doi:10.36849/JDD.7657

 ORIGINAL ARTICLE

Treatment of Acne Scars With Microneedling and Chemical Reconstruction of Scarred Skin Therapy (CROSS) Using Penol/Croton Oil Combination

Quita Lopez MD

Private Practice Lake, Oswego, OR

ABSTRACT

Background: Microneedling has been shown to release growth factors, which improves the appearance of acne scars by itself and in combination with different therapy modalities. Combining microneedling with Chemical Reconstruction of Scarred Skin (CROSS) therapy using a 60% phenol and 0.2% croton oil combination results in a significant improvement of acne scarring.

Objective: To assess the safety and efficacy of combination treatments using microneedling in combination with CROSS therapy that contains 60% phenol and 0.2% croton preparation in patients with Fitzpatrick skin types III to V.

Materials and Methods: Patients were treated over a 5-year period for atrophic acne scars using microneedling combined with CROSS. Most of the patients had combination atrophic scarring. High-quality before and after photographs were taken of the patients to assess the improvement in the scars.

Results: Most of the patients (89.5%) had Fitzpatrick skin types IV through V. Analysis was done on a maximum of 3 microneedling sessions with 1 to 3 CROSS sessions. Photographic evaluation using the Global Aesthetic Improvement Scale showed an 18% grade-1 improvement and 81% grade-2 improvement. The Goodman and Baron Qualitative scar grading system showed a 62% grade-1 improvement and 38% grade-2 improvement.

Conclusion: Combination treatments work best for atrophic scars. This is the first published report of using microneedling with a 60% phenol/0.2% croton oil combination. It proved to be very effective and safe in treating atrophic acne scars in Fitzpatrick skin types III to V, with minimal side effects and a quick recovery.

J Drugs Dermatol. 2024;23(6):418-422. doi:10.36849/JDD.7657

INTRODUCTION

Acne scarring is a common problem that results in adverse psychological symptoms including depression, low self-esteem, and embarrassment about appearance. In the past, various therapeutic options have been described with variable clinical outcomes. These include medical topical treatments, subcision, surgical excision, fractional lasers, CO2 resurfacing, radiofrequency, dermabrasion, and deep chemical peels. Microneedling has become more popular recently compared to 15 years ago. Studies in the literature show that combination therapies are the most effective for treating acne scars.[1-5]

Phenol formulas with croton oil in the range of 0.1% to 0.7% were popular from the 1920s to the 1960s. Baker and Litton were early plastic surgeons who used these formulas. The Baker-Gordon formulas had 2.1% croton oil concentrations.

Hetter and Stone were plastic surgeons who clarified that the croton oil is a vesicant, allowing the phenol to penetrate more deeply. When less than 1% croton oil is used, there is minimal abnormal pigmentation or delayed healing.[6-9]

Rullan noted that in his first 20-plus years of peeling experience that phenol peels liquefied both the epidermis and upper dermis, whereas trichloroacetic acid (TCA) caused protein denaturation without liquefaction.[10] He performed a 2-day phenol/croton oil peel consisting of 60% phenol and 0.2% croton oil. On the second day he performed an abrasion of the scar with curettes or sandpaper, the goal being to achieve punctate bleeding in the shoulders (or edges) and deepest defects of the scars. The croton oil/phenol solution was then applied again with pencil-tip applicators. He concluded that the 2-day peel with chemabrasion was superior to peeling alone, and he obtained an 80% improvement in acne scars. He published his study in 2004.

In 2002, Lee coined the term CROSS (Chemical Reconstruction of Scarred Skin).[11] His study described the application of 65% and 100% TCA to atrophic scars by pressing a wooden applicator to the entire scar to help break down the shoulders of the scars. The 100% TCA concentration had a better result after 4 to 6 treatments; and after 6 treatments there was a greater than 70% improvement.

MATERIALS AND METHODS

Twenty-one patients were treated for atrophic acne scars using an automated microneedling device. The 3MD[R] model 3 was used to treat these patients. This device has twelve 33-guage needles that are 0.02 mm in diameter. This causes a stamping effect on the skin with a depth of penetration up to 2.5 mm. The highest oscillation speed produces 1296 micro-channels per second. The patients were treated with the highest frequency setting, and the depth of penetration was between 0.5 mm and 1.75 mm depending on the anatomy of the face.

