A Prospective, Multicenter, Randomized, Evaluator-Blinded, Split-Hand Study to Evaluate the Effectiveness and Safety of Large-Gel-Particle Hyaluronic Acid with Lidocaine for the Correction of Volume Deficits in the Dorsal Hand

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PATIENT SAFETY

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2 THERAPEUTIC

Background: Hand rejuvenation has become increasingly popular, but there are few reports published on the use of hyaluronic acid gels for correction of volume deficits in the dorsal hand.
Methods: This study evaluated the efficacy and safety of large-gel-particle hyaluronic acid with lidocaine, a 20-mg/ml hyaluronic acid gel with 0.3% lidocaine, compared to no treatment for the correction of volume deficits in the dorsal hand. This was a prospective, multicenter, split-hand study in 90 subjects who received treatment with product in one hand. The primary efficacy endpoint was based on a 1 point of improvement with treatment versus no treatment according to the Merz Hand Grading Scale at week 12. Other assessments included Central Independent Photographic Reviewers evaluations of hand photographs, Global Aesthetic Improvement Scale, subject satisfaction, and safety.
Results: The mean injection volume was 2.1 ml at the first treatment. Subjects demonstrated significantly higher response rates with treatment compared to no treatment at week 12 (85.9 percent versus 21.2 percent) and at weeks 16, 20, and 24 ($p < 0.0001$). Photographic Reviewers assessments showed consistently greater improvements in the treated hands compared with the untreated hands from week 12 to week 24. Most subjects and investigators (≥92.8 percent) reported improvements in Global Aesthetic Improvement Scale score across all time points with treatment. Treatment-related adverse events were reported in seven subjects (7.9 percent). Most of these were mild, and none were serious.
Conclusion: Hyaluronic acid with lidocaine is safe, effective, and well tolerated for the correction of volume deficits in the dorsal hand. (*Plast. Reconstr. Surg.* 144: 586e, 2019.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, II.

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A "Hot Topic Video" by Editor-in-Chief Rod J. Rohrich, M.D., accompanies this article. Go to PRSJournal.com and click on "Plastic Surgery Hot Topics" in the "Digital Media" tab to watch.

Hand rejuvenation has become increasingly popular in recent years.[1] The aesthetics of the hand is an important cosmetic concern because this is a visible, typically unclothed area of the body.[2] The appearance of the hands is thought to be an indicator of true age.[1,3]

Intrinsic aging affects the deeper soft tissues of the hand.[1] Dermal atrophy causes the skin to appear more transparent.[1] Some structures of the hand such as bones, tendons, and veins become more visible because of the loss of fat and water.[1] During the aging process, the blue color of the veins becomes more noticeable through the skin.[2] In the dorsal hand, subcutaneous fullness slowly declines as these tissues atrophy with normal aging.[4]

There are currently few treatments approved for the correction of volume loss in the hand. Although various products have been used to restore dorsal hand volume loss such as poly-L-lactic acid and calcium hydroxylapatite, at the time of this research study, there was only one non–hyaluronic acid product approved by the U.S. Food and Drug Administration for this indication (i.e., calcium hydroxylapatite).[5,6] However, a small open-label study provided promising results with small-gel-particle hyaluronic acid for the correction of volume loss in the dorsal hand.[7] Fat injections have been used for replenishing the volume deficits.[2,5]

Large-gel-particle hyaluronic acid with lidocaine (HAL; Restylane Lyft with Lidocaine; Galderma Laboratories, LP, Fort Worth, Texas) is a hyaluronic acid gel that contains 0.3% lidocaine.[8] At the time of this study, the product was approved in the United States for moderate to severe facial folds and wrinkles and cheek augmentation.[8] This multicenter, randomized, evaluator-blinded, split-hand study in adult subjects evaluated the safety and efficacy of HAL for injection into the dorsal hand to correct volume deficits.

Disclosure: *Drs. Moradi, Allen, Bank, and Cohen are paid consultants and clinical trial investigators for Galderma. Drs. Marmur and Glaser are paid clinical trial investigators for Galderma. Dr. Fagien is a paid speaker, consultant, and clinical trial investigator for Galderma. Ms. Maguire is an employee of Galderma R&D, LLC..*

SUBJECTS AND METHODS

This was a prospective, multicenter, randomized, evaluator-blinded, split-hand study conducted in the United States. This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, and was approved by an institutional review board.[9]

Key Inclusion Criteria

Subjects with a volume deficit in the dorsal hand had to be willing to provide written informed consent, including photography consent. Men or women aged 22 years or older at baseline were eligible for inclusion in the study. In addition, potential subjects had to be willing and able to perform hand functionality tests.

Key Exclusion Criteria

Subjects with a history of allergy or hypersensitivity to injectable hyaluronic acid gel, gram-positive bacterial proteins, lidocaine, or other amide type anesthetics were excluded from participation in the study. Previous hand surgery (including sclerotherapy, or history of hand trauma) was not allowed. Finally, advanced photoaged/photodamaged skin or a skin condition with very fragile skin on the dorsal hands disqualified a subject from participation.

Randomization

Subjects (n = 90) meeting the entry criteria received treatment on day 0 with HAL in the left or right hand in a randomized fashion (randomization using an interactive response technology system). Randomization was stratified by Fitzpatrick skin type.

