

Microneedling combined with platelet-rich plasma or trichloroacetic acid peeling for management of acne scarring: A split-face clinical and histologic comparison

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Summary

Background: Minimally invasive procedures provide effective, safe, relatively long-lasting, and natural results without large damage to the skin. A combination treatment is considered an approach that includes at least 2 different and unrelated modalities.

Objectives: This study aims to evaluate the use and effectiveness of some combined minimally invasive procedures for management of acne scarring.

Patients/methods: Twenty-four volunteers with postacne atrophic scars were randomly divided into 3 equal groups according to performed procedure on each side of the face (microneedling by dermaroller alone or combined with platelet-rich plasma [PRP] or trichloroacetic acid [TCA] 15% peeling) and received 6 bi-weekly sessions of treatment. Photography and punch biopsies were taken before and after 3 months of treatment for clinical, histological, and histometrical evaluation.

Results: Combined treatment of dermaroller and PRP or dermaroller and TCA 15% showed significant improvement when compared with dermaroller alone ($P = .015$ and $.011$ respectively). Epidermal thickness showed statistically significant increase in studied groups, mainly after dermaroller and TCA 15%. Moreover, the 3 studied groups showed more organized collagen bundles and newly formed collagen formation and markedly decreased abnormal elastic fibers.

Conclusions: Based on the clinical, histometrical, and histochemical assessment, in spite that most volunteers showed significant improvement after treatment, however, the combined use of dermaroller and TCA 15% was more effective in post-acne atrophic scars than the use of dermaroller and PRP or dermaroller only.

KEYWORDS

acne scarring, collagen-induction therapy, microneedling, platelet-rich plasma, trichloroacetic acid peeling

1 | INTRODUCTION

Many different terms have been used to describe minimally invasive skin rejuvenation procedures including subsurface resurfacing and laser toning.¹

A combination treatment is considered an approach that includes at least 2 different and unrelated modalities, such as microneedling combined with platelet-rich plasma (PRP) or with trichloroacetic acid (TCA), or a laser or light device combined with nonlaser technology such as radiofrequency.²⁻⁴

Appropriate patient selection and combination of different procedures allow individualized treatment with optimal outcomes. Multiple sessions of combined minimally invasive modalities, along with the use of future home devices, would fill the gap between ablative and nonablative approaches in maintaining the clinical and the histological improvement.³

Combined minimally invasive procedures are used in management of many cosmetic skin problems such as the treatment of post-acne scars, skin laxity, hyperkinetic facial wrinkles, and hyperpigmentation disorders.⁵

Acne is prevalent in over 90% of adolescents, and it may persist into adulthood in approximately 12%-14% of cases with psychological and social impacts.⁶⁻⁸ In some patients with acne, the inflammatory response results in permanent, disfiguring scars from either increased tissue formation or due to loss or damage of tissue.⁹

There are many types of treatment for postacne scars including medical, surgical, procedural management, tissue augmentation, and various ablative and nonablative lasers and light energies.¹⁰ Of these multiple options, treatment has to be tailored to patient's needs, tolerance, and goals along with the physician's assessment, skills, and expectation. Patient should be informed that the ultimate goal of any intervention is to improve the scars, and no currently available treatment will attain total cure or perfection.⁴

As the demand for less invasive, highly effective cosmetic procedures is growing, a combination of treatment for acne scars has shown good results with no high failure rates or loss of days at work. There is a high level of patient satisfaction, minimal downtime, and the treatment is cost-effective to the patient.^{4,11}

This study aims to evaluate and compare clinically, histometrically, and histochemically the use and effectiveness of some of the combined minimally invasive procedures, using microneedling in conjunction with TCA peeling or platelet rich plasma for the management of postacne atrophic scars.

2 | PATIENTS AND METHODS

This study was conducted on 24 volunteers from attendants of the Dermatology outpatient clinic, Minia University Hospital, seeking for postacne atrophic scars management. Twenty-one volunteers were Fitzpatrick skin type IV (87.5%), and the remaining 3 volunteers were type III (12.5%). The duration of scars ranged from 1 to 14 years with a mean of 6.63 ± 4.03 . Recruited volunteers did not receive any treatment for their scars apart from routine acne treatment.

This study was approved by the Committee for Postgraduate Studies and Research of Faculty of Medicine, Minia University.

These volunteers were randomly divided into 3 equal groups, according to performed split-face procedure:

Group (A): Eight volunteers were treated with combined technique of dermaroller and PRP on right (Rt) side of the face versus dermaroller only on left (Lt) side.

Group (B): Eight volunteers were treated with combined technique of dermaroller and TCA 15% on Lt side of the face versus dermaroller only on Rt side.

Group (C): Eight volunteers were treated with combined technique of dermaroller and PRP on Rt side of the face versus combined technique of dermaroller and TCA 15% on Lt side.

All volunteers have been subjected to full history taking, general and local examination, and photographing of the face before and after each session. Each volunteer received 6 sessions of treatment, 1 session every 2 weeks for 3 months. Punch biopsies were taken from all volunteers before and after 3 months of treatment. An informed consent was taken from each volunteer for treatment, photography, and taking biopsies.

The following minimally invasive therapeutic modalities have been performed:

2.1 | PRP preparation

Ten millilitre blood had been drawn from each patient under sterile condition, collected and put into conical tubes (15 mL; BD Falcon, BD Biosciences, Bedford, MA, USA), that contains 2 mL acid citrate dextrose solution (ACD) at ratio of 2:8 as an anticoagulant. To isolate plasma, tube had been centrifuged at 252 g for 10 minutes (1st spin). Precipitation of RBCs occurred at the bottom of the tube and the plasma-containing platelets at the rest of the tube. The plasma had been gently transferred to an empty tube and centrifuged again at a higher spin at 1792 g for 5 minutes (2nd spin) to precipitate the platelets at the bottom of the tube. After the 2nd spin, sample had been divided into 2 parts; the PRP (the lower one-third) and the platelet-poor plasma (PPP, the remaining upper portion). Calcium gluconate (activator material) had been added to PRP in a ratio of 1:9. Then PRP was ready to be used immediately after activation, as once PRP had been activated, a fibrin network begins to form, solidifying the plasma and causing clot formation.^{2,12}

