Microneedling Outcomes in Early Postsurgical Scars

R. Brannon Claytor, M.D.
Casey Gene Sheck, D.O.
Vinod Chopra, M.D.

Bryn Mawr, Pa.; Camden, N.J.; and Chantilly, Va.

Background: Scars are a vexing sequela of surgery. Microneedling, also known as minimally invasive percutaneous collagen induction, has demonstrated impressive improvements in chronic acne scars; however, no evidence exists for treating postsurgical scars during active wound healing. The purpose of this study was to demonstrate the utility and safe use of minimally invasive percutaneous collagen induction in acute postsurgical scars.
Methods: Twenty-five patients who underwent surgery had scars treated with three treatments of minimally invasive percutaneous collagen induction in the postoperative period. Scar assessment was measured by Vancouver Scar Scale, Patient and Observer Scar Assessment Scale, and Global Aesthetic Improvement Scale after each of the three treatments and at final 2-month follow-up.
Results: Patients had positive improvement in Vancouver Scar Scale, Patient and Observer Scar Assessment Scale, and Global Aesthetic Improvement Scale scores at 16-week posttreatment initiation evaluation compared to initial measurement ($p < 0.001$). No statistically significant differences were noted when comparing the age of the patient, location of scars, or Fitzpatrick phototype scales among patients. When comparing patients who began treatment early (6 to 7 weeks postoperatively) to those who began treatment late (13 to 16 weeks postoperatively), there was a statistically significant difference in the Patient and Observer Scar Assessment Scale group ($p < 0.04$).
Conclusions: Postsurgical scars treated with minimally invasive percutaneous collagen induction in the maturation and remodeling phase had no adverse outcomes. Interestingly, the data show treatment initiated early in the maturation phase (6 to 7 weeks postoperatively), while natural collagen formation was tapering off, demonstrated improved aesthetic outcomes compared to treatments initiated late in the maturation phase (13 to 16 weeks postoperatively). (*Plast. Reconstr. Surg.* 150: 557e, 2022.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Modulation of scar formation has been the subject of investigation since the beginning of surgery itself. Factors influencing how a scar will change during the healing process are numerous and well researched, with multiple studies showing improved results using fractional lasers on both surgical and acne scars.[1–3] With the advent of minimally invasive percutaneous collagen induction through the mechanical stimulation of microneedling, a novel modality has

From Main Line Health, Claytor/Noone Plastic Surgery; the Division of Plastic Surgery, Cooper University Hospital; and Chantilly Cosmetic Surgery.
Received for publication September 21, 2020; accepted October 15, 2021.
Presented at Plastic Surgery The Meeting, the 88th Annual Meeting of the American Society of Plastic Surgeons, in San Diego, California, September 20 through 23, 2019; Skin Care 2019, the 25th Annual Meeting of the Society of Plastic Surgical Skin Care Specialists, in New Orleans, Louisiana, May 16 through 19, 2019; and Summit of Beauty, 32nd French Society of Aesthetic Plastic Surgeons (SOFCEP) Congress, in Val d'Isère, France. April 25, 2019.

DOI: 10.1097/PRS.0000000000009466

Disclosure: *Dr. Claytor owns stock in Allergan and Barkly (cybersecurity firm), is a clinical instructor for Sinclair, and provides research support with supplies and international review board for Crown Medical. The remaining authors have no financial interests to report.*

Related digital media are available in the full-text version of the article on www.PRSJournal.com.

A Video Discussion by Sachin M. Shridharani, M.D., accompanies this article. Go to PRSJournal.com and click on "Video Discussions" in the "Digital Media" tab to watch.

emerged that can mimic the fractional ablative function of a laser.[4,5]

The science of wound healing indicates that the biologically active time to intervene for improving scars is during the late proliferative to early maturation phase. Current recommendations suggest that minimally invasive percutaneous collagen induction not be used on scars until they are at least 1 year old, however. The purpose of our study was to investigate whether stimulating the wound bed during scar maturation with minimally invasive percutaneous collagen induction could be done safely, and if so, whether any given timing for initiation improves the clinical aesthetic results of scars.

METHODS

Twenty-five women were enrolled into an IntegReview international review board–approved clinical trial for the treatment of postsurgical scars with minimally invasive percutaneous collagen induction. The patients' ages ranged from 21 to 73 years, with a mean age of 53 years old. Surgical procedures included face lift/blepharoplasty (n = 5), tummy tuck (n = 5), breast surgery (n = 4), benign skin lesion removal (n = 9), and brachioplasty (n = 2). All wound closures had a common element of absorbable sutures placed in the deep dermis. Open enrollment was offered to patients with a 6- to 16-week postoperative window. As a result, postoperative treatment groups included 6 to 7 weeks (n = 7), 8 to 9 weeks (n = 7), 10 to 12 weeks (n = 4), and 13 to 16 weeks (n = 7).

