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A topical regimen improves skin healing and aesthetic outcomes when combined with a radiofrequency microneedling procedure

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Abstract

Introduction: Novel topical products formulated using tri- and hexapeptide technology (TriHex Technology®; Alastin Skincare®, Inc) are used to clear the extracellular matrix, stimulate neocollagenesis and elastogenesis, decrease inflammation, and accelerate the epidermal healing process.

Aims: This study assessed the efficacy of two topical tri- and hexapeptide-containing products pre- and post-treatment with radiofrequency (RF) microneedling of the photoaged neck with respect to healing and aesthetic outcomes.

Subjects/Methods: In this open-label, nonrandomized study, eligible subjects underwent one screening visit, one RF microneedling procedure and follow-up visits on post-treatment Days 3, 7, 30, and 90. Subjects were instructed to apply one product to the neck for 2 weeks prior to treatment and 7 days post-treatment. On post-treatment Day 7, subjects switched to the other product until the end of the study. At each visit, subject and investigator questionnaires were completed and standardized digital images were obtained.

Results: Female subjects (N = 10) with a mean age of 51.3 years (range, 44-59 years) completed the study. All subjects achieved statistically significant improvements in Investigator Global Assessment scales at post-treatment Day 90 and reported improvement in all Skin Quality Assessments. Among Subjective Tolerability Assessments, all post-treatment reports of tingling and burning resolved by Day 3. 90% of stinging resolved by Day 3 with 100% resolving by Day 7. 40% of subjects had minimal itching on Day 3 which resolved by Day 7. Among the Investigator Post-treatment Tolerability Assessments, edema resolved in all subjects by Day 3 and erythema settled between Day 3 and Day 7.

Conclusion: Pre- and post-treatment use of topical products formulated with tri- and hexapeptide technology appears to hasten healing and complement aesthetic outcomes associated with RF microneedling of the neck.

1 | INTRODUCTION

An unfortunate but inescapable consequence of aging is unwanted changes in skin appearance resulting from oxidative stress and a lifetime of cumulative DNA damage.[1] These changes are the result of intrinsic factors, resulting from chronological aging, and exposure to environmental extrinsic factors. Intrinsic factors include the unavoidable consequences of chronological aging such as diminished levels of androgens and growth hormone, decreased collagen production, and breakdown of the elastin network.[2-4] The extent of aging due to intrinsic factors is affected by genetic factors such as gender and ethnicity.[5]

Extrinsic factors responsible for skin aging are environmental. By far, the most significant of these is exposure to ultraviolet light resulting in photodamaged skin.[2,5] The effects of sunlight on the skin are estimated to account for up to 90% of visible skin aging.[6] Histological studies have demonstrated significantly greater decreases in elastin and type I and type III collagen among sun-exposed individuals.[7] Other extrinsic factors include psychological stress, diet, medications, smoking, air pollutants, and comorbid illness.[5]

Clinically, aging is associated with diminished skin strength, impaired skin barrier function, and altered immunity which may be detrimental to overall health;[8,9] however, changes in facial appearance appears to be of greater concern for many individuals as they may be associated with diminished self-esteem and have an overall negative impact on quality of life.[10] Aesthetic changes include skin atrophy, laxity, wrinkling, sagging, dryness, dyschromia, and carcinomas.[8] Not surprisingly, improvements in appearance following minimally invasive facial cosmetic procedures can have significantly positive psychosocial effects.[10,11] Microneedling, also known as percutaneous collagen induction, has demonstrated efficacy for treating a variety of skin conditions including atrophic acne scars,[12,13] traumatic and burn scars,[14,15] striae,[16,17] and skin rejuvenation [18-20] on all skin types.[21] Histological studies have shown that microneedling can tighten and improve the appearance of photoaged skin. This rejuvenation is associated with significant increases in collagen types I, III, and VII and elastin.[22] The physical trauma caused by needle penetration induces the normal wound healing response while causing minimal damage to the epidermis.[23] A 400% increase in collagen and elastin has been demonstrated following several microneedling sessions.[24] Advantages of this procedure include simplicity, rapid recovery, being well-tolerated, minimal risk of post-inflammatory hyperpigmentation, convenience, and cost-effectiveness.[25]

Microneedling has been further refined by combining it with radiofrequency (RF) technology. Insulated needles penetrate the skin where radiofrequency currents produce thermal zones in the skin without damaging the overlying epidermis.[20] This stimulates long-term dermal remodeling, neoelastogenesis, and neocollagenesis. The needle depth can be adjusted which enables treatment of different layers of the dermis. Microneedling is also an effective method of enhancing the efficacy of chemical peels and other skin rejuvenation procedures.[23]

Compared to facial skin, neck skin has fewer sebaceous glands and loses its elasticity more rapidly with age. Neck skin is more fragile and thinner than the skin on the face and in fact, the skin on the neck is more comparable to the dermal thickness of the eyelids than that of the face. Due to the structure of the neck skin, delays in post-procedural healing outcomes tend to occur.[26-28]

A topical treatment formulated with tri- and hexapeptides using proprietary TriHex Technology® has previously been shown to stimulate collagen and elastin production resulting in overall improvement in periocular skin when applied twice-daily for 2 weeks [29] and improve healing following nonablative thulium-doped facial resurfacing treatment.[30] Using this technology, a new product has been developed to reduce post-treatment redness and discomfort associated with RF microneedling, to improve neocollagenesis and elastogenesis, and improve skin hydration. The objective of this open-label pilot study was to assess the safety and efficacy of this treatment regimen for diminishing treatment-related adverse events and improving aesthetic outcomes following RF microneedling of the neck.

