

Microfocused Ultrasound with Visualization for the Treatment of Stretch Marks

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J Clin Aesthet Dermatol. 2019;12(2):20–24

ABSTRACT

Objective: Stretch marks (striae) can be distressing for many people, and currently available treatments are less than optimal. A previous study showed that the use of a calcium hydroxylapatite (CaHA) filler followed by the topical application of 20% ascorbic acid solution and microneedling significantly improved striae appearance. We sought to evaluate additional improvements in atrophy and color of striae following treatment with microfocused ultrasound with visualization (MFU-V) in subjects who received previous treatments using CaHA, 20% ascorbic acid, and microneedling. **Participants:** Subjects with remaining skin atrophy (N=20) were treated with MFU-V using transducers with a frequency of 7MHz and 10MHz and a focal depth of 3.0 mm and 1.5 mm, respectively, applied in a cross-hatch pattern. **Measurements:** Efficacy was based on changes in Manchester Scar Scale scores. **Results:** At Day 90 post-treatment, the mean (\pm standard deviation) baseline Manchester Scar Scale score decreased from 9.35 (\pm 1.18) to 6.30 (\pm 1.26) ($p < 0.001$) and the mean Patient Satisfaction Scale score increased from 3.75 (\pm 0.44) to 4.70 (\pm 0.47) ($p < 0.001$). Most subjects (70%) were very satisfied with their results. No adverse events were reported. **Conclusion:** The combined use of CaHA, 20% ascorbic acid, and microneedling appears to be effective in improving the appearance of striae. Additional esthetic improvements were seen with the application of MFU-V. **KEYWORDS:** Striae, stretch marks, microfocused ultrasound, microneedling, topical ascorbic acid

The etiology of stretch marks (striae distensae) remains unclear. Possible mechanisms for the development of striae include mechanical stretching of the skin, hormonal alterations, and structural skin changes. Evidence for mechanical stretching is the perpendicular position of stretch marks in relation to skin direction,¹ with a greater prevalence among younger people whose skin is less able to stretch.²

Striae often occur during altered hormonal conditions. Adrenocorticotrophic hormone and cortisol appear to promote fibroblast activity, leading to increased protein catabolism and changes in collagen and elastin fibers.² Accordingly, stretch marks often occur during adolescence, pregnancy and obesity,^{3,4} Cushing's syndrome⁵ and chronic steroid use.^{2,4} Structural changes in the skin have been linked to a genetic propensity for developing stretch marks.⁶ The expression of collagen, elastin, and fibronectin is decreased in striae tissue, with changes in fibroblast metabolism.^{7,8}

The prevalence of stretch marks ranges from 11 to 88 percent, and they commonly affect the abdomen, breasts, thighs, and buttocks.² Among susceptible populations, the prevalence is reported to range from 43 to 88 percent for pregnant women, 86 percent for adolescents, and 43 percent for individuals with obesity.² African-American women are more severely affected than Caucasian women.⁹

Newly formed stretch marks are red (striae rubrae), eventually fading into permanent, hypopigmented, atrophic areas (striae albae).²

Depending on their anatomical location, the appearance of stretch marks can pose a significant psychological burden for some patients¹⁰ and have a negative impact on quality of life measures.¹¹

Although there are commercial creams, lotions, and oils that claim to prevent stretch marks,⁴ the published literature reports no evidence that these remedies provide any benefit.^{4,12,13} One systematic literature review described six clinical trials that evaluated the use of topical products for preventing stretch marks during pregnancy.¹⁴ The authors concluded that there was no high-quality evidence supporting the use of any of the topical preparations for preventing stretch marks. Treatments for existing striae have been less than optimal, as they cannot be completely removed.¹⁵

Microfocused ultrasound with visualization (MFU-V) (Ultherapy®, Merz Aesthetics, Raleigh, North Carolina) has been shown to safely and effectively tighten and lift lax skin on the face and neck.¹⁶ The use of ultrasound visualization at depths of up to 8mm below the skin surface enables accurate treatment of targeted tissues and avoidance of nontarget tissues, such as bone, helping to improve the safety of the technology. MFU-V heats tissue to approximately 60 to 70 degrees Celsius, producing small (<1mm³) zones of thermal coagulation to a depth of up to 5mm within the mid-to-deep reticular layer of the dermis and subdermis, while sparing overlying skin layers.¹⁷ Delivering MFU-V to targeted areas in

FUNDING: Funding for this study was provided by Merz Pharmaceuticals GmbH, Frankfurt am Main, Germany.

