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Effectiveness of Microneedling Combined with Topical Triamcinolone Acetonide versus Microneedling Alone in Treatment of Alopecia Areata

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ABSTRACT

Background: Alopecia areata (AA) is a prevalent, inflammatory, non-scarring form of hair loss. The clinical presentation of AA exhibits considerable variability. Although numerous therapies are available for managing this condition, these treatment modalities yield inconsistent clinical outcomes, and there are currently no treatments that reliably induce or sustain remission. **Methods:** A comparative study was conducted at the Pakistan Emirates Military Hospital's Department of Dermatology from June 2024 to November 2024. The study included 40 patients aged 16 to 50 with localized alopecia areata (AA) who had not received treatment in the prior three months. Exclusions were severe AA forms, recent AA treatment, known allergies to medications, and active infections. Participants provided informed consent and were divided into two groups: Group A received microneedling combined with topical triamcinolone acetonide (10 mg/ml), and Group B received microneedling alone. Baseline and follow-up assessments included digital photography and Severity of Alopecia Tool (SALT) scoring. Data were analysed using IBM-SPSS 21.0 with statistical significance set at $p \leq 0.05$. **Results:** The age distribution showed a mean ± SD of 32.6 ± 9.7 years for the MN + TrA group and 33.5 ± 10.4 years for the MN alone group, with a p-value of 0.09. The MN + TrA group comprised 60.0% males and 40.0% females, while the MN alone group had 25.0% males and 75.0% females ($p = 0.12$). Baseline SALT scores were comparable ($p = 0.14$). MN + TrA yielded significantly better responses, with 60.0% achieving complete recovery versus 5.0% in MN alone ($p = 0.001$). Side effects were minimal; irritation occurred in 5.0% of MN + TrA participants, with no significant differences in redness or scaling ($p = 0.13$). MN + TrA was more effective and well-tolerated than MN alone. **Conclusion:** Microneedling combined with topical triamcinolone acetonide are safe and effective therapeutic options for localized AA.

INTRODUCTION

Alopecia areata (AA) is a chronic, widespread autoimmune disorder characterized by non-scarring hair loss, while preserving the hair follicles (HFs). It can affect individuals of all ages and both sexes, with a general population prevalence of 0.1%–0.2%. The disorder presents in various forms of hair loss, including well-defined patches of varying sizes or complete loss of hair, potentially affecting all hair-bearing areas [1]. In AA, anagen-phase HFs are specifically targeted by the autoimmune response, leading to dystrophic changes and a rapid transition from the anagen to telogen phase [2]. Despite the availability of numerous treatment options, ranging from corticosteroids to biologics, none have been shown to be curative or capable of inducing sustained remission [3, 4].

Microneedling (MN) is a technique involving the repeated puncturing of the skin with sterile microneedles. This method can be employed to manage a range of aesthetic and dermatological conditions [5]. MN promotes hair regeneration by activating stem cells in the hair bulge, leading to the production of growth factors. Additionally, it enhances blood circulation to the hair follicles (HFs) and modulates local immune cells [6]. Moreover, when MN is combined with topical drugs, it facilitates their absorption through the microchannels created within the epidermis [7]. Most studies have demonstrated the effectiveness of MN combined with topical therapies, such as triamcinolone acetonide, in treating alopecia areata (AA), as reported by Chandrashekar et al [6].

Microneedling (MN) is a procedure that involves the repeated puncturing of the skin with sterilized microneedles. MN provides a relatively low-cost and minimally invasive option for treating a variety of cosmetic and dermatological conditions [5]. However, the use of MN alone in the treatment of AA has been documented in only a few studies.

The delivery of triamcinolone acetonide at a concentration of 10 mg/ml via MN appears to significantly promote the conversion of vellus hairs to terminal hairs, without the associated risk of atrophy. This method has the potential to become a therapeutic option for managing recalcitrant or relapsing cases of alopecia areata (AA) [6].

The aim of this study is to compare the efficacy and safety of triamcinolone acetonide (TrA) with microneedling (MN) versus microneedling (MN) alone in the treatment of alopecia areata, both clinically and dermoscopically.

