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Comparing the Efficacy of Intra-dermal Platelet Rich Plasma (PRP) Injection versus 35% Trichloroacetic Acid (TCA) for Treatment of Atrophic Acne Scars

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Abstract

Background: Atrophic acne scars are a common concern among individuals of all ages and skin types, impacting both appearance and self-esteem. Platelet-rich plasma (PRP) and trichloroacetic acid (TCA) have gained attention as potential treatments for atrophic acne scars due to their regenerative and collagen-stimulating properties.

Aim of the Work: This study aims to compare the efficacy of intra-dermal PRP injections and 35% TCA in treating atrophic acne scars.

Patients and Methods: A randomized controlled trial involving 60 participants with atrophic acne scars was conducted. The participants were divided into two groups: the first group received intra-dermal PRP injections, while the second group received 35% TCA treatment. The efficacy of both treatments was evaluated based on scar improvement, patient satisfaction, and adverse effects.

Results: The study findings indicate that both PRP injections and TCA treatment significantly improved the appearance of atrophic acne scars. The application of TCA resulted in a significantly higher percentage of scar improvement compared to PRP. Complications were minimal, with a slightly higher incidence observed in the TCA group. These results support the notion that TCA is more effective than PRP in improving the appearance of atrophic acne scars. The findings also highlight the overall safety of both treatments, although TCA carries a slightly higher risk of complications.

Conclusion: This study provides evidence supporting the superior efficacy of TCA over PRP in treating atrophic acne scars. It emphasizes the importance of considering patient satisfaction, demographic factors, and potential complications when choosing between these treatment options.

Keywords: intra-dermal platelet rich plasma (PRP); trichloroacetic acid (TCA); atrophic acne scars

Introduction

Acne Vulgaris (AV), is a long-term skin disease that occurs when hair follicles are clogged with dead skin cells and oil from the skin. It is characterized by blackheads or whiteheads, pimples, oily skin, and possible scarring [1]. Acne sequelae differ according to the duration of inflammation and the site of damage whether dermal or epidermal. Purely epidermal damage is followed by erythema or dyschromia, whereas dermal damage is the actual cause of atrophic scars of different shapes [2]. Scarring occurs in almost 95% of patients with acne. Unfortunately, the atrophic type is often a permanent complication that affects the psychological status of patients negatively [3]. Atrophic acne scars can result from inflammatory skin disease causing sufficient damage to the epidermis and to the dermal collagen. Facial scars resulting from any etiologies are associated with psychological trauma and loss of self-esteem [4].

The main morphological types of atrophic postacne scars are ice pick pitted scars, superficial or deep boxcar scars, and rolling scars. Treatment of each morphological scar type varies, and although one scar type responds to some treatment modality, the same treatment option may not be necessarily effective in other type of scars [5]. A chemical peel is a quick outpatient procedure that can be used to treat acne scarring. Trichloroacetic acid was used conventionally over years in different strengths ranging from 35% to 100% in various application methods [6].

However, these chemical peels usually work best for macular scars, have limited use for deeper atrophic scars, and should be used cautiously in darker-skinned patients because of the potential for pigmentary alterations. Deep chemical peels have fallen out of favor for the treatment of acne scars because of their significant side effect profile, such as dyschromia and scarring [7]. Platelet Rich Plasma (PRP) is a blood

product with a high platelet and a normal plasma fibrinogen level. Given the effective factors of PRP in repairing damaged tissues, its application in the field of regenerative medicine has widely been interested over the last three decades [8]. Autologous PRP injection is a safe process, applicable even at outpatient clinic, repeatable and reproducible technique that doesn't require post injection precautions such as avoidance of sun exposure which may interfere with patient usual habits like laser therapy or dermabrasion [9].

Aim of the Work

The aim of this study was to compare the safety and the efficacy of intra-dermal platelet rich plasma (PRP) versus 35% trichloroacetic acid (TCA) for treatment of atrophic post-acne scars.