Jacob et al coined the terms for 3 different subtypes of atrophic scars as ice pick, rolling, and box car.[12] Goodman and Barron presented a qualitative grading system to describe severity of acne scarring,[13] describing grades 1 to 4, with 1 being macular flat and 4 being deep boxcar, bridges and tunnels, gross atrophy, dystrophic scars, and significant hypertrophy or keloid. These are common descriptions found in the literature.

Eighty-six percent of the patients in the current study had grade 3 or 4 acne scarring consisting of rolling, box car, and ice picks scars, with a few having hypertrophic and keloid scars. The patients had their face cleaned with an antiseptic solution, such as chlorhexidine 4%, prior to the topical anesthetic; and care was taken to avoid the eyes. Neuro Med 7 (4% lidocaine HCL, Sambria Pharmaceuticals, Atlanta, GA) was applied to the patient's face. A plastic wrap was then placed over the face to increase the penetration of the lidocaine and improve its efficacy. After 20 minutes, the anesthetic was then removed and the face cleaned with an antiseptic solution.

A gliding agent was needed to move the pen over the face. Having tried several agents, Factor 5 treatment serum (Factor 5 Skin Care, Chico, California), which is composed of adipose-derived growth factors, was used for this. It is the opinion of the author that the penetrated growth factors contributed to the final result.

The depth of penetration was from 0.5 mm to 1.75 mm depending on the area of the face treated, the thickness of the skin, and the severity of the scarring. The depth was based on the skin's response to the needling. Based on the author's experience, a bleeding endpoint is usually a satisfactory end point. At this level, which is usually a depth of 1 mm, fibroblasts will be stimulated to produce new collagen, and remodeling occurs. The pen is glided in horizontal and vertical motions with some overlap. Over thick atrophic scars, the author has started to stamp the area for better penetration and treatment of thickened edges. The author usually performs the microneedling twice. In areas where there is scarring, if treated more than twice, the level of penetration is always decreased; there is a need to pay attention to the skin's response. After the microneedling is complete, the skin is wiped with sterile saline and CROSS is then performed on the atrophic acne scars.

A toothpick is dipped in the solution of 60% phenol/0.2% croton oil (Stone 100 Delasco, Plano, TX) and applied to the scar. Frosting is seen at varying times after the application, which is the endpoint. Over the years, the author has found that mechanically stretching out the thick edges of the scar with the toothpick helps to liquefy and better break those down. Patients need to be warned that the scars may appear larger as the edges break down. Once collagen is remodeled, they lift and appear smaller.

Factor 5 treatment serum is then layered on the surface of the skin and the patients are sent home with recovery kits that consist of a gentle foaming wash, sunscreen to be applied the next day, and a product called Medical Barrier Cream (Epionce, Boise, Id) which is an effective barrier repair treatment applied to the scabs that form after the acid treatment. The Medical Barrier Cream is a patent-pending reparative system that contains key lipids from botanical extracts and skin-specific ratios of endogenous omega fatty acids. Patients usually have 3 to 6 treatments at 6 to 8 week intervals. The patient's photographs are then assessed by the treating physician and a blinded observer, and the improvement is noted.

As mentioned, in 2002 Lee et al coined the term CROSS (Chemical Reconstruction of Skin Scars).[12] This South Korean dermatologist performed a study in which he described the technique of focal application of higher TCA concentrations to atrophic acne scars by pressing the entire area of the depressed scar with a wooden applicator. By pressing the scars locally, one is able to break down the deep edges of the scars. This process is similar to Rullan's chemabrasion where he abraded the acne scar on day 2 of his phenol peel and reapplied the phenol to further break down the scar.

RESULTS

A total of 21 patients were included in the study. The median age was 39.5 years with a range of 21 to 58 years and a mean age of 33 years. There were 10 male and 11 female patients. Two patients (9.5%) were Fitzpatrick type III, 14 patients (66.7%) were Fitzpatrick type IV, and 5 patients (23.8%) were Fitzpatrick type V. The majority of patients (90.5%) were Fitzpatrick types IV and V. The improvement was only graded on a maximum of 3 CROSS and 3 microneedling sessions. Some patients had fewer CROSS treatments. Each patient's improvement was graded using the Goodman and Baron Qualitative grading. The Global Aesthetic Improvement Scale was also used. The patient photographs were assessed by the treating physician and a blinded physician. Of the patients whose photos were analyzed, 2 (9.5%) had grade 2 scars, 9 (42.9%) had grade 3 scars, and 10 (47.6%) had grade 4 scars.