METHODOLOGY

A comparative study was conducted in the Department of Dermatology at the Pakistan Emirates Military Hospital. The study spanned a duration of six months, from June 2024 to November 2024. Patients of both sexes, aged between 16 and 50 years, with localized (patchy) alopecia areata (AA) were included, provided they had not received any treatment for AA in the three months preceding the study. Patients with severe forms of AA, such as alopecia totalis (AT), alopecia universalis (AU), and ophiasis, were excluded, as were those who had been treated for AA within the previous three months. Patients with known allergies to the study medications or active infections at the treatment site were also excluded.

The study involved the enrollment of 40 patients from the Dermatology Department. Consent was obtained from all participants after they were informed about the potential benefits and adverse effects of the treatment. The 40 patients were then divided into two groups, each comprising 20 patients. Group A received microneedling combined with topical triamcinolone acetonide (10 mg/ml), while Group B underwent microneedling alone.

The procedure commenced with a thorough medical history and examination, assessing the onset, duration, and progression of the condition. The history included details of past surgeries, fevers, illnesses, stress, anemia, autoimmune diseases, medication use, radiation or chemotherapy exposure, and allergies to previous treatments. A family history, particularly of similar conditions, was also taken into account. This was followed by a general medical examination and a detailed dermatological assessment of the scalp, focusing on the site, size, and number of alopecia areata lesions.

The severity of the condition was evaluated using the Severity of Alopecia Tool (SALT) score, which divides the scalp into four areas: Vertex (40% of the scalp surface area), right profile (18%), left profile (18%), and posterior aspect (24%). The SALT score was calculated by multiplying the percentage of hair loss in each area by the corresponding scalp surface area percentage and summing the results. The Severity of Alopecia Tool (SALT) score categorised the extent of hair loss on the scalp into six distinct subclasses. S0 indicated no hair loss, while S1 represented hair loss of less than 25% of the scalp. S2 corresponded to hair loss ranging between 25% and 49% of the scalp. S3 was assigned to cases where hair loss affected 50% to 74% of the scalp. S4 referred to hair loss covering 75% to 99% of the scalp, and S5 indicated complete hair loss, covering 100% of the scalp. For all participants, digital photography was used to document the lesions at baseline (week 0) and at intervals of 2, 4, 6, and 8 weeks, with a final evaluation after 12 weeks.

In Group A, patients received combined therapy with microneedling and topical triamcinolone acetonide

(10 mg/ml). Microneedling was performed using a Microneedling pen (Ultima A6) with a disposable tip cartridge containing 36 micro-needles, adjusted to a length of 1.5 mm. After disinfection with an alcohol solution, the dermapen was applied perpendicularly to the scalp, exerting light pressure for 3 seconds in a circular motion over the affected area until mild erythema or pinpoint bleeding was observed, marking the end of the procedure. Following microneedling, 10 mg/ml of triamcinolone acetonide was applied and gently rubbed into the affected areas, followed by a second session of microneedling. This procedure was repeated weekly for 8 weeks. In Group B, the same microneedling procedure was performed, but without the application of triamcinolone acetonide. All patients were monitored for three months following the cessation of treatment to evaluate the sustainability of the response and the incidence of AA recurrence. Any side effects observed by physicians or reported by patients were documented.

For statistical analysis, the data were verified, coded, and analysed using IBM-SPSS 21.0 (IBM-SPSS Inc., Chicago, IL, USA). Descriptive statistics, including means, standard deviations, medians, ranges, and percentages, were calculated. The chi-square test was used to compare frequency distribution differences among the groups, while an independent t-test was applied to analyse continuous variables concerning the treatment modalities. A significance level of $p \leq 0.05$ was considered statistically significant.

RESULTS

The bifurcation of demographic and clinical data in relation to treatment modalities is presented in Table 1. The age distribution, measured in years, showed a mean ± SD of 32.6 ± 9.7 in the MN + TrA group and 33.5 ± 10.4 in the MN alone group, with a p-value of 0.09, indicating no statistically significant difference between the groups. The median age ranged from 18 to 50 years in the MN + TrA group and from 21 to 47 years in the MN alone group. In terms of sex distribution, the MN + TrA group had 60.0% male participants and 40.0% female participants, whereas the MN alone group had 25.0% male and 75.0% female participants. The p-value was 0.12, showing no significant difference between the groups regarding sex distribution.

