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Comparative evaluation of the effectiveness and safety of trichloroacetic acid chemical reconstruction of skin scars versus microneedling in facial atrophic acne scars

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ABSTRACT

Background: Acne vulgaris is a common skin condition that affects numerous adolescents and young adults, often resulting in atrophic acne scars that can cause significant psychological distress for many individuals. **Aims and Objectives:** The primary objective of this study is to assess the effectiveness and safety of trichloroacetic acid (TCA) chemical reconstruction in comparison to microneedling for the treatment of atrophic acne scars. **Materials and Methods:** In this study, patients with facial atrophic acne scars were randomly assigned to one of two groups, each consisting of 20 participants. They received either TCA chemical reconstruction of skin scars (CROSS) or microneedling treatment at 4-week intervals for 16 weeks. The final outcomes were assessed 4 weeks following the last treatment session. Various evaluation methods were employed, including Goodman and Baron's qualitative and quantitative acne scarring grading systems, the physician's global assessment (PGA), and a visual analog scale to measure treatment results in both groups. Additionally, any side effects were documented during each visit. **Results:** On completion of the treatment, there was a notable enhancement in the qualitative acne scar grades, as assessed by Goodman and Baron, alongside a reduction in the mean quantitative acne scar scores. The percentage decrease in these scores, as well as the evaluations from PGA and visual analog scales, showed comparable results across both groups, with no significant differences observed and minimal adverse effects reported. **Conclusion:** Both microneedling and TCA CROSS are effective and safe in diminishing facial acne scars, yielding similar outcomes between the two treatment groups.

Key words: Acne scars; Dermaroller; Trichloroacetic acid chemical reconstruction of skin scars; Goodman and Baron qualitative and quantitative grading system for acne scarring

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INTRODUCTION

Acne vulgaris is a chronic inflammatory condition affecting the pilosebaceous glands, primarily impacting the facial area and upper trunk of adolescents and young adults. This condition can result in post-inflammatory hyperpigmentation and scarring, leading to psychological distress and significantly hindering daily activities due to feelings of embarrassment and societal expectations regarding appearance.[1] A variety of treatment options exist for addressing acne scars, including laser therapy, radiofrequency ablation, fillers, subcision, chemical

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peels, microneedling, and Trichloroacetic acid chemical reconstruction of skin scars (TCA CROSS).[2] Microneedling, performed with a dermaroller, creates numerous micro-injuries in the skin, which promotes the release of growth factors and stimulates collagen production, thereby aiding in the reduction of acne scars.[1] TCA serves as a peeling agent frequently utilized for superficial and medium-depth peels. The TCA CROSS technique employs a higher concentration of TCA (ranging from 65% to 100%) applied directly to the center and base of the scar tissue. This method induces chemical tissue ablation and promotes subsequent collagen synthesis.[2] While numerous studies have established the efficacy of microneedling and TCA CROSS as standalone treatments for acne scars, there is a scarcity of research comparing the safety and effectiveness of these two modalities, specifically in Indian subjects. This gap in the literature motivated the present study to evaluate and compare these treatment approaches for facial acne scars.

Aims and objectives

The aim of this study is to assess the impact of TCA CROSS versus microneedling for the treatment of acne scars with the objectives of comparing the effectiveness and safety of the TCA CROSS technique versus the microneedling technique using a dermaroller in the treatment of atrophic acne scars. This comparison will be assessed through the reduction of Goodman and Baron's quantitative acne scar scores and the improvement in Goodman and Baron's qualitative acne scar grades.

MATERIALS AND METHODS

The research was a 16-week, prospective, single-centered, randomized interindividual study that received approval from the local ethics committee and was conducted in alignment with the principles outlined in the Declaration of Helsinki (approval number: IEC/Th/17/SVD/306). Written informed consent was obtained from all participating patients. The study included forty patients over 18 who presented with facial atrophic acne scars classified as grade 2 to grade 4. The grading of acne scars was carried out utilizing Goodman and Baron's qualitative acne scar grading system, which categorizes acne scar lesions into four distinct grades.[3]

Exclusion criteria consist of individuals with active acne, herpes labialis, facial warts, molluscum contagiosum, patients on systemic retinoids within the past 6 months, anti-acne treatment, history of or evidence of keloid scars, pregnant, breastfeeding women, photosensitivity, active dermatosis, hypersensitivity to the study formulation, systemic illnesses, and malignancies are also excluded. A comprehensive history and clinical examination were conducted for all patients to ensure that all exclusion criteria were adequately addressed.

