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ORIGINAL ARTICLE

Microneedling versus Modified Jessner's Solution versus Combination Therapy for Atrophic Acne Scars in Fitzpatrick Skin Type III-V: A Randomised Control Study

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ABSTRACT: Atrophic acne scars are a common sequela of acne vulgaris and can impose a substantial cosmetic and psychosocial burden. Several treatment modalities are available, including chemical peels and microneedling; however, no single gold-standard treatment has been established. Combination approaches have been proposed to enhance treatment outcomes by targeting multiple mechanisms involved in dermal remodelling. This study aimed to compare the efficacy and safety of microneedling alone, Modified Jessner's Solution alone, and their combination in the treatment of atrophic acne scars among patients with Fitzpatrick skin types III–V. This randomised controlled study included Filipino patients aged 18–45 years with clinically diagnosed atrophic acne scars assessed using the Global Acne Scarring Grading System (GASGS). Participants were randomly assigned to three treatment groups: chemical peeling (CP), microneedling (MN), or combination therapy (MC). Treatments were administered at Weeks 0, 4, and 8, with follow-up at Week 12. Outcomes were assessed using the GASGS based on standardised clinical photographs evaluated by blinded dermatologists, as well as the Facial Acne Scar Quality of Life (FASQoL) questionnaire. Fifty-five participants completed the study: 18 in the CP group, 17 in the MN group, and 20 in the MC group. Median quantitative GASGS scores decreased progressively across all treatment groups over the 12-week study period, indicating improvement in acne scarring from baseline. The CP group demonstrated a less pronounced reduction by Week 12 compared with the MN and MC groups, although no intervention demonstrated consistent superiority. All procedures were well tolerated, with mild and transient adverse events reported. Quality-of-life scores improved across all treatment groups. Microneedling, Modified Jessner's Solution, and their combination were well tolerated and showed potential for improving atrophic acne scars among patients with Fitzpatrick skin types III–V. Combination therapy may offer additional benefits over either modality alone.

Keywords: Microneedling, Jessner, Acne scars, GASGS

INTRODUCTION

Acne vulgaris is a common inflammatory disorder of the pilosebaceous unit characterised by papules, pustules, and nodules that primarily affect the face but may also involve the trunk and upper arms [1]. It affects individuals across all age groups, with prevalence rates ranging from 42% to 74% among adolescents and young adults [2]. Acne may result in long-term sequelae, including scarring, which can cause substantial cosmetic and psychological distress. Acne scars occur in up to 95% of patients and are often associated with delayed treatment or severe inflammatory lesions [3]. The pathophysiology of acne scarring involves inflammation of the pilosebaceous unit extending into the dermis following rupture of the follicular wall. This process leads to tissue destruction, aberrant wound healing, dermal collagen loss, and contraction of the surrounding tissue, ultimately resulting in skin indentation and the formation of atrophic scars [4]. In the Philippines, acne scarring remains a prevalent dermatological concern, with 41–60% of acne patients presenting with scarring at their initial consultation [4]. In a survey of 269 Filipino dermatologists, Handog et al. reported that scarring was most frequently observed among patients aged 26–35 years, with 78% having Fitzpatrick skin type IV. The most commonly reported scar types were hyperpigmented scars (84%), depressed scars (80%), atrophic scars (67%), hypertrophic scars (55%), and hypopigmented scars (29%) [4].

The management of acne scars remains challenging. Available treatment modalities include chemical peels, dermabrasion, microneedling, subcision, punch techniques, injectable fillers, and energy-based devices [5]. Most dermatologists report using a combination of topical therapies and procedural interventions, including chemical peels, microdermabrasion, microneedling, and energy-based devices [4]. However, no single treatment modality has been established as the gold standard.

Chemical peels are widely used in acne scar management and act by inducing controlled epidermal injury that promotes dermal remodeling and regeneration of new epidermal and dermal tissue [6,7]. Jessner's solution is a commonly used chemical peel composed of resorcinol, salicylic acid, lactic acid, and ethanol [8]. However, resorcinol has been associated with contact dermatitis and post-inflammatory hyperpigmentation, particularly in patients with darker skin types [9]. Modified Jessner's Solution replaces resorcinol with citric acid and contains higher concentrations of salicylic and lactic acids, potentially improving tolerability and reducing adverse effects [10].