Patients and Methods

Study design: This study is a prospective comparative study.

Settings (Locality) and duration: Outpatient clinic of Dermatology, Andrology& STDs Department, Mansoura University hospital in the period between January 2022 and December 2022.

Study subjects: The study included 60 patients with atrophic facial acne scars. According to the application of the treatment regimen; we had two groups as follows: **Group A:** This group (30 patients) were treated with 35% TCA and **group B:** This group (30 patients) were treated with PRP injection.

Inclusion criteria

Both genders were included, age ≥ 18 years, patients with atrophic facial acne scars and skin types ranging from II to IV.

Exclusion criteria

Receiving any treatment in the last 6 months for their scars, active acne, skin types V and VI, systemic isotretinoin in the past 6 months, history of keloid, history of facial surgery or procedure for scar, pregnancy and lactation, systemic diseases that can impair healing (e.g., Renal and hepatic diseases) and patients using non-steroidal anti-inflammatory drugs and anticoagulant drugs such as aspirin.

Ethical considerations: Informed consent was taken from all patients included in the Study, all precautions were taken for the privacy of patients, all the results were used only for scientific purposes, this study was taken out after agreement of the local ethical committee, acceptance of the IRB of Mansoura Faculty of Medicine was obtained before starting of the research and code number; MS.22.01.1823

Methods

Complete history taking: Name, age, sex, duration of the lesion, progression of the lesion, previous medication or intervention, family history of similar conditions and site of the scar.

Clinical examination

General and Dermatological examination:

General examination: Clinical examination of patients for any signs of systemic diseases.

Dermatological examination: Determination of acne scar severity was done using global acne scar Grading system [10]. The patients were informed about the nature of the procedures, number of sessions and expected side effects of the procedures.

Photography: All photographs were taken for the face using a digital camera (Sony Alpha A6400) using fixed settings, lighting, and patient positioning (front and profile views of the face) for standardization. Photographs were taken before the sessions. Also were taken before and after each session and after the follow up period. Photographic evaluation was done with the same camera by 3 dermatologists.

Treatment regimen

Trichloroacetic acid peel: the face was treated with one pass of 35% TCA soaked gauze, the end point of treatment was the appearance of white frosting,some Patients experienced a stinging and burning sensation, patients were advised to rinse the face with water until clearance of burning sensation, patients were advised to close their eyes during the application of treatment and patients were advised to avoid sun exposure after the session.

Platelet rich plasma regimen

Preparation of PRP: PRP was prepared by double spin method for each session, 10ml blood was withdrawn from the antecubital vein under complete aseptic conditions in 5cm sterile tube prefilled with 3ml of acid citrate dextrose anticoagulant with (1: 10)

ratio (anticoagulant: blood), first centrifugation was performed at 1500g for 5min, both Buffy coat and plasma layer was taken for further centrifugation and red cell sediment was discarded, second centrifugation was performed at 4000g for 10min, resulting in the formation of platelet poor plasma above platelet rich zone at the bottom, platelet Poor Plasma was removed and discarded leaving behind a solution of 2ml PRP and then PRP solution was injected.

Injection: After cleaning the face with spirit, it was anesthetized using a topical anesthetic cream for about 45 minutes, PRP was injected intradermally through a 30G sterile disposable needle (insulin syringe) deep to each scar on both cheeks, the amount injected was sufficient to elevate the scar and the end point was taken as the elevation of scar, total amount injected was 3-4 mL depending on the number of scars, after injecting, the site was gently massaged and compressed for a few seconds to control the bleeding and the patients were advised to use topical antibiotic after the session.

Treatment duration and follow up: All patients were exposed to four treatment sessions at 4 week's intervals, when there was complete cure before completion of 4sessions, treatment was stopped, the cases were followed for three months to monitor the improvement of the scar and the side effects of TCA when developed.

Statistical Analysis: The collected data was revised, coded, and tabulated using Statistical package for Social Science (**IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.).** Data were presented and suitable analysis was done according to the type of data obtained for each parameter.