DISCLOSURES: The author has no conflicts of interest relevant to the content of this article.

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TABLE 1. Manchester Scar Scale*

COMPONENT	POINT
Color	
Perfect	1
Slight mismatch	2
Obvious mismatch	3
Gross mismatch	4
Finish	
Matte	1
Shiny	2
Contour	
Flush with surrounding skin	1
Slightly raised or indented	2
Hypertrophic	3
Keloid	4
Distortion	
None	1
Mild	2
Moderate	3
Severe	4
Texture	
Normal	1
Just palpable	2
Firm	3
Hard	4

*The scale also includes a visual analogue scale ranging from 1 to 10 points (1= worst, 10=best) that rates the overall cosmetic scar appearance.²¹

the superficial muscular aponeurotic system and platysma results in immediate collagen contraction and initiates neocollagenesis and collagen remodeling.¹⁸

A recent retrospective study previously assessed the effectiveness of combined treatment with a calcium hydroxylapatite (CaHA) filler (Radiesse®, Merz North America, Raleigh, North Carolina), topical application of a 20% ascorbic acid solution, and microneedling for treating new (red) and old (white) striae on various anatomical areas.¹⁹ Additional treatments with ascorbic acid and microneedling only were repeated twice at 30-day intervals. Among the enrolled subjects (N=35), 30 (86%) were very satisfied or satisfied with their treatment results one month after the last treatment session.

TABLE 2. Descriptive analysis of efficacy variables

SCALE	MEAN (±SD)	MEDIAN (MIN, MAX)	SIGNIFICANCE ^a
Manchester Scar Scale, N=20			
Pretreatment scores	9.35 (±1.18)	10.0 (8.0, 11.0)	<i>p</i> <0.001
Posttreatment scores	6.30 (±1.26)	6.0 (4.0, 8.0)	
Change	-3.05 (±1.05)	-3.0 (-6.0, -2.0)	
Patient Satisfaction Scale, N=20^b			
Pretreatment scores	3.75 (±0.44)	4.0 (3.0, 4.0)	<i>p</i> <0.001
Posttreatment scores	4.70 (±0.47)	5.0 (4.0, 5.0)	
Change	0.95 (±0.60)	1.0 (0.0, 2.0)	

^aWilcoxon test for related samples
^bScores ranged from very satisfied (5 points) to unsatisfied (1 point)

Histology studies demonstrated an increase in the quantity and quality of collagen and elastin fibers in the dermis targeted with this combination treatment.

The objective of the present retrospective, nonrandomized study was to assess the safety and effectiveness of MFU-V for further improving the appearance of moderate-to-severe stretch marks previously treated with CaHA, ascorbic acid solution, and microneedling. The combined use of CaHA and MFU-V is consistent with recently adopted guidelines for combined aesthetic interventions.²⁰

MATERIALS AND METHODS

Study subjects. Healthy female subjects aged 18 to 55 years who were previously treated with CaHA, topical 20% ascorbic acid solution, and microneedling, as described above, were provided an opportunity to receive additional treatment with MFU-V in an effort to achieve additional improvement in striae appearance. Enrolled subjects (N=20) were required to have recent or old, moderate-to-severe stretch marks on the buttocks, thighs, breasts, or abdomen and a body mass index of less than 35kg/m². Subjects were required to have not undergone any other treatment for striae during the previous 90 days.

Procedure. MFU-V was delivered using transducers with a frequency of 7MHz at a focal depth of 3.0mm and a frequency of 10MHz at a focal depth of 1.5mm. Each transducer was used to deliver up to 75 parallel treatment lines, 2 to 3mm apart, to each treated area in a cross-hatched pattern. Two-dimensional digital images were obtained prior to treatment and at 90 days post-treatment.

The 90-day effectiveness measures included changes in baseline Manchester Scar Scale scores.²¹ There are five components to this scale: color, contour, distortion, texture, and finish. All components were scored on a scale of 1 to 4, except for finish, which was scored either 1 (matte) or 2 (shiny) (Table 1). Manchester Scar Scale scores range from a possible high of 18 points to a low of five points, with lower scores indicating better aesthetic appearance (the 10-point visual analog scale was not used) (Table 1).²¹ Subject satisfaction with the aesthetic results was assessed at 90 days via a satisfaction questionnaire. Four possible responses ranged from very satisfied (5 points) to unsatisfied (1 point). Safety assessments included physical examination of the treated area for the presence of erythema or edema and reports of adverse events.