Microneedling is another established modality that creates controlled micro-injuries within the epidermis and papillary dermis, stimulating collagen production through activation of growth factors and fibroblast proliferation [11,12]. The microchannels created during the procedure may also enhance transdermal drug delivery [11]. Microneedling is generally well tolerated, with adverse effects such as erythema, oedema, and pain typically resolving spontaneously [12,13].

Combination therapies may enhance treatment outcomes by targeting multiple mechanisms involved in scar remodelling [14]. Several studies have reported greater improvement in atrophic acne scars when microneedling is combined with chemical peeling compared with either treatment alone [11,15-17].

Despite the promising results reported with combination therapies, few studies have evaluated the combined use of microneedling and Modified Jessner's Solution. Most existing studies have investigated traditional Jessner's solution or other chemical peeling agents, while data among individuals with darker skin phototypes remain limited. Furthermore, few randomised controlled trials have directly compared microneedling, chemical peeling, and combination therapy within the same study population. To our knowledge, no randomised controlled trial has evaluated these treatment modalities using Modified Jessner's Solution among Filipino patients with Fitzpatrick skin types III–V. Therefore, this study aimed to compare the efficacy and safety of microneedling alone, Modified Jessner's Solution alone, and their combination in the treatment of atrophic acne scars, as assessed using clinical photography and the Goodman and Baron Global Acne Scarring Grading System (GASGS).

METHODOLOGY

Study Design and Participants

This randomized controlled trial with blinded outcome assessment was conducted between September and December 2024. The participants were recruited from patient attend outpatient dermatology clinic of the Research Institute for Tropical Medicine. The study protocol was reviewed and approved by the Institutional Ethics Review Board of the Research Institute for Tropical Medicine (Reference No.: 2024-02). Written informed consent was obtained from all participants prior to enrolment.

Participants aged 18–45 years with clinically diagnosed atrophic acne scars and Fitzpatrick skin types III–V were eligible for inclusion. Atrophic acne scars were classified using the Qualitative GASGS, and participants with mild, moderate, and severe acne scars were included in the study. Exclusion criteria included previous acne scar treatment within the preceding four months, isotretinoin therapy within the past six months, active skin infection, bleeding disorders, pregnancy, a history of keloid formation, collagen vascular disease, uncontrolled diabetes mellitus, and known hypersensitivity to Modified Jessner's Solution.

Sample Size and Randomization

Sample size estimation was based on a previous randomized study evaluating microneedling and Jessner's solution for the treatment of acne scars [8]. Assuming improvement rates of 80% with combination therapy, 30% with microneedling alone, and 25% with chemical peel alone, a minimum sample size of 18 participants per treatment arm was calculated using STATA version 17.0, with a statistical power of 80%, a significance level of 0.05, and a 20% allowance for potential loss to follow-up. Participants were randomized using block randomization stratified by acne scar severity and allocated to three treatment groups: chemical peel (CP), microneedling (MN), and combination therapy (MC).

Treatment Protocol

Participants underwent three treatment sessions at Weeks 0, 4, and 8, with the final evaluation performed at Week 12. In the microneedling group, a topical anaesthetic containing 2.5% lidocaine and 2.5% prilocaine was applied for one hour prior to the procedure. Microneedling was performed using a motorized microneedling device (M.pen Pro, Mesoestetic Pharma Group, Spain) at a needle depth of 1.5 mm, with vertical, horizontal, and diagonal passes until uniform pinpoint bleeding was achieved.

In the chemical peel group, Modified Jessner's Solution (14% salicylic acid, 14% lactic acid, and 8% citric acid) was applied evenly using a brush in three coats over the treatment area, while avoiding the periorbital and

perioral regions. Participants in the combination therapy group underwent microneedling followed immediately by application of Modified Jessner's Solution according to the same protocol. Following treatment, participants in the MN and MC groups were instructed to apply mupirocin ointment twice daily for five days. All Participants were advised to use a gentle cleanser and strict photoprotection with SPF 50 sunscreen throughout the study period.

Outcome Measures

Standardized facial photographs were obtained at baseline and at Weeks 4, 8, and 12 using the Quantificare LifeViz device (QuantifiCare, France) system under consistent lighting conditions, camera settings, and patient positioning. Photographs included frontal and bilateral lateral views. The primary outcome was the improvement in acne scar severity measured using the GASGS, which incorporates both quantitative and qualitative assessments. Acne scar severity was independently evaluated by two dermatologists blinded to treatment allocation.