A total of forty patients participated in the study, which involved a random allocation into two groups of twenty individuals each, determined by a computer-generated randomization chart. The first group received treatment with TCA CROSS, while the second group underwent microneedling with a dermaroller. Patients were positioned supine on the treatment table, with their heads elevated at a 45° angle, and a drape sheet was placed around their necks. The procedure was thoroughly explained to each patient, who were then instructed to close their eyes, which were covered with cotton pads. The facial skin was cleansed with spirit and degreased using acetone applied with 2"×2" gauze pieces. The skin was stretched, and 100% TCA was applied precisely to the atrophic scars using a wooden toothpick, ensuring that the surrounding skin was not affected. The treatment area was closely monitored until a frosted appearance indicated the endpoint, after which patients were instructed to wash their faces with cold water and gently pat them dry. A broad-spectrum sunscreen with a sun protection factor >30 was then applied. In the second group, the patients' faces were gently cleansed, followed by the application of a topical anesthetic cream under occlusion for approximately 1 h. Microneedling was performed using a dermaroller equipped with 192 microneedles, each 1.5 mm in length, applied in horizontal, vertical, and diagonal patterns until pinpoint bleeding was observed. After the procedure, the face was cleaned with normal saline, and ice compresses were applied. Both groups were advised to adhere to strict photoprotection measures. Follow-up evaluations were conducted 1 week later to assess any side effects, with additional follow-ups scheduled at 1 month. Serial photographs were taken at baseline and subsequently at the end of the 4th, 8th, 12th, and 16th weeks.

The results were assessed utilizing Goodman and Baron's qualitative grading system for acne scarring, along with their quantitative grading system.[3,4] Both groups underwent evaluation through the physician's global assessment (PGA) and a visual analogue scale. Clinical photographs were captured during each visit to document progress. Additionally, all patients were monitored for potential side effects, including hypo- or hyperpigmentation, persistent erythema, and edema.

Statistical analysis

The data was systematically coded and subsequently entered into a Microsoft Excel spreadsheet. The analysis was conducted utilizing the Statistical Package for the Social Sciences (SPSS version 20, IBM SPSS Statistics Inc., Chicago, Illinois, USA) software for Windows. Descriptive

statistics were calculated, which included the determination of percentages, means, and standard deviations. For the comparison of quantitative data across two groups, the independent t-test was employed, while the paired t-test was utilized to assess quantitative data before and after observations. The Chi-square test was applied for qualitative data comparisons involving two or more groups. A significance level was established at P≤0.05.

RESULTS

The demographic characteristics of the patients participating in the study are presented in Table 1. At baseline, both groups exhibited no significant differences regarding age, sex distribution, disease duration, baseline qualitative acne scar grades, according to Goodman and Baron, and baseline quantitative acne scar scores (P>0.05), indicating that the groups were comparable prior to the initiation of therapy.[3,4] The outcomes of the two groups were assessed based on improvements in Goodman and Baron's qualitative acne scar grades, reductions in mean quantitative acne scar scores, the percentage decreases in mean quantitative scores, PGA, and visual analog scales.[3,4] Clinical photographs taken before and after treatment for one patient from each group are illustrated in Figures 1 and 2 (TCA CROSS) and Figures 3 and 4 (Microneedling). An analysis of the distribution of cases according to Goodman and Baron's qualitative acne scar grading system revealed a statistically significant difference between the two groups at baseline and after 16 weeks of therapy (P<0.03), as detailed in Table 2. However, no significant improvement was observed in Goodman and Baron's quantitative acne scar scores at the conclusion of the therapy between the two groups (P<0.79), as indicated in Table 3. It was noted that there were no significant differences in the mean percentage reduction of Goodman and Baron's quantitative acne scar scores between the two groups at the conclusion of the treatment, as illustrated in Table 4 and Figure 5. The physician global assessment also revealed no statistically significant differences at the end of the treatment period (P>0.05), as depicted in Figure 6. Similarly, the visual analog score indicated no statistical difference between the two groups (P>0.05), as shown in Figure 7. Regarding side effects, both procedures were well tolerated by the patients, with no major adverse effects reported in either group. All patients experienced transient edema following the procedure, which lasted for 1 day and resolved spontaneously without intervention. 4 patients from group 1 and 1 patient from group 2 developed postinflammatory hyperpigmentation. Furthermore, none of the patients in either group exhibited persistent erythema, postinflammatory hypopigmentation, as represented in Figure 8.