Treatments

HAL was manufactured by Q-Med AB (Q-Med AB/Galderma, Uppsala, Sweden). The sterilized gel contained 20 mg/ml of stabilized hyaluronic acid and 0.3% lidocaine in a physiologic buffer. Each syringe contained 1 ml of gel. HAL was injected using 29-gauge, 0.5-inch, thin-wall needles. All subjects received the dermal filler in one hand at the first treatment and then in the other hand at the 6-month treatment. No control or comparator treatment was administered. The fellow hand served as the primary comparator.

Treatments were administered to all subjects on day 0 and at month 6, including optional touch-up 4 weeks after the first injection. Touch-up treatment was only performed if the optimal treatment result was not met and both the investigator and subject agreed that a second treatment would be beneficial. Four weeks after the 6-month visit, a touch-up treatment of the fellow hand (first treatment at 6 months) was offered. Hands retreated at 6 months were not eligible for touch-up.

Endpoints

The primary efficacy endpoint was based on at least 1 point of improvement with HAL versus no treatment according to the Merz Hand Grading Scale (MHGS) at week 12.[10] Primary effectiveness in this study was based on the intent-to-treat analysis. This population included all subjects who received injections at least once and met the inclusion criteria for the MHGS.

Other efficacy endpoints included the MHGS response at weeks 16, 20, and 24. The Central Independent Photographic Reviewers (CIPR) conducted blinded assessments comparing photographs obtained at baseline and at weeks 12, 16, 20, and 24. Both the treating physicians and the study subjects evaluated aesthetic improvement of the dorsal hands using the Global Aesthetic Improvement Scale (GAIS) (3 = very much improved, 2 = much improved, 1 = improved, 0 = no change, and −1 = worse). Subject satisfaction at week 12 was assessed using the 13-item subject satisfaction questionnaire graded using a five-point Likert response scale (1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree).

Safety assessments were performed by the treating physician at all visits to monitor the incidence of adverse events. Safety assessments included evaluations and passive and active range of motion for thumb and all fingers, functional dexterity test, sensation test (light fingertip touch to the dorsal side of the hand), and strength test (grip, key, palmar pinch, and tip pinch). The flexion and extension angles of all metacarpophalangeal joints in each hand were measured using a Jamar finger goniometer (Sammons Preston Rolyan, Bolingbrook, Ill.). The impact on the subjects' day-to-day activities was based on the Michigan Hand Outcomes Questionnaire (MHOQ) at baseline and at weeks 12 and 24.[11] Subjects maintained a diary of injection-site reactions during the first 4 weeks after treatment.

Blinding

Investigator blinding was accomplished by using a treating investigator to administer the treatments and a blinded evaluator, to whom randomization and treatment were concealed, to perform the blinded assessments. This blinded evaluator was not allowed to discuss treatments with the treating investigator or the study subjects. Subjects were placed behind a partition, and placed each hand through a curtain for the blinded evaluator to rate separately.

Statistical Analyses

A responder was defined as a hand with at least 1 point of improvement from baseline on the MHGS. The primary endpoint, the responder rate at week 12, based on the blinded evaluator assessment, was compared between the hyaluronic acid filler and no treatment using the McNemar test. The percentages of responders at later time points were analyzed in a similar manner. Other secondary analyses were performed using descriptive statistics as appropriate. The frequency and percentage of subjects with adverse events were summarized by coded body system and preferred term using the Medical Dictionary for Regulatory Activities.

Analyses of the MHGS data set used the baseline observation value carried forward as the primary method of imputation. Imputation was only performed for the week-12 assessments. Ninety subjects provided more than 99 percent power to detect a difference in responder rates of 50 percent between the dermal filler and no treatment using the McNemar test with a 5 percent significance level (two-sided).

RESULTS

Subject Disposition

Ninety-nine subjects were screened for this study, and 90 received treatment (Table 1). There were 89 subjects included in the safety population and 85 subjects in the intent-to-treat population.

Table 1. Subject Disposition

Subjects	No. (%)
Randomized	92
Treated	90
Safety population	89 (96.7)
ITT population	85 (92.4)
Completed study	
Yes	84 (91.3)
No	8 (8.7)

ITT, intent-to-treat. This population included all subjects who were injected at least once and met the inclusion criteria for the Merz Hand Grading Scale.

Subject Demographics and Baseline Characteristics

The mean age of the subjects included in this study was 55.7 years (Table 2). The majority of subjects were white women.

Most subjects in this study were right-hand-dominant (91.8 percent) (Table 2) with Fitzpatrick skin types II (24.7 percent), III (45.9 percent), or IV (14.1 percent). Most hands in the study were classified as either MHGS score of 2 (31.8 percent), 3 (36.5 percent), or 4 (31.8 percent) at baseline.