For the quantitative GASGS assessment, individual acne scar lesions were counted, and numerical scores were assigned according to their number, type, and severity using a standardised grading system [3,18]. For the qualitative GASGS assessment [3,18], improvement was defined as a decrease of at least one severity grade from baseline to Week 12. Hyperpigmented and hypopigmented lesions were also documented as part of the GASGS assessment.

Secondary outcomes included patient-reported quality of life assessed using the Facial Acne Scar Quality of Life (FASQoL) questionnaire and the incidence of treatment-related adverse events, including erythema, bleeding, and burning sensation.

Statistical Analysis

Statistical analyses were performed using Stata version 18 (StataCorp LLC, College Station, TX, USA). Descriptive statistics were used to summarize participant demographic and clinical characteristics. Continuous variables were presented as mean ± standard deviation, while categorical variables were summarized as frequencies and percentages. Baseline characteristics were compared among the three treatment groups using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test for continuous variables, depending on data distribution, and the chi-square test or Fisher's exact test for categorical variables.

GASGS scores were summarized as medians and interquartile ranges (IQRs). Differences in GASGS scores among the three treatment groups at each time point were assessed using the Kruskal–Wallis test. Changes in GASGS scores over time within each treatment group were evaluated using the Friedman test for repeated measures. Statistical significance was defined as $p < 0.05$.

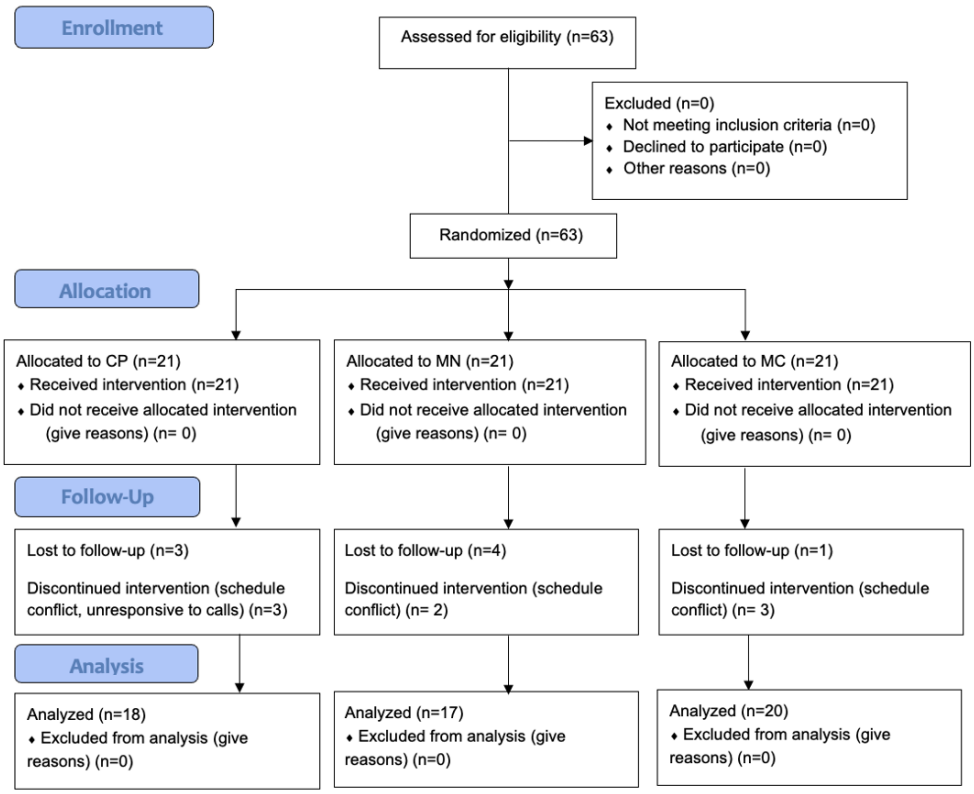

Figure 1. Participant flow diagram.