Three treatments total were completed, one at time of enrollment, followed by treatments at 4 and 8 weeks. The SkinPen Precision microneedling device (Crown Aesthetics, Dallas, Texas) was utilized with depths ranging between 1 mm and 2.5 mm, based on the location of treatment area (face or body). [**See Video 1 (online)**, which demonstrates microneedling treatment for early postsurgical breast reduction scars.] [**See Video 2 (online)**, which demonstrates microneedling treatment for early postsurgical brachioplasty scars.] At the completion of treatment, Skinfuse Rescue Calming Complex (Crown Aesthetics) was applied. All patients were provided with a Skinfuse Post-Procedure Protocol kit (Crown Aesthetics) and given instructions for use.

Assessments were completed at time of enrollment and before each treatment, and a final assessment was done at 8-week posttreatment completion. The Vancouver Scar Scale and Patient and Observer Scar Assessment Scale were completed at every visit, with the Global Aesthetic Improvement Scale being completed after the initial visit. The Vancouver Scar Scale, Patient and Observer Scar Assessment Scale, and Global Aesthetic Improvement Scale of all participants and treatment groups were analyzed by independent t test for statistical significance. A value of $p < 0.05$ was deemed significant. All statistical analyses were performed using IBM SPSS Statistics V22.0 (IBM Corp., Armonk, N.Y.).

RESULTS

For all participants, the Vancouver Scar Scale (mean ± standard error) demonstrated a statistically significant improvement when the initial evaluation (7 ± 0.3) was compared to the final evaluation at 16 weeks after initiation (3.1 ± 0.5) ($p < 0.001$). In addition, the improvement by the third treatment at 8 weeks after initiation (4.9 ± 0.4) was also statistically significant ($p < 0.001$) when compared to the initial evaluation (Fig. 1). The Patient and Observer Scar Assessment Scale also showed statistically significant improvement from initial evaluation (23.7 ± 1.8) to the third treatment (15.8 ± 1.0) and at the final evaluation at 16 weeks after initiation (11.7 ± 1.0) ($p < 0.001$) (Fig. 1).

Patients' treatments were initiated at time points ranging from 6 weeks to 16 weeks postoperatively. When analyzing data from patients who started treatment at 6 to 7 weeks postoperatively compared to 13 to 16 weeks postoperatively (Table 1), dramatic differences in final results were revealed. The Patient and Observer Scar Assessment Scale scores for patients in the 6 to 7-week postoperative group, initiation versus 16 weeks after initiation (16.8 ± 1.6 to 8.1 ± 0.7), were markedly better than those in the 13- to 16-week postoperative group (26.1 ± 4.2 to 14.2 ± 2.3) ($p < 0.04$) (Fig. 2). When comparing outcomes between age, Fitzpatrick phototype scale, and location of scars on the body or face, no significant difference was noted.

DISCUSSION

Scar formation is regulated by a three-phase process: inflammation, proliferation, and maturation and remodeling.[6,7] Historically, physicians have recommended conservative care through the inflammation and proliferation phases. After this, the standard of care through the maturation phase has been limited, relying on the use of silicone scar cream, mechanical massage, sun

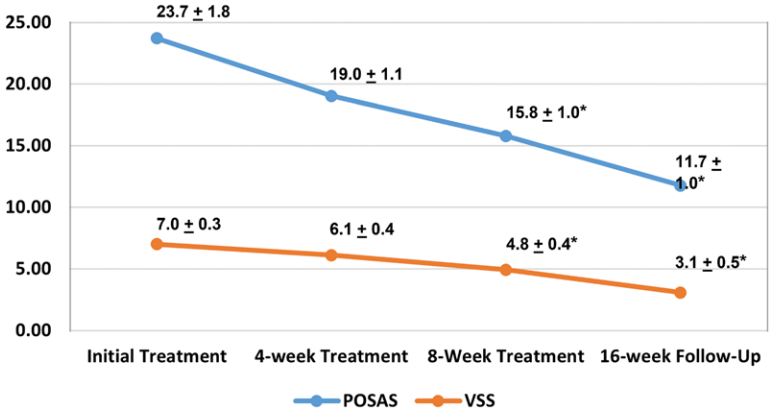

Fig. 1. Patient and Observer Scar Assessment Scale (*POSAS*) with possible scores of 6 to 60, and Vancouver Scar Scale (*VSS*) with possible score of 0 to 13, taken at treatment initiation, before treatment at 4 and 8 weeks, and at follow-up at 16 weeks after initiation. Compared to initial observation, both assessment modalities showed statistical improvement before the 8-week treatment and at the 16-week follow-up ($p < 0.001$).

