doi:10.36849/JDD.6442



 ORIGINAL ARTICLE 

# Effectiveness and Safety of Calcium Hydroxylapatite With Lidocaine for Improving Jawline Contour

Amir Moradi MD,[a] Jeremy B. Green MD,[b] Joel L. Cohen MD,[c] John H. Joseph MD,[d] Rada Dakovic PhD,[e] Gemma Odena PhD,[f] Amit Verma PhD,[f] Richard Scher MD[f]

[a]Moradi MD, Vista, CA
[b]Skin Research Institute and Skin Associates of South Florida, Coral Gables, FL
[c]AboutSkin Dermatology and AboutSkin Research Greenwood Village and Lone Tree, CO; Department of Dermatology, University of California, Irvine, CA
[d]Clinical Testing Center of Beverly Hills, Encino, CA
[e]Merz Pharmaceuticals GmbH, Frankfurt am Main, Germany
[f]Merz North America, Inc., Raleigh, NC

## ABSTRACT

**Background:** One of the early signs of aging is loss of jawline contour. Not all cases require surgical intervention and soft-tissue augmentation with injectable fillers may restore the profile and youthful appearance of the jawline.

**Objective:** To demonstrate the effectiveness and safety of calcium hydroxylapatite with lidocaine [CaHA (+); Radiesse® (+)] to improve the contour of jawline after deep (subdermal and/or supraperiosteal) injection.

**Methods:** Healthy eligible patients with moderate or severe ratings on the Merz Jawline Assessment Scale (MJAS) were randomized 2:1 to treatment with CaHA (+) or to control. Patients in the control group remained untreated until week 12, then received delayed treatment. Touch-ups were allowed in both groups, and re-treatment was allowed in the treatment group only. Effectiveness was evaluated on the MJAS, patient and investigator Global Aesthetic Improvement Scales, and FACE-Q™ questionnaires. Adverse events were recorded over a 60-week period.

**Results:** Treatment response rate (≥1-point MJAS improvement) was 93/123 (75.6%) for the treatment group and 5/57 (8.8%) for the control/delayed-treatment group at week 12. The difference between response rates was statistically significant ($P<0.0001$), showing superiority of treatment over control. Satisfaction with aesthetic improvement was reported by patients and treating investigators throughout the study. A total of 76/113 (67.3%) patients who responded to treatment 12 weeks after initial injection also demonstrated persistent improvement 48 weeks after initial treatment. The study demonstrated a favorable safety profile, with no reported unexpected adverse events.

**Conclusions:** CaHA (+) is a safe and effective treatment for improving the contour of the jawline.

*J Drugs Dermatol.* 2021;20(11):1231-1238. doi:10.36849/JDD.6442

## INTRODUCTION

Multiple factors, including hereditary and aging aspects, lead to a noticeable, undesirable contour of the jawline, such as loss of bone volume, fat atrophy (volume loss), and descent of fat.[1] Volume loss in relation to the attachment points of the skin to the underlying superficial muscular aponeurotic system and/or bone results in specific patterns of deflation, pseudoptosis, and shadowing – all of which characterize the aging face. As soft tissue fullness shifts from the upper face to the lower face, the aging face changes from a youthful heart-shaped appearance to a more rectangular shape.[2] A surgical facelift is the standard treatment used to address these signs of aging and aids in redefining the jawline. As the aesthetic market evolves, patients are increasingly seeking to enhance their appearance with less invasive procedures and reduced downtime.[3]

Soft tissue fillers may be injected to replenish volume and restore the contour of the jawline; fillers also provide an opportunity to enhance the prominence of the jaw by adding volume at the chin and/or on the sides of the jawline. This enhancement can be achieved through filling volume and contour deficits, repositioning of ptotic, superficial fat compartments, and tightening the skin around the jawline.[3,4] To reestablish or correct optimal jawline contour, a soft tissue filler with high elasticity and viscosity offers the best volumizing capacity.[2]

Over the last decade, multiple published reports have demonstrated that fillers, such as calcium hydroxylapatite (CaHA; Radiesse®, Merz North America, Raleigh, NC, USA) improve the appearance of the aging jawline.[4-11] The available

literature supports both the effectiveness and safety of CaHA for injection along the jawline, from the mentum to the mandibular angle. Multiple authors have reported favorable results 6- and 12-months after product placement, noting both investigator and patient satisfaction.[6-8,11-12] Few procedure-related adverse events, such as pain, erythema, edema, and bruising, were reported – most of which were mild and resolved quickly without intervention. Overall, the reported safety profile of CaHA for improving jawline contour is favorable and comparable to other established treatment indications.