The duration of the disease, measured in years, had a mean ± SD of 0.56 ± 1.01 in the MN + TrA group and 0.85 ± 1.32 in the MN alone group, with a p-value of 0.17. The median duration ranged from 1 month to 4 years in the MN + TrA group and from 1 month to 5 years in the MN alone group. Family history was absent in 40.0% of participants in the MN + TrA group and 75.0% in the MN alone group, while 60.0% of participants in the MN + TrA group and 25.0% in the MN alone group had a positive family history. The p-value for this variable was 0.21. The number of patches showed a mean ± SD of 1.13 ± 0.26 in the MN + TrA group and 1.34 ± 1.81 in the MN alone group, with a median ranging from 1 to 1 in the MN + TrA group and from 1 to 6 in the MN alone group. Regarding the types of alopecia, 95.0% of participants in the MN + TrA group had patchy alopecia, while 5.0% had ophiasis. In the MN alone group, 90.0% had patchy alopecia and 10.0% had ophiasis. The p-value was 0.11. The baseline SALT scores were as follows: S0 was observed in 80.0% of the MN + TrA group

and 85.0% of the MN alone group, S1 was observed in 15.0% of the MN + TrA group and 10.0% of the MN alone group, and S2 was observed in 5.0% of participants in both groups. The p-value for this variable was 0.14, indicating no significant difference in the baseline severity of alopecia areata between the two treatment modalities.

Table 1

Bifurcation of demographic and clinical data with respect to treatment modalities.

Variables	Categories	Treatment modalities		p-value
		MN + TrA 20 (50.0%)	MN alone 20 (50.0%)	
Age (years)				0.09
	Mean ± SD	32.6 ± 9.7	33.5 ± 10.4	
	Median (min-max)	33 (18-50)	34 (21-47)	
Sex				0.12
	Male	12 (60.0)	5 (25.0)	
	Female	8 (40.0)	15 (75.0)	
Duration of disease (years)		0.17		
	Mean ± SD	0.56 ± 1.01	0.85 ± 1.32	
	Median (min-max)	0.17 (1m-4y)	0.33 (1m-5y)	
Family history			0.21	
	Absent	8 (40.0)	15 (75.0)	
	Present	12 (60.0)	5 (25.0)	0.08
Number of patches				
	Mean ± SD	1.13 ± 0.26	1.34 ± 1.81	
	Median (min-max)	1 (1.-1)	1 (1-6)	
Types				0.11
	Patchy	19 (95.0)	18 (90.0)	
	Ophiasis	1 (5.0)	2 (10.0)	
Salt score baseline			0.14	
	S0	16 (80.0)	17 (85.0)	
	S1	3 (15.0)	2 (10.0)	
	S2	1 (5.0)	1 (5.0)	

SD (standard deviation).

Table 2 presents the bifurcation of the treatment response among the studied groups, as measured by the Severity of Alopecia Tool (SALT) score after 12 weeks. The distribution of treatment response showed significant differences between the two groups, with a p-value of 0.001. In the MN + TrA group, the responses were as follows: 5.0% of participants had an A0 response, indicating no improvement; 5.0% had an A1 response; 10.0% had an A2 response; 20.0% had an A3 response; 25.0% had an A4 response, indicating substantial improvement; and 35.0% had an A5 response, representing complete recovery. In contrast, the MN alone group showed a less favourable response distribution: 30.0% had an A0 response, 20.0% had an A1 response, 30.0% had an A2 response, 15.0% had an A3 response, and only 5.0% achieved an A4 response, with no participants reaching an A5 response.

When categorised into broader response groups, the results further highlighted the efficacy of the MN + TrA treatment. In the MN + TrA group, 5.0% of participants showed no response, 35.0% had a partial response, and a significant 60.0% achieved a complete response. In contrast, the MN alone group had 30.0% of participants showing no response, 65.0% with a partial response, and only 5.0% achieving a complete response. These findings suggest that the combination of microneedling with triamcinolone acetonide is more effective in achieving a complete treatment response in patients with alopecia areata compared to microneedling alone. The statistically significant p-value of 0.001 supports the conclusion that the observed differences in treatment outcomes between the two groups are unlikely to be due to chance.

Table 2

Bifurcation of response of treatment among the studied group according SALT score after 12 weeks.