Normality of data: Shapiro-Wilk test was done to test the normality of data distribution.

Descriptive statistics: Mean, Standard deviation (± SD), median, minimum and maximum for distributed numerical data and frequency and percentage of non-numerical data.

Results

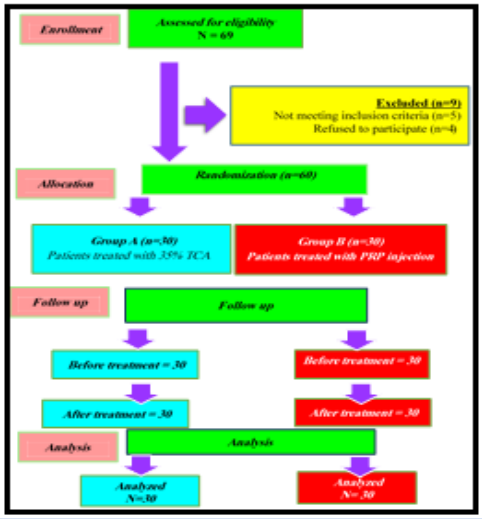

Figure 1: Study flow chart.

"The study included 60 patients (23 males, 37 females) with atrophic acne scars, who met the inclusion criteria. They were randomly assigned to two groups: Group A (n=30) received 35% TCA treatment, and Group B (n=30) received PRP injection.

Table 1: Complications among patients with atrophic acne scars.

	All cases n=60	
	№	%
Complication		
No	58	96.7
Yes	2	3.3

Table 2: Demographic data among patients treated with TCA and PRP

	TCA n=30		PRP n=30		Test (p)
	№	%	№	%	
Sex					
Male	12	40.0	11	36.7	x^2=0.071
Female	18	60.0	19	63.3	p=0.791
Age (years)					
Mean ± SD.	27.70 ± 9.06		27.03 ± 9.19		t=0.283
Median (Range)	24.50 (16.0–50.0)		24.50 (13.0–45.0)		p=0.778
Marital status					
Married	18	60.0	18	60.0	x^2=0
Single	12	40.0	12	40.0	p=1.000

SD. Standard deviation, Range: Min. – Max; X^2, chi square test; t Student-t test; p<0.05 is considered significant.

Table 3: Baseline scar score difference between patients treated with TCA and PRP

Score of scars	TCA n=30	PRP n=30	Test (p)
Before treatment			
Mean ± SE.	3.33 ± 0.17	3.0 ± 0.18	U=357.0
Median (Range)	4.0 (1.0 – 4.0)	3.0 (1.0 – 4.0)	p=0.139

SE. Standard error, Range: Min. – Max; U, Mann-Whitney; p<0.05 is considered significant.

Table 4: Scar score among patients treated with TCA and PRP after therapy

Score of scars	TCA n=30	PRP n=30	Test (p1)
Before treatment			
Mean ± SE.	3.33 ± 0.17	3.0 ± 0.18	U=357.0,
Median (Range)	4.0 (1.0 – 4.0)	3.0 (1.0 – 4.0)	p1=0.139
After treatment			
Mean ± SE.	1.87 ± 0.16	2.47 ± 0.18	U=598.0,
Median (Range)	2.0 (0.0 – 3.0)	2.0 (0.0 – 4.0)	P2=0.020*
Test P2	Z=0.0 P3<0.001*	Z=0.0 P4<0.001*	

SE. Standard error, Range: Min. – Max. U Mann-Whitney; Z: Wilcoxon test; p<0.05 is considered significant. *: Significant <0.05; P1, comparison between TCA and PRP by Mann-Whitney; P2, comparison between before and after treatment at each group by Wilcoxon test