The purpose of this large, robust, randomized pivotal study was to investigate the safety and effectiveness of CaHA with lidocaine [CaHA (+); Radiesse® (+), Merz North America, Raleigh, NC, USA] treatment in patients who desired improvement of moderate to severe loss of jawline contour and to support the recent US Food and Drug Administration (FDA) approval for this indication.

## MATERIALS AND METHODS

### Study Design

This was a 60-week, prospective, multicenter, randomized, controlled, rater-blinded, pivotal clinical study (ClinicalTrials.gov: NCT03583359).

All eligible patients were randomized (2:1 allocation ratio; Figure 1) to either treatment with CaHA (+) or to control/delayed treatment (ie, untreated controls until primary endpoint assessment at week 12, when the controls were eligible for treatment).

Patients randomized to the treatment group received an initial CaHA (+) injection in both the right and left jawline and were assessed at week 4 for a touch-up in one or both jawlines to achieve optimal correction. These patients returned at week 12 for their primary effectiveness assessment. Patients in the treatment group were eligible to receive re-treatment with CaHA (+) at week 48. Patients randomized to the control group remained untreated until completion of the primary endpoint assessment at week 12; subsequently, they were treated with CaHA (+) and assessed 4-weeks later for a touch-up. These patients were not offered re-treatment. All patients were followed for at least 48 weeks post initial treatment and until the end of the study to assess long-term effectiveness and safety.

Institutional review boards of all participating sites reviewed the protocol and approved the study before enrolling the first patient.

### Patients

Patients were recruited at 15 sites within the United States. To be considered for study inclusion, male and female patients had to be between 22 and 65 years of age with right and left jawline ratings of 2 or 3 (moderate or severe) on the Merz Jawline Assessment Scale (MJAS) and have symmetrical jawlines.

Key exclusion criteria included non-age-related skin or fat atrophy in the midfacial and/or jawline region or diagnosis of a connective tissue disorder; skin laxity and/or sun damage beyond typical of the patient's age; prior surgery on the jaw or in the jawline area or a permanent implant or graft in the lower face and/or jawline area; previous treatment with fat injections, permanent fillers, or semi-permanent fillers in the lower face or jawline area; treatment with porcine-based collagen fillers or CaHA fillers in the lower face and/or jawline area received within 24 months prior to randomization; and administration