Variables	Categories	Treatment modalities		p-value
		MN + TrA 20 (50.0%)	MN alone 20 (50.0%)	
Response				0.001
	A0 (no change or regrowth)	1 (5.0)	6 (30.0)	
	A1 (1-24% regrowth)	1 (5.0)	4 (20.0)	
	A2 (25-49% regrowth)	2 (10.0)	6 (30.0)	
	A3 (50-74% regrowth)	4 (20.0)	3 (15.0)	
	A4 (75-99% regrowth)	5 (25.0)	1 (5.0)	
	A5 (100%) regrowth	7 (35.0)	-	
Response categories				0.001
	No	1 (5.0)	6 (30.0)	
	Partial	7 (35.0)	13 (65.0)	
	Complete	12 (60.0)	1 (5.0)	

Table 3 details the bifurcation of side effects observed in the study participants. Regarding irritation, the MN + TrA group had 5.0% (1 participant) experiencing irritation, whereas no participants in the MN alone group reported this side effect. Despite this difference, the p-value of 0.15 indicates that this observation was not statistically significant. In terms of abnormal hair growth, no participants in either treatment group experienced this side effect, with a p-value of 0.001. Although the p-value suggests statistical significance, it reflects the absence of this side effect in both groups rather than a difference between them. Redness was reported in 10.0% (2 participants) of the MN + TrA group, while no cases were observed in the MN alone group. Similar to irritation, the p-value of 0.13 suggests that this difference was not statistically significant. Scaling was observed in 10.0% (2 participants) of those treated with MN + TrA, while no participants in the MN alone group experienced this side effect. Again, the p-value of 0.13 indicates that this difference was not statistically significant. Overall, the side effects observed in the study were relatively minor, with low incidence rates in both treatment groups. Although the MN + TrA group showed slightly higher instances of irritation, redness, and scaling compared to the MN alone group, these differences were not statistically significant. The absence of abnormal growth in both groups further suggests that the treatments were well-tolerated by the participants.

Table 3

Bifurcation of side effects with respect to treatment modalities.

Variables	Categories	Treatment modalities		p-value
		MN + TrA 20 (50.0%)	MN alone 20 (50.0%)	
Irritation				0.15
	No	19(95.0)	20(100.0)	
	Yes	1(5.0)	-	
Abnormal growth				0.001
	No	20(100.0)	20(100.0)	
	Yes	-	-	
Redness				0.13
	No	18(90.0)	20(100.0)	
	Yes	2(10.0)	-	
Scale				0.13
	No	18(90.0)	20(100.0)	
	Yes	2(10.0)	-	

DISCUSSION

Alopecia areata is an organ-specific, T-cell-mediated autoimmune disorder that targets hair follicles. The primary pathophysiological mechanism involves peribulbar lymphocytic infiltration, which disrupts the normal hair cycle. However, the perifollicular inflammatory infiltrate spares the bulge region of the follicle, where the follicular epithelial stem cells are located. Consequently, unlike cicatricial alopecia, the inflammation does not compromise the integrity of the hair follicle [8]. Assessing the effectiveness of treatments for alopecia areata objectively is particularly challenging, as spontaneous remission is unpredictable. In cases where the affected area presents as patchy, hair may regrow spontaneously in many instances. However, it is important to note that none of the current therapeutic options offer a cure or prevention for the condition [9].

To the best of our knowledge, this is the first study from Pakistan to evaluate the efficacy and safety of topical triamcinolone acetonide combined with microneedling (MN) versus microneedling (MN) alone in for the treatment of patchy alopecia areata. In our study, the effectiveness of topical triamcinolone acetonide combined with microneedling (MN) in promoting hair regrowth in alopecia areata (AA) patches was emphasised, as a highly statistically significant reduction in the SALT score from baseline to the end of follow-up was observed across all groups.

Corticosteroids are among the most widely utilised and effective treatments for alopecia areata (AA) [10]. Intralesional corticosteroids (ILCs), particularly triamcinolone acetonide, are regarded as the first-line therapy for adult patients with AA. The primary mechanism of action involves immunosuppression, where corticosteroids reduce inflammation in AA lesions by suppressing the T cell-mediated immune attack on hair follicles [11, 12].