RESULTS

Demographic and Clinical Characteristics of Participants

A total of 63 participants were assessed for eligibility and randomized into CP, MN, and MC groups, with 21 participants allocated to each group (**Figure 1**). During the study period, eight participants were lost to follow-up, resulting in 55 participants included in the final analysis. The participants ranged in age from 20 to 44 years, with a mean age of 29 years. Among the analysed participants, 36 (65%) were male and 19 (35%) were female. The duration of acne scars ranged from 4 months to 31 years. Rolling scars were the most frequently observed scar type, followed by boxcar scars. Most participants had Fitzpatrick skin type III (65%), while the remaining participants had skin type IV. Baseline demographic and clinical characteristics were comparable among treatment groups, except for age, which differed significantly between groups at p<0.01 (**Table 1**).

Table 1. Descriptive Characteristics of the studied groups

Variable	CP		MN		MC		F	P
Total participants (%)	18 (32.73)		17 (30.91)		20 (36.36)			
Age (Years)							8.46	0.0036
Mean ± SD	27.556 (4.501)		29.294 (4.120)		32.600 (6.021)			
Range	20-34		24-37		23-44			
Sex							0.0109	0.9167
Female	6 (33.3)		6 (35.3)		7 (35.0)			
Male	12 (66.7)		11 (64.7)		13 (65.0)			
Variable	CP		MN		MC		H	P
Duration (Years)							2.121	0.3462
Mean ± SD	7.78(3.42)		8.21(5.59)		13.55(6.57)			
Range	4-17		0.5-22		3-31			
Variable	CP		MN		MC	CP	χ^2	P
	n	%	n	%	n	%		
Scar Type							32.44	0.179
Boxcar	17	37.78	13	28.89	15	33.33		
Icepick	7	38.89	5	27.78	6	33.33		
Rolling	15	31.25	17	35.42	16	33.33		
Hyperpigmented	13	41.94	9	29.03	9	29.03		
Hypopigmented	4	44.44	3	33.33	2	22.22		
Skin Type							1.69	0.429
III	10	27.78	13	36.11	13	36.11		
IV	8	42.11	4	21.05	7	36.84		
V	0	0	0	0	0	0		

Improvement in Acne Scar Severity

The quantitative GASGS scores were evaluated over 12 weeks across the three treatment groups (**Table 2**). The GASGS scores decreased progressively throughout the 12-week follow-up period in all groups, indicating an improvement in acne scar severity compared with baseline. Between-group comparisons using the Kruskal–Wallis test showed no statistically significant differences in GASGS scores among the three treatment groups at baseline, Week 4, Week 8, or Week 12 (all $p > 0.05$). However, within-group analysis using the Friedman test demonstrated significant changes in GASGS scores over the 12-week study period in each treatment group (all $p < 0.001$). Post hoc pairwise comparisons were conducted using the Wilcoxon signed-rank test with exact p-values and Bonferroni correction (adjusted significance level, $\alpha = 0.0083$). After Bonferroni adjustment, no pairwise comparisons remained statistically significant in the CP and MC groups. In contrast, significant reductions in total GASGS scores were observed in the MN group between Week 0 and Week 8 (exact $p = 0.0078$), Week 0 and Week 12 (exact $p = 0.0039$), and Week 4 and Week 12 (exact $p = 0.0078$).

Table 3 presents the qualitative GASGS assessment outcomes across the three treatment groups. One participant (5.56%) in the CP group, two participants (11.76%) in the MN group, and two participants (10.0%) in the MC group demonstrated a one-grade improvement. However, the proportion of participants achieving improvement did not differ significantly among the three treatment groups based on the chi-square test ($\chi^2 = 0.439$, $p = 0.803$).

Representative Clinical Photographs

Figure 2 to **Figure 4** show representative clinical photographs of participants from each treatment group, along with their corresponding qualitative and quantitative GASGS scores over the 12-week study period. Based on the clinical photographs, noticeable improvements were observed across all treatment groups.

Table 2. Quantitative GASGS score among treatment groups over time.

Week	CP	MN	MC	Between-group p-value[a]
Week 0	8.0 (6.0 12.0)	7.0 (5.0, 11.0)	7.5 (4.0, 9.5)	0.595
Week 4	7.5 (6.0 12.0)	7.0 (5.0, 9.0)	6.0 (4.0, 9.5)	0.451
Week 8	7.5 (5.0, 12.0)	6.0 (5.0, 9.0)[c]	6.0 (3.5, 9.0)	0.504
Week 12	7.5 (5.0, 12.0)	6.0 (5.0, 9.0)[c,d]	5.5 (2.5, 9.0)	0.377
Within-group p-value[b]	<0.001	<0.001	<0.001	

Values are presented as median (interquartile range)
[a]Kruskal-Wallis test
[b]Friedman test
[c]Significant difference compared with Week 0.
[d]Significant difference compared with Week 4
† A Bonferroni correction was applied for six pairwise comparisons within each treatment group, resulting in an adjusted significance level of α = 0.0083 (0.05/6). Comparisons with exact p < 0.0083 were considered statistically significant

Table 3. Qualitative GASGS score outcomes across treatment groups.