**FIGURE 1.** Study design. R: Randomization. PEV: Primary endpoint visit. EOS: End of study.

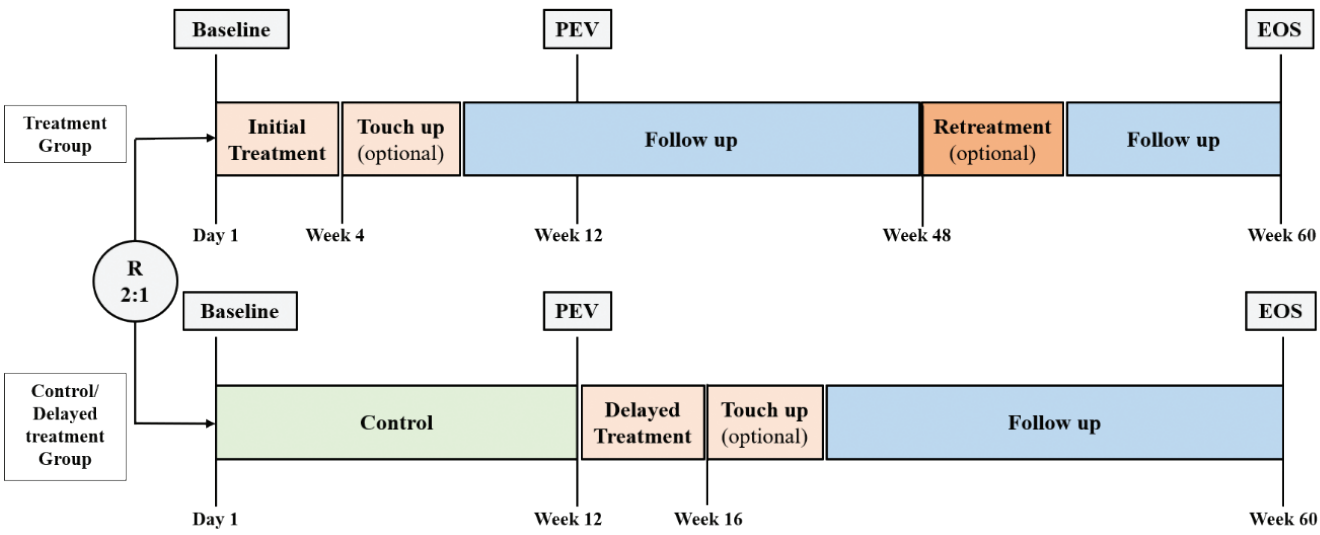


**FIGURE 2.** Patient disposition.

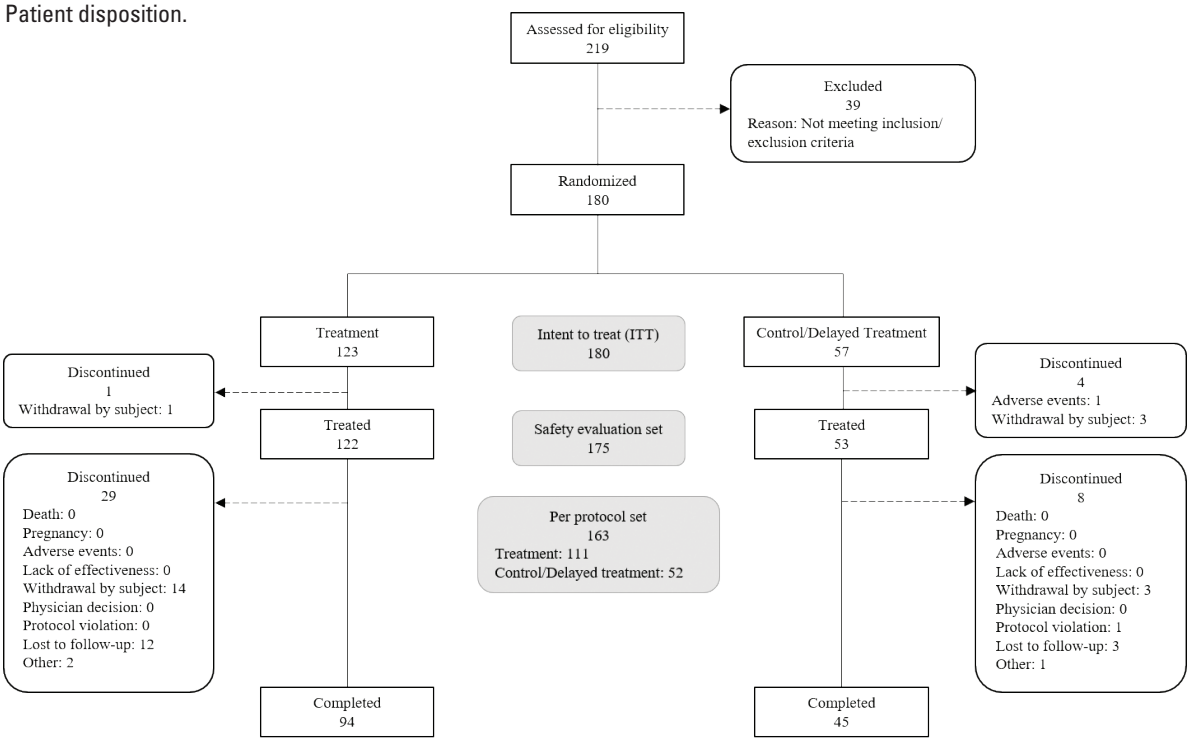



**TABLE 1.**

| Demographic and Other Baseline Characteristics | | | |
|---|---|---|---|
| | Treatment (N=123) | Control/DT (N=57) | Total (N=180) |
| Sex, (n [%]) | | | |
| Male | 21 (17.1) | 13 (22.8) | 34 (18.9) |
| Female | 102 (82.9) | 44 (77.2) | 146 (81.1) |
| Age [years] | | | |
| Mean (SD) | 55.5 (7.3) | 55.0 (6.6) | 55.3 (7.1) |
| Ethnicity (n [%]) | | | |
| Hispanic or Latino | 22 (17.9) | 9 (15.8) | 31 (17.2) |
| Not Hispanic or Latino | 101 (82.1) | 48 (84.2) | 149 (82.8) |
| Race (n [%]) | | | |
| White | 103 (83.7) | 42 (73.7) | 145 (80.6) |
| Asian | 5 (4.1) | 5 (8.8) | 10 (5.6) |
| Black or African American | 14 (11.4) | 10 (17.5) | 24 (13.3) |
| American Indian or Alaska Native | 1 (0.8) | 0 (0.0) | 1 (0.6) |
| Fitzpatrick skin type (n [%]) | | | |
| I – III | 77 (62.6) | 32 (56.1) | 109 (60.6) |
| IV – VI | 46 (37.4) | 25 (43.9) | 71 (39.4) |
| MJAS score by blinded rater | | | |
| Left jawline | | | |
| 2=Moderate | 65 (52.8) | 34 (59.6) | 99 (55.0) |
| 3=Severe | 58 (47.2) | 23 (40.4) | 81 (45.0) |
| Right jawline | | | |
| 2=Moderate | 65 (52.8) | 34 (59.6) | 99 (55.0) |
| 3=Severe | 58 (47.2) | 23 (40.4) | 81 (45.0) |