Table 2. Subject Demographics, Intent to Treat

Characteristic	No. (%)
No. of subjects	85
Age, yr	
Mean	55.7
Range	37–77
Sex	
Male	3 (3.5)
Female	82 (96.5)
Ethnicity	
Hispanic or Latino	9 (10.6)
Not Hispanic or Latino	76 (89.4)
Race	
White	71 (83.5)
Black or African American	5 (5.9)
Asian	0
American Indian or Alaska Native	0
Native Hawaiian or Other Pacific Islander	4 (4.7)
Other	5 (5.9)
Hand dominance	
Left	7 (8.2)
Right	78 (91.8)
Both	0
Fitzpatrick skin type	
I	4 (4.7)
II	21 (24.7)
III	39 (45.9)
IV	12 (14.1)
V	7 (8.2)
VI	2 (2.4)
MHGS score of the treated hand (blinded evaluator)	
0	0
1	0
2	27 (31.8)
3	31 (36.5)
4	27 (31.8)
MHGS score of the fellow hand (blinded evaluator)	
0	0
1	0
2	18 (21.2)
3	39 (45.9)
4	28 (32.9)

ITT, intent-to-treat; MHGS, Merz Hand Grading Scale (0 = no loss of fatty tissue; 1 = mild loss of fatty tissue, slight visibility of veins; 2 = moderate loss of fatty tissue, mild visibility of veins and tendons; 3 = severe loss of fatty tissue, marked visibility of veins and tendons; 4 = very severe loss of fatty tissue, marked visibility of veins and tendons. [Carruthers A, Carruthers J, Hardas B, et al. A validated hand grading scale. *Dermatol Surg.* 2008;34(Suppl 2):S179–S183.]

Injection Characteristics

The mean injection volumes were 2.1 ml for the first treatment and 1.1 ml for the touch-up treatment (Table 3). The total volume injected ranged from 1 to 5 ml. All injections were made in the subcutaneous plane. A variety of methods were used for performing the injections, including micropuncture, linear, and small bolus (Fig. 1). All injections (100 percent) were made using a needle, and in most cases (≥98.9 percent), a topical anesthetic was not used. The majority of subjects (≥88.6 percent) received posttreatment care, which included massage and cooling. With increasing baseline MHGS scores, there was a trend of higher total injection volumes (Table 4). In some subjects with MHGS scores of 2 or 3, only 1 ml of HAL was injected (range, 1 to 5 ml).

Responder Rates

The blinded-evaluator assessment of MHGS grade found a significantly higher responder rate for hyaluronic acid (85.9 percent) compared with no treatment (21.2 percent) at week 12, the primary endpoint (difference, 64.7 percent; $p < 0.0001$) (Fig. 2). Similarly, significantly more responders were observed in the HAL treatment group compared with no treatment at weeks 16, 20, and 24.

CIPR Assessments

CIPR assessments of the aesthetic improvement of each hand at weeks 12, 16, 20, and 24 showed consistent improvements in the treated hands compared with untreated hands from week 12 to week 24 (range, 69.5 to 88.1 percent) (Fig. 3).

Table 3. Injection Characteristics in the Safety Population

	First Treatment		6-Mo Treatment	
Volume of Injection	HA Gel	Fellow Hand	HA Gel	Fellow Hand
Treatment				
No.	89	N/A	70	77
Mean, ml	2.13		0.95	2.05
Median, ml	2.00		1.00	2.00
Range, ml	1.0–3.0		0.2–3.0	1.0–3.0
Touch-up				
No.	74	N/A	N/A	44
Mean, ml	1.13			1.13
Median, ml	1.00			1.00
Range, ml	0.3–2.0			0.3–3.0
Treatment plus touch-up				
No.	89	N/A	70	77
Mean, ml	3.07		0.95	2.69
Median, ml	3.00		1.00	2.90
Range, ml	1.0–5.0		0.2–3.0	1.0–5.0

HA, hyaluronic acid; N/A, not applicable.

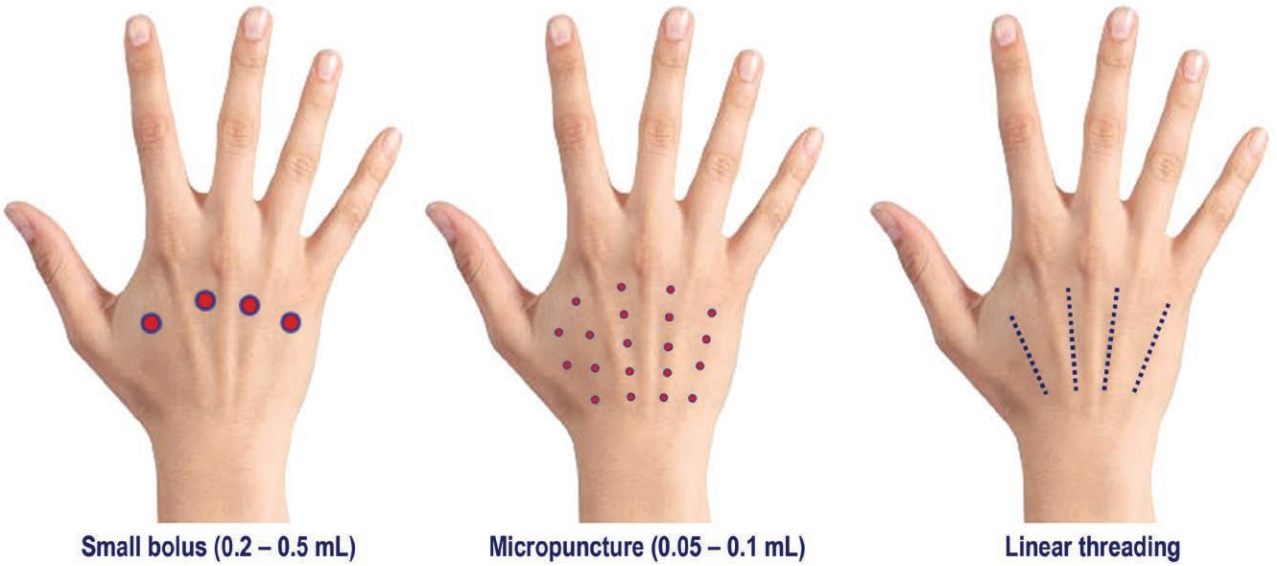

Fig. 1. Injection techniques use in this study.