2 | METHODS

2.1 | Study subjects

Eligible subjects were healthy women, 25 to 65 years old with Fitzpatrick Skin Types II-IV who were seeking RF microneedling treatment of the neck to reduce the signs of photoaging, including rhytids, lentigines, keratoses, telangiectasias, loss of skin translucency and elasticity, and sallow color.[31,32] Subjects were otherwise free of bruises, edema, or dermatological disorders which could jeopardize the study objectives or increase the risk of treatment-related adverse events. Subjects expressed their willingness to comply with all study requirements which included avoiding the use of skincare products, other than the provided study products, for the duration of the study; avoiding excessive sun exposure and the use of tanning beds; and refraining from treatment with neurotoxins or dermal filler injections, or any other energy-based therapies to the planned treatment area.

Reasons for exclusion from the study included a history of keloids or hypertrophic scars; a disorder or medication use that could interfere with normal wound healing; a known hypersensitivity to lidocaine, other topical anesthetics, or any ingredient in the study products; unwillingness or inability to provide informed consent or comply with study protocol requirements; use of topical products containing alpha-hydroxy acids, salicylic acid, benzoyl peroxide, retinol, vitamins C or E or their derivatives on the neck during the previous 14 days; chemical peels, systemic steroids, nonablative laser, light or radiofrequency therapy, dermabrasion (deep) or ablative laser treatments on their neck during the previous 3 months; microdermabrasion (light or medium) on the neck during the previous 30 days; excessive exposure to sunlight or artificial UV light (tanning bed) during the previous 7 days; topical tretinoin product or

TABLE 1 RF microneedling treatment parameters

Recommended initial treatment parameters		
Energy (Watts)	**Needles depth (mm)**	**Pulse duration (msec)**
13	1.5 to 2	110
Recommended treatment modification		
Effect	**Sign/Symptom**	**Change**
Skin effects	Mild to moderate redness and edema	Continue with same settings
Subject sensation	Mild to supportable discomfort	
Skin effects	No erythema/edema	Increase pulse duration by 30 msec or increase power by 2 W and retreat
Subject sensation	Treatment not felt at all	
Skin effects	Severe edema over bony areas (jaw, zygomatic arch, temples)	Decrease pulse duration by 30 msec or decrease power by 2 W and retreat
Subject sensation	High level of discomfort	

derivative use on the neck during the previous 2 weeks; systemic retinoid use during the previous 6 months.

2.2 | RF microneedling

Prior to RF microneedling, each planned treatment area was visually assessed by the investigator to determine appropriate treatment parameters. The neck was thoroughly washed and dried prior to applying a topical anesthetic cream according to the manufacturer guidelines. Prior to the procedure, the anesthetic cream was removed using a gauze pad moistened with 70% alcohol.

The RF microneedling procedure was performed using a commercially available device which uses a unique proprietary fractionated pulse mode technology (Intensif; Endymed™ 3Deep Skin Science).[33] Treatments were administered according to the instructions described in the user manual. Two passes were performed on each subject. Suggested treatment parameters are shown in Table 1. A test spot was performed in the planned treatment area prior to treating the entire neck to confirm optimal parameters for the subject.

2.3 | Test material

The first skincare product (RSN; Regenerating Skin Nectar®; Alastin Skincare®, Inc) is designed to be applied before and immediately following invasive and noninvasive aesthetic procedures to enhance elastin and collagen production for faster recovery and improved aesthetic outcomes. The product is formulated with a proprietary TriHex Technology™, the flavanone naringenin, panthenyl triacetate, *Arnica montana* extract, and the carotenoids phytoene and phytofluene. The formulation possesses a high antioxidant activity to calm inflamed skin and reduce redness.

A second skincare product, Restorative Neck Complex (RNC; Restorative Neck Complex; Alastin Skincare®, Inc) is a proprietary formulation which also incorporates TriHex Technology® and a proprietary blend of peptides and potent antioxidants for treating crepey skin and photoaged discoloration of the neck and décolleté.

Each subject was instructed to cleanse their neck prior to applying the first product, RSN, in the morning and evening beginning 2 weeks prior to the RF microneedling procedure and continuing 1-week post-treatment. RSN was also applied to the neck within 15 minutes following RF microneedling. Beginning on the evening of study Day 21 (post-treatment Day 7), subjects began applying the second product, RNC, morning and evening for the remainder of the study. Daily diaries were used to confirm compliance.

2.4 | Assessments

The Investigator Photodamage Assessment (modified Glogau Scale [34]) was completed on screening (two weeks prior to treatment), pre- and post-treatment on Day 14, and on post-treatment Days 3, 7, 30 (±7 days) and 90 (±7 days). These assessments were as follows Type I, No Wrinkles (minimal-to-no discoloration or wrinkling, no keratoses); Type II, Dynamic Wrinkles (skin wrinkling with muscle movement, slight lines, no keratoses; Type III, Wrinkles at Rest (visible wrinkles at all times, noticeable discolorations, visible keratoses); Type IV, Only Wrinkles (wrinkles throughout [makeup appears to cake and crack when applied], gray or yellow discoloration of the skin, history of prior skin cancer).