Table 1. Group Demographics

Groups (Postoperative Initiation)	No. of Patients	Location on Body				Mean Age (Range), yr	Skin Phototype					
		Face	Abdomen	Breast, Chest, Back	Extremities		I	II	III	IV	V	VI
6–7 Weeks	7	3	0	2	2	53 (28–73)	0	1	2	3	0	1
8–9 Weeks	7	1	1	3	2	55 (43–70)	1	4	1	1	0	0
10–12 Weeks	4	2	1	1	0	53 (44–62)	1	1	1	0	1	0
13–16 Weeks	7	2	4	1	0	52 (21–76)	0	5	1	0	1	0

avoidance, and compression therapy.[8] Our hypothesis was that conservative care in the early maturation phase misses an influential time period for scar modulation with reactivation of the healing pathway locally by minimally invasive percutaneous collagen induction. It has been shown that, by penetrating into the reticular dermis, minimally invasive percutaneous collagen induction causes activation and stimulation of fibroblasts to produce collagen and elastin and induce angiogenesis.[5,9–16] We sought to utilize minimally invasive percutaneous collagen induction to increase

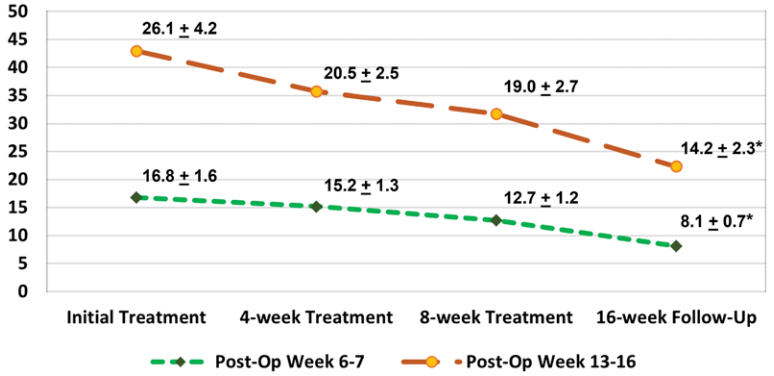

Fig. 2. Patient and Observer Scar Assessment Scale (*POSAS*) with score limits of 6 to 60 for groups with initiation of treatment on postoperative weeks 6 to 7 versus postoperative weeks 13 to 16. Improvement from initial treatment to 16-week follow-up for the postoperative week 6 to 7 group was significantly better than that for the postoperative week 13 to 16 group ($p < 0.04$).

Fig. 3. (*Above*) Brachioplasty scar 6 weeks postoperatively before first microneedling treatment. (*Below*) Brachioplasty scar 8 weeks after third and final microneedling treatment.

local release of platelet-derived growth factor, fibroblast growth factor, and transforming growth factor-α and -β[17,18] during a time in the late proliferation/early maturation phase when collagen production reaches a maximum and starts to decrease after postwounding weeks 4 and 5,[19] with the aim to improve appearance of scars with few side effects or complications. Although basic maneuvers to minimize scarring, such as placing scars within Langer's lines, are helpful, they cannot prevent unattractive scars, hypertrophic scars, or keloids.

Upon examination of the data collected from the study, we found that there was marked improvement in all groups over the course of treatment as would be expected of any healing wound. Interestingly, a statistically significant improvement in healing was seen in the 6-week to 7-week postoperative group compared to the 13-week to 16-week postoperative group. We have provided photographic examples from before treatment and at 8-week follow-up in both the 6-week to 7-week (Fig. 3) and 13-week to 16-week treatment groups (Fig. 4). Although more research is needed to fully evaluate this finding, it certainly represents a significant paradigm shift in scar management.[20] The conventional wisdom currently holds that scars will become static by 1 year and that revision surgery can be considered at that time. Even new minimally invasive percutaneous collagen induction research showing improved overall appearance in scars of multiple causes in multiple body locations excludes any scars younger than 6 months old.[21] What we have learned is that, by waiting, a window of opportunity may be passed over. Therefore, patients and surgeons interested in maximizing scar management may elect for early intervention with microneedling before development of undesirable scars as a matter of preventative care. In our experience, minimally invasive percutaneous collagen induction has been demonstrated to be

Fig. 4. (*Left*) Face lift incision scar 13 weeks postoperatively before first microneedling treatment. (*Right*) Face lift incision scar 8 weeks after third and final microneedling treatment.

well-tolerated in the early postoperative period with no signs of adverse effects. Earlier intervention in the maturation phase of scar healing resulted in more aesthetic scars. Although optimal timing of initiation of treatment is still a matter of further investigation, our results showing that microneedling need not be delayed until 6 to 12 months postoperatively when looking for scar optimization is an important starting point and addition to the literature.