Table 4. Total Injected Volume of Hyaluronic Acid with Lidocaine at the Initial Treatment*

Baseline MHGS Score of the Treated Hand	No.	Mean ± SD	Minimum	Median	Maximum
2	27	2.64 ± 0.84	1	3	5
3	31	3.13 ± 0.92	1	3	5
4	27	3.65 ± 0.89	1.8	4	5

MHGS, Merz Hand Grading Scale.
*Treatment plus touch-up by baseline Merz Hand Grading Scale scores in the treated hand in the intent-to-treat population.

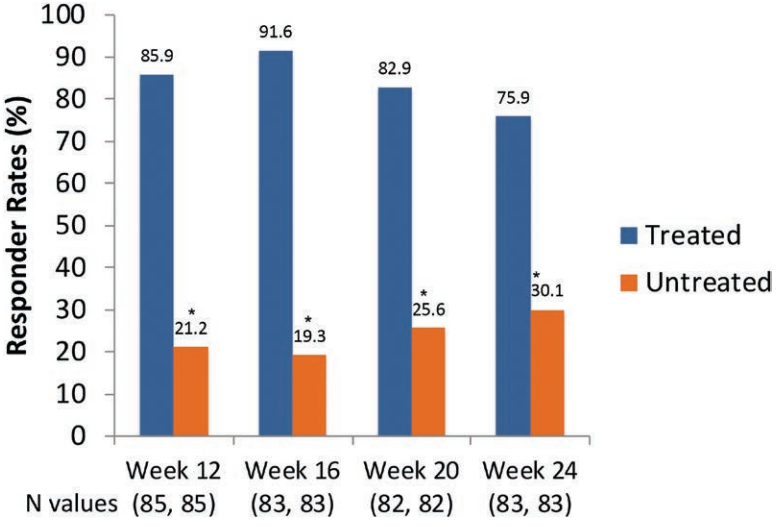

Fig. 2. Blinded evaluator responder rates at weeks 12, 16, 20, and 24. The primary endpoint was the responder rate at week 12 of the comparison between large-gel-particle hyaluronic acid with lidocaine compared to no treatment. A responder was defined as having at least a 1-point improvement from baseline on the MHGS by the treatment-blinded evaluator. *Difference in responder rates $p < 0.0001$ in the intent-to-treat population.

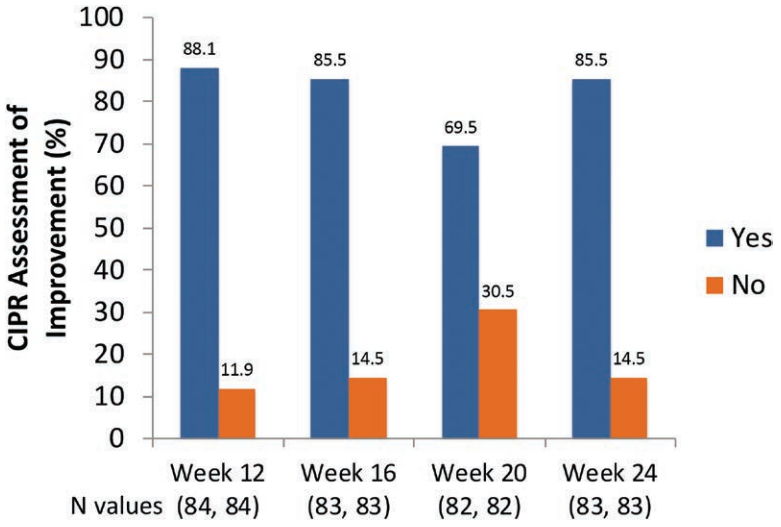

Fig. 3. Central Independent Photographic Reviewers (*CIPR*) assessment of improvement at weeks 12, 16, 20, and 24 in the intent-to-treat population.

Hand photographs of the treated hands showed improvements in the appearance of fullness in the hand (Figs. 4 and 5). These improvements could still be observed 24 weeks after treatment.

GAIS

Both subjects and treating investigators saw consistent improvements in the GAIS evaluations with treatment (Fig. 6). Based on the subjects' evaluation of the treated hand, greater than or equal to 92.8 percent reported improvement (included very much improved, much improved, and improved) across all time points. The treating investigators reported similar improvement rates in the treated hands, from 95.2 percent to 100 percent. In contrast, both the subjects' and treating investigators' rates of perceived aesthetic improvement was low in the untreated fellow hand (≤2.4 percent).

Subject Satisfaction at Week 12

Responses to each item of the subject satisfaction questionnaire were transformed into percentage agreement (percentage of subjects with a score of 1 or 2) (Fig. 7). The majority of subjects provided favorable responses in terms of the overall treatment in 11 of the 13 questions and felt their treated hand appeared more attractive and youthful. Overall, most subjects would recommend the treatment to a friend (84.5 percent) and would be willing to undergo repeated treatment in the future (77.4 percent).