TABLE 1.

Studies With Combination Therapies and Microneedling		
Investigator	**Methods**	**Results**
Leheta et al[1]	Microneedling with 20% CROSS vs deep phenol peels	Both equally effective
Asif et al[2]	PRP + microneedling vs Microneedling alone	After 3 treatments: 1.PRP + microneedling = 62% improvement 2. Microneedling = 46% improvement (P<0.001)
Nofal et al[3]	PRP injections vs CROSS with 100% TCA vs microneedling with PRP	After 3 treatments: all groups had significant improvement (P<0.001)
Sharad[4]	Microneedling + 35% gycolic peels vs microneedling alone	After 5 treatments: combination treatments had significant improvement
Ruma et al[5]	Microneedling vs microneedling. Interspersed with 70% glycolic peels.	After 3 treatments: combination treatments had better results

TABLE 2.

Response Using Goodman and Baron Qualitative Grading			
Pre-Treatment Grade of Acne Scars	**Number of Patients**	**Post-Treatment Reduction by 2 Grades (%)**	**Post-Treatment Reduction by 1 grade (%)**
Grade 4	10	6 (60%)	4 (40%)
Grade 3	9	2 (22.2%)	7 (77.8%)
Grade 2	2	0	2 (100%)

Thirteen (61.9%) of the patients had a 1-grade improvement in their scarring. Eight (38.1%) had a 2-grade improvement; most of these patients had grade-4 acne scarring, with 60% of them having a 2-grade improvement. Of interest, 2 patients had a 2-grade improvement with only one CROSS treatment but with 2 to 3 microneedling treatments. Both had previous microneedling treatments prior to the CROSS treatment and were young adults in their 20s.

Adhering strictly to the Goodman and Baron Qualitative grading, it was difficult to assess a 3-grade improvement with most patients having only 3 combination treatments. If the patients had more treatments, then a 3-grade improvement would have been possible. The author and blinded observer felt the scars were still visible at 50 cm, hence a 3-grade improvement was not possible.

Using the Global Aesthetic Improvement Scale, 4 (19%) of patients showed much improvement, which the author interpreted as a 75% improvement or better. Seventeen (81%) of patients had a marked improvement, which the author interpreted as 50% to 75% improvement. The physician's assessment of the response to treatment using the Goodman and Baron scoring system is summarized in Table 2 (See Figures 1 to 7).

FIGURE 1. 29 y/o female, right side of face before treatments.

FIGURE 2. 29 y/o female after 3 microneedling and 3 CROSS treatments.

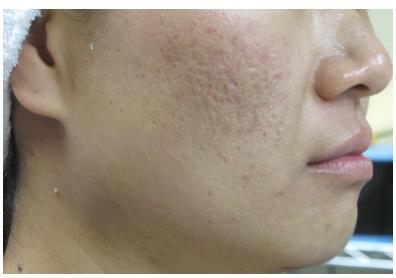


FIGURE 3. 29 y/o female, left side of face before treatments.

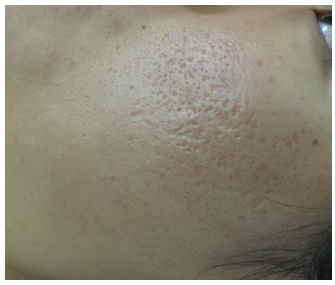


FIGURE 4. 29 y/o female after 3 microneedling and 3 CROSS treatments.

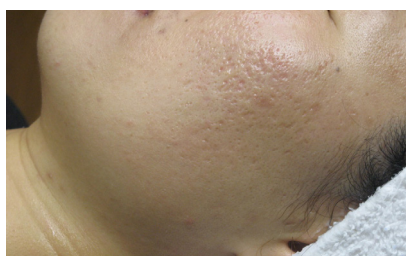
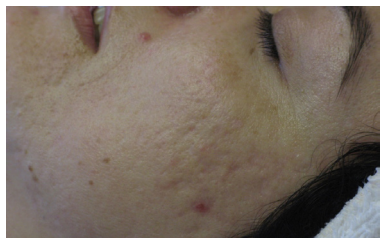


FIGURE 5. 57 y/o male, right side of face before treatments.

FIGURE 6. 57 y/o male after 3 microneedling and 3 CROSS treatments.