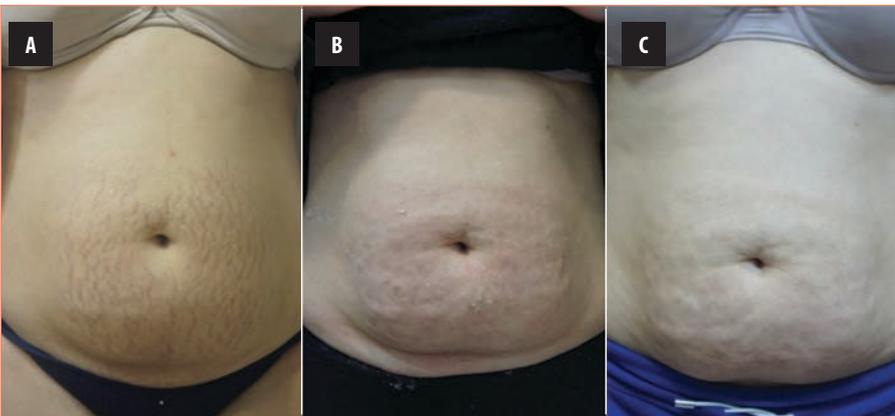
Statistical analysis. Numerical data were described using descriptive statistics. The Wilcoxon test for related samples was used to compare pretreatment Manchester Scar Scale scores and Patient Satisfaction Scale scores with scores obtained at Day 90. The level of significance for statistical tests was five percent (*p*<0.05). Statistical reporting was performed using the SAS® System for Windows, version 9.2 (SAS Institute Inc., Cary, North Carolina).

RESULTS

The 20 enrolled subjects received MFU-V for striae on their breasts (n=2; 10%), buttocks (n=3; 15%), thighs (n=7; 35%), or abdomen (n=8; 40%), and all patients completed the 90-day evaluation. The mean (± standard deviation [SD]) pretreatment Manchester Scar Scale score decreased from 9.35 (±1.18) to

TABLE 3. Changes in patient satisfaction scores

RATING	PRE-TREATMENT, n (%)	POST-TREATMENT, n (%)
Very satisfied	0	14 (70)
Satisfied	15 (75)	6 (30)
Neither satisfied nor unsatisfied	5 (25)	0
Unsatisfied	0	0

**FIGURE 1.** Abdominal striae (A) before treatment, (B) after microneedling, and (C) after microfocused ultrasound with visualization (MFU-V)

6.30 (± 1.26) after 90 days ($p < 0.001$) (Table 2). Separately, the mean Patient Satisfaction Scale score increased from 3.75 (± 0.44) to 4.70 (± 0.47) at 90 days ($p < 0.001$). Although the majority of subjects (75%) were satisfied with the appearance of their striae prior to MVU-F treatment, most (70%) became very satisfied 90 days post-treatment with MFU-V (Table 3). There were no reported adverse events. Figures 1 and 2 are examples of improvements seen in the striae of study subjects.

DISCUSSION

Currently, there are no effective topical treatments available for preventing stretch marks,¹⁴ and the effectiveness of available products used to treat existing stretch marks is

very limited. Treatment with topical tretinoin was reported to improve the appearance of stretch marks in two small studies.^{22,23} Alpha-hydroxy acid peels, such as glycolic acid, increase collagen expression in the skin²⁴ and have also been reported to improve striae.²⁵ The beneficial effects of topical ascorbic acid additionally include neocollagenesis.²⁶

Use of laser- and light-emitting devices, such as nonablative fractional lasers^{27,28} and fractional CO₂ lasers,^{29,30} for the treatment of striae has gained recent attention. These techniques; however, require multiple treatments over extended periods of time to achieve improvements in the appearance of striae. For example, nonablative fractional erbium fiber lasers typically require 3 to 4

treatments at 4- to 5-week intervals,^{27,28} and fractional CO₂ lasers generally require five sessions at 2- to 4-week intervals.^{29,30} Lasers achieve their beneficial effects by contracting old collagen and stimulating the production of new collagen;^{31,32} however, laser therapies are not suitable for all skin types.³³ Reported adverse events include transient erythema and severe edema,²⁸ mild postinflammatory hyperpigmentation,^{27,30} and mild-to-moderate acne.²⁷

Microneedling has recently emerged as a new method for treating stretch marks, and was shown to be beneficial after three treatments at monthly intervals.³⁴ The results of two subsequent studies indicate microneedling is superior to CO₂ laser application³⁵ and microdermabrasion with sonophoresis³⁶ for treating striae. Microneedling stimulates the release of growth factors and induces collagen production,³⁷ and it has been used in combination with glycolic acid peels for treating atrophic acne scars.³⁸