Safety

Seven subjects (7.9 percent) experienced 13 of 82 total adverse events (15.9 percent) related to the product and/or the injection procedure. Overall, the majority of adverse events were considered mild in intensity and resolved within 4 days.

Across all treatments (first, second, and third), eight subjects reported hand-specific adverse events (Table 5). Several of these subjects experienced delayed-onset adverse events (>21 days after treatment). However, all of these events had resolved by the end of the study, with or without treatment. No subjects experienced any serious adverse events. Hand function tests, including passive range of motion, active range of motion for fingers, sensation, pinch strength, and grip strength, were stable following treatment. Twenty-two subjects experienced a negative change in active flexion of the thumb for the treated hand compared to 33 subjects for the fellow hand, according to the protocol definition (at least a 10-degree decrease from baseline in the fellow hand and a change from baseline at least 10 degrees worse than in treated hand). The largest mean negative change in active thumb flexion in the treated and untreated hands did not exceed −2.9 and −4.6 degrees, respectively. Functional dexterity improved through the week -24 visit. The total score of the eight hand-specific MHOQ questions increased at weeks 12 and 24 compared with baseline (data not shown).

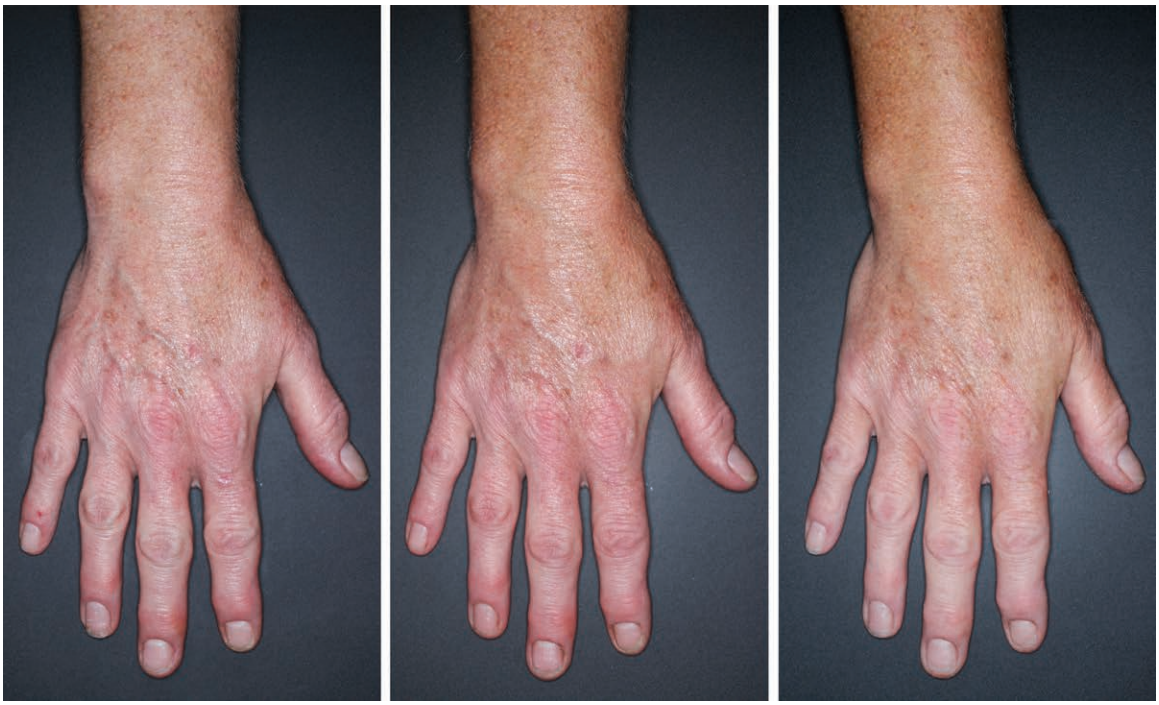

Fig. 4. (*Left*) Baseline hand photograph of a 49-year-old female subject before treatment, with a MHGS score of 2. This subject was classified as white with Fitzpatrick type III skin. (*Center*) Hand photograph of a 49-year-old female subject 12 weeks after receiving treatment in the right hand, with a MHGS score of 1. (*Right*) Hand photograph of a 49-year-old female subject 24 weeks after receiving treatment in the right hand, with a MHGS score of 1.