2.2 | Dermaroller procedure

The face had been sterilized with povidone-iodine and alcohol. The area to be treated had been anesthetized with topical combined anesthesia formed of 2.5% prilocaine + 2.5% lidocaine (EMLA cream, Astra Zeneca UK Limited, Macclesfield, Cheshire, UK) for 45-60 minutes. The treatment had been performed using the needling tool (dermaroller, ADROLL TD, Spain), which consists of 600 stainless steel, mechanically strong and nontoxic needles arranged in 10 rows with a needle length of 1.5 mm. The dermaroller had been passed over the affected areas 8 times in 4 directions (vertical, horizontal, and diagonal). In patients with deep scars, stretching of the skin perpendicular to the dermaroller movement was performed to reach the base of the scar. Pinpoint bleeding and oozing occurred at the needling puncture areas on the skin; it bled for about 30 seconds to 2 minutes and was easily controlled by saline-soaked gauze

swabs that had been used to soak up any fluid ooze and to minimize the pain.^{13,14}

2.3 | PRP application

Topical application of the PRP had been performed at this step after the needling procedure on Rt side of the face in patients of groups A and C, and dermaroller created pores on the skin through which the PRP was delivered to the top layer of the skin easily. The applied PRP was left for about 5 minutes, after that cleaning of the face by saline-soaked gauze had been carried out with application of 1% fusidic acid ointment over the face. The patients were advised to avoid sun exposure, trauma, and to use sun screens daily with a sun protection factor of 30 or more.^{2,13}

2.4 | TCA 15% peeling

Immediately after the dermaroller procedure and cleaning with saline and drying, application of TCA 15% was performed on acne scars on the left side of the face of patients in groups B and C using a cotton-tipped applicator to apply even layers of TCA 15% until an even white frosting was seen which mean coagulation of epidermis. Areas showing insignificant frosting were recoated. Immediate postpeel care included washing the skin with sterile saline. The patients were instructed to avoid sun exposure and to use sunscreens regularly and moisturizers whenever needed.¹⁵

2.5 | Clinical evaluation

During the period of follow-up, 3 end points were chosen for evaluation of the volunteers (baseline, after 1 month of treatment [2 sessions] and after 3 months of treatment). Two blinded dermatologists and 2 independent observers were asked to evaluate the improvement of each of the following criteria: atrophic scar appearance, skin texture, and overall satisfaction based on a 5-point scale (none = 0%, mild = 1%-25%, moderate = 26%-50%, good = 51%-75%, and very good = 76%-

100%).^{14,16} The results were tabulated and compared to baseline for statistical significance with the Pearson chi-squared test (Table 1).

2.6 | Histopathological assessment

Skin biopsies (3 mm punch) had been taken from postacne atrophic scars from both sides of the face before and after 3 months of treatment (2 weeks after last session).

Skin biopsies were subjected to:

- Histologic processing: Skin biopsies were fixed in formalin 10%, embedded in paraffin, sectioned into 5- μ m-thick sections, and then stained with hematoxylin and eosin (H&E) to be examined under light microscope (Accu-Scope #3025 Five Headed [A 3025-5]-OLYMPUS), with a built-in camera (Olympus, digital camera E-330 SLR, Japan), that had been used to examine and photograph the sectioned skin biopsies.
- Histometry: The epidermal thickness (mean distance between the outermost surface of the epidermis, excluding the stratum corneum, and the dermo-epidermal junction) of all skin biopsies were measured by a computer-assisted program (analySIS[®]Five by Olympus Soft Imaging Solutions GmbH, Johann-Krane-Weg 39, D-48149 Münster, Germany) at the dermatopathology unit of the Dermatology Department, Minia University Hospital.
- Special histochemical stains: Orcein stain was used for demonstration of elastic fibers¹⁷ and Masson trichrome stain for collagen.¹⁸

2.7 | Statistical evaluation

The collected data had been analyzed and figured using a computer-based program, SPSS software package for statistical analysis (SPSS for Windows, Version 16.0, copyright ©; SPSS Inc., Chicago, IL, USA). The data had been summarized in the form of mean \pm SD. The significance of clinical improvement in the same group was assessed using dependent (paired) *t* test. The significance of the different clinical results between the 3 groups had

TABLE 1 Clinical improvement in the 3 studied groups

Groups	Group (A)		Group (B)		Group (C)	
	Rt side (dermaroller + PRP)	Lt side (dermaroller)	Rt side (dermaroller)	Lt side (dermaroller + TCA 15%)	Rt side (dermaroller + PRP)	Lt side (dermaroller + TCA 15%)
Improvement score percent						
Range	15-95	10-75	25-80	70-85	40-87	38-90
Mean \pm SD	64.87 \pm 28.67	29.12 \pm 22.52	61.87 \pm 18.69	81.87 \pm 5.3	63.37 \pm 19.04	62.87 \pm 20.5
P value	.015*		.011*		.960	
Score						
Very good	4 (50%)	0 (0%)	1 (12.5%)	7 (87.5%)	2 (25%)	2 (25%)
Good	0 (0%)	1 (12.5%)	3 (37.5%)	1 (12.5%)	2 (25%)	2 (25%)
Moderate	3 (37.5%)	1 (12.5%)	3 (37.5%)	0 (0%)	4 (50%)	4 (50%)
Mild	1 (12.5%)	6 (75%)	1 (12.5%)	0 (0%)	0 (0%)	0 (0%)
P value	.023*		.023*		1	

*Significant P value \leq .05.

been assessed using Pearson's test and ANOVA test. This was interpreted in the form of P value. The value of $P \leq .05$ was regarded statistically significant.

3 | RESULTS

The study included 24 volunteers with postacne atrophic scars. Eighteen volunteers were females (75%) and 6 were males (25%), their age ranged from 18 to 33 years with a mean age \pm SD of 27.33 ± 4.05 years.

Group (A): Eight volunteers were treated with combined technique of dermaroller and PRP on Rt side of the face versus dermaroller only on Lt side, 6 patients were females (75%) and 2 were males (25%), their age ranged from 25 to 32 years with a mean and SD of 27.87 ± 2.47 . Seven volunteers were Fitzpatrick skin type IV (87.5%) and only 1 male was type III (12.5%).

