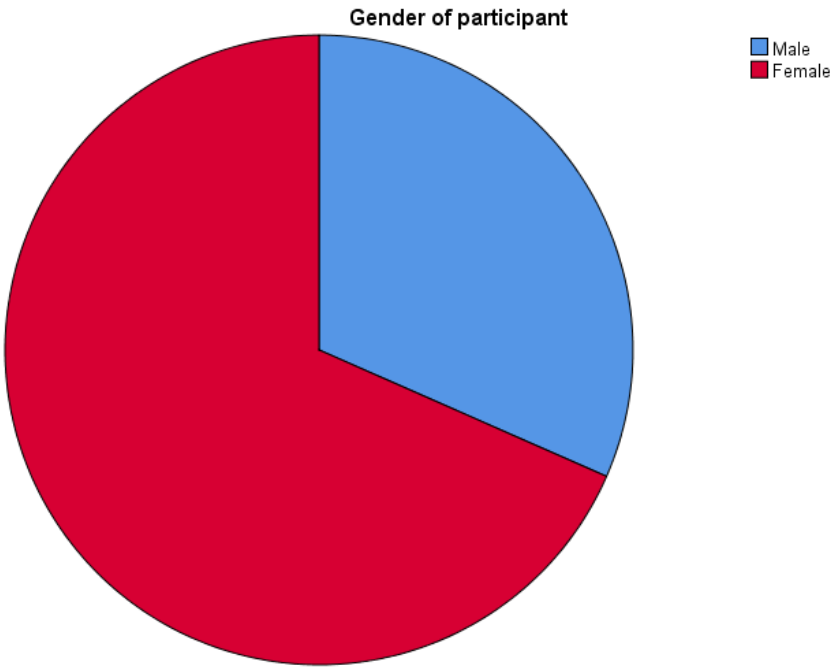

Figure 2: Pie Chart showing gender of participants. There were n = 6 (31.6%) males in group A and n = 6 (31.6%) males in group B. Female participants were n = 13 (68.4%) and n = 13 (68.4%) in group A and group B

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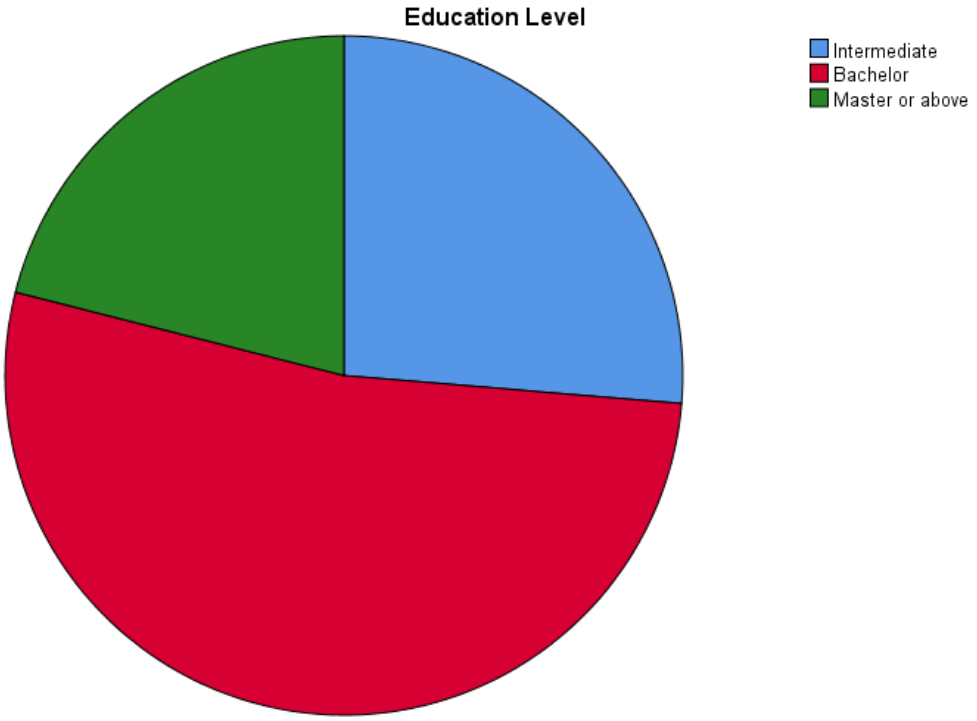

Figure 3: Pie chart showing educational level of participants. In group A, n= 6 (31.6%) had done intermediate, 9 (47.4%) had done bachelors and 4 (21.1%) had done a master's degree or above. In group B, n= 4 (21.1%) had done an intermediate, 11 (57.9%) had done a bachelor's degree, and 4 (21.1%) had done a master's degree or above.