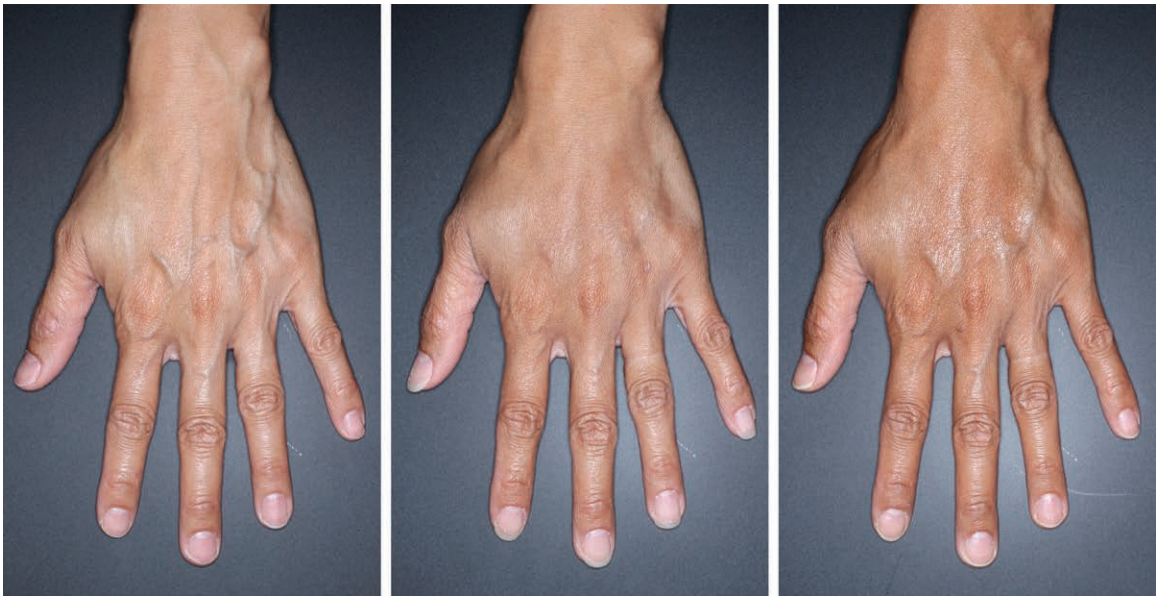

Fig. 5. (*Left*) Baseline hand photograph of a 38-year-old female subject at day 1 before treatment. This subject was classified as a native Hawaiian or other Pacific Islander with Fitzpatrick type V skin, and an MHGS score of 3. (*Center*) Hand photograph of a 38-year-old female subject 12 weeks after receiving treatment in the left hand, with an MHGS score of 1. (*Right*) Hand photograph of a 38-year-old female subject 24 weeks after receiving treatment in the left hand, with an MHGS score of 0.

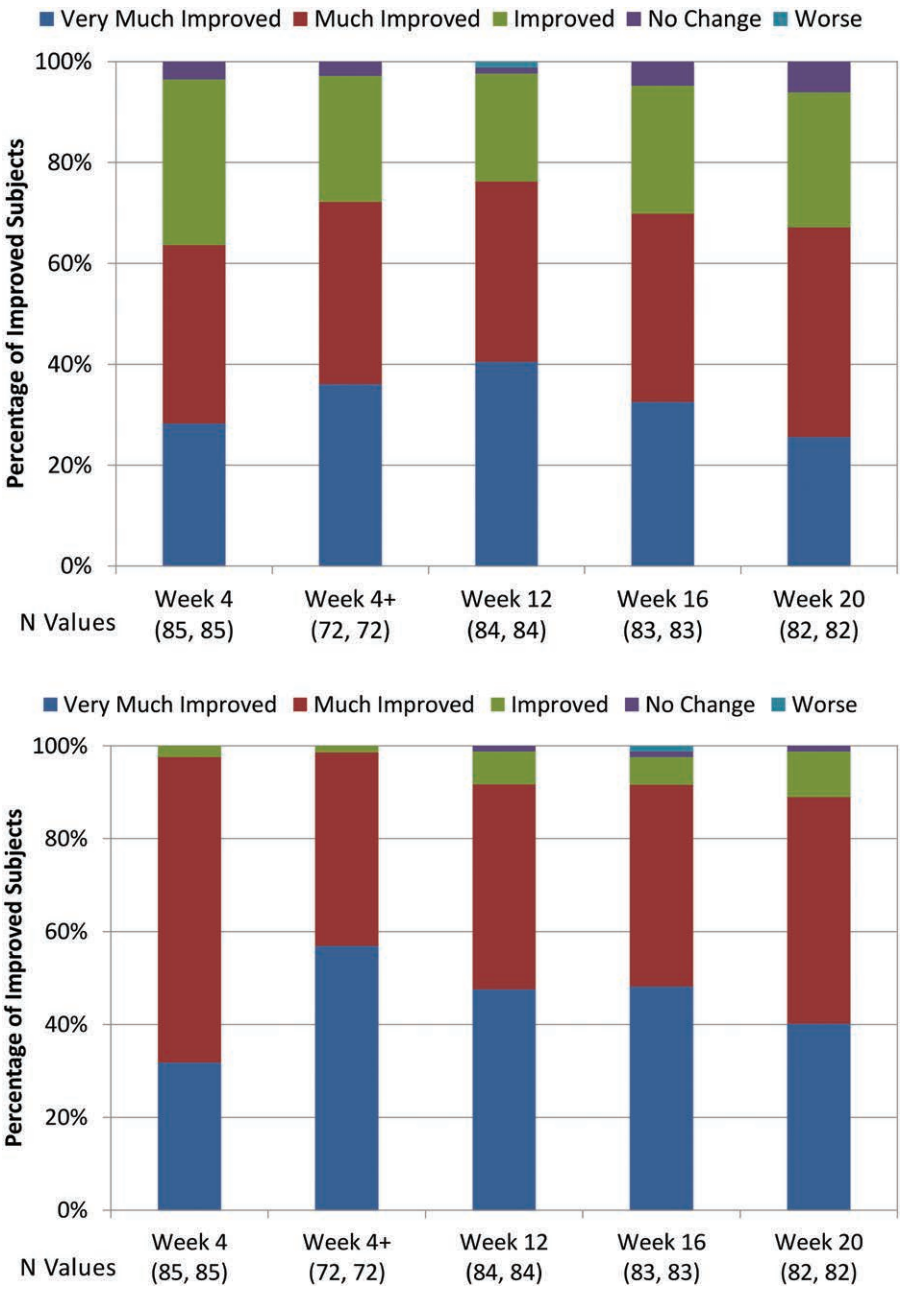

Fig. 6. (*Above*) Subjects' assessments according to GAIS results by visit of treated hands in the intent-to-treat population. Week 4+ denotes week 4 after the touch-up. Percentages are based on the number of subjects with a nonmissing assessment at that visit. (*Below*) Investigators' assessments according to GAIS results by visit of treated hands in the intent-to-treat population. Week 4+ denotes week 4 after the touch-up. Percentages are based on the number of subjects with a nonmissing assessment at that visit.