Microneedling, commonly used for treating acne scars, has also recently been employed in the treatment of androgenic alopecia. Its proposed mechanism of action involves stimulating dermal papillae and stem cells, leading to the release of platelet-derived growth factors and enhanced epidermal growth factors through platelet activation and the skin wound regeneration process [13].

In the MN group, regrowth scores of 4 (regrowth ≥75%) and 3 (regrowth 51%–75%) were achieved in 5.0% and 15.0% of patients, respectively, by the conclusion of the study (after three months of follow-up). Consequently, a therapeutic response (A3 + A4) was observed in 20% of patients. Our findings align with those of Aboeldahab et al., who reported a favourable therapeutic response (A3 + A4) in 22.5% of patients treated with MN alone at the end of their study [14]. Conversely, our results differ from those of Giorgio et al., who did not observe hair regrowth in AA patches treated with MN alone [15]. This discrepancy may be attributed to the small sample size (nine patients in the MN group) and the inclusion of patients with severe AA resistant to previous treatments in their study. Previous studies have elucidated the effect of microneedling (MN) on stimulating hair growth in alopecia areata (AA). They suggest that MN may promote hair regrowth by activating stem cells, delivering growth factors, and enhancing blood flow to the hair follicles [6, 16].

However, our results demonstrated a statistically significant difference between the two groups concerning the percentage of improvement. A complete response was observed in 60.2% of the MN + TrA group, compared to only 5.0% in the MN alone group (p-value = 0.001). In the triamcinolone acetonide (TrA) group, we utilised 10 mg/ml triamcinolone acetonide in combination with microneedling (MN). To our knowledge, only a few prior studies have employed this approach in the treatment of alopecia areata (AA), and their findings align with ours. Chandrashekar et al. [17] utilised microneedling (with a derma roller) followed by the topical application of 10 mg/ml triamcinolone acetonide in treating two patients with patchy AA. Both patients underwent three sessions at three-week intervals, showing improvement with each session and achieving excellent hair growth three weeks after the final session. Consistent with our results, they concluded that combination therapy can induce faster hair regrowth due to the uniform and painless drug administration, with the added benefit that collagen induction by microneedling may counteract the potential atrophy caused by triamcinolone [17].

Chandrashekar et al. [16] administered treatment to fifteen patients with alopecia areata, who had previously tried various treatment modalities. Among these 15 individuals, 4 had alopecia totalis (AT), 4 had the ophiasis pattern of alopecia areata (AA), 6 had discrete patches, and 1 had the diffuse pattern of AA. The treatment regimen involved five sessions of triamcinolone acetonide administered to the scalp via microneedling, with each session occurring at three-week intervals. Significant improvement was observed in the treated areas of 8 out of 15 patients, characterised by the emergence of numerous vellus hairs and a gradual transition to terminal hairs by the end of the treatment period. After 6 sessions, the number of patients showing improvement increased to 12 [16].

A 2016 study evaluated hair growth in 40 female patients following microneedling combined with 10 mg/ml triamcinolone acetonide. Hair growth was assessed at 12 and 28 weeks' post-treatment initiation. The study reported a significant increase in hair count and density, with 48% of patients experiencing hair regrowth [18]. In contrast, our study found a complete response rate of 60.2%. This discrepancy may be attributed to the smaller sample size and shorter treatment duration in our study. Additionally, during our study, no side effects were

observed in cases treated with microneedling combined with triamcinolone acetonide compared to microneedling alone. There were no statistically significant differences in side effects between the two treatment groups.

In our study, the combination of microneedling with topical triamcinolone acetonide enhanced the absorption of both agents and ensured a more uniform distribution of the drug. We included a control group treated with microneedling alone to demonstrate the efficacy of topical triamcinolone acetonide in the treatment of alopecia areata. However, limitations of the study include the small sample size and the short duration of the follow-up period.

CONCLUSION

Topical triamcinolone acetonide is a safe, effective, and promising treatment alternative for localized alopecia areata, particularly when used in combination with microneedling. The combination of topical triamcinolone acetonide and microneedling has been found to be more effective than microneedling alone. Further studies with larger sample sizes and extended follow-up periods are recommended to validate the efficacy of these therapeutic options for alopecia areata. Additionally, evaluating the efficacy and safety of higher doses of topical triamcinolone acetonide in future trials is suggested.

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