DISCUSSION

Atrophic acne scars, which may develop following acne vulgaris, result in significant psychological distress for affected individuals.[5-7] Prompt intervention for acne vulgaris can mitigate the severity of these scars; however, the treatment of atrophic scars remains a challenge for many dermatologists, primarily due to patients' financial limitations and the high costs associated with certain treatment modalities. It is essential for dermatologists to present various treatment options, clearly outlining the benefits, safety, expected outcomes, and associated costs, tailored to the patient's financial capacity. Among the more affordable options, TCA CROSS and microneedling can be effectively utilized in standard clinical settings, particularly in regions where laser treatments are either unavailable or prohibitively expensive.[8-11] The CROSS employs 100% TCA to achieve controlled destruction akin to chemical peels, facilitating re-epithelization and subsequent modification of the scars.[9] The application of high-strength TCA peels at the base of the scar effectively ablates the epithelial wall, thereby promoting dermal remodeling. Clinical improvements are generally proportional to the number of CROSS treatment sessions, with over 90% of patients reporting significant enhancement after three to six treatments.[2] Numerous studies have validated the clinical effectiveness of TCA CROSS for atrophic acne scars, demonstrating good cosmetic results with minimal adverse effects.[12-16]

Microneedling with a dermaroller is based on the concept of percutaneous collagen induction, which involves the

Table 1: Demography of the patients included in the study

Demographic data	Group 1 (TCA CROSS)	Group 2 (Microneedling)	P-value
Age in years (Mean±SD)	22.61±3.11 years	22.78±2.19 years	0.49
Sex ratio (Male: Female)	13:7	14:6	0.73
Duration of disease in months (Mean±SD)	28.8±14.11 months	31.8±14.70 months	0.51
Baseline goodman and Baron's qualitative acne scar grade according to percentage (Grade 2, 3 and Grade 4)	35%, 50%, 15%	30%, 50%, 20%	0.89
Baseline goodman and Baron's quantitative acne scar scores (Mean±SD)	6.65±2.75	7.25±2.26	0.45

TCA CROSS: Trichloroacetic acid chemical reconstruction of skin scars

Table 2: The allocation of cases based on Goodman and Baron's qualitative grading system for acne scars was assessed in both groups at baseline and after a 16-week treatment period

Number of lesions	At baseline				At the end of 16th week of therapy			
	Group 1 (TCA CROSS)		Group 2 (Microneedling)		Group 1 (TCA CROSS)		Group 2 (Microneedling)	
	Number of patients (n=20)	Percentage of cases	Number of patients (n=20)	Percentage of cases	Number of patients (n=20)	Percentage of cases	Number of patients (n=20)	Percentage of cases
Grade 1	0	0	0	0	0	0	0	0
Grade 2	0	0	0	0	9	45	3	15
Grade 3	9	45	4	20	7	35	15	75
Grade 4	11	55	16	80	4	20	2	10
P-value	0.34				0.03			

TCA CROSS: Trichloroacetic acid chemical reconstruction of skin scars

Table 3: Mean Goodman and Baron's quantitative acne scar scores at baseline and at the end of 16 weeks of therapy

Mean acne scar score (Mean±SD)	Group 1 (TCA CROSS)	Group 2 (Microneedling)	P-value
At baseline	6.65±2.75	7.25±2.26	0.45
At the end of 16th weeks	4.65±2.97	4.45±1.82	0.79

TCA CROSS: Trichloroacetic acid chemical reconstruction of skin scars

Table 4: Mean percentage reduction in Goodman and Baron's quantitative acne scar scores of the two groups

Mean percentage reduction in quantitative acne scar scores	Group 1 (TCA CROSS)	Group 2 (Microneedling)
Mean±SD	35.41±15.33	43.84±15.53
P-value	0.09	

TCA CROSS: Trichloroacetic acid chemical reconstruction of skin scars

creation of multiple microperforations within the scarred dermal layer, effectively disrupting the scar tissue and resulting in minor bleeding. This microinjury serves as a catalyst for the release of growth factors, which in turn stimulates the synthesis of new collagen without destroying the epidermis.[9] Numerous studies have validated the efficacy of microneedling in treating acne scars.[17-19] In our investigation, the majority of participants felt within the age range of 18–25 years. The average age of individuals in group 1 (TCA CROSS group) was 22.61±3.11 years, while in group 2 (Microneedling group), it was 22.78±2.19 years. The difference in average age between the two groups was not statistically significant (P=0.49). The study comprised 13 males and 7 females in group 1, and 14 males and 6 females in group 2, indicating a predominance of males in both groups. In group 1, a significant enhancement in Goodman and Baron's acne scar grades was first observed at the conclusion of 12 weeks of treatment (P=0.008), with this improvement being maintained at the end of 16 weeks.