Subject Diary Results

The majority of subjects reported injection-site reactions following the first treatment that included swelling (75.0 percent), tenderness (75.0 percent), redness (71.6 percent), bruising (60.2 percent), pain (44.3 percent), itching (13.6 percent), and impaired hand function (6.8 percent). The incidence of injection-site reactions decreased over the first week. Most injection-site reactions reported in the subject diaries were considered mild in intensity.

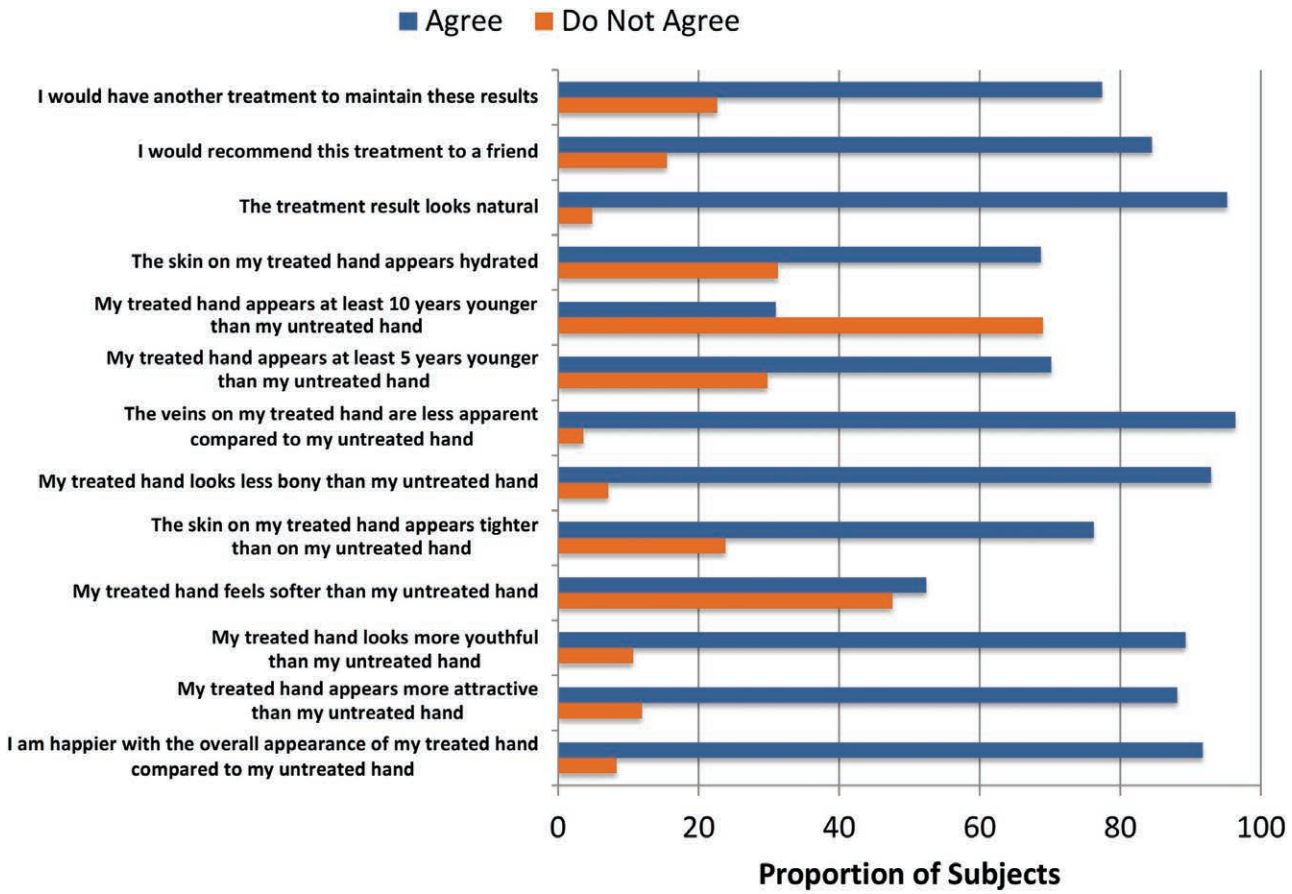

Fig. 7. Responses to subject satisfaction questionnaire at week 12 in the intent-to-treat population. Subject satisfaction was assessed using the 13-item subject satisfaction questionnaire graded using a five-point Likert response scale, where 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree (*n* = 84 subjects).