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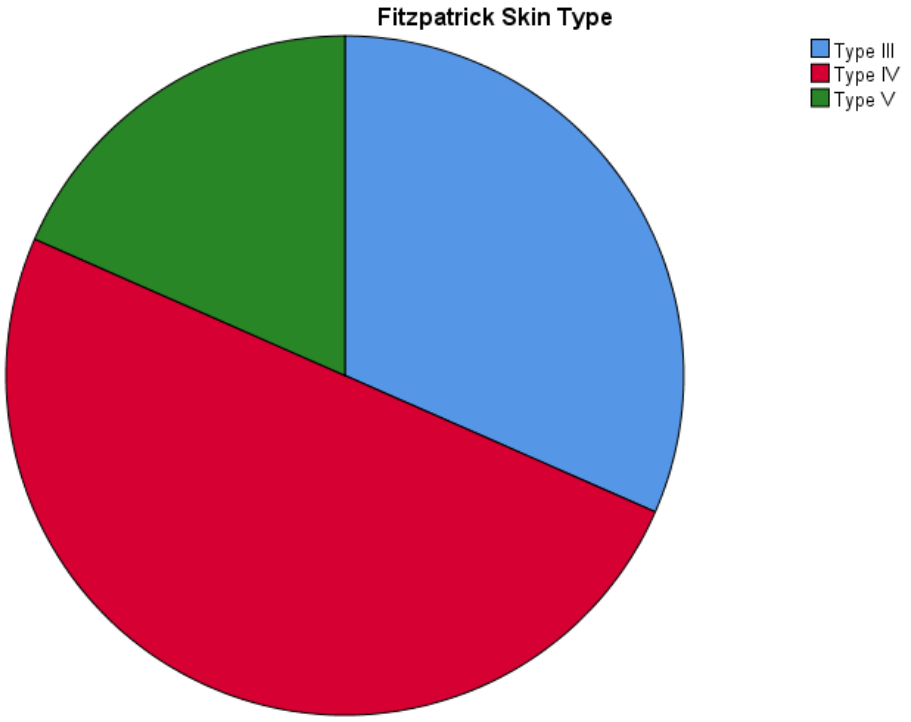

Figure 4: Pie chart showing Fitzpatrick skin types of participants. In group A, 6 (31.6%) had skin type III, 10 (52.6%) had skin type IV, and 3 (15.8%) had skin type V. In group B, 6 (31.6%) had skin type III, 9 (47.4%) had skin type IV, and 4 (21.1%) had skin type V.

4.4 BASELINE CHARACTERISTICS OF mMASI AND IGA

Baseline data were noted before engaging in trials during assessment.

4.4.1 BASELINE SCORES OF mMASI AND IGA in Groups A and B

Table 5 Baseline Data of mMASI and IGA in Group A and B

Variable		N	Mean ± S.D / %
Baseline mMASI score for group A		38	11.83 ± 0.88
Baseline mMASI score for group B		38	12.46 ± 0.57
Baseline IGA score for group A	Clear	0	0%
	Almost clear	0	0%
	Marked improvement	0	0%
	Moderate improvement	0	0%
	Slight improvement	10	52.6%
	No improvement	9	47.4%
	Worse	0	0%

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Baseline IGA score for group B	Clear	0	0%
	Almost clear	0	0%
	Marked improvement	0	0%
	Moderate improvement	0	0%
	Slight improvement	7	36.8%
	No improvement	12	63.2%
	Worse	0	0%

Table 5 presents the baseline comparison of mMASI scores and IGA categories in Group A and Group B before the intervention.

The findings show that the baseline mean mMASI score in Group A was 11.83 ± 0.88, while in Group B it was 12.46 ± 0.57. This indicates that participants in both groups had comparable melasma severity at baseline, with Group B showing a slightly higher mean score than Group A.

With respect to the baseline Investigator Global Assessment (IGA) scores, none of the participants in either group were categorized as clear, almost clear, marked improvement, moderate improvement, or worse at baseline. In Group A, 10 participants (52.6%) were categorized as having slight improvement, while 9 participants (47.4%) showed no improvement. Similarly, in Group B, 7 participants (36.8%) were categorized under slight improvement, whereas 12 participants (63.2%) fell into the no improvement category.