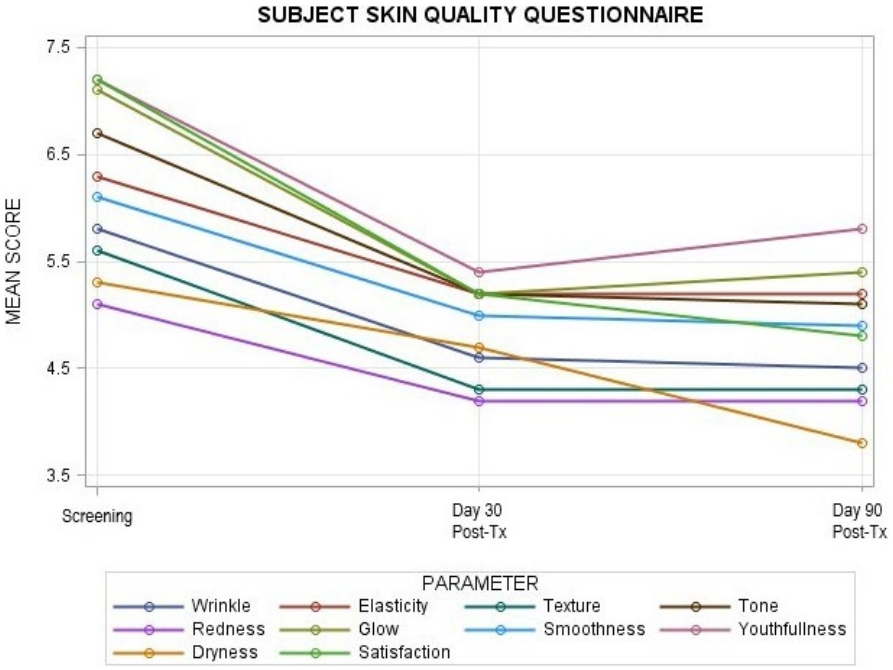
The Investigator Global Assessments also assessed the following skin qualities using a 5-point scale: skin tone (evenness) from 0, even, healthy color to 4, uneven, discolored appearance; skin smoothness (visual) from 0, smooth appearance to 4, severe, rough appearance; skin texture (tactile) from 0, smooth, even feeling texture to 4, rough, uneven feeling skin texture; red blotchy skin from 0, clear to 4, severe redness; dry/flaky skin from 0, smooth to 4, rough and dry; and overall appearance from 0, healthy, youthful skin appearance to 4, poor skin appearance. This was assessed on pretreatment Day 14 and post-treatment Days 3, 7, 30 (±7 days) and 90 (±7 days).

The Investigator Objective Tolerability Assessment graded skin erythema, edema, dryness and peeling as 0, none; 1, minimal; 2, mild; 3, moderate; or 4, severe. The Subjective Tolerability Assessment graded the severity of stinging, tingling, itching, and burning on a scale from 0, none to 4, severe. This assessment was done at each visit including pre- and ≥15 minutes post-treatment.

The Subject Skin Quality Questionnaire was completed at screening and post-treatment Days 30 and 90. For each question, subjects indicated their response using a visual analog severity scale from 0 to 10 where 0 generally meaning no signs of skin aging or no skin damage, and 10 generally meaning severe signs of skin aging or severe skin damages (Table 2). Subject Improvement Questionnaire was completed on post-treatment Days 30 and 90. See Table 3 for details.

TABLE 2 Skin quality questionnaire

Regarding the quality of your neck skin, how do you rate:
The fine lines and wrinkles on your neck?
0, No fine lines and wrinkles to 10, Severe fine lines and wrinkles
The elasticity of your skin?
0, Very elastic to 10, Very inelastic
The texture of your skin?
0, Smooth, Even texture to 10, Very rough, Uneven texture
The tone of your skin?
0, Very even, to 10, Very uneven
The redness and broken blood capillaries of your skin?
0, Not red with no broken capillaries to 10, Severe redness with many broken capillaries
The glow of your skin?
0, Very radiant to 10, Very dull
The smoothness of your skin?
0, Very smooth and soft to 10, Very coarse and uneven
The youthful appearance of your skin?
0, Very youthful to 10, Very aged
The dryness of your skin?
0, Very hydrated to 10, Very dry
How satisfied are you with the look of your skin?
0, Very satisfied to 10, Very dissatisfied



Note: Each line represents the mean score for that parameter at screening, Day 30 Post-Tx and Day 90 Post-Tx. All parameters show improvements after screening assessments. At Day 30, texture ($P = 0.0390$), glow ($P = 0.0085$), smoothness ($P = 0.0067$), youthfulness ($P = 0.0066$) and overall satisfaction ($P = 0.0022$) statistically improved. At Day 90, the seven parameters showing statistically significant change including wrinkle ($P = 0.0176$), elasticity ($P = 0.0318$), texture ($P = 0.0133$), tone ($P = 0.0133$), glow ($P = 0.0058$), smoothness ($P = 0.0086$), and overall satisfaction ($P = 0.0005$).

2.5 | Digital images

Three digital images were obtained at each clinic visit using a mounted camera with consistent position and lighting including full frontal of the neck and right and left side at 90-degree angles. On the day of the procedure, images were obtained pre- and post-treatment. All images were obtained when the neck was clean and dry prior to any product application. Subjects were required to remove

TABLE 3 Subject improvement questionnaire

Regarding the quality of your neck skin, how have the following improved since starting treatment:
Fine lines and wrinkles?[a]
Elasticity?[a]
Glow?[a]
Smoothness?[a]
Skin tone?[a]
Youthful appearance?[a]
Overall skin quality?[a]
How well are you tolerating the treatment products?
Very well, Without discomfort; Well, Hardly any discomfort; Barely noticeable, Temporarily discomfort; Noticeable, Temporarily discomfort; Significant discomfort
How do the treatment products feel immediately after application?
Absorbs fast and is not sticky, Absorbs slowly and is sticky, Do not know
How much do you like the odor, smell, or scent of the treatment products?
Like much, Like somewhat, No not like, Do not notice any odor, smell, or scent
At this stage of the study, how satisfied are you with the treatment products?
Very satisfied, Satisfied, Slightly satisfied, Not satisfied
Would you recommend the treatment products to a friend or colleague?
Yes, No