The Rt side showed very good improvement of acne scars in 50% of volunteers, moderate in 37.5%, and mild improvement in only 1 case (12.5%). Meanwhile, the Lt side showed mild improvement of acne scars in 75% of volunteers and good and moderate improvement in only 12.5% for each of them ($P = .023$). There was a significantly higher score of improvement on the Rt side (combined treatment) (mean of 64.87 ± 28.67) when compared to the Lt side (mean of 29.12 ± 22.52 ; $P = .015$) (Table 1, Figure 1A).

All volunteers of group (A) showed improvement in skin texture, and 3 volunteers (37.5%) showed improvement in pigmentation on both sides.

Apart from slight erythema which was observed on both sides of the face, no other side effects have been encountered. However, erythema resolved after 1-2 days after the session.

Group (B): Treated with combined technique of dermaroller and TCA 15% on Lt side of the face versus dermaroller only on Rt side, 6 volunteers were females (75%) and 2 were males (25%), their age ranged from 18 to 33 years with a mean of $26.12 \pm .548$. Seven volunteers were Fitzpatrick skin type IV (87.5%), and only 1 female was type III (12.5%).

The Rt side showed good and moderate improvement of acne scars appearance in equal percentages of volunteers (37.5%), very good and mild improvement in 12.5% for each of them. On the other hand, the Lt side showed very good improvement in 87.5% of volunteers and only 12.5% showed good improvement ($P = .023$). There was a significantly higher degree of improvement of the Lt side (combined treatment) (mean of 81.87 ± 5.3) when compared to the Rt side (mean of 61.87 ± 18.69) ($P = .011$) (Table 1, Figure 1B).

Most volunteers showed improvement in skin texture. Apart from transient slight pigmentation on the Lt side of the face in 1 volunteer (12.5%) with skin type IV that resolved within 1 week and slight erythema and edema that resolved completely after 1-2 days, no other side effects have been encountered.

Group (C): Treated with combined technique of dermaroller and PRP on Rt side of the face versus combined technique of dermaroller and TCA 15% on Lt side. Six volunteers were females (75%) and 2 were males (25%), their age ranged from 20 to 33 years with mean of 28 ± 4.21 . Seven volunteers were Fitzpatrick skin type IV (87.5%), and only 1 male was type III (12.5%).

The degree of improvement of the Rt side (mean of 63.37 ± 19.04) showed nonsignificant difference when compared with the Lt side (mean of 62.87 ± 20.5 ; $P = .960$) (Table 1, Figure 1C).

Improvement in skin texture was observed in most volunteers, and 2 volunteers (25%) showed improvement of pigmentation on both sides. Slight pigmentation on the Lt side of the face was observed in 1 volunteer (12.5%) with skin type IV, which resolved within 2 weeks and slight edema and erythema on both sides that resolved completely after 1 to 2 days. The independent observers and dermatologists' evaluation were comparable to the volunteers' assessment rates.

3.1 | Histological and histometrical results

The epidermis became acanthotic after all types of treatment (dermaroller only or combined with PRP or TCA 15%). The keratinocytes became well organized, and the malpighian layer thickness had increased with development of rete ridges.

The dermis showed increased deposition of collagen fibers. Interfibrillary spaces decreased with linear orientation of fibers that became more parallel to the epidermis.

3.2 | Histometrical evaluation of epidermal thickness

The epidermis showed improvement in all studied groups as follows:

3.2.1 | Group (A)

There was a highly significant increase in the mean thickness of the epidermis from $44.03 \pm 1.92 \mu\text{m}$ before treatment to $54.91 \pm 1.08 \mu\text{m}$ after 3 months of treatment ($P < .001$) on Rt side. Meanwhile, there was a significant increase in the mean thickness of the epidermis from $42.05 \pm 1.72 \mu\text{m}$ before treatment to $50.93 \pm 4.692 \mu\text{m}$ after treatment ($P = .002$) on Lt side. The Rt side (combined treatment) showed a more significant increase in epidermal thickness when compared to the Lt side ($P = .032$) (Table 2, Figure 2A).

3.2.2 | Group (B)

There was significant increase in the mean thickness of the epidermis from $44.12 \pm 7.34 \mu\text{m}$ before treatment to $50.04 \pm 8.87 \mu\text{m}$ after 3 months of treatment ($P = .003$) on Rt side. On the other hand, on the Lt side, there was a highly significant increase in the mean thickness of the epidermis from $45.03 \pm 7.04 \mu\text{m}$ before treatment to $64.94 \pm 6.83 \mu\text{m}$ after 3 months of treatment ($P < .001$). The Lt side (combined treatment) showed a more significant increase in epidermal thickness when compared to the Rt side ($P = .002$) (Table 2, Figure 2B).

3.2.3 | Group (C)

There was significant increase in the mean thickness of the epidermis from $44.71 \pm 6.27 \mu\text{m}$ before treatment with dermaroller and