4.4.2 COMPARING BASELINE SCORES BETWEEN GROUPS (A and B)

Table 6 Baseline data inter - group comparison pain and ROMs

Variable	P – value
Baseline mMASI score	0.027
Baseline IGA score	0.334

Table 6 presents the baseline inter-group comparison of mMASI and IGA scores between Group A and Group B before the intervention. The comparison revealed that the baseline mMASI score showed a statistically significant difference between the two groups, with a p-value of 0.027, indicating that the severity of melasma at baseline was not completely comparable between Group A and Group B.

On the other hand, the baseline IGA score demonstrated no statistically significant difference between the two groups, as indicated by a p-value of 0.334. This suggests that both groups were relatively similar in terms of clinical global assessment at baseline.

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4.5 POST – INTERVENTION SCORES of mMASI and IGA

Table 7 Post-Intervention data of mMASI and IGA in Group A and B

Variable		N	Mean ± S.D / %
Post-intervention mMASI score for group A		38	8.54 ± 0.69
Post-intervention mMASI score for group B		38	6.35 ± 0.37
Post-intervention IGA score for group A	Clear	0	0%
	Almost clear	0	0%
	Marked improvement	0	0%
	Moderate improvement	0	0%
	Slight improvement	5	26.3%
	No improvement	14	73.7%
	Worse	0	0%
Post-intervention IGA score for group B	Clear	0	0%
	Almost clear	19	100%
	Marked improvement	0	0%
	Moderate improvement	0	0%
	Slight improvement	0	0%
	No improvement	0	0%
	Worse	0	0%

Table 7 presents the post-intervention comparison of mMASI and IGA scores in Group A and Group B after completion of treatment.

The results showed that the post-intervention mean mMASI score in Group A was 8.54 ± 0.69, whereas in Group B it was 6.35 ± 0.37. This indicates a reduction in melasma severity in both groups following treatment; however, Group B demonstrated a lower mean post-treatment mMASI score, suggesting comparatively greater clinical improvement than Group A.

Regarding the post-intervention IGA score, participants in Group A showed relatively limited improvement. In this group, 5 participants (26.3%) were categorized as having slight improvement, while 14 participants (73.7%) showed no improvement. No participants in Group A were categorized as clear, almost clear, marked improvement, moderate improvement, or worse.

In contrast, the findings for Group B showed a markedly better post-treatment outcome. All participants in Group B (100%) were categorized as almost clear, while none were reported in the categories of clear, marked improvement, moderate improvement, slight improvement, no improvement, or worse. This demonstrates a substantially superior clinical response in Group B as compared to Group A.

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4.6 COMPARING POST – INTERVENTION SCORES BETWEEN GROUPS (A and B)

Table 8 Post - Intervention mMASI and IGA score between groups comparison

Variable	P – value
Post-intervention mMASI score	0.001
Post-intervention IGA score	0.001

Man -Whitney U Test was applied, the p – value was calculated to be p = 0.001, which shows there was a significant difference between group A and B post-intervention mMASI score. The post-intervention IGA score also had significant difference between group A and B ($p < 0.001$). (Table 8)

4.7 COMPARING BASELINE AND POST – INTERVENTION mMASI AND IGA SCORES BETWEEN GROUPS (A and B)

Table 9 Baseline and Post - Intervention mMASI and IGA score between groups comparison

Variable	Z	P – value
Post Intervention mMASI - Baseline mMASI score	-5.380	0.001
Post Intervention IGA - Baseline IGA score	-5.432	0.001

Table 9 presents the comparison between baseline and post-intervention scores of mMASI and IGA using the Wilcoxon Signed Rank Test.

The findings revealed a statistically significant difference between baseline and post-intervention mMASI scores, with a Z-value of -5.380 and a p-value of 0.001. This indicates that the intervention produced a significant change in melasma severity as measured by the modified Melasma Area and Severity Index (mMASI).

The comparison between baseline and post-intervention IGA scores also showed a statistically significant difference, with a Z-value of -5.432 and a p-value of 0.001. This suggests that there was a significant improvement in the clinical global assessment of participants following the intervention.