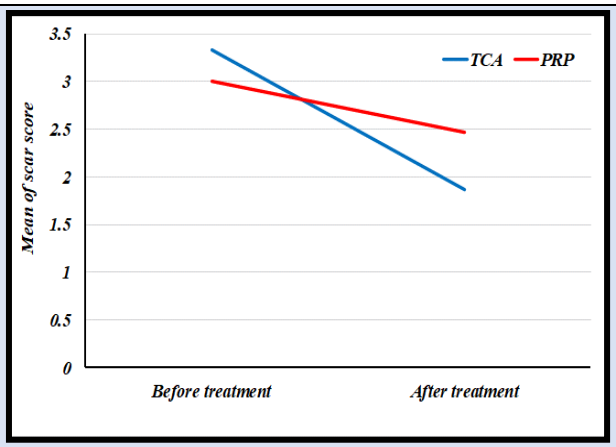

Figure 2: Line chart for scar score among patients treated with TCA and PRP.

Patients treated with TCA demonstrated a higher percent improvement in scar scores compared to the PRP group.

Table 5: Percent improvement of scar score among patients treated with TCA and PRP

Score of scars	TCA n=30	PRP n=30	Test (p)
Percent improvement			
Mean ± SE.	46.39 ± 3.80	17.78 ± 4.26	U=148.5
Median (Range)	50.0 (0.0 – 100.0)	0.0 (0.0 – 100.0)	p<0.001*

SE. Standard error, Range: Min. – Max., U, Mann-Whitney; *: Significant <0.05

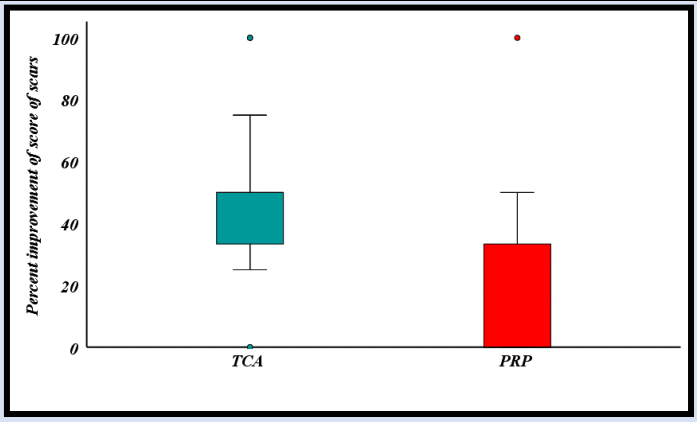

Figure 3: Boxplot for percent improvement of scar score among patients treated with TCA and PRP.

Complications were observed in two TCA-treated cases, while there were no complications in the PRP group.

Table 6: Complications among patients treated with TCA and PRP

	TCA n=30		PRP n=30		Test (p)
	№	%	№	%	
Complication					
No	28	93.3	30	100.0	x^2=2.069
Yes	2	6.7	0	0.0	p=0.492

X2, chi square test; p<0.05 is considered significant.

Patient satisfaction was significantly higher in the TCA group compared to the PRP group.

Table 7: Patient satisfaction among patients treated with TCA and PRP

	TCA n=30		PRP n=30		Test (p)
	№	%	№	%	
Patient satisfaction					
No	3	10.0	22	73.3	x^2=24.754,
Yes	27	90.0	8	26.7	p<0.001*

X2, chi square test; p<0.05 is considered significant.