Parameters	Percentage of Subjects Who Reported Improvement (%)	
	Day 30 Post-Tx	Day 90 Post-Tx
Q1 (wrinkle)	100.0	90.0
Q2 (elasticity)	100.0	100.0
Q3 (glow)	90.0	100.0
Q4 (smoothness)	100.0	100.0
Q5 (tone)	100.0	100.0
Q6 (youthfulness)	100.0	100.0
Q7 (overall skin quality)	100.0	100.0
Q8 (discomfort level- very well, without discomfort)	90.0	80.0
Q9 (product absorption-absorbs fast and is not sticky)	90.0	80.0
Q10 (product smell-subjects either liked or did not notice a smell)	100.0	100.0
Q11 (satisfaction of products)	90.0	100.0
Q12 (recommendation of products)	70.0	80.0

[a]Each rated as Very much improved, Much improved, Slightly improved, No change, Worse, Much worse.

all jewelry and use headbands to keep their hair off their neck as necessary.

2.6 | Safety

Subjects completed a tolerability assessment following the RF microneedling procedure and at each post-treatment study visit thereafter. At each study visit, the investigator examined the treatment area for evidence of treatment-related adverse events. Subjects were also queried about possible treatment-related adverse events.

2.7 | Data analysis

As this was an open-label study, each subject served as their own control. The summation of changes in study assessments was analyzed using Student's *t* test. Changes were considered statistically significant at $P \leq 0.05$.

2.8 | Ethics

Each subject provided signed informed consent in compliance with FDA regulations (21 CFR Part 50) prior to participating in any study-related activities. The protocol and informed consent approved by a commercial institutional review board (Advarra IRB). Subjects also provided written permission to use their digital images.

3 | RESULTS

Ten female subjects with a mean age of 51.3 years (range, 44 to 59 years) and Fitzpatrick skin types 2 (n = 7) and 3 (n = 3) were enrolled and completed the study. All subjects were Caucasian of non-Hispanic descent.

The mean Investigator Photodamage Assessment score decreased from 2.3 at screening to 1.6 at post-treatment Day 30 and Day 90 (for each, $P = 0.015$) (Table 4). The mean Investigator Global Assessment scores are summarized in Table 5. By post-treatment Day 30, all skin parameters showed statistically significant improvement except Skin Dry/Flaky; nevertheless, skin dryness improved from the screening visit with only 10% having minimal dryness/flakiness. The greatest improvement was observed in Tactile Skin Texture (79%). Overall appearance was significantly improved with a mean change of 0.9 unit at Day 30 ($P < 0.00001$) and Day 90 ($P = 0.0013$). Improvement in overall appearance is evident in the pre- and post-treatment images of the subjects shown in Figures 1 and 2.

Among the Investigator Objective Tolerability Assessments, 50% of reported erythema resolved by post-treatment Day 3, 100% between Day 3 and Day 7. Mean Investigator and subject tolerability

TABLE 4 Investigator photodamage assessment

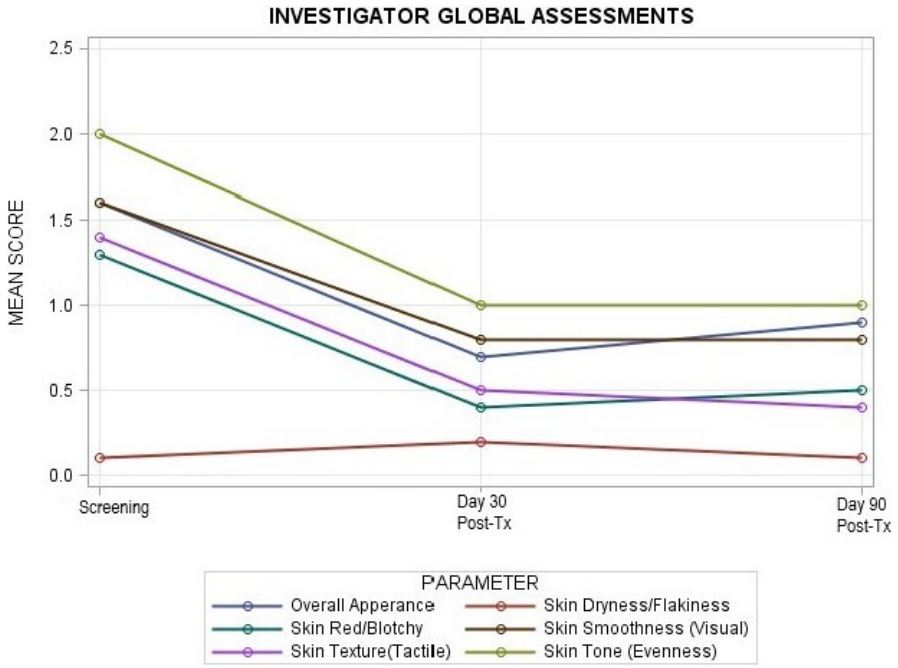
Score[a]	Screening	Pre-Treatment	Day 3 post-tx	Day 7 post-tx	Day 30 post-tx	Day 90 post-tx
Type 1	0	1	1	1	4	4
Type 2	7	7	9	9	6	6
Type 3	3	2	0	0	0	0
Type 4	0	0	0	0	0	0
Mean scores	2.3	2.1	1.9	1.9	1.6	1.6

Note: Type I: No wrinkles: Minimal to no discoloration or wrinkling; No keratosis. Type II: Wrinkles in motion: Wrinkling in skin with movement; Slight lines; No keratosis. Type III: Wrinkles at rest: Visible wrinkles all the time; Noticeable discolorations; Visible keratosis; Type IV: Only wrinkles: Wrinkles throughout (make-up appears to cake and crack when applied); Grey or yellow discoloration of the skin; History of prior skin cancer.
[a]One person observed wrinkle improvement using study product alone from screening to Day 14.