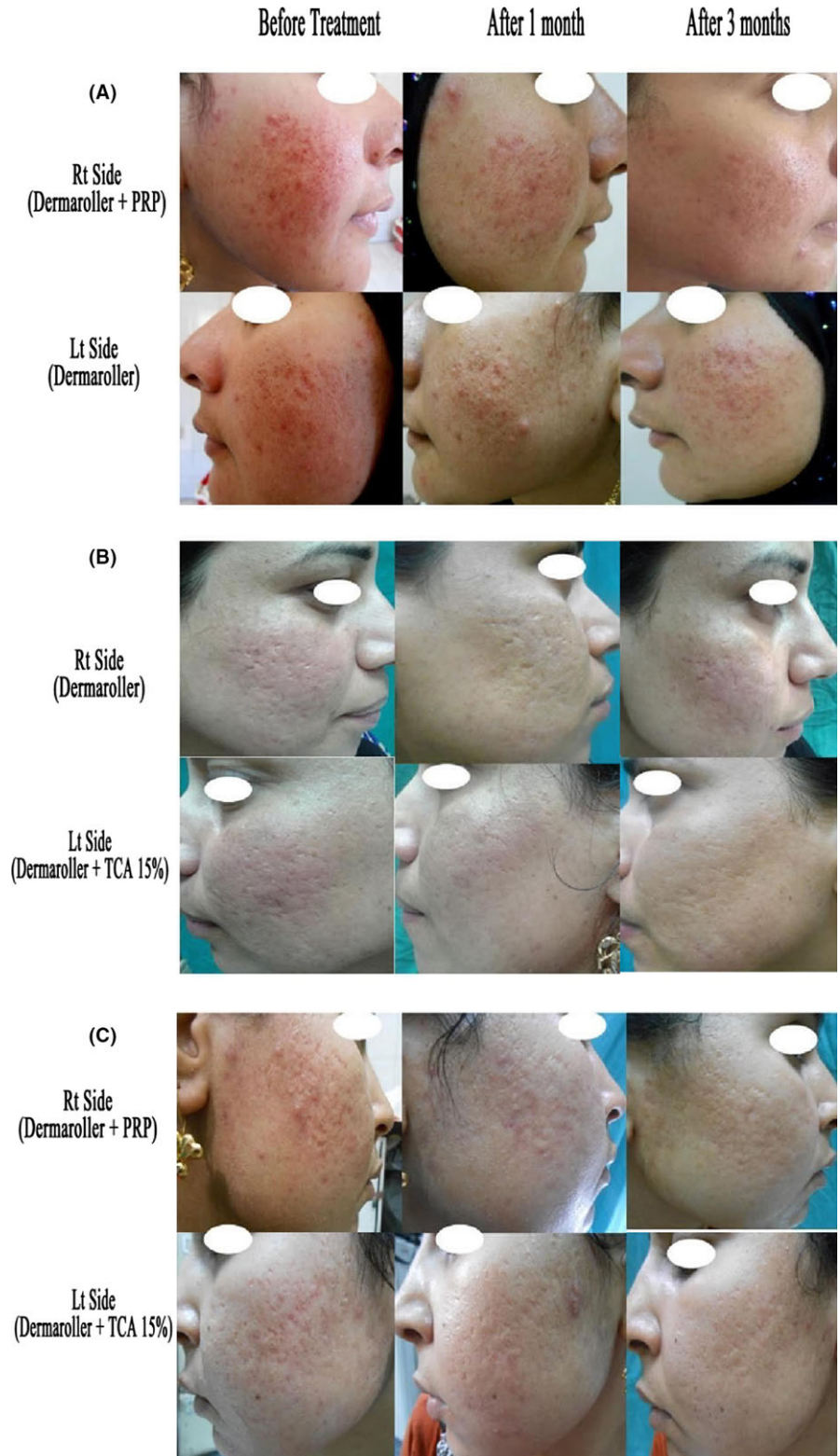


FIGURE 1 Clinical improvement before, after 1 and 3 months of treatment in the 3 studied groups: Group (A): Combined treatment with dermaroller and PRP on the Rt side of the face shows very good improvement. Meanwhile, Lt side (dermaroller) of the face shows mild improvement (A). Group (B): The Rt side, treated with dermaroller alone, shows good improvement. On the other hand, combined treatment with dermaroller and TCA 15% shows very good improvement on the Lt side (B). Group C: Comparison between both combined procedures shows good improvement of Rt side (dermaroller and PRP) and very good improvement of Lt side (dermaroller and TCA 15%) (C)

PRP to $65.81 \pm 11.54 \mu\text{m}$ after 3 months of treatment ($P = .02$) on Rt side. Dermaroller and TCA 15% on Lt side showed significant increase in the mean thickness of the epidermis from $43.61 \pm 6.17 \mu\text{m}$ before treatment to $67.37 \pm 18.63 \mu\text{m}$ after treatment ($P = .014$). The increased mean epidermal thickness on the Lt side was slightly more than the Rt side, however, with no significant value ($P = .843$) (Table 2, Figure 2C).

3.3 | Histochemical Evaluation of Dermal Structures

3.3.1 | Collagen fibers

Before treatment, disorganized collagen bundles appear in both sides of the face, but after 3 months of treatment, by combined dermaroller and PRP or TCA 15% or dermaroller alone, increase in

TABLE 2 Changes in mean epidermal thickness before and after treatment in the 3 studied groups

Groups	Group (A)		Group (B)		Group (C)	
	Rt side (Dermaroller + PRP)	Lt side (dermaroller)	Rt side (dermaroller)	Lt side (dermaroller + TCA 15%)	Rt side (dermaroller + PRP)	Lt side (dermaroller + TCA 15%)
Thickness before treatment (μm)						
Range	41-45.44	40-43.24	36.8-48.29	37.3-54.69	33.02-50.62	35.06-51.53
Mean \pm SD	44.03 \pm 1.92	42.05 \pm 1.72	44.12 \pm 7.34	45.03 \pm 7.04	44.71 \pm 6.27	43.61 \pm 6.17
Thickness after 3 months of treatment (μm)						
Range	53.44-56.06	45.88-57.75	41.16-61.11	59.32-75.8	55.01-81.17	51.78-95.94
Mean \pm SD	54.91 \pm 1.08	50.93 \pm 4.6	50.04 \pm 8.87	64.94 \pm 6.83	65.81 \pm 11.54	67.37 \pm 18.63
Thickness before vs. after (P value)	<.001**	.002*	.003*	<.001**	.02*	.014*
Thickness before Rt side vs. Lt side (P value)	.885		.977		.965	
Thickness after Rt side vs. Lt side (P value)	.032*		.002*		.843	

*Significant P value \leq .05.

**Highly Significant P value \leq .001.

deposition of collagen bundles occurred, which became more organized, more dense, and parallel to epidermis in both sides especially the side treated with dermaroller and PRP than on dermaroller and TCA 15% peeling or dermaroller alone (Figure 3A-C).

3.3.2 | Elastic fibers

In the 3 studied groups, dermal elastic fibers showed increased abnormal elastotic fibers in close contact with epidermis in both sides of the face. After treatment, newly formed well-organized elastic fibers were apparent, while old dense abnormal elastotic material decreased and moved downwards in reticular dermis by evident neo-collagen formation (Figure 4A-C).