FIGURE 7. 31 y/o female, left side of face before treatments.

FIGURE 8. 31 y/o female after 3 microneedling and 3 CROSS treatments.



DISCUSSION

Atrophic acne scar treatments have no standard treatment options. The different treatment modalities can have variable outcomes and complications. Different treatment options discussed in the literature include punch excisions, subcision, filler injections, resurfacing techniques such as dermabrasion, and ablative lasers that include CO2 and Er:YAG lasers or combinations. More recently, plasma energy devices that combine radiofrequency and helium gas have been used to treat acne scars. Varying depth chemical peels made of different formulations have also been described with varying success rates. Lee described CROSS in 2002 in which he showed better than 70% improvement with 6 or more treatments.

Combination treatments have recently become more widespread. Combination treatments with PRP, radiofrequency, peeling, and microneedling have already been described.

It is the author's opinion that the combination of microneedling with CROSS using the phenol/croton oil concentration described by Rullan in his study offers comparable results that are cost effective for the patients. With the increased collagen remodeling as noted in the studies below, fillers are not needed to fill in volume deficiencies. The author likes this combination treatment because it has the versatility to treat a wider array of Fitzpatrick skin types, showing comparable results to more aggressive treatments that require longer downtime and have higher complication rates in terms of scarring and pigment loss.

Microneedling has been around for a while. In 1997 Andre Camirand and Jocelyn Doucet[14] developed Needle Dermabrasion. They noticed that cosmetic tattooed areas caused reduction in tissue, improved texture, and re-pigmenting. In 1996, Des Fernandes of South Africa invented the needling stamp that had 20 needles. Later he created the first roller that had 70 needles. Drs Fernandes and Aust[15-16] wrote some of the first papers on microneedling and coined the term Percutaneous Collagen Induction (PCI). In 2010 Stene Marshall invented the first automated needling device with Advanced Vertical Oscillating Needling (AVON™) technology, which is now called the 3MD Microneedling Pen. This is the device used on the patients in this study.

Some of the studies mentioned earlier had treatment intervals that were as frequent as every 2 weeks. It is the author's belief that these treatment intervals are too close together and pro-fibrotic growth factors could be produced. The following study explains why.

In 2010 Aust et al studied why microneedling does not cause dermal fibrosis like laser ablative procedures.[16] They studied the inflammatory response in 80 male Sprague-Dawley rats whose skin was similar to humans. Transforming growth factors-beta 1-3 (TGF-β 1-3) has been shown to play a crucial role in fibrotic scar formation. TFG-β 3 elicits a scar-free healing response. TGF-β 1 and TGF-β 2 causes a fibrotic scarring response. Using DNA microarray experiments, upregulated genes were

identified in treated and untreated skin. His finding was that all 3 genes that control production of TGF-β 1-3 were upregulated 4 weeks after treatment. At week 8, TGF-β 2 was downregulated and TGF-β 3 was upregulated. This higher ratio is needed for scarless rejuvenation. This has also been shown in studies by Ferguson et al.[17] This is the reason why the author waits 6 to 8 weeks between treatments.

Aust et al described the effects of microneedling on epidermal thickness and induction of genes relevant for regenerative process in an animal model.[18] They observed epidermal and dermal changes via histology and immunofluorescence. Their results were a 112% increase in the thickness of the epidermis with microneedling over 8 weeks. If topical vitamins were added (Vitamin C and Vitamin A) after treatment, there was a 140% increase in the thickness of the epidermis. The histology showed that the collagen fibers were increased, thickened, and loosely woven in the papillary and reticular dermis.

CONCLUSION

According to Fulton, who wrote some of the articles on dermabrasion, "treating acne scars is perhaps the most difficult cosmetic surgery procedure that exists."[19] Correcting the effects of inflammatory acne on the epidermis, dermis, and subcutaneous tissue is very challenging. Most practitioners strive for as much improvement as possible. One has to break down the scar and obtain volume for maximal correction.

Combination treatments have recently become more widespread and have been shown to provide better results than single treatment modalities. Combination treatments with PRP, radio frequency, peeling, and microneedling have already been described. It is of the author's opinion that the combination of microneedling and CROSS, using the phenol/croton oil concentration described by Rullan in his study, offers comparable results which are cost effective for the patients.

DISCLOSURES

The author has no financial disclosures to declare.