TABLE 5 Investigator global assessment

Mean scores							
Parameter	**Screening**	**Tx day[a]**	**Tx day[b]**	**Day 3 post-tx**	**Day 7 post-tx**	**Day 30 post-tx**	**Day 90 post-tx**
Skin tone (Evenness)	2.0	2.0	2.1	1.9	1.4	1.0	1.0
Skin smoothness (Visual)	2.1	1.6	1.6	1.5	0.9	0.8	0.8
Skin texture (Tactile)	1.9	1.4	1.7	1.3	0.7	0.5	0.4
Skin red/Blotchy	1.3	1.3	2.2	1.3	0.5	0.4	0.5
Skin dryness/ Flakiness	0.5	0.1	0.3	0.6	0.1	0.2	0.1
Overall appearance	1.8	1.6	1.8	1.4	0.9	0.7	0.9

Note: At Day 30, four out of five parameters including tone, smoothness, texture, and red/blotchy were improved and statistically significant (*P*-values = 0.0007-0.0085). Similar improvement in these parameters was observed at Day 90. Overall appearance was statistically improved with (*P*-values = 0.0000-0.0013) at Day 30 and Day 90.
[a]Pretreatment.
[b]Post-treatment.



assessments are summarized in Table 6. Most reports of discomfort were between 1 (minimal) and 2 (mild) and occurred on the day of the procedure. All (100%) reports of tingling and burning resolved between post-treatment and Day 3, 90% of stinging resolved by Day 3, and 100% between Day 3 and Day 7. 40% of subjects had minimal itching at Day 3 which all resolved by Day 7.

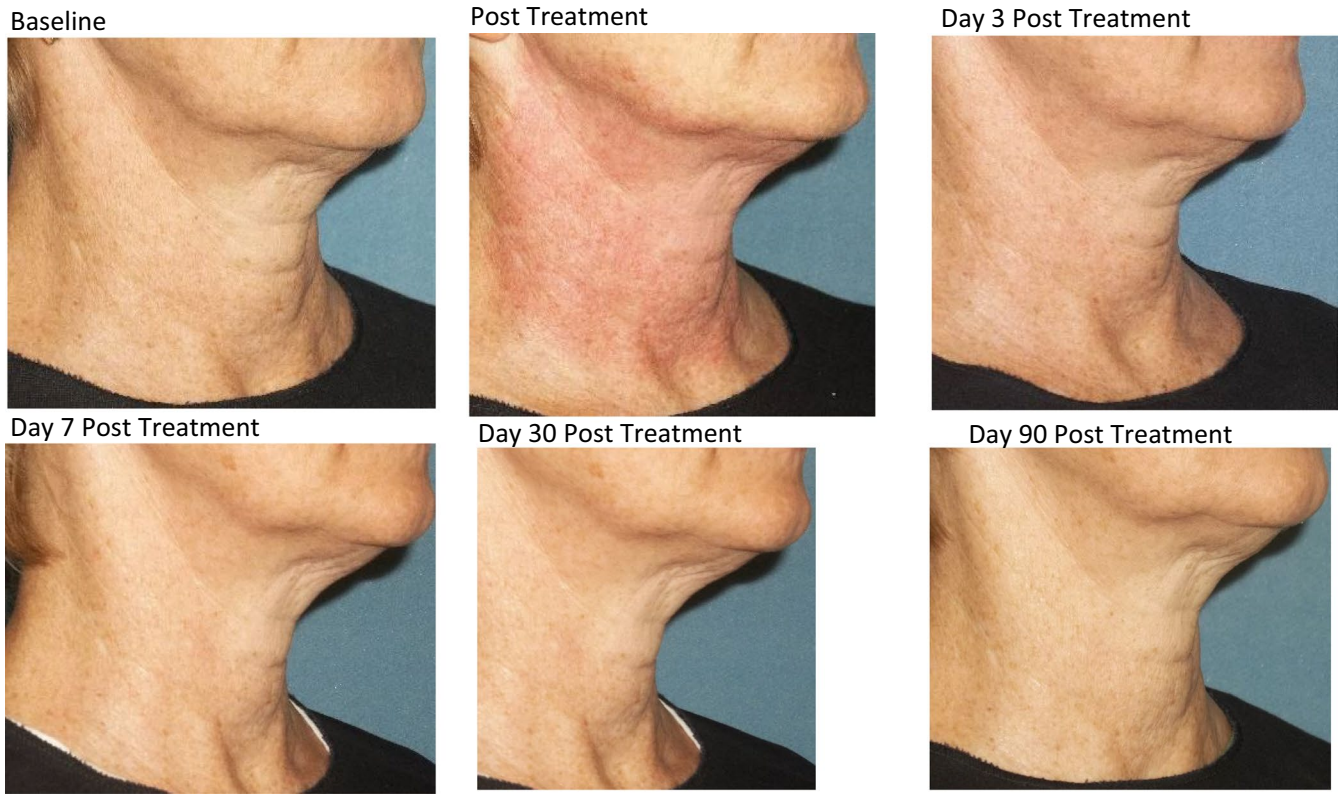


FIGURE 1 Pre- and Post-Treatment Images—Female Age: 56 Patient used Regenerating Skin Nectar two weeks prior and one-week post-RF Microneedling of the neck. Patient used Restorative Neck Complex one-week postprocedure through end of study