4 | DISCUSSION

Combination therapy means application of 2 or more different techniques with potentially optimizing outcomes and improving tolerability.¹⁹

Minimally invasive procedures are used for skin rejuvenation, tightening, and scar remodeling. They enhance dermal extracellular matrix proteins (ECM) without ablation of the epidermis, therefore, limiting side effects and minimizing downtime.³ The goal of most minimally invasive procedures is to initiate selective dermal injury that results in wound-healing response while the epidermis remains intact.¹ They include chemical peels, microdermabrasion, mesotherapy, microneedling, PRP, nonablative lasers, selective photothermolysis, and dermal fillers.²

Microneedling is a simple and effective method for atrophic acne scar treatment, with minimal disruption of the epidermis, thus limiting adverse effects and minimizing downtime.^{14,16} The recurring cost

of the device is very affordable, as it is a mechanical hand-held device made of plastic and stainless steel. It is safe in dark skin (skin types III-V) with acne scars.²⁰

Autologous PRP is a form of bio-stimulation that is safe and creates an immediate, long-lasting volumetric effect with natural-looking results. The technique is easy to perform and has virtually no side effects. The PRP application provides a high level of patient satisfaction.²¹

Methods of PRP application includes topical application after the use of any microneedling device,² as used in the present study. The other is PRP direct injection into the dermis, which is more invasive and may give similar results to that obtained by topical application.²²

Acne can cause both physical and psychological scarring. Scarring frequently results from severe inflammatory nodulocystic acne but may also result from more superficial inflamed lesions or from self-manipulation. The aim of scar treatment is to give the skin a more acceptable physical appearance.²

The present study demonstrated a more promising results with combined treatment of dermaroller and PRP for volunteers with acne scars when compared to the other side treated only with dermaroller ($P = .015$). This is in agreement with Fabbrocini et al² who proposed that PRP contains autologous growth factors, which could enhance the wound-healing response and showed that the combined use of skin needling and PRP is more effective in improving acne scars than skin needling alone.

Trichloroacetic acid peeling causes coagulative necrosis to the epidermal proteins. It is a very versatile peeling, with excellent rejuvenation results and improvement of scars.²³ In the present study, we used superficial TCA peeling (TCA 15%).²⁴ When it is combined with microneedling, it causes improvement in skin texture as well as collagen induction.⁴

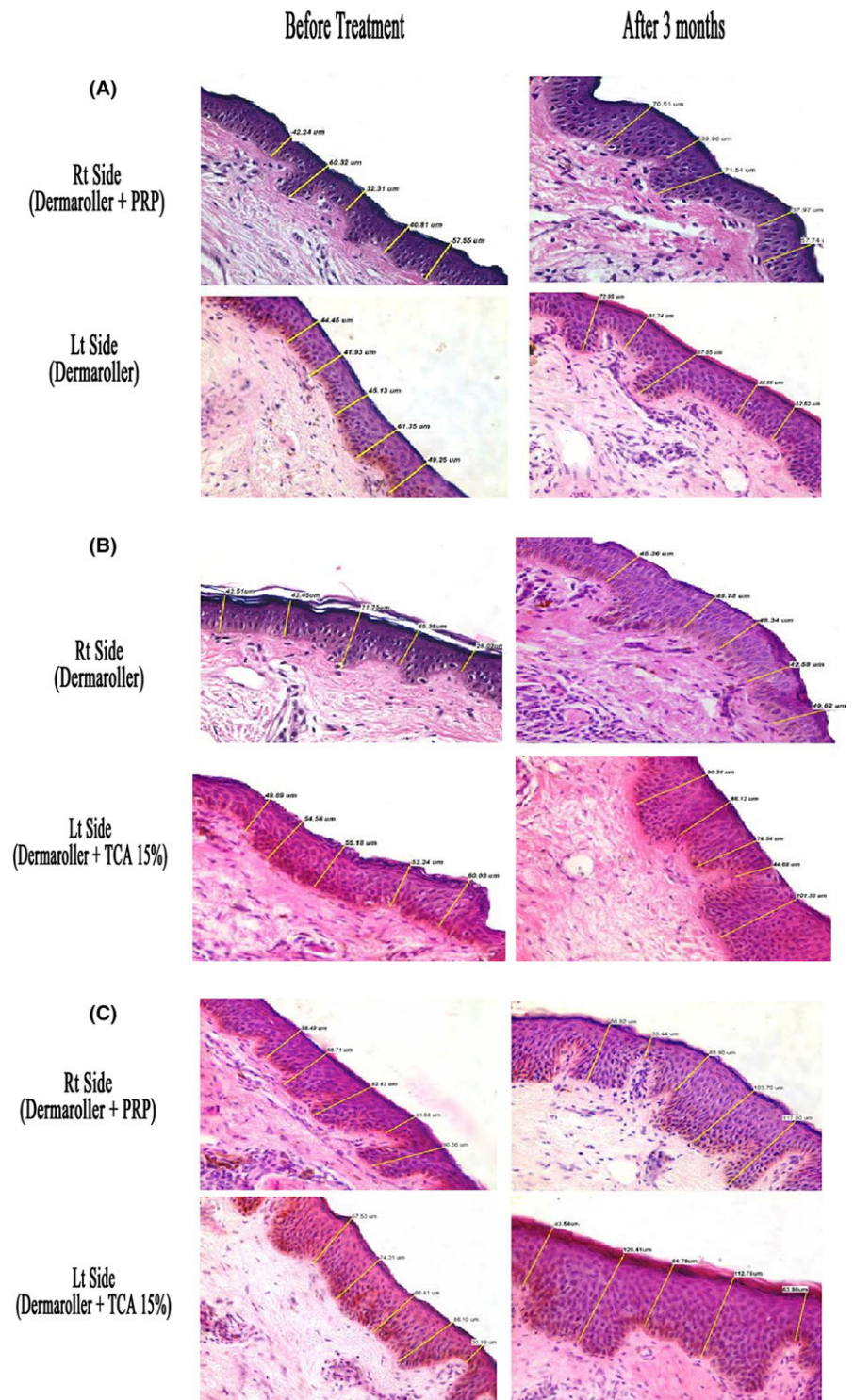


FIGURE 2 Histometry shows a significant increase in epidermal thickness after 3 mo of treatment in the 3 studied groups: Group (A): Rt side shows a more significant increase in epidermal thickness when compared to Lt side (A). Group (B): More significant increase in epidermal thickness on Lt side (combined treatment) when compared to Rt side (B). Group (C): More significant increase in epidermal thickness after 3 mo of treatment on Lt side (dermaroller and TCA 15%) than Rt side (dermaroller and PRP) (C) (H&E; original magnification $\times 400$)

Combined dermaroller with TCA 15% gave the best clinical improvement among the studied groups with very good results in 87.5% of volunteers with significant difference when compared with dermaroller only ($P = .011$). A study from India showed a better statistically significant improvement of combined glycolic acid 35% alternating with skin needling when compared to single treatment with dermaroller only²⁰. This goes with our results, denoting that glycolic acid 35% peels gave close results to TCA 15%.