Figure 1: At baseline (group 1)

Figure 2: At the end of 16 weeks therapy (group 1)

Figure 3: At baseline (group 2)

In group 2, a notable enhancement in the qualitative acne scar grade as assessed by Goodman and Baron, was observed at the conclusion of 12 weeks of treatment (P=0.005), with this improvement persisting until the end of 16 weeks (P=0.004). When comparing the two groups in our study, the differences in the distribution of patients

Figure 4: At the end of 16 weeks therapy (group 2)

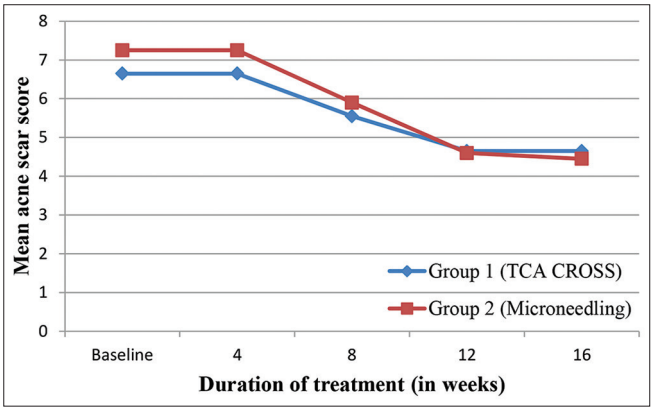

Figure 5: Mean percentage reduction in Goodman and Baron's quantitative acne scar scores in group 1 trichloroacetic acid chemical reconstruction of skin scars and group 2 (microneedling) from baseline till 16 weeks