DT= delayed treatment; SD = standard deviation, n = number of observations, N = number of patients; MJAS = Merz Jawline Assessment Scale.
Note: More than one response was allowed for race.

of hyaluronic acid products within 12 months prior to randomization.

**Treatment**

Patients were randomized (1:1) to receive CaHA (+) treatment in the jawline area with either needle (27 gauge, ¾") or cannula (27 gauge, 1.6") at baseline. The injection method assigned at baseline was maintained if patients received a touch-up and/or re-treatment. The injection techniques used were a combination of linear-threading/tunneling, serial puncture and fanning, and linear-threading/tunneling. In all three treated anatomical locations (ie, angle/ramus, mid-body, and anterior), injection at multiple depths was allowed (ie, subdermal and/or supraperiosteal). The maximum volume of CaHA (+) per jawline side was limited to 3 mL during initial treatment and no more than 1.5 mL per jawline side during touch-up. At retreatment, the maximum volume of CaHA (+) per jawline side was limited to 3 mL.

**Outcomes**

Primary effectiveness was assessed on the MJAS by blinded raters. The 5-point MJAS ranges from grade 0 (a continuous jawline contour and no loss of volume) to grade 4 (an extreme loss of jawline contour and loss of jawline volume). Prior to study initiation, the MJAS was validated in a live setting (ie, 2 sessions, 3-weeks apart) by board-certified facial plastic surgeons and dermatologists who rated male and female volunteers with varying jawline severities, Fitzpatrick skin types, and ages. All raters exceeded the minimum weighted Kappa point estimate of ≥0.70 for the intra- and inter-rater reliability, demonstrating the reliability of the MJAS. All blinded raters were qualified using the same criteria as used for MJAS validation before rating study patients.

The primary effectiveness endpoint was the comparison of responder rates between the treatment group and the untreated control group at week 12, according to the MJAS, as assessed live by the blinded rater. Treatment response was defined as a 1-point or greater improvement on both jawlines compared to baseline. Secondary and other endpoint assessments at week 12 included: FACE-Q™ Satisfaction with Lower Face and Jawline; patient and treating investigator ratings on the Global Aesthetic Improvement Scale (GAIS); independent panel review (IPR) responder rates according to the MJAS as assessed by three blinded raters in photographs (response defined as ≥1-point improvement on both jawlines by at least 2 raters), and FACE-Q™ Patient-perceived Age Visual Analogue Scale (VAS). Retention of treatment response was also assessed at 48 weeks post-treatment.

Safety assessments included investigator-reported adverse events (AEs) over a 60-week period and patient-reported common treatment responses (CTRs) recorded in an electronic diary for 28 days after each treatment session.

**Statistical Analysis**

Two hypothesis tests for the primary endpoint were performed in sequential order: 1) a binomial test was used to demonstrate at least 50% of treated patients were responders ($H_{01}$: $P_{treatment} \leq 50\%$ vs $H_{11}$: $P_{treatment} > 50\%$), and 2) the Fisher's exact test was used to compare the treatment group with the control group ($H_{02}$: $P_{treatment} \leq P_{control}$ vs $H_{12}$: $P_{treatment} > P_{control}$). Each hypothesis test was a one-sided test, at a significance level of 0.025. Secondary and other endpoints, as well as safety, were descriptively summarized. Additionally, subgroup analysis by sex and Fitzpatrick skin types were performed. The SAS® software package (SAS Institute, Cary, NC, USA) was used.