In addition to long-lasting correction of moderate-to-severe facial wrinkles and folds,³⁹ CaHA has also been shown to be effective in treating blemishes such as acne scars.^{40,41} CaHA filler provides immediate volume to atrophic areas and also stimulates long-term neocollagenesis surrounding filler microspheres,⁴² which might contribute to the overall improvement in the appearance of treated areas.⁴³ CaHA results in active, physiologic remodeling of the extracellular matrix by increasing elastin and stimulating a two-step process whereby collagen type I gradually replaces collagen type III.⁴⁴

A recent report demonstrated the safety and effectiveness of combining CaHA with microneedling and topical ascorbic acid for treating red and white striae on buttocks, thighs, knees, abdomen, and breasts.¹⁹ CaHA

**FIGURE 2.** Striae on the buttocks (A) before treatment, (B) after microneedling, and (C) after microfocused ultrasound with visualization (MFU-V)

filler was diluted 1:1 with lidocaine 2% without epinephrine. A maximum of 3.0mL of filler was injected into each patient at all skin depths and immediately followed by microneedling and topical application of 20% ascorbic acid. Microneedling with ascorbic acid was repeated twice more at one-month intervals. One month after the final treatment, mean baseline Manchester Scar Scale scores decreased from 12.0 to 7.1. More than 85 percent of subjects reported satisfaction with their results.

MFU energy heats tissue in the mid-to-deep reticular layer of the dermis and subdermis to produce small points of thermal coagulation.^{17,18,45} The goal is to elevate the local temperature to a point at which collagen fibers become denatured and contract.^{46,47} In addition, *de-novo* collagen synthesis occurs within the areas of thermal tissue coagulation.^{48,49} Although MFU-V is approved for treating skin laxity in the eyebrow area and rhytides on the lower face and décolletage areas,⁵⁰ it has also been used for skin tightening in other areas including the abdomen,⁵¹ thighs,^{51,52} upper arms,^{51,52} elbows,⁵³ knees,^{51,52} and buttocks.^{51,54} Many of these areas are highly susceptible to the formation of stretch marks.

Similarly, the injection of CaHA has been shown to decrease skin flaccidity and increase skin density and thickness in the abdomen, thighs, and upper arms.⁵⁵ Not surprisingly, increased collagen and better aesthetic results have been demonstrated when more than one type of therapy is used for treating stretch marks, such as combining fractionated microneedle radiofrequency and fractional carbon dioxide laser.⁵⁶ Expert consensus supports the use of combined treatments for facial rejuvenation,⁵⁷ and position statements have been developed for the use of multiple procedures for treating the upper arms, abdomen, buttocks, and knees.²⁰

The safety and efficacy combining MFU-V with CaHA for treating skin laxity and improving the appearance of cellulite on the buttocks and thighs has been previously demonstrated.⁵⁸ Immediately after MFU-V, subjects received treatment with 1.5mL CaHA diluted in a 1:1 manner with 1.5mL of 2% lidocaine solution. Using a 25-gauge, 48-mm-long cannula, 3.0mL of diluted CaHA was injected into the subdermis using a microdroplet fanning technique (1mL per treatment site with 10 lines of 0.1mL per line) to cover the same area as the MFU-V.

After 90 days, there was a significant improvement in cellulite appearance (i.e., 4.5 points on the 15-point Cellulite Severity Scale). Nearly all of the subjects (95%) reported satisfaction with their treatment results. Histology studies demonstrated neocollagenesis in treated skin.

While 75 percent of enrolled subjects with red and white striae in the current study were satisfied following the combined treatment with CaHA, topical ascorbic acid, and microneedling, satisfaction improved further following the additional treatment with MFU-V (in that 70% were very satisfied). These results are further supported by other investigators who recently demonstrated the safety and efficacy of combining several aesthetic treatments, including botulinum toxin, temporary and semipermanent dermal fillers, microfocused ultrasound, and other energy-based treatments for facial rejuvenation.^{59,60}

CONCLUSION

The currently available treatments for improving the appearance of stretch marks are less than optimal. The combined use of CaHA with a 20% topical ascorbic acid solution and a microneedling procedure known to increase collagen production appears to be an effective treatment for the appearance of stretch marks. Post-treatment application of MFU-V appears to offer additional benefits and improve outcomes.

ACKNOWLEDGMENT

The author acknowledges Carl Hornfeldt for his editorial assistance with the preparation of this manuscript.

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