Meanwhile, there was a significant increase in score of improvement of the sides treated with combined dermaroller and PRP when compared with dermaroller alone ($P = .015$). However, comparing both combined treatment in split-face of volunteers of group (C) showed nonsignificant difference ($P = .96$).

Mild erythema and edema were the main side effects encountered that resolved completely after 1-2 days. Meanwhile, slight temporary pigmentation was observed on the side treated with

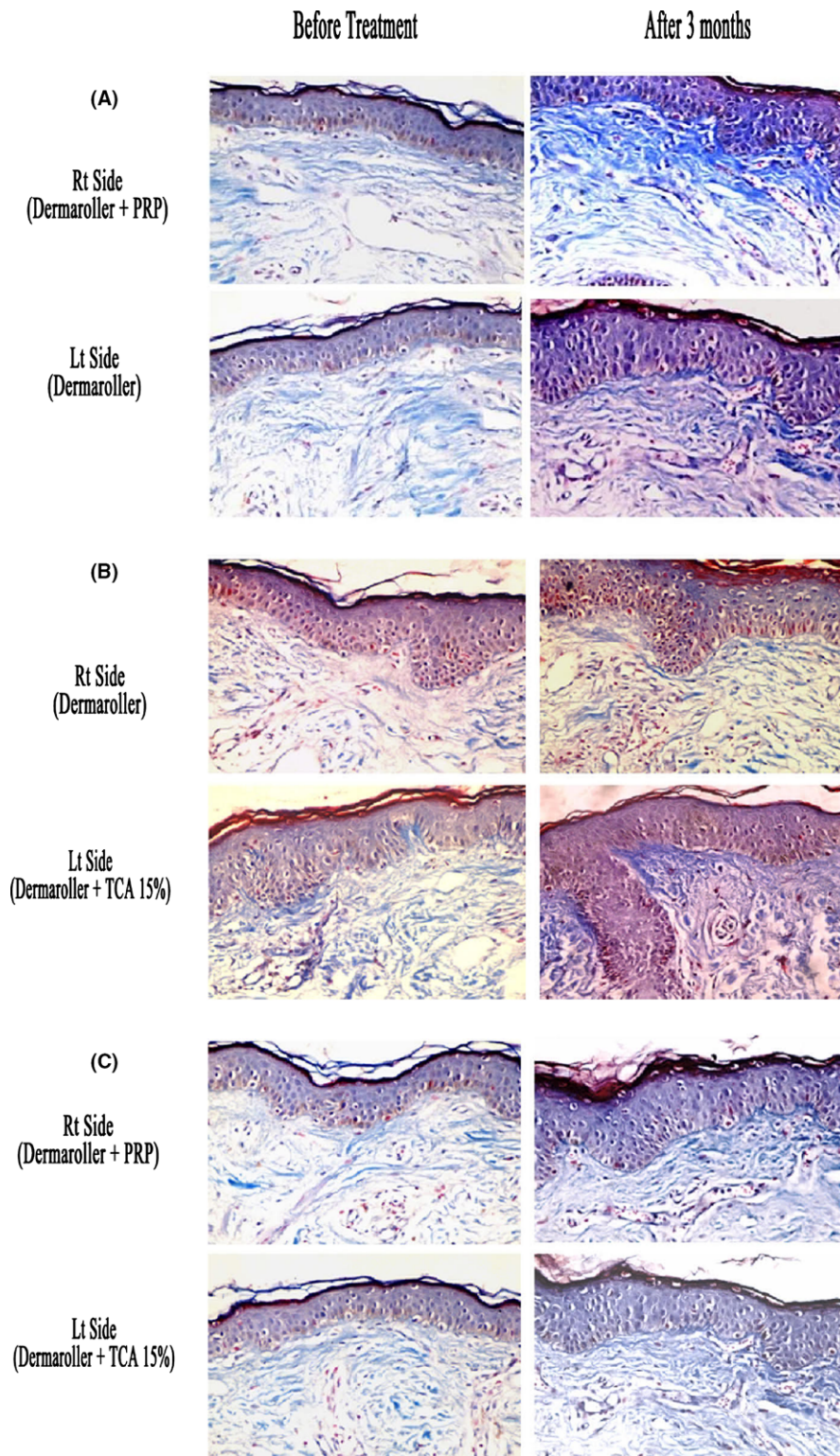


FIGURE 3 Histochemical evaluation of collagen fibers: before treatment showing disorganized collagen bundles in both sides of the face, but after 3 mo of treatment, collagen bundles appear more dense with darker stain, improved organization, and become more parallel to epidermis on both sides in the 3 studied groups A, B, and C. Note increased density of collagen bundles on the combined treatment side than that receiving single treatment (Masson trichrome, original magnification $\times 400$)

combined technique of dermaroller and TCA 15% (Lt side of group B&C) in only 2 volunteers (8.3%) with Fitzpatrick's skin type IV, which resolved within 1-2 weeks after treatment aided by strict avoidance of sun and regular use of sunscreens. This explains why microneedling can be repeated safely in dark skin and is also suited to areas where laser treatments and deep peels cannot be performed.²⁰

Histometrical evaluation of epidermis showed statistically significant increase in epidermal thickness in the studied groups. It showed significant increase in volunteers treated with combined dermaroller and PRP or TCA 15% in one side of the face when compared to the other side treated with dermaroller only ($P = .032$ and $.002$), which correlates to our clinical observation as combined procedures achieved better improvement than dermaroller only.