## RESULTS

**Patients**

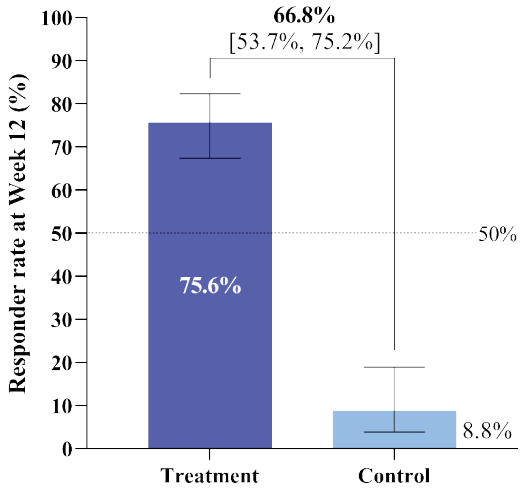
A total of 219 patients were screened with 180 patients being enrolled and randomized (123 to treatment and 57 to control/delayed treatment; Figure 2) including patients of all Fitzpatrick skin types, both males and females, and patients of various ages and races. The majority (81.1%) of patients were female, self-identified as White (80.6%) and mean (SD) age was 55.3 (7.1) years (Table 1). Regarding Fitzpatrick skin type categories, 60.6% of patients had skin types I, II, or III, and 39.4% had skin types IV, V, or VI. For baseline severity MJAS scores, 55% of patients had a score of 2 (moderate) and 45% had a score of 3 (severe); all patients had the same baseline score on both sides of their jawlines.

**Treatment**

A total of 175/180 randomized patients received treatment (Figure 2) with either needle (88/175 patients) or cannula (87/175 patients). The median injection volume for each side of the jawline was 1.80 mL. Among patients receiving a touch-up (132/175, 75.4%), the median volume injected was 1.10 mL in the right jawline and 1.25 mL in the left jawline. In treatment-group patients eligible for re-treatment at week 48 (76/122, 62.3%), median re-treatment injection volumes were 1.40 mL for the right jawline and 1.50 mL for the left jawline. No patient was injected with more than 3 mL of CaHA (+) per jawline per treatment session. No clinically significant trends were identified when considering the volume injected during each injection cycle or between the treatment and delayed-treatment groups.

The most commonly used injection techniques were serial puncture when injecting with a needle and linear-threading/tunneling when injecting with a cannula. The most common injection depth was subdermal and patients were frequently injected at multiple depths. The median number of injection points per jawline was 3 for all three treatment sessions, with a higher number of injection points when a needle was used, as expected.

**FIGURE 3.** Merz Jawline Assessment Scale (MJAS) responder rate at week 12 as assessed live by a blinded rater among the intent-to-treat population. Treatment response is defined as ≥ 1-point improvement on both jawlines compared to baseline. Bars represent confidence intervals (CI). Wilson CIs are calculated for responder rates. Newcombe CIs are calculated for responder rate differences.




| | |
|---|---|
| Responder rate for Treatment ≤ 50% *(Binomial test)* | <0.0001 |
| Treatment vs. Control *(Fisher's exact test)* | <0.0001 |

### Effectiveness

At week 12, the majority of patients (75.6%) in the treatment group showed a ≥ 1-point improvement on the MJAS in both jawlines when compared to baseline. The responder rates were significantly greater than 50% in the treatment group ($P$<0.0001), meeting the threshold for clinical effectiveness (Figure 3). In contrast, only 8.8% of patients in the control group were responders.

A statistically significant difference of 66.8% ($P$<0.0001) was demonstrated between the response rates in the treatment and the control groups. The 95% confidence interval (CI) for the difference in response rates was [53.7%, 75.2%], showing a lower bound greater than zero. Representative before and after treatment photographs are shown in Figure 4.

Similar results were also observed when stratifying MJAS responder rates at week 12 by Fitzpatrick skin type categories (difference in response rates between treatment and control group [95% CI]: I–III = 65.2% [47.5%, 75.1%] and IV–VI = 70.6% [48.2%, 82.0%]) and sex (females = 70.6% [56.1%, 79.0%] and males = 51.3% [17.0%, 70.8%]) with lower bounds of CIs greater than zero in both skin type categories and in both males and females.

Regarding durability, 76/113 (67.3%) patients who responded to treatment 12 weeks after initial injection also retained response 48 weeks after initial treatment. A small subset of patients who were responders at week 12 and did not receive re-treatment, retained response up to 60 weeks post-initial treatment (7/17, 41.2%).

For the FACE-Q Satisfaction with Lower Face and Jawline module, the mean (SD) Rasch-transformed scores in patients randomized to the treatment group increased from 21.5 (18.9) at baseline to 75.2 (22.3) at week 12. The mean (SD) change from baseline to week 12 was 53.9 (25.7), and the respective 95% CI of [49.2, 58.7] excluded zero. Overall, the improvement in mean Rasch-transformed scores indicated a better outcome, with patients reporting being more satisfied with how prominent and how sculpted their jawline looked, how their jawline looked in profile, how nice their lower face looked, and how smooth their faced looked.