Table 5. Summary of Hand-Specific Adverse Events in the Safety Population

	First Treatment		Second Treatment		Third Treatment	
	Events	No. (%)	Events	No. (%)	Events	No. (%)
No. of subjects		89		77		70
Any related AE	3	3 (3.4)	5	3 (3.9)	4	2 (2.9)
Peripheral swelling	2	2 (2.2)	2	2 (2.6)	2	2 (2.9)
Pain in extremity	0	0 (0)	2	2 (2.6)	1	1 (1.4)
Pruritus	0	0 (0)	1	1 (1.3)	1	1 (1.4)
Skin mass	1	1 (1.1)	0	0 (0)	0	0 (0)

AE, adverse event.

DISCUSSION

The study met its primary objective of demonstrating the statistical superiority of HAL compared with no treatment in the dorsal hand for the percentage of responders based on MHGS assessments at week 12. The results clearly show an aesthetic improvement of the hands after treatment with HAL. Significant improvements (≥75.9 percent) in MHGS scores were observed through week 24, and most subjects and treating physicians reported improvements in GAIS scores across all time points. In addition, the blinded evaluators of photographs were consistently able to differentiate the treated hand from the untreated hand through week 24, and the CIPR assessments demonstrated a higher rate of improvement for the treated hand versus the untreated hand at all time points.

The MHGS is a validated tool for evaluating the efficacy of clinical treatments to the dorsal hand.[10,12] This scale has been used successfully in other studies of hand-volumizing treatment with dermal fillers and has demonstrated consistent intrarater and interrater agreement.[6,10,12,14] Improvements observed in the MHGS have previously corresponded to improvements in GAIS ratings and subject satisfaction.[6,14] These correlations were also corroborated in the current study and support the clinical relevance of the favorable aesthetic results with this hyaluronic acid product.

The CIPR assessments of improvement supported the findings of the MHGS and GAIS. These improvements were consistent over the course of the study, and these results together support the clinical utility of HAL for restoring volume loss in the hand.

Global Aesthetic Improvement Scale findings from the treated hands showed consistently high proportions of study subjects and treating physicians noting improvement (including improved, much improved, and very much improved) in the aesthetics of the dorsal hand with hyaluronic acid filler treatment. The treating physicians generally reported a slightly higher rate of improvement than the subjects. These favorable effects were stable over the course of the study. The duration of efficacy in the current study is consistent with results in other studies when HAL was used on the face, and high proportions of subjects showed improvements at 6 months and even out to 1 year.[15–17] Similarly, global aesthetic improvements have been maintained out to 6 months with small-gel-particle hyaluronic acid in hand rejuvenation.[7]

Consistent with the current results, HAL has previously demonstrated efficacy in the correction of moderate to severe facial folds and wrinkles and cheek augmentation.[15–21] A study in 200 subjects seeking cheek augmentation found efficacy with HAL.[15] Most (91.7 percent) of those subjects still showed improvement at 6 months, and efficacy was maintained for up to 12 months. These results are comparable with those from the current study, where at least 92.8 percent of subjects showed improvement based on the GAIS evaluated by either the subjects or the treating physicians. Considered together, these results demonstrate how this hyaluronic acid dermal filler provides clinically significant improvements in the aesthetics of two highly visible areas of the body: the face and the dorsal hand.

Subjects were pleased with the results from their dermal filler treatment. Most study subjects agreed their treated hands appeared younger and were happier with the appearance of their treated hands. Most study subjects would be willing to undergo repeated treatment in the future and would recommend the filler treatment to a friend.

HAL was associated with a favorable safety profile when injected in the dorsal hand. A relatively small percentage of subjects experienced adverse events related to the product and/or injection procedure, and most of these were considered mild in intensity. Low numbers/proportions of subjects experienced related hand-specific adverse events. Injection of HAL in the hand and posttreatment behavior such as strenuous use or trauma to the hands may increase the risk for delayed-onset adverse events in the hand. Pain and swelling were the most common hand-related adverse events. Most incidences were considered mild, and none were severe. Similarly, pain and swelling were some of the most common adverse events observed in treatments with other types of dermal fillers when applied to the hand.[6,14]

The majority of subjects at the week 4 through week 24 visits demonstrated a slightly reduced flexion in both the treated and untreated hand. The largest mean negative changes in active thumb flexion in the treated and untreated hands were consistent with the variability of joint function measurements in the hand, estimated at between 5 and 10 degrees.[22,23] In addition, functional dexterity improved through the week-24 visit. The total score of the eight hand-specific MHOQ questions increased at weeks 12 and 24 compared with baseline. These results suggest that the negative change in active flexion for thumb for treated and untreated hands found through week 24 do not constitute a clinically detrimental effect on hand functionality.

With greater emphasis in recent years placed on body image, hand rejuvenation has become increasingly popular.[1] Intrinsic aging affects deeper soft tissues of the hand.[1] Structures of the hand such as bones, tendons, and veins are more visible because of loss of fat.[1] These factors underscore the need for a safe and effective dermal filler that provides lasting improvements in the aesthetic appearance of the hand.

HAL treatment provided clinically significant improvements in the appearance of the dorsal hand as assessed by the treating investigators, blinded photographic graders, and the subjects themselves. These aesthetic improvements were stable over the course of the study. The incidence of hand-related adverse events was low, and these events were mostly mild in intensity. This hyaluronic acid dermal filler, applied with a needle, appears to be

a safe and effective treatment that provides lasting improvements in the aesthetic appearance of the dorsal hand.

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