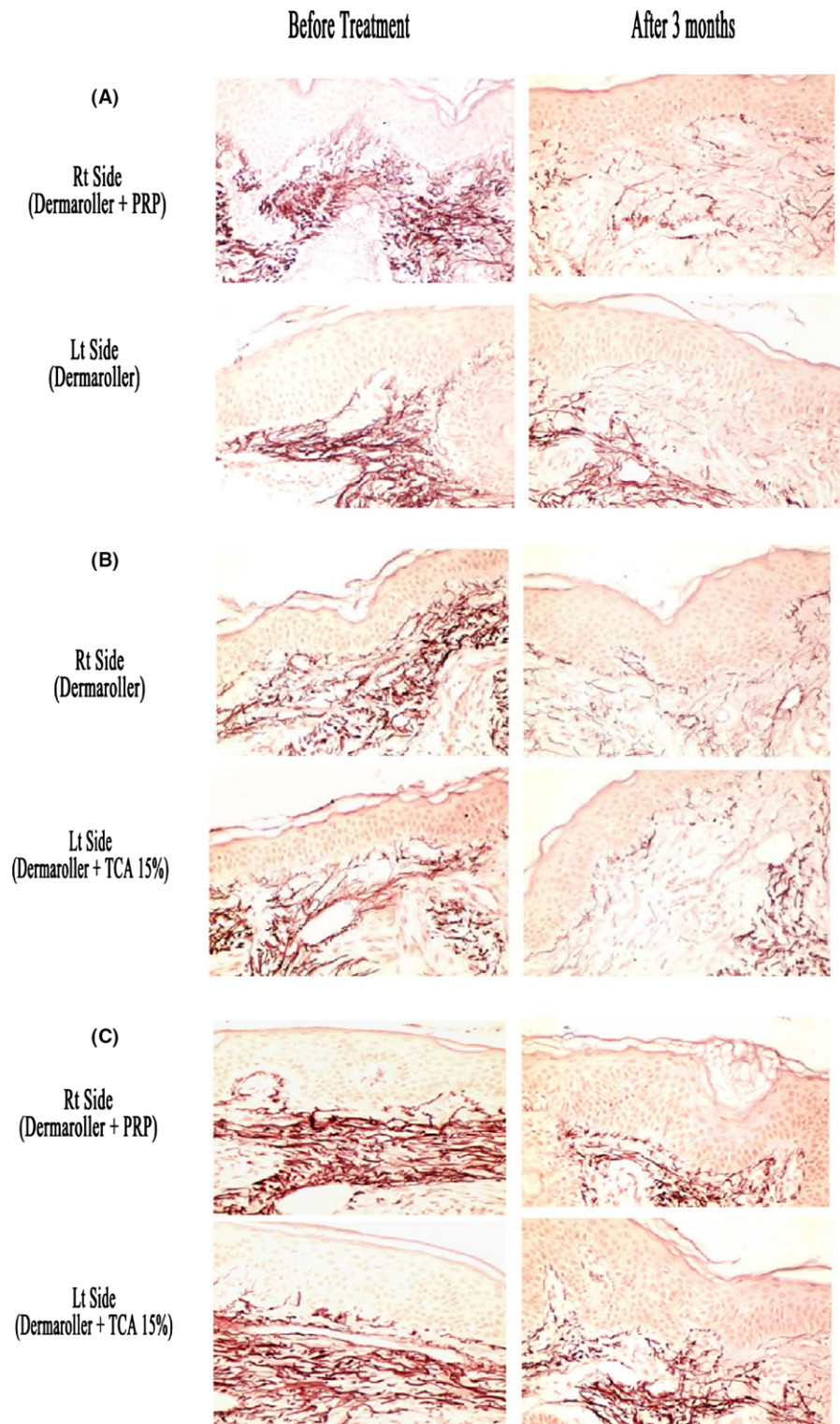


FIGURE 4 Histochemical evaluation of elastic fibers: Dermal elastic fibers before treatment showing increased microfibrils in close contact with epidermis on both sides of the face, while after treatment, the elastic fibers becomes more fine and well organized in the 3 studied groups A, B and C. Note that old dense abnormal elastic material moved downward to reticular dermis due to neocollagen formation, particularly, in sides receiving combined treatments (Masson trichrome, original magnification $\times 400$)

When comparing both combined procedures in the split-face of volunteers, a nonsignificant increase in epidermal thickness after combined dermaroller and TCA 15% was observed ($P = .820$). Our histometric results objectively confirmed different studies that used H&E staining to subjectively evaluate the effect of dermaroller on postacne atrophic scars.²⁵⁻²⁷

El-Domyati et al¹⁴ reported significant histometrical increase in epidermal thickness of postacne scar volunteers treated with

dermaroller, whereas in the present study, microneedling either alone or with PRP or TCA 15% resulted in a significant increase in the epidermal thickness of different groups.

Collagen fibers, the main structural and most abundant ECM component of the skin (about 80% of the skin dry weight), are responsible for tensile properties of the dermis and allow the skin to serve as a protective organ against external trauma.^{28,29} Meanwhile,

elastic fibers, another component accounting for about 2%-4% of ECM proteins, form an interconnecting network that provides elasticity and normal resilience to the normal skin.²⁸ El-Domyati et al¹⁴ reported significant objective quantitative increase in collagen types I, III, and VII after multiple microneedling sessions for atrophic acne scars, with a decrease in abnormal elastin level.

In the present study, histochemical staining with Masson trichrome stain after combined treatment with dermaroller and PRP or TCA 15% or dermaroller only showed more organized collagen bundles in the papillary dermis that became parallel to the epidermis with marked decrease in the interfibrillar spaces giving them a more compact appearance. Meanwhile, histochemical staining with Orcein stain revealed markedly decreased abnormal elastic fibers that were pushed downward to reticular dermis by neocollagen formation, and newly formed microfibrils appeared finer and better arranged after dermaroller treatment or combination of the later with PRP or TCA 15%. The improvement of dermal structures was better noticed after combined treatment of dermaroller and PRP than dermaroller and TCA 15%.