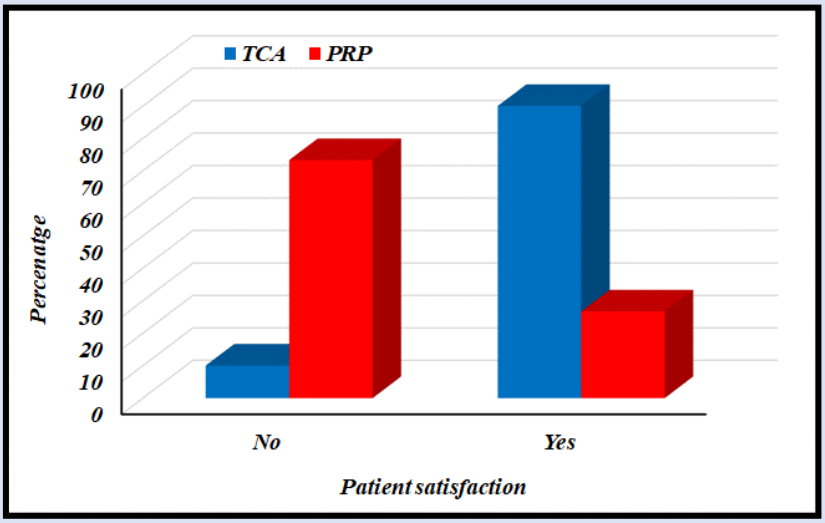

Figure 4: Column chart for patient satisfaction among patients treated with TCA and PRP.

No significant associations were found between the percent improvement of scar scores and demographic data, course, complications, or patient satisfaction in the TCA group.

Table 8: Association between percentage of clinical improvement of scar score and demographic data in patients treated by TCA.

	% Improvement of scar score			Test (p)
	Mean ± SE.	Median	Range	
Sex				
Male, n=12	40.28 ± 4.68	50.0	0.0 – 50.0	U=127.0, p=0.439
Female, n=18	50.46 ± 5.41	50.0	25.0 – 100.0	
Marital status				
married, n=18	44.91 ± 5.27	50.0	0.0 – 100.0	U=117.5, p=0.692
single, n=12	48.61 ± 5.51	50.0	25.0 – 100.0	
Special habit				
No, n=26	48.72 ± 3.89	50.0	25.0 – 100.0	U=32.5, p=0.245
Yes, n=4	31.25 ± 11.97	37.50	0.0 – 50.0	

SE. Standard error, Range: Min. – Max; U, Mann-Whitney.

Table 9: Association between percentage of clinical improvement of scar score and course in patients treated by TCA.

	% Improvement of scar score			Test (p)
	Mean ± SE.	Median	Range	
Course				
Progressive, n=11	46.97 ± 2.03	50.0	33.33 – 50.0	U=90.5, p=0.553
Stationary, n=19	46.05 ± 5.96	50.0	0.0 – 100.0	

SE. Standard error, Range: Min. – Max; U, Mann-Whitney.

Table 10: Association between percentage of clinical improvement of scar score and complications in patients treated by TCA.

	% Improvpement of scar score			Test (p)
	Mean ± SE.	Median	Range	
Complication				
No, n=28	46.73 ± 4.05	50.0	0.0 – 100.0	U=24.5, p=0.777
Yes, n=2	41.67 ± 8.33	41.67	33.33 – 50.0	

SE. Standard error, Range: Min. – Max; U, Mann-Whitney.

Table 11: Association between percentage of clinical improvement of scar score and patient satisfaction in patients treated by TCA.

	% Improvement of scar score			Test (p)
	Mean ± SE.	Median	Range	
Patient satisfaction				
No, n=3	16.67 ± 8.33	25.0	0.0 – 25.0	U=77.0, p=0.005*
Yes, n=27	49.69 ± 3.63	50.0	25.0 – 100.0	