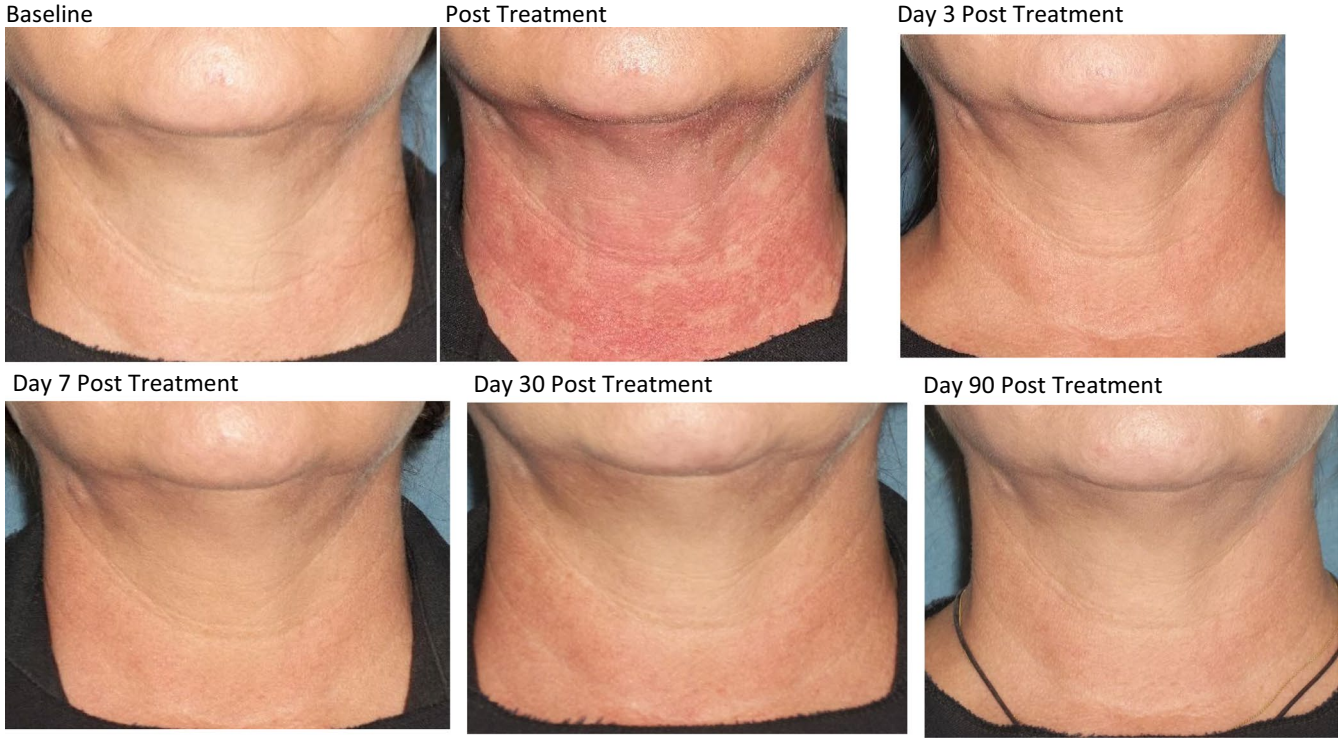


FIGURE 2 Pre- and Post-Treatment Images—Female Age: 45 Patient used Regenerating Skin Nectar two weeks prior and one-week post-RF Microneedling of the neck. Patient used Restorative Neck Complex one-week postprocedure through end of study

TABLE 6 Post-treatment tolerability assessment

	Treatment Day[a]	Post-treatment Day 3	Post-treatment Day 7	Resolved post-treatment (%) Day 3	Resolved post-treatment (%) Day 7
Mean subject scores					
Stinging	2	0.1	0	90	100
Tingling	1.1	0	0	100	100
Burning	1.4	0	0	100	100
Itching	0.4	0.4	0	60	100
Mean investigator scores					
Erythema	2.3	1.2	0	50	100
Edema	1.1	0	0	100	100
Dryness	0	0.5	0	50	100
Peeling	0	0	0	100	100

[a]Post-treatment.

All parameters in the Subject Skin Quality Questionnaire showed improvements from baseline to Day 30 and continuing through Day 90 (Table 2). At Day 30, texture ($P = 0.0390$), glow ($P = 0.0085$), smoothness ($P = 0.0067$), youthfulness ($P = 0.0066$), and overall satisfaction ($P = 0.0022$) were significantly statistically improved. At day 90, the seven parameters showing statistically significant changes included wrinkle ($P = 0.0176$), elasticity ($P = 0.0.318$), texture ($P = 0.0133$), tone ($P = 0.0133$), glow ($P = 0.0058$), smoothness ($P = 0.0086$), and overall satisfaction ($P = 0.0005$).