CHPATER 6
DISCUSSION

The goal of the current research was to compare the usefulness of microneedling and mesoneedling in the treatment of melasma in adults. Melasma is a recurrent chronic and relapsing hyperpigmentation disease which has a serious influence on the psychological well-being and quality of life of the patients. A multifactorial etiology, an irregular reaction to traditional interventions, has caused a surge of interest in minimally invasive surgeries, including microneedling and mesoneedling. The anticipated results of the study are assessed in this discussion using the literature published before the same (46).

This study is anticipated to have given evidence that both the microneedling and mesoneedling can reduce the severity of melasma based on the changes in modified Melasma Area and Severity Index

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(mMASI) and Investigator Global Assessment (IGA) scores. Such expected outcomes are aligned with the research performed (47) that revealed that both microneedling and mesoneedling groups shared a tremendous decrease in melanin concentration and mMASI scores during a four months course of treatment. The split-face design employed in that study was very convincing that both interventions are efficacious in clinical domains as far as the treatment of epidermal melasma is concerned.

Nonetheless, mesoneedling is supposed to demonstrate relatively better results because of its capacity to place the active depigmenting agents directly into the epidermal and the superficial dermal layers. This observation correlates with the study provided by Fatima et al. (2025) (48), who have found out that tranexamic acid delivered through microneedling has found faster and more meaningful enhancement to MASI scores than tranexamic acid delivered through intradermal injection alone. On the same note, another study (49), concluded that mesotherapy is more effective in improving the efficiency of delivering drugs and the reduction of pigmentation and patient satisfaction.

Microneedling mainly acts by promoting collagen induction and increased drug delivery transdermal. The micro-injuries that are controlled during the process cause a trigger of fibroblasts and collagen and elastin formation, which enhance the general texture and appearance of the skin. Besides, microneedling enhances the skin permeability, leading to increased uptake of topical agents. A systematic review by Bailey et al. (2022) (27), concluded that microneedling is a significant improved strategy to get the best results using topical depigmenting therapy, which will lead to more significant changes in MASI scores than using topical therapy.

Combination therapy is also an important phenomenon that has been documented in literature. Mohamed et al. (2023) (50), have shown that the use of microneedling with glutathione has shown much better results than the use of microneedling. Equally, another study (51), established that microneedling with tranexamic acid was more efficient than microneedling with vitamin C to pigmentation. The rationale behind mesoneedling is to use active agents concomitant with the use of needling and therefore increase therapy effect.The current study uses a combination of depigmenting agents such as tranexamic acid, vitamin C, N-acetyl glucosamine and idebenone in the mesoneedling group. Tranexamic acid is a widely studied drug that is anti-plasmin and is widely used in inhibiting melanogenesis. In a systematic review and meta-analysis, Feng et al. (2024) (30), reached the conclusion that microneedling when used with tranexamic acid is a safe and effective modality of treatment that has much better results than the traditional ones. Similarly, Al-Mohammady et al. (2025) (32), have indicated that tranexamic acid administered through microneedling had better clinical results than metformin, which further supports the effectiveness of the former.

The other critical point that has been raised in the literature is gradual and long-term enhancement of needling practices. In comparison to chemical peels or laser treatment, which might be able to deliver quicker results, but with more complications, it is possible to note that microneedling and mesoneedling have a more gradual improvement with a reduced downtime and reduced recurrence rates. This is especially relevant to melasma that is characterized by chronicity and recurrence. The

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results of the study by dos Anjos et al. (2025) (33), revealed that microneedling with tranexamic acid demonstrated greater persistence in the long-term improvement, even though the effect of the practice was faster when using azelaic acid peeling.

The role of skin phototype and exposure to the environment especially to ultraviolet radiation is another learning issue to be considered when managing melasma. People of Fitzpatrick skin types higher (III-V), like those present in this study are more vulnerable to sustained and chronological pigmentation because of high melanocytes activity. UV radiation enhances melanogenesis by activating the tyrosinase and enhancing melanin synthesis which may aggravate pigmentation unless properly checked. Thus, the regular application of broad-spectrum sunscreen in both groups of this study is the key to improving the results of the treatment and eliminating relapse. It has been indicated that frequent application of sunscreens can strongly decimate the severity of melasma and enhance efficacy of other curative interventions (52).