Casey Gene Sheck, D.O.
American Surgical Arts
199 Mullica Hill Road
Mullical Hill, N.J. 08062
drsheck@americansurgicalarts.com
Instagram: @DrCaseyGeneSheck

REFERENCES

1. Zhang Y, Liu Y, Cai B, et al. Improvement of surgical scars by early intervention with carbon dioxide fractional laser. *Lasers Surg Med*. 2019;52:137–148.
2. Fabbrocini G, Fardella N, Monfrecola A, Proietti I, Innocenzi D. Acne scarring treatment using skin needling. *Clin Exp Dermatol*. 2009;34:874–879.
3. Casanova D, Alliez A, Baptista C, Gonelli D, Lemdjadi Z, Bohbot S. A 1-year follow-up of post-operative scars after the use of a 1210-nm laser-assisted skin healing (LASH) technology: A randomized controlled trial. *Aesthetic Plast Surg*. 2017;41:938–948.
4. Fernandes D. Minimally invasive percutaneous collagen induction. *Oral Maxillofac Surg Clin North Am*. 2005;17:51–63, vi.
5. Aust MC, Knobloch K, Vogt PM. Percutaneous collagen induction therapy as a novel therapeutic option for striae distensae. *Plast Reconstr Surg*. 2010;126:219e–220e.
6. Broughton G, Janis JE, Attinger CE. Wound healing: An overview. *Plast Reconstr Surg*. 2006;117(7 Suppl):1e-S–32e-S.
7. Carre AL, Hu MS, James AW, et al. β-catenin-dependent Wnt signaling: A pathway in acute cutaneous wounding. *Plast Reconstr Surg*. 2018;141:669–678.
8. Chen MA, Davidson TM. Scar management: Prevention and treatment strategies. *Curr Opin Otolaryngol Head Neck Surg*. 2005;13:242–247.
9. Alster TS, Graham PM. Microneedling: A review and practical guide. *Dermatol Surg*. 2018;44:397–404.
10. Bonati LM, Epstein GK, Strugar TL. Microneedling in all skin types: A review. *J Drugs Dermatol*. 2017;16:308–313.
11. Dufour AM, Alvarez M, Russo B, Chizzolini C. Interleukin-6 and type-I collagen production by systemic sclerosis fibroblasts are differentially regulated by interleukin-17A in the presence of transforming growth factor-beta 1. *Front Immunol*. 2018;9:1865.
12. Garg S, Dahiya N, Gupta S. Surgical scar revision: An overview. *J Cutan Aesthet Surg*. 2014;7:3–13.
13. Hou A, Cohen B, Haimovic A, Elbuluk N. Microneedling: A comprehensive review. *Dermatol Surg*. 2017;43:321–339.
14. Mujahid N, Shareef F, Maymone MBC, Vashi NA. Microneedling as a treatment for acne scarring: A systematic review. *Dermatol Surg*. 2020;46:86–92.
15. Puiu T, Mohammad TF, Ozog DM, Rambhatla PV. A comparative analysis of electric and radiofrequency microneedling devices on the market. *J Drugs Dermatol*. 2018;17:1010–1013.
16. Ramaut L, Hoeksema H, Pirayesh A, Stillaert F, Monstrey S. Microneedling: Where do we stand now? A systematic review of the literature. *J Plast Reconstr Aesthet Surg*. 2018;71:1–14.
17. Aust MC, Reimers K, Gohritz A, et al. Percutaneous collagen induction. Scarless skin rejuvenation: Fact or fiction? *Clin Exp Dermatol*. 2010;35:437–439.
18. Aust MC, Reimers K, Kaplan HM, et al. Percutaneous collagen induction-regeneration in place of cicatrisation? *J Plast Reconstr Aesthet Surg*. 2011;64:97–107.
19. Janis JE, Harrison B. Wound healing. *Plast Reconstr Surg*. 2014;133:199e–207e.
20. Cary JH, Li BS, Maibach HI. Dermatotoxicology of microneedles (MNs) in man. *Biomed Microdevices* 2019;21:66.
21. Alster TS, Li MKY. Microneedling of scars: A large prospective study with long-term follow-up. *Plast Reconstr Surg*. 2020;145 :358–364.