Improvement	CP		MN		MC		χ^2	p
	n	%	n	%	n	%		
Yes	1	5.56	2	11.76	2	10		
No	17	94.44	15	88.24	18	90	0.4393	0.8028
Total	18	100	17	100	20	100		

Figure 2. Clinical photographs of a participant who underwent CP treatment at Weeks 0, 4, 8, and 12. Dermatologist-assigned GASGS scores (qualitative grade/quantitative score): **Dermatologist 1**: Week 0 (IV/11), Week 4 (IV/11), Week 8 (IV/9), and Week 12 (IV/8); **Dermatologist 2:** Week 0 (IV/16), Week 4 (IV/13), Week 8 (III/8), and Week 12 (III/5).

Safety Evaluation

The incidence of procedure-related erythema, burning/stinging, and bleeding across the three treatment groups is presented in **Figure 5**. All adverse events were transient and resolved spontaneously following the procedures. Erythema, burning/stinging sensations, and pinpoint bleeding resolved shortly after treatment, with no cases persisting for several days. No additional medications were required for the management of these adverse events. As part of routine post-procedure care, participants in the microneedling and combination groups were instructed to apply mupirocin ointment twice daily for five days, while all participants were advised to use a mild cleanser and SPF 50 sunscreen daily.

Erythema was observed across all treatment modalities. Most cases were mild and presented as slight

reddening. Bleeding was observed only in the MN and MC groups, likely attributable to the microneedling component, in which pinpoint bleeding served as the procedural endpoint. No bleeding events were observed in the CP group, and no cases of severe bleeding were reported. Burning or stinging sensations were reported across all treatment groups but were generally mild and tolerable. No severe adverse events were reported. Overall, all treatment modalities demonstrated favourable safety profiles (**Figure 5**).

Quality of Life Outcomes

Total FASQoL scores decreased from Week 0 to Week 12 across all treatment groups, indicating an improvement in quality of life (**Table 4**). However, the Kruskal–Wallis test showed no statistically significant differences in FASQoL scores among the CP, MN, and MC groups at Week 0 or Week 12 ($p > 0.05$).

Table 4. Total FASQoL scores across treatment groups.

	CP	MN	MC	H	p-value
Week 0	28 (17)	23 (19)	23.5 (16.5)	0.769	0.6807
Week 12	16.5 (10)	18 (9)	17.5 (8)	0.088	0.9570

Values are presented as median (interquartile range).

Figure 3. Clinical photographs of participant who underwent MN treatment at Weeks 0, 4, 8, and 12. Dermatologist-assigned GASGS scores (qualitative grade/quantitative score): **Dermatologist 1:** Week 0 (IV/15), Week 4 (IV/15), Week 8 (IV/14), and Week 12 (IV/14); **Dermatologist 2:** Week 0 (IV/15), Week 4 (IV/14), Week 8 (III/9), and Week 12 (III/9).

Figure 4. Clinical photographs of participant who underwent MC treatment at Weeks 0, 4, 8, and 12. Dermatologist-assigned GASGS scores (qualitative grade/quantitative score): **Dermatologist 1:** Week 0 (III/6), Week 4 (III/6), Week 8 (III/4), and Week 12 (III/4); **Dermatologist 2:** Week 0 (III/9), Week 4 (III/8), Week 8 (II/3), and Week 12 (II/3).