All but one (99.1%) patient in the treatment group showed some level of improvement on the GAIS, as determined by the treating investigator (Figure 5). The remaining patient was reported to show no change in the treating investigator's judgement. The

**FIGURE 4.** Representative photographs of the jawline before (left) and after (right) treatment with CaHA (+). Lateral (top) and oblique (bottom) photographs are provided for each patient.

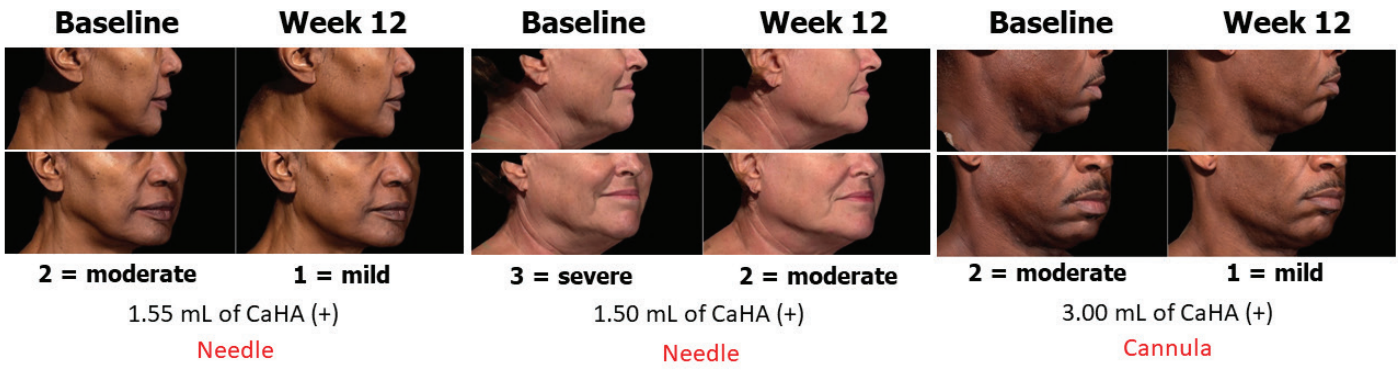
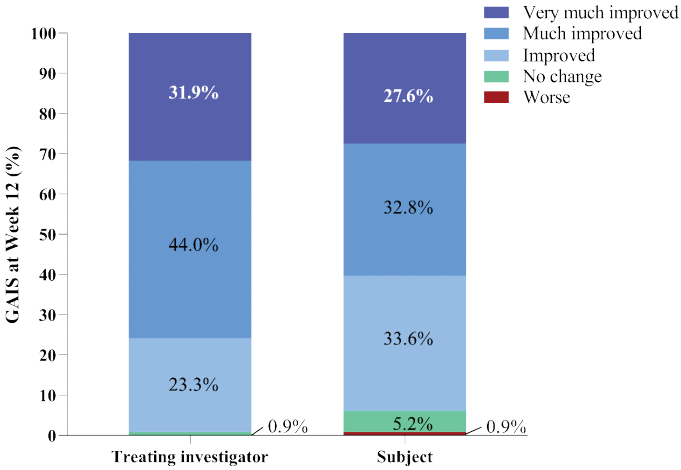


**FIGURE 5.** Treating investigator and patient Global Aesthetic Improvement Scores (GAIS) at week 12 among the intent-to-treat population. GAIS was assessed relative to baseline photographs.




majority of patients (94.0%) in the treatment group self-reported some level of improvement on the GAIS (Figure 5). Six (5.2%) patients reported seeing no change, and 1 (0.9%) patient reported looking worse when compared to baseline photographs.
At least two blinded IPRs assessed that 53 (47.7%) of 111 patients in the treatment group and 4 (8.2%) of 49 patients in the control group showed a treatment response of ≥1-point change on both jawlines, showing a difference of 39.6% [25.3%, 50.0%] between groups.

Furthermore, according to FACE-Q VAS, patients in the treatment group self-reported on average looking younger by approximately 3 years at week 12 when compared to baseline.

**Safety**

CaHA (+) was found to be tolerable and safe at up to three treatment sessions, and during the study's long-term follow-up period. Investigators reported at least one treatment emergent adverse event (TEAE) in 74/175 (42.3%) patients exposed to treatment. Three (3/175, 1.7%) patients had serious TEAEs that were unrelated to the treatment device. No TEAEs leading to study discontinuation were reported.

Overall, 46/175 (26.3%) patients had at least one TEAE that was deemed to be related to treatment by the investigator (Table 2). The most frequently reported treatment-related TEAEs were administration site conditions that were mild, lasted less than 15 days, and resolved without sequelae. Importantly, only one patient injected with needle had treatment-related TEAEs that were severe: injection site bruising (1 event, lasting 16 days) and injection site edema (1 event, lasting 16 days), and both events resolved. There were no treatment-related serious adverse events (SAEs). Only one patient (0.8%) had one mild treatment-related TEAE with unknown outcome due to being lost to follow-up.

**TABLE 2.**

| Treatment-Related Treatment Emergent Adverse Events, Safety Set | | |
|---|---|---|
| | Total (N=175) | |
| Preferred Term | n | (%) |
| Patients with at least one treatment-related TEAE | 46 | (26.3) |
| Injection site mass | 19 | (10.9) |
| Injection site bruising | 12 | (6.9) |
| Injection site pain | 12 | (6.9) |
| Injection site nodule | 6 | (3.4) |
| Injection site edema | 6 | (3.4) |
| Injection site swelling | 6 | (3.4) |
| Injection site hemorrhage | 4 | (2.3) |
| Injection site erythema | 3 | (1.7) |
| Injection site induration | 3 | (1.7) |
| Injection site inflammation | 3 | (1.7) |
| Device dislocation | 2 | (1.1) |
| Injection site extravasation | 2 | (1.1) |
| Product distribution issue | 2 | (1.1) |
| Ear pain | 1 | (0.6) |
| Injection site discomfort | 1 | (0.6) |
| Injection site rash | 1 | (0.6) |

N = number of patients exposed, TEAE = treatment emergent adverse event. Treatment-related TEAEs are defined as any adverse event with onset date on or after date of initial treatment related to injection procedure or related to CaHA (+).

Rates of treatment-related TEAEs were comparable between female (37/144, 25.7%) and male (9/31, 29.0%) subgroups.
Rates of patients with treatment-related TEAEs were equally similar and favorable for Fitzpatrick skin type category I to III when compared to skin type category IV to VI (I–III = 30/109, 27.5% and IV–VI = 16/66, 24.2%).

Common treatment responses (CTRs) were self-reported by patients in electronic diaries for 28 days post-treatment. After initial treatment, the majority of patients reported CTRs (eg, swelling, firmness, lumps/bumps, bruising, and discomfort/pain) that were mild (81/175, 46.3%) to moderate (81/175, 46.3%) in nature and had a duration of 14 days or less (1–3 days: 22/175, 12.6%; 4–7 days: 68/175, 38.9%; and 8–14 days: 46/175, 26.3%). CTRs reported in the study were similar for all three diary cycles (initial treatment, touch up, and retreatment), although incidences of subjects reporting at least 1 CTR tended to be lower after touch-up (77.8%) and re-treatment when compared to initial treatment.

## DISCUSSION

CaHA (+) demonstrated clinically and statistically significant sustained improvements in the contour of the jawline. This objective measure was further supported by multiple patient- and investigator-reported endpoints demonstrating aesthetic improvements following treatment.

The study population, which included male and female patients of various ages and races and all Fitzpatrick skin types, was representative of the diverse group of patients that typically receives aesthetic treatments in the facial region.[13]

Overall, the injection volumes utilized lead to the desired aesthetic outcome and were in line with standard clinical practice.[4,12,14-15]

At week 12, responder rates were calculated according to the MJAS as assessed by a blinded rater. Treatment response was defined as a ≥1-point improvement on both jawlines compared to baseline; this metric of improvement is a common criterion for aesthetic-medicine clinical trials, indicating demonstration of clinically relevant results.[16-20] The treatment response rate for the CaHA (+) group was 75.6%, exceeding the targeted margin of 50% ($P$<0.0001). In contrast, 8.8% of patients in the untreated control group were assessed as responders at week 12. The difference between the response rates in the treated and untreated groups at week 12 was statistically significant (66.8%, $P$<0.0001). Overall, comparable results were observed when stratifying results by Fitzpatrick skin type categories (I–III vs IV–VI) and sex (females vs males).

These findings demonstrate that CaHA (+) is an effective treatment for improving the contour of the jawline area. All patients categorized as responders at week 12 were assessed for duration of treatment effectiveness with the majority of patients demonstrating retention of treatment response at 48 weeks. Additionally, a small subset of patients who did not receive re-treatment retained treatment response up to 60 weeks post-treatment.

All results from the secondary endpoints related to patient- and investigator-reported assessments (eg, FACE-Q Satisfaction with Lower Face and Jawline and investigator and patient GAIS) successfully support the primary endpoint indicating that CaHA (+) is an effective treatment for improving contour of the jawline area.

Overall, study findings indicate improvements reported by investigators and patients 12 weeks after treatment with CaHA (+) (ie, when patients were expected to experience maximum treatment benefit), and additionally support the sustained effect of CaHA (+) treatment for up to 48 weeks when injected in the jawline.

This CaHA (+) pivotal study demonstrated a favorable safety profile, with no treatment-related SAEs and no unexpected or atypical events reported. Treatment-related adverse events consisted primarily of administration site conditions, were generally mild to moderate in intensity, lasted for less than 15 days, and mainly resolved prior to study end. Findings from the patient's CTR diary were in line with expectations for injection procedures with dermal fillers in the face and the expected safety profile of CaHA (+) from a patient self-reporting perspective.[16-20] In general, safety findings were similar in incidence, severity, and duration when stratified by Fitzpatrick skin type categories (I–III vs IV–VI) and sex (females vs males). These findings demonstrate that injected CaHA (+) is a safe and well tolerated treatment option to improve jawline contour.

## CONCLUSION

These study findings demonstrate that CaHA (+) is a safe and effective treatment for improving moderate to severe loss of jawline contour and have substantiated its FDA-approval for this indication.

## DISCLOSURES

This research was supported and funded by Merz North America, Inc.

Dr. Cohen has served as a consultant, clinical investigator, and member of the Global Key Opinion Leader Network for Merz Aesthetics. Dr. Green is a consultant, clinical investigator, and speaker for Merz Aesthetics. Dr. Scher, Dr. Verma, and Dr. Odena are employees of Merz North America, Inc. Dr. Dakovic is an employee of Merz Pharmaceuticals GmbH.

## REFERENCES

1. Loghem JV, Yutskovskaya YA, Philip Werschler W. Calcium hydroxylapatite: over a decade of clinical experience. *J Clin Aesthet Dermatol.* 2015;8(1):38-49.
2. Lorenc ZP, Lee JC. Composite volumization of the aging face: supra-periosteal space as the foundation for optimal facial rejuvenation. *J Drugs Dermatol.* 2016;15(9):1136-41.
3. Pavicic T, Few JW, Huber-Vorländer J. A novel, multistep, combination facial rejuvenation procedure for treatment of the whole face with incobotulinumtoxinA, and two dermal fillers- calcium hydroxylapatite and a monophasic, polydensified hyaluronic acid filler. *J Drugs Dermatol.* 2013;12(9):978-84.
4. Dallara JM, Baspeyras M, Bui P, et al. Calcium hydroxylapatite for jawline rejuvenation: consensus recommendations. *J Cosmet Dermatol.* 2014;13(1):3-14.
5. Sclafani AP, Kwak E. Alternative management of the aging jawline and neck. *Facial Plast Surg.* 2005;21(1):47-54.
6. Graivier MH, Bass LS, Busso M, et al. Calcium hydroxylapatite (Radiesse) for correction of the mid- and lower face: consensus recommendations. *Plast Reconstr Surg.* 2007;120(6 Suppl):55s-66s.
7. Dayan SH, Lieberman E, Larimer K. High-volume calcium hydroxylapatite filler to the lower one-third of the face. *Arch Facial Plast Surg.* 2009;11(2):145-7.
8. Hamilton D. Calcium Hydroxylapatite for Augmentation of the Posterior Mandibular Angle in Men. *Cosmetic Dermatology.* 2009;22(9):474-78.
9. Bartus CL, Sattler G, Hanke CW. The tower technique: a novel technique for the injection of hyaluronic acid fillers. *J Drugs Dermatol.* 2011;10(11):1277-80.
10. Braz A, Humphrey S, Weinkle S, et al. Lower face: clinical anatomy and regional approaches with injectable fillers. *Plast Reconstr Surg.* 2015;136(5 Suppl):235S-57S.
11. Buckingham ED, Glasgold R, Kontis T, et al. Volume rejuvenation of the facial upper third. *Facial Plast Surg.* 2015;31(1):43-54.

12. Baspeyras M, Dallara JM, Cartier H, et al. Restoring jawline contour with calcium hydroxylapatite: A prospective, observational study. *J Cosmet Dermatol*. 2017;16(3):342-7.
13. The American Society for Aesthetic Plastic Surgery: Cosmetic Surgery National Data Bank Statistics; Available at: https://www.surgery.org/sites/default/files/ASAPS-Stats2016.pdf. Accessed November 2016.
14. Juhász MLW, Marmur ES. Examining the efficacy of calcium