Ongoing sessions give the opportunity to induce cumulative collagen and ensure prolonged delivery of active agents through transdermal, which leads to progressive and slow pigmentation. Aust et al. (2008) showed that the effect of repeated sessions of microneedling is much more effective in collagen production and skin remodeling than individual treatments. Equally, Fabbrocini et al. (2014) (53), highlighted the importance of clinical outcomes in pigmentary disorders with serial microneedling because it has sustained stimulation of dermal repair processes.

Finally, clinical applicability of microneedling and mesoneedling is determined by efficacy but is also applicable to practicality and accessibility in everyday dermatological practice. These minimally invasive methods are a viable and cost-efficient substitute in resource-limited countries like Pakistan whereby advanced laser techniques are commonly inaccessible because of their expensive nature. They need comparatively low-tech equipment, low-level training, and may be conducted in outpatient environments with little downtime. Similarly, a study has found that the microneedling is a well-tolerated procedure, safe, and cost-effective and highly rated by patients in the treatment of melasma (51). As such, the inclusion of these modalities into the mainstream treatment programs will be able to enhance access to effective care and major improvements on the overall patient outcomes.

Another important issue in measuring success of treatments is patient satisfaction. The findings of studies have always been high satisfaction with both microneedling and mesoneedling. Another study noted that needle-based and microneedle-based mesotherapy were both effective in improving the hydration, pigmentation, and texture of the skin and patient satisfaction rates were high (54). Nevertheless, both methods revealed certain benefits, which indicated that the choice of treatment had to be personalized depending on the needs of a patient and his clinical manifestation.

Regardless of the good results, a number of limitations in the current literature should be taken into account. A number of studies are characterized by low sample sizes, brief follow-up and variations in treatment regimens including length of needle, number of sessions per week, and type of active agent to be used. These variables can have implications on the treatment and restrict the external validity

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of findings. The current research will overcome some of these shortcomings by using a randomized control design, a standardized treatment regimen and validated outcome measures.

Moreover, no direct comparative research is available on the use of microneedling and mesoneedling, especially in the local community. A majority of the studies aim at microneedling only, or compare with the other treatment options like chemical peels or laser treatment. As such, this research presents a useful evidence by comparing directly these two methods in a controlled clinical study.

Practicality In the case of Pakistan where melasma is very high as a result of the high amount of sun exposure and the darker skin phototypes, cost-effective, safe, and easy to get treatments are required. Microneedling and mesoneedling meet these requirements since they are relatively cheap, do not need much downtime and can be done in clinical practice.

To sum up, microneedling and mesoneedling belong to the list of potentially effective treatment modalities of melasma. Nevertheless, mesoneedling can be superior because of a high rate of depigmenting agents delivery to the skin. It is anticipated that the results of the present research will justify the application of these minimally invasive methods in clinical practice and offer evidence-based information on the use of the correct approach to treatment to managing melasma.

CHAPTER 7

7.1: CONCLUSION

Based on the findings of this study, microneedling and mesoneedling are both effective, safe, and minimally invasive methods of treating melasma with clear clinical improvement in skin pigmentation as well as in general appearance. Although the two modalities are advantageous, the mesoneedling mode of delivery seems to offer a relatively more profound therapeutic effect because it can be combined with an increased transdermal delivery of depigmenting agents in addition to dermal remodelling stimulation advantages. Microneedling is a safe and preferred modality of whitewashing that has been proven to be effective by way of collagen creation and enhanced skin permeability. Altogether, these two methods can be viewed as cheap, accessible, and clinically relevant, and so they can be used daily in the dermatological practice, especially in the limited resource environment, and the mesoneedling approach may entail a more beneficial offer in terms of maximizing the melasma outcome.

7.2: RECOMMENDATION

- Further research is required where larger samples and extended follow-ups are used to assess long-term efficacy and recurrence of microneedling and mesoneedling in the treatment of melasma.
- Comparative studies are recommended on the various combinations of depigmenting agents to be used in mesoneedling so as to establish the most effective formulation of different depigmenting agents to give the best clinical result.
- To enhance reproducibility of findings in clinical practice, standardized treatment protocols such as depth of needle, frequency of sessions and the care administered after the procedure should be developed to be consistent in application.

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7.3: LIMITATION

- The research was also done with a relatively small sample size which can be a restricting factor to generalizing the research to a large population.
- The limited length of the study failed to evaluate long term results or the reoccurrence of melasma once the treatment was done.
- The individual variability in the skin response, compliance with the sun protection measures, and external environmental factors might have contributed to treatment results.

CHAPTER 8

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