5 | CONCLUSION

Microneedling, PRP, and TCA 15% are easy, safe, simple, and effective methods for collagen induction using the combined minimally invasive techniques employed in the present study. They showed good improvement in most cases of postacne atrophic scars, with minimal downtime.

Meanwhile, combined techniques proved to be more beneficial and advisable over the application of single procedure (dermaroller alone). Nevertheless, combined use of dermaroller with PRP has a more profound effect on the ECM dermal structures, while combined use of dermaroller and TCA 15% showed a more pronounced effect on epidermal thickness with better clinical improvement.

Based on the clinical, histometrical, and histochemical assessment, inspite that most volunteers showed significant improvement after treatment, however, the combined use of dermaroller with TCA 15% has a priority for volunteers of postacne atrophic scars over the use of dermaroller with PRP, although both combinations are effective.

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REFERENCES

- DeHoratius DM, Dover JS. Non ablative tissue remodeling and photorejuvenation. *Clin Dermatol*. 2007;25:474-479.
- Fabbrocini G, Valerio DV, Francesco P, et al. Combined use of skin needling and platelet-rich plasma in acne scarring treatment. *Cosmet Dermatol*. 2011;24:177-183.
- El-Domyati M, Medhat W. Minimally invasive facial rejuvenation: current concepts and future expectations. *Expert Rev Dermatol*. 2013;8:565-580.
- Garg S, Baveja S. Combination therapy in the management of atrophic acne scars. *J Cutan Aesthet Surg*. 2014;7:18-23.
- Goldman A, Wollina U. Facial rejuvenation for middle-aged women: a combined approach with minimally invasive procedure. *Clin Interv Aging*. 2010;5:293-299.
- Williams C, Layton AM. Persistent acne in women: implications for the patient and for therapy. *Am J Clin Dermatol*. 2006;7:281-290.
- Ghodsí SZ, Orawa H, Zouboulis CC. Prevalence, severity, and severity risk factors of acne in high school pupils: a community-based study. *J Invest Dermatol*. 2009;129:2136-2141.
- Capitano B, Sinagra JL, Bordignon V, Cordiali Fei P, Picardo M, Zouboulis CC. Underestimated clinical features of post adolescent acne. *J Am Acad Dermatol*. 2010;63:782-788.
- Jacob CI, Dover JS, Kaminer MS. Acne scarring: a classification system and review of treatment options. *J Am Acad Dermatol*. 2001;45:109-117.
- Rivera AE. Acne scarring: a review and current treatment modalities. *J Am Acad Dermatol*. 2008;59:659-676.
- Finn JC, Cox SE, Earl ML. Social implications of hyperdynamic lines. *Dermatol Surg*. 2003;29:450-455.
- Gawdat HI, Hegazy RA, Marwa M, Fawzy MM, Fathy M. Autologous platelet rich plasma: topical versus intradermal after fractional ablative carbon dioxide laser treatment of atrophic acne scars. *Dermatol Surg*. 2013;40:152-161.
- Lotfi R, Moneib H, Yehia H. Clinical and histopathological evaluation of percutaneous collagen induction (dermaroller) in the treatment of postacne scar. *JEWDS*. 2013;10:152-159.
- El-Domyati M, Barakat M, Awad S, Medhat W, El-Fakahany H, Farag H. Microneedling therapy for atrophic acne scars: an objective evaluation. *J Clin Aesthet Dermatol*. 2015; 8: 36-42.
- El-Domyati M, Attia S, Saleh F, Ahmad H, Uitto J. Trichloroacetic acid peeling versus dermabrasion: a histometric, immunohistochemical, and ultrastructural comparison. *Dermatol Surg*. 2004;30(2 pt 1):179-188.
- El-Domyati M, Barakat M, Awad S, Medhat W, El-Fakahany H, Farag H. Multiple microneedling sessions for minimally invasive facial rejuvenation: an objective assessment. *Int J Dermatol*. 2015; 54:1361-1369.
- Friedberg SH, Goldstein DJ. Thermodynamics of orcein staining of elastic fibres. *Histochem J*. 1969;1:361-376.
- Cohen AH. Masson's trichrome stain in the evaluation of renal biopsies. An appraisal. *Am J Clin Pathol*. 1976;65:631-643.
- Douglas F, Christopher BZ. Combining techniques for treating acne scars. *Curr Derm Rep*. 2012;18:7-17.
- Sharad J. Combination of microneedling and 35% glycolic acid peel for treatment of acne scars in dark skin. *J Cosmet Dermatol*. 2011;10:317-323.
- Zenker MS. Platelet rich plasma (PRP) for facial rejuvenation. *J Méd Esth et Chir Derm*. 2010;148:179-183.
- Eby BW. Platelet rich plasma harvesting with a single spin centrifuge. *J Oral Implant*. 2002;28:297-301.
- Rendon MI, Berson DS, Cohen JL, Roberts WE, Starker I, Wang B. Evidence and considerations in the application of chemical peels in skin disorders and aesthetic resurfacing. *J Clin Aesthet Dermatol*. 2010;3:32-43.
- Vania Marta FY, Tania Maria HB, Chinobu C, Paula HB. Chemical peels: review and practical applications. *Surg Cosmet Dermatol*. 2013;5:58-68.
- Fernandes D. Minimally invasive percutaneous collagen induction. *Oral Maxillofac Surg Clin North Am*. 2005;17:51-63.

26. Fabbrocini G, Farella N, Monfrecola A, Proietti I, Innocenzi D. Acne scarring treatment using skin needling. *Clin Exp Dermatol.* 2009;34:874-879.
27. Majid I. Microneedling therapy in atrophic facial scars: an objective assessment. *J Cutan Aesthet Surg.* 2009;2:26-30.
28. Uitto J. Biochemistry of elastic fibers in normal connective tissue and its alterations in disease. *J Invest Dermatol.* 1979;72:1-10.
29. Bernstein EF, Lee J, Brown DB, Yu R, Van Scott E. Glycolic acid treatment increases type I collagen mRNA and hyaluronic acid content of human skin. *Dermatol Surg.* 2001;27:429-433.

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