With regard to the subject improvement questionnaire, all subjects at post-treatment Day 30 reported an improvement in wrinkles, elasticity, smoothness, skin tone, youthfulness, and overall skin quality. 90% reported an improvement in glow. This trend continued at post-treatment Day 90 with all subjects reporting an improvement in elasticity, glow, smoothness, skin tone, youthfulness, and overall skin quality. 90% reported an improvement in wrinkles and 10% reported no change. 100% of subjects were satisfied with the products at post-treatment Day 90 (Table 3).

4 | DISCUSSION

The application of peptide-containing topical products has beneficial effects against the signs of intrinsic and extrinsic skin aging.[35] These products rejuvenate the appearance of photoaged skin by clearing the extracellular matrix and stimulating collagen and elastin production. In one study, the twice-daily application of a product containing active botanicals and the same tri- and hexapeptide technology used in the present study to periorbital areas resulted in significant improvement in crow's feet, eye hollowing, eye bags, and dark circles after 12 weeks.[29] When applied pre- and postfractional resurfacing treatment of the face and décolleté, the tri- and hexapeptide-containing product was significantly more effective for achieving aesthetic outcomes and post-treatment healing than a basic wound-care regimen.[30]

The use of microneedling has demonstrated efficacy for treating dyschromia, atrophic scars, and for rejuvenating photodamaged skin on the face and décolleté.[23,36] Although microneedling has an excellent safety profile, treatment-related adverse events may include at least minor pain or discomfort, erythema, and edema.[21,37-40] Based on the promising results of topical products containing tri- and hexapeptides formulated using proprietary TriHex Technology®, the products used in the present study were developed to reduce the severity of treatment-related adverse events and improving aesthetic outcomes following RF microneedling of the neck. The results of this present study provide further evidence of the beneficial effects of topical peptides.

The mean Investigator Photodamage Assessment score was 2.3 at baseline, indicating moderately severe photodamaged skin prior to treatment. Mean scores steadily decreased, becoming significant at 30 days post-treatment, which persisted through Day 90. One subject observed wrinkle improvement using the RSN study product alone for the 14 days prior to the RF microneedling procedure. Based on mean Investigator Global Assessment scores, all skin quality parameters were statistically significantly improved by post-treatment Day 30. The greatest changes occurred in tactile skin texture (79%), visual skin smoothness (62%), red, blotchy skin (62%), and overall appearance. Similar to Investigator Global Assessment scores, all 10 parameters in the Subject Skin Quality Questionnaire parameters showed improvements at post-treatment Day 30 which persisted until Day 90.

The RF microneedling procedure was well-tolerated and no unexpected adverse events were reported. Subjective reports were mild or moderate and transient, being resolved within 3 to 7 days. Similarly, objective reports of erythema and edema were mild and moderate, respectively, on the day of the procedure and resolved within 3 to 7 days. There were no adverse events associated with the tri- and hexapeptide-containing test products.

Overall, the results of this study provide additional evidence supporting the safety and efficacy of tri- and hexapeptide-containing topical products. The results are also in agreement with previous studies

demonstrating the efficacy of TriHex Technology products for facial rejuvenation and enhancing post-treatment healing of the face and décolleté following ablative and nonablative resurfacing treatment. Limitations of this pilot study include a small study population lacking racial diversity and an open-label study design.

5 | CONCLUSION

When used pre- and post-RF microneedling for treating signs of photoaged skin of the neck, two novel topical products formulated using tri- and hexapeptide technology (TriHex Technology®; Alastin Skincare®, Inc) stimulates neocollagenesis and elastogenesis, decreased erythema and accelerated epidermal healing with improved global appearance outcomes.