SE. Standard error, Range: Min. – Max; U, Mann-Whitney. *: Significant <0.05

Clinical Results

Group A: Treated with 35% TCA

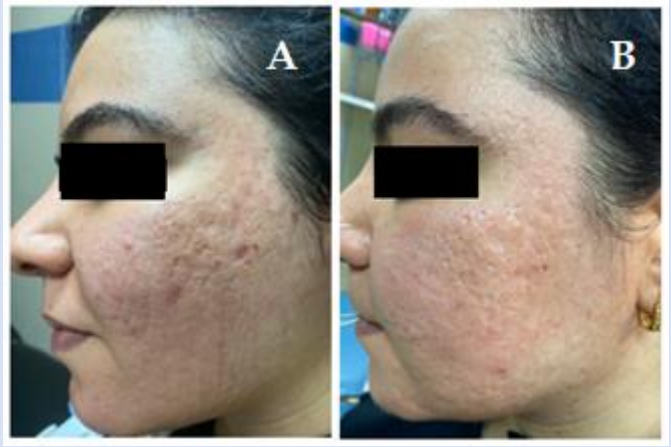

Figure 5: A 28 years old female with atrophic acne scars.
A: Before treatment, Goodman and Baron Global classification of acne scars (4).
B: At the end of follow up with good improvement, Goodman and Baron classification (2).

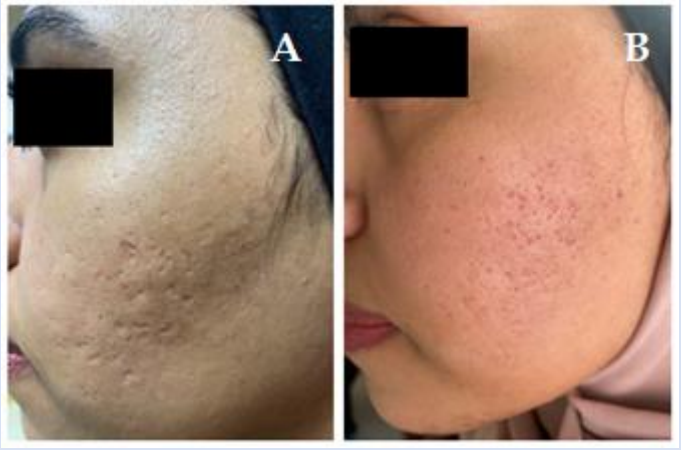

Figure 6: A 24 years old female with atrophic acne scars.
A: Before treatment, Goodman and Baron Global classification of acne scars (4).
B: At the end of follow up with excellent improvement, Goodman and Baron classification (2).

Group B: Treated with PRP injection

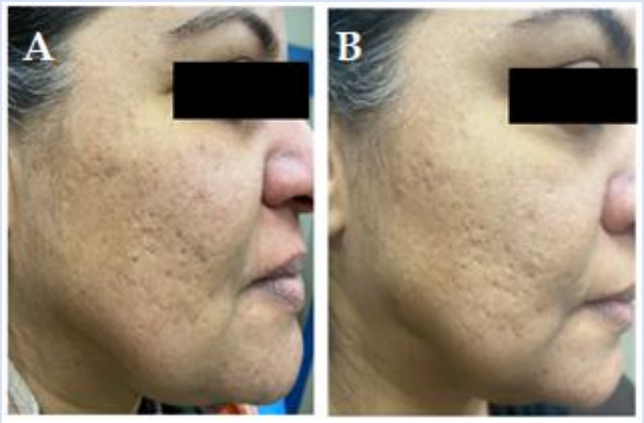

Figure 7: A 45 years old female with atrophic acne scars.
A: Before treatment, Goodman and Baron Global classification of acne scars (4).
B: At the end of follow up with moderate improvement, Goodman and Baron classification (3).

Figure 8: A 37 years old male with atrophic acne scars.
A: Before treatment, Goodman and Baron Global classification of acne scars (3).
B: At the end of follow up with moderate improvement, Goodman and Baron classification (2).

Discussion

Atrophic acne scars are a common problem affecting individuals of all ages and skin types. These scars can have a significant impact on the appearance and self –esteem of individuals, leading them to seek treatment options to improve their appearance [11]. Autologous PRP provided a full array of potential bioactive growth factors and chemokines released on platelet activation, which aid in quick wound healing and actively reduce atrophic acne scarring [12]. Chemical peeling is a quick outpatient procedure that can be used to treat acne scarring. Trichloroacetic acid was used conventionally over years in different strengths ranging from 35% to 100% in various application methods [6]. The aim of present study is to compare the efficacy of intradermal PRP injection versus 35% TCA for the treatment of post acne atrophic scar. This study was carried out on 60 patients with atrophic acne scars. All patients were recruited from those attending the outpatient clinic of Dermatology, Andrology &STDs Department, Mansoura University Hospitals, Mansoura, Egypt. The patients were divided into two groups; The first group was treated with PRP injection, and the second group was treated with 35% TCA.