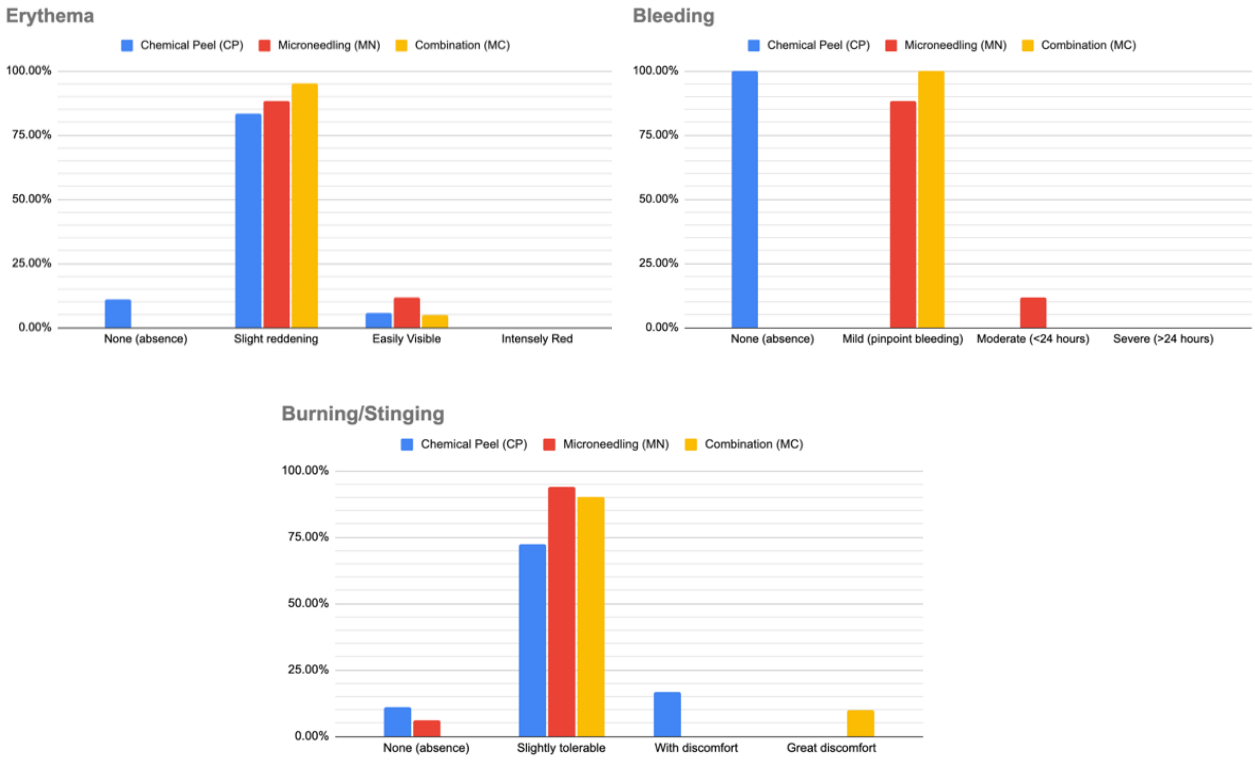

Figure 5. Safety profiles of the three treatment groups.

DISCUSSION

In this study, we evaluated the efficacy and safety of microneedling, Modified Jessner's Solution and combination treatments in participants with atrophic acne scars and Fitzpatrick skin types III–V. All three treatment modalities resulted in modest improvements in acne scar severity from baseline to Week 12, although no single treatment modality demonstrated consistent superiority. Among the three groups, the CP group showed a less pronounced reduction in scar severity compared with the MN and MC groups, suggesting a potential benefit of microneedling-based approaches in the management of atrophic acne scars. Previous studies

have also suggested that microneedling-based approaches may provide greater clinical improvement compared with CP alone in the management of acne scars. Ali et al. reported that the combination of microneedling and Jessner's solution achieved greater clinical improvement with fewer treatment sessions compared with single-treatment approaches [8]. In another study, Ishfaq et al. demonstrated that microneedling produced better acne scar outcomes compared with 35% glycolic acid peeling in patients with darker skin types [19].

The modest improvement observed in this study may be attributed to several factors, including the limited sample size, relatively short follow-up duration, baseline variations in scar severity, heterogeneity of scar morphology, and the limited number of treatment sessions performed. As improvement in atrophic acne scars depends on gradual collagen remodelling following procedural interventions, longer treatment durations and extended follow-up periods may be necessary to identify clinically meaningful differences between treatment modalities. Accordingly, our findings suggest that, although microneedling, Modified Jessner's Solution and combination treatments may all provide short-term improvement in atrophic acne scars, microneedling and combination treatments may have greater potential for continued improvement with additional treatment sessions.