REFERENCES

1. Leheta TM, Hay A, Garem E. Deep peeling using phenol versus percutaneous collagen induction combined with tricholoracetic acid 20% in atrophic post-acne scars; a randomized controlled trial. *J Dermatolog Treat.* 2014;25(2):130-136.
2. Asif M, Kanodia S, Singh K. Combined autologous platelet-rich plasma with microneedling versus microneedling with distilled water in the treatment of atrophic acne scars: a concurrent split-face study. *J Cosmet Dermatol.* 2016;15(4):434-443.
3. Nofa E, Helmy A, Nofal A, Alakad R. Platelet-rich plasma versus CROSS technique with 100% TCA acid versus combined skin needling and platelet rich plasma in the treatment of atrophic acne scars: a comparative study. *Dermatol Surg.* 2014;40(8):864-873.
4. Sharad J. Combination of micronedling and gycolic acid peels for the treatment of acne scars in dark skin. *J Cosmet Dermatol.* 2011;10(4):317-323.
5. Rana S, Mendiratta V, Chander R. Efficacy of microneedling with 70% gylcolic acid peel vs. microneedling alone in treatment of atrophic acne scars – a randomized controlled trial. *J Cosmet Dermatol.* 2017;16(4):454-459.
6. Hetter G. Examination of the phenol-croton oil peel: Part 1. Dissecting the formula. *Plast Reconstr Surg.* 2001;105:227-239.
7. Hetter GP. An examination of the phenol-croton oil peel: Part II. The lay peelers and their croton oil formulas. *Plast Reconstr Surg.* 2000;105(1):240-248; discussion 249-251. doi:10.1097/00006534-200001000-00040
8. Hetter G. Examination of the phenol-croton oil peel: Part III. The plastic surgeon's role. *Plast Reconstr Surg.* 2001;105:752-763.
9. Hetter GP. An examination of the phenol-croton oil peel: Part IV. Face peel results with different concentrations of phenol and croton oil. *Plast Reconstr Surg.* 2000;105(3):1061-1083; discussion 1084-1087. doi:10.1097/00006534-200003000-00035
10. Rullan PP, Lemon J, Rullan J. The 2-day light phenol chemabrasion for deep wrinkles and acne scars: a presentation of face and neck peels. *Am J Cosmet Surg.* 2004;21(4):199-210. doi:10.1177/074880680402100402
11. Lee JB, Chung WG, Kwahck H, Lee KH. Focal treatment of acne scars with trichloroacetic acid: chemical reconstruction of skin scars method. *Dermatol Surg.* 2002;28(11):1017-1021; discussion 1021. doi:10.1046/j.1524-4725.2002.02095.x
12. Jacob CI, Dover JS, Kaminer MS. Acne scarring. A classification system and review of the treatment options. *J Am Acad Dermatol.* 2001;45:109-117.
13. Goodman GJ, Baron JA. Postacne scarring: a qualitative global scarring grading system. *Dermatol Surg.* 2006;32(12):1458-1466. doi:10.1111/j.1524-4725.2006.32354.x
14. Camirand A, Doucet J. Needle dermabrasion. *Aesthetic Plast Surg.* 1997;21(1):48-51. doi:10.1007/s002669900081
15. Aust MC, Fernandes D, Kolokythas P, Kaplan HM, Vogt PM. Percutaneous collagen induction therapy: an alternative treatment for scars, wrinkles, and skin laxity. *Plast Reconstr Surg.* 2008;121(4):1421-1429. doi:10.1097/01.prs.0000304612.72899.02
16. Aust M, Reimers K, Gohritz A. Percutaneous collagen induction: scarless skin rejuvenation: fact or fiction? *Clin Exper Dermatol.* 2010;35:437-439.
17. Ferguson MW, Okane S. Scar-free healing: from embryonic mechanisms to adult therapuetic intervention. *Philos Trans R Soc Lond B Biol Sci.* 2004;359:839-850.
18. Aust MC, Reimers K, Kaplan HM, et al. Percutaneous collagen induction-regeneration in place of cicatrisation? *J Plast Reconstr Aesthet Surg.* 2011;64(1):97-107. doi:10.1016/j.bjps.2010.03.038
19. Fulton JE. Dermabrasion, chemabrasion and laser abrasion. *Dermatol Surg.* 1996;22:619-628.

AUTHOR CORRESPONDENCE

Quita Lopez MD
E-mail:..... quitalopezmd@gmail.com