In the current study, Scar score after treatment improved significantly at both groups, However, there was a statistically significant difference of acne scar grade post treatment between the two groups. The TCA group showed significantly better score than PRP group (mean =1.87 versus 2.47, P1= 0.020). Our study found that the application of TCA resulted in a statistically significant higher percent improvement in scar score compared to PRP (46.4% versus 17.8%, P <0.001). In line with our results [13], evaluated the efficacy of a local application of 35% TCA for the treatment of atrophic acne scars. Sixty-five patients were included in the study and the response rate was very good in 61.5% of cases [14], assessed the utility of 35% TCA on the basis of laid down criteria with CROSS technique in their nine cases, out of which seven were females. They found that five (55.5%) out of nine patients experienced good clinical response, while four patients had excellent response, i.e., more than 70% improvement. Only one patient presented with >25% improvement (fair response), despite the overall clinical improvement being more than 50%, which is consistent with the results of our study [15]. noticed improvement of acne scarring by PRP intradermal injection, while using PRP for skin rejuvenation. They were the first to recommend further trials to examine the benefit of injecting PRP in acne scars, which support the results of our study [6]. found that intra-dermal PRP was significantly better at 12 and 24 weeks after treatment as compared to 50% TCA applied by CROSS technique, and it was seen that mean scar score at 12 weeks was 14.15 ± 3.05 vs. 17.57±4.51 (p <0.001); and at 24 weeks it was 7.09 ± 1.46 vs. 10.09 ± 3.58 with p value of <0.001, which antagonize our results and may be due to different method of TCA application.

According to a study done by [16], they compared PRP with 100% TCA applied by CROSS technique. They further found that, in grade I acne scar, there were no cases, in grade 2, efficacy of PRP vs. 100% TCA was 40% vs. 33%, in grade 3 it was 33% vs. 40%, and in grade 4, it was 26.7% each, which antagonize our results may be due to different method of application of TCA. In our study, all patients treated with 35% TCA were exposed to four treatment sessions at 4 weeks interval. In line with our work [17], found that, Treatment with 35% TCA is directly

related to number of sessions. Increasing number of sessions improved the final outcome. Minimum four sessions is required to reach optimal goals. In our study, some patients with shallower scars improved early before completing the four sessions which is consistent with the results of [18], who found that, shallower scars are associated with earlier improvement and require lesser sessions, also found that, increasing the number of sessions increases the chances of deeper penetration of TCA and reduces scarring. Our study compared treatment by PRP and 35% TCA as separate treatment and there was a statistically significant improvement in the TCA group than the PRP group, combination of treatment may be more beneficial for patients with minimal improvement.

Other studies used combination treatment for post acne atrophic scars as follows; In study done by [19], they compared PRP combined with derma roller vs. derma roller alone and treatment assessment was done by Goodman and Baron's quantitative scores. It was found that a statistically significant difference was noted between the two groups after the treatment ($p<0.05$), favoring PRP and derma roller group. They further described that improvement was noted in 58.58% of cases in PRP and derma roller group and in 43.03% in derma roller group; and on quantitative assessment, the mean acne score after third session was 18.58 ± 4.12 in PRP and derma roller group when compared to 23.58±5.71 in derma roller group. The triple combination of subcision, PRP, and CROSS technique with TCA 50% was previously studied on 20 patients in the form of dot peeling by [20], followed by subcision and intradermal PRP injection 2 weeks later and reported excellent improvement in 30% of patients, good improvement in 20%, moderate improvement in 20%, and mild improvement in 30%.