Differences in scar morphology may have also influenced treatment response among participants. Atrophic acne scars consist of various subtypes, including icepick, boxcar, and rolling scars, which may respond differently to treatment depending on scar depth, width, and degree of dermal tethering. Previous studies have reported that rolling and boxcar scars generally respond better to treatment compared with icepick scars, which are typically deeper, narrower and may require longer treatment duration or scar-specific approaches. El-Domyati et al. reported good to very good responses of rolling and boxcar scars following microneedling, whereas icepick scars demonstrated only moderate improvement [20]. Similarly, Sharad reported that combination therapy with microneedling and chemical peel improved acne scarring across different scar types, except icepick scars [16]. Therefore, the presence of mixed scar subtypes among participants in the present study may have contributed to the modest overall improvement observed across all treatment groups.

Multiple treatment sessions may be required to achieve more pronounced clinical improvement in atrophic acne scars. In a study by Ali et al., noticeable improvement was achieved following multiple treatment sessions, with a mean of 4.6 sessions for combination therapy using microneedling and Jessner's solution, 6.1 sessions for microneedling alone, and 6.75 sessions for Jessner's solution alone [8]. Similarly, Sharad et al. reported that improvements in superficial and moderately deep scars, skin texture, and post-acne pigmentation were observed following five sessions of microneedling combined with 35% glycolic acid peel [16]. These findings suggest that additional treatment sessions and longer follow-up periods may be necessary to achieve greater clinical improvement.

In the present study, all treatment modalities demonstrated favourable safety profiles. The observed procedure-related reactions, including erythema, pinpoint bleeding, and burning sensations, were mild and transient, resolving spontaneously without additional intervention. These findings are consistent with previous studies demonstrating that microneedling and superficial chemical peel are generally well tolerated, with minimal complications when performed appropriately [8,16].

Beyond clinical assessment, patient-reported outcomes also demonstrated positive changes following treatment. The reduction in FASQoL scores across all treatment groups suggests an improvement in acne scar-related psychosocial burden, including emotional well-being, social interactions, and daily activities. This finding is consistent with previous reports indicating that improvements in acne scars, even when modest, may contribute to enhanced quality of life [17].

Evidence specifically evaluating procedural treatments for atrophic acne scars among Filipino patients remains limited. Therefore, this study provides clinically relevant insights into the management of atrophic acne scars in Filipino patients with Fitzpatrick skin types III–V. Consistent with previous literature, microneedling-based approaches appear to be well tolerated and may contribute to improvement in acne scars among darker skin populations, while combination therapy with Modified Jessner's Solution may offer additional benefits by targeting multiple aspects of acne scar pathology.

Limitations of The Study

This study has several limitations. First, participants underwent only three treatment sessions over a 12-week period. Previous studies evaluating microneedling and chemical peeling for acne scars often used a greater number of treatment sessions or longer follow-up periods, which may allow for more pronounced collagen remodeling and clinical improvement. Consequently, the modest improvements observed in the present study may be attributable to the relatively short treatment duration and follow-up period.

Second, the evaluation of treatment outcomes was primarily focused on atrophic acne scar severity using the GASGS. Other clinically relevant parameters, including post-inflammatory hyperpigmentation (PIH), post-inflammatory erythema (PIE), and changes in overall skin texture, were not formally assessed. In addition, treatment responses according to specific scar subtypes, such as icepick, boxcar, and rolling scars, were not evaluated. Third, although standardised clinical photographs and blinded dermatologists were used to minimise assessment bias, photographic evaluation

remains inherently subjective. In addition, the study was conducted at a single centre with a relatively small sample size, which may limit the generalisability of the findings.

Future studies involving larger sample sizes, additional treatment sessions, and longer follow-up periods are warranted to further evaluate the long-term efficacy and safety of these treatment modalities. Further investigations should also consider scar subtype-specific responses and include additional clinical outcomes, such as pigmentation changes and skin texture improvement.

CONCLUSION

Microneedling, Modified Jessner's Solution, and their combination were well tolerated and associated with improvements in atrophic acne scars and patient-reported quality of life over the 12-week study period. Further studies with larger sample sizes, longer follow-up periods, and additional treatment sessions are needed to further clarify the long-term efficacy of these treatment approaches, particularly among individuals with darker skin types.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest. This study received no commercial funding.

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