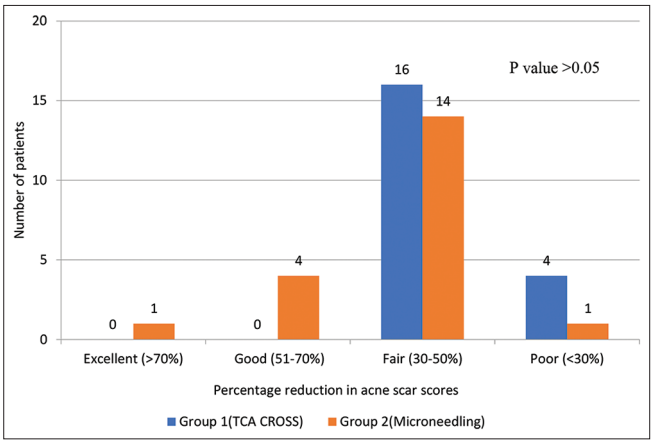

Figure 6: Physician's global assessment

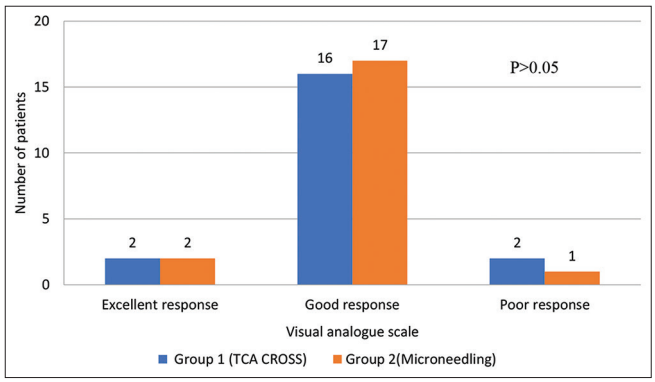

Figure 7: Visual analogue scale

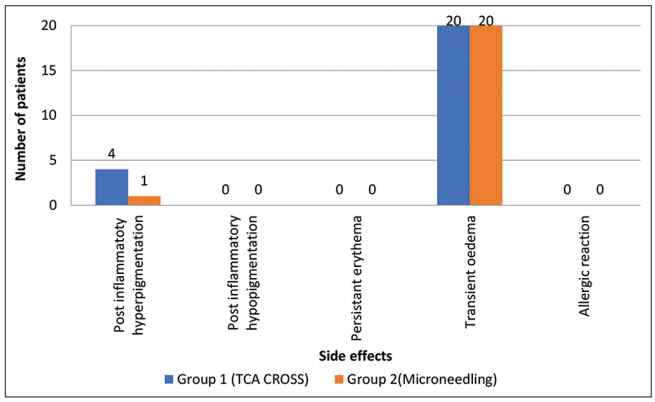

Figure 8: Side effects

regarding Goodman and Baron's qualitative acne scar grading were found to be statistically insignificant at the 4-week (P=0.89), 8-week (P=0.2), 12-week (P=0.63), and 16-week (P=0.81) marks of therapy, suggesting that both groups exhibited a comparable response to treatment in terms of improvement in the qualitative acne scar grades as measured by Goodman and Baron. When analyzing the outcomes of group 1 (TCA CROSS) in comparison to group 2 (Microneedling), the differences in mean scores for Goodman and Baron's quantitative acne scar assessments at the conclusion of 4 weeks (P=0.45), 8 weeks (P=0.72), 12 weeks (P=0.94), and 16 weeks (P=0.79) of treatment were not statistically significant between the two groups. This observation aligns with the results of a study conducted by Dhollan and Thirunavukkarasu.[9] At the end of the 16-week treatment period, the mean percentage reduction in Goodman and Baron's quantitative acne scar scores for group 1 (TCA CROSS) was 35.41±15.33%, while for group 2 (Microneedling), it was 43.84±15.53%. The difference in mean percentage reduction between the two groups was also statistically insignificant (P=0.09) at the 16-week mark. Therefore, there was no statistically significant difference in the percentage reduction of Goodman and Baron's quantitative acne scar scores between the two treatment groups at the conclusion of the therapy. In a previous study conducted by Leheta et al., the effectiveness and safety of percutaneous collagen induction, specifically microneedling, were compared to 100% TCA CROSS for treating atrophic acne scars, revealed a statistically significant enhancement in the overall scar severity scores before and after treatment for both techniques (P<0.001 for each), yet no significant difference was observed between the two groups (P=0.98), suggesting that both treatments yielded comparably similar outcomes.[20] Additionally, a reduction in the percentage of overall improvement was noted after each treatment, although this difference was not

statistically significant (P=0.51). In their findings, Leheta et al. reported an average improvement of 68.3% in the microneedling group and 75.3% in the TCA CROSS group, with the difference in improvement levels being statistically insignificant (P=0.47). Consequently, our research aligns with the earlier findings of Leheta et al., reinforcing the conclusion that both treatment modalities are comparable in efficacy. However, the percentage improvement in acne scar scores reported by Leheta et al., was higher than that observed in our study, which may be attributed to their use of overall scar severity scores for quantification, whereas our study employed Goodman and Baron's quantitative acne scar scores to assess the severity of acne scars.[20]

In our investigation regarding side effects, it was noted that none of the participants experienced allergic reactions, persistent erythema, or post-inflammatory hypopigmentation. However, all patients in both the group experience transient edema and 4 out of 20 patients (10%) in the TCA CROSS group exhibited post-inflammatory hyperpigmentation, while 1 out of 20 patients (5%) in the Microneedling group also developed this condition. Consequently, the incidence of post-inflammatory hyperpigmentation was marginally higher in the TCA CROSS group, aligning with findings from the study conducted by Dhollan and Thirunavukkarasu, which reported three patients in the TCA CROSS group experiencing significant post-inflammatory hyperpigmentation, in contrast to none in the microneedling group.[9] This discrepancy may be attributed to the use of a 100% concentration of TCA in both studies. Additionally, considering that the study involved Indian patients with darker skin tones, there is a heightened likelihood of developing post-inflammatory hyperpigmentation following TCA treatment.

Our research indicated that both TCA CROSS and microneedling with a dermaroller are effective methods for addressing atrophic acne scars. However, when these two techniques are compared, they yield similarly favorable outcomes, demonstrating comparable clinical efficacy, safety, and tolerability.

Limitations of the study

This is a single-centric study that has a restricted sample size.

CONCLUSION

We found that the TCA CROSS technique utilizing 100% TCA and microneedling with a dermaroller are equally effective in the treatment of atrophic acne scars. Both procedures are considered safe and are well tolerated by patients.

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Authors' Contribution:
SL- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article; **PGM**- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **NB-** Design of study, statistical analysis and interpretation; **PGM-** Review manuscript; **NB**- Literature survey and preparation of figures; **PGM**- Coordination and manuscript revision.

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