In a study done by [21]. The combination of subcision, 50% TCA with CROSS technique was used and the pre- and post- treatment outcome was assessed in the form of photographic record; and it was observed that out of 14 patients with grade 4 acne scars, 9 patients (64.3%) improved to grade 2, and 5 patients (35.7%) improved to Grade 3. Out of 10 patients with Grade 3 scars, 6 patients (60%) improved to grade 1, and 4 patients (40%) were improved to grade 2 at the end of the study. All five patients with Grade 2 scars showed significant improvement from baseline [17]. postulated that using PRP injection immediately after carbon dioxide laser resurfacing enhances the recovery of laser damaged skin and synergistically improves the clinical appearance of acne scars. Our study explored the association between the percentage improvement of scar scores and various patient factors (age, duration, course and special habits). Percentage improvement of scar score after TCA application and PRP injection showed non statistically significant correlations with age or duration of the scar ($P>0.05$ for each). Also, non-statistically significant association was found between percent improvement after TCA application and PRP injection as regard course of the scar and special habits.

In our study, there was a statistically significant difference between the studied groups as regard patient satisfaction. Patients who applied TCA showed higher satisfaction when compared to those treated with PRP (90% versus 26.7, $P <0.001$) [16]. assessed the relation between the therapeutic response and the patient satisfaction after treatment with PRP and TCA and found non statistically significant differences in satisfaction after treatment between the treated groups, which antagonize our results. This may be due to different application methods of treatment. In the current study, non-statistically significant differences were found between the TCA and PRP treated groups regarding complications. Only two cases who applied TCA developed complications (6.7%), One of them developed post inflammatory hyperpigmentation, while the other one developed first-degree burn, but those treated by PRP did not have any complications. These findings suggest that both treatments are generally safe, but the use of TCA may carry a slightly higher risk of complications compared to PRP.

Most of the dermatologists prefer a higher concentration of TCA as it increase collagen volume and leads to dermal thickening at higher concentrations. Higher concentration TCA causes severe scarring because of resurfacing issue and damages the normal skin tissue. Lower concentrations of TCA avoid this complication, because the hair follicles and adjacent normal tissues are spared from chemical damage. Peeling with higher TCA concentrations is not recommended, as we did in our study, due to these potential complications [22]. Previous studies utilized the CROSS technique using high concentrations of TCA as TCA 100% [23, 24] and TCA 90% [25] and concluded that the CROSS technique is best suited for ice pick scars 926]. used TCA 50% to guard against severe inflammation and minimize possible adverse effects, especially PIH with

regard to their skin phototypes (Fitzpatrick III, IV), because the patients were scheduled to undergo the traumatic succession and PRP injection after TCA application [16]. Found that Platelet -rich plasma injection is a promising modality for the treatment of atrophic acne scars without the risk of hyperpigmentation or scarring, which is consistent with the results of our study.

The regression analysis conducted in this study aimed to predict the percent improvement of scar scores using various factors as confounders. The factors considered in the analysis included demographic data such as age, gender, marital status, special habits, course, and duration of the condition and the use of either TCA or PRP. The results of the analysis showed that only the use of topical TCA was a favorable predictor of improvement in the appearance of atrophic acne scars. One limitation of the study is the lack of a placebo control group, it is difficult to determine whether the observed improvements in scar scores were due to the treatments themselves or other factors, such as natural healing processes. A placebo control group would have allowed for a more rigorous comparison of the effectiveness of TCA and PRP in improving the appearance of the atrophic acne scars. **This study** did not investigate the long–term effects of TCA and PRP treatment on the atrophic acne scars. The study only measured the percent improvement of scar scores three months after treatment, and it is unclear whether these improvements are sustained over time or not.

Conclusion

Both PRP and TCA are effective treatment options for reducing the severity of atrophic acne scars. However, TCA was found to be more effective than PRP in producing a greater percent improvement of scar score. Furthermore, patient satisfaction was found to be an important outcome measure to consider when evaluating treatment effectiveness.

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