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REFERENCES

1. Panich U, Sittithumcharee G, Rathviboon N, Jirawatnotai S. Ultraviolet radiation-induced skin aging: the role of DNA damage and oxidative stress in epidermal stem cell damage-mediated skin aging. *Stem Cells Int*. 2016;2016:7370642.
2. Uitto J. The role of elastin and collagen in cutaneous aging: intrinsic aging versus photoexposure. *J Drugs Dermatol*. 2008;7:S12-S16.
3. Zouboulis CC, Makrantonaki E. Hormonal therapy of intrinsic aging. *Rejuvenation Res*. 2012;15:302-312.
4. Makrantonaki E, Zouboulis CC. Androgens and ageing of the skin. *Curr Opin Endocrinol Diabetes Obes*. 2009;16:240-245.
5. Farage MA, Miller KW, Elsner P, Maibach HI. Intrinsic and extrinsic factors in skin ageing: a review. *Int J Cosmet Sci*. 2008;30:87-95.
6. Südel KM, Venzke K, Mielke H, et al. Novel aspects of intrinsic and extrinsic aging of human skin: beneficial effects of soy extract. *Photochem Photobiol*. 2005;81:581-587.
7. El-Domyati M, Attia S, Saleh F, et al. Intrinsic aging vs. photoaging: a comparative histopathological, immunohistochemical, and ultrastructural study of skin. *Exp Dermatol*. 2002;11:398-405.
8. Fore J. A review of skin and the effects of aging on skin structure and function. *Ostomy Wound Manage*. 2006;52:24-35.
9. Boireau-Adamezyk E, Baillet-Guffroy A, Stamatas GN. Age-dependent changes in stratum corneum barrier function. *Skin Res Technol*. 2014;20:409-415.
10. Hibler BP, Schwitzer J, Rossi AM. Assessing improvement of facial appearance and quality of life after minimally-invasive cosmetic dermatology procedures using the FACE-Q scales. *J Drugs Dermatol*. 2016;15:62-67.
11. Imadojemu S, Sarwer DB, Percec I, et al. Influence of surgical and minimally invasive facial cosmetic procedures on psychosocial outcomes: a systematic review. *JAMA Dermatol*. 2013;149:1325-1333.
12. Saadawi AN, Esawy AM, Kandeel AH, et al. Microneedling by dermapen and glycolic acid peel for the treatment of acne scars: comparative study. *J Cosmet Dermatol*. 2018;18(1):107–114.
13. El-Domyati M, Abdel-Wahab H, Hossam A. Microneedling combined with platelet-rich plasma or trichloroacetic acid peeling for management of acne scarring: a split-face clinical and histologic comparison. *J Cosmet Dermatol*. 2018;17:73–83.
14. Eilers RE, Ross EV, Cohen JL, Ortiz AE. A combination approach to surgical scars. *Dermatol Surg*. 2016;42:S150–S156.
15. Aust MC, Knobloch K, Reimers K, et al. Percutaneous collagen induction therapy: an alternative treatment for burn scars. *Burns*. 2010;36:836.
16. Wollina U, Goldman A. Management of stretch marks (with a focus on striae rubrae). *J Cutan Aesthet Surg*. 2017;10:124–129.
17. Naspolini AP, Boza JC, da Silva VD, et al. Efficacy of Microneedling Versus Fractional Non-ablative Laser to Treat Striae Alba: A Randomized Study. *Am J Clin Dermatol*. 2019;20(2):277–287. https://doi.org/10.1007/s40257-018-0415-0.
18. Badran KW, Nabili V. Lasers, microneedling, and platelet-rich plasma for skin rejuvenation and repair. *Facial Plast Surg Clin North Am*. 2018;26:455–468.
19. Zhang M, Fang J, Wu Q, Lin T. A prospective study of the safety and efficacy of a microneedle fractional radiofrequency system for global facial photoaging in Chinese patients. *Dermatol Surg*. 2018;44:964–970.
20. Hruza G, Taub AF, Collier SL, et al. Skin rejuvenation and wrinkle reduction using a fractional radiofrequency system. *J Drugs Dermatol*. 2009;8:259–265.
21. Bonati LM, Epstein GK, Strugar TL. Microneedling in all skin types: a review. *J Drugs Dermatol*. 2017;16:308–313.
22. 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.
23. Iriarte C, Awosika O, Rengifo-Pardo M, et al. Review of applications of microneedling in dermatology. *Clin Cosmet Investig Dermatol*. 2017;10:289–298.
24. 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;121:1421–1429.
25. Nair PA, Microneedling BT, Treasure Island FL.StatPearls [Internet]: StatPearls Publishing, 2018. Available: https://www.ncbi.nlm.nih.gov/books/NBK459344/. Accessed January 17, 2019.
26. Kim E, Cho G, Won NG, Cho J. Age-related changes in skin biomechanical properties: the neck skin compared with the cheek and forearm skin in Korean females. *Skin Res Technol*. 2013;19:236–241.
27. Ha RY, Nojima K, Adams WP Jr, Brown SA. Analysis of facial skin thickness: defining the relative thickness index. *Plast Reconstr Surg*. 2005;115(6):1769–1773. https://doi.org/10.1097/01.PRS.0000161682.63535.9B.
28. Perez MI. An anatomic approach to the rejuvenation of the neck. *Dermatol Clin*. 2001;19(2):387–396.
29. Reivitis A, Karimi K, Griffiths C, Banayan A. A single-center, pilot study evaluating a novel TriHex peptide- and botanical-containing eye treatment compared to baseline. *J Cosmet Dermatol*. 2018;17:467–470.
30. Robinson DM, Frulla AP. Randomized, split-face/décolleté comparative trial of procedure enhancement system for fractional non-ablative laser resurfacing treatment. *J Drugs Dermatol*. 2017;16:707–710. [Accessed date 02/2019]

31. Balin AK, Pratt LA. Physiological consequences of human skin aging. *Cutis*. 1989;43:431–436.
32. Han A, Chien AL, Kang S. Photoaging. *Dermatol Clin*. 2014;32:291–299.
33. Intensif. Endymed™ 3Deep Skin Science. Product brochure. Available: http://www.endymed.com/site/products/intensif.php Accessed February 2019
34. Alam M, DesJardin J, Arndt KA, et al. A quality rating scale for aesthetic surgical procedures. *J Am Acad Dermatol*. 2006;54:272–281.
35. Schagen SK. Topical peptide treatments with effective anti-aging results. *Cosmetics*. 2017;4:1–14.
36. Lyons A, Roy J, Herrmann J, et al. Treatment of décolletage photoaging with fractional microneedling radiofrequency. *J Drugs Dermatol*. 2018;17:74–76.
37. Singh A, Yadav S. Microneedling: advances and widening horizons. *Indian Dermatol Online J*. 2016;7:244–254.
38. Ablon G. Safety and effectiveness of an automated microneedling device in improving the signs of aging skin. *J Clin Aesthet Dermatol*. 2018;11:29–34.
39. Zahr AS, Kononov T, Sensing W, et al. An open-label, single-site study to evaluate the tolerability, safety, and efficacy of using a novel facial moisturizer for preparation and accelerated healing pre and post a single full-face radiofrequency microneedling treatment. *J Cosmet Dermatol*. 2019;18(1):94–106. https://doi.org/10.1111/jocd.12817
40. Gold M, Taylor M, Rothaus K, Tanaka Y. Non-insulated smooth motion, micro-needles RF fractional treatment for wrinkle reduction and lifting of the lower face: international study. *Lasers Surg Med*. 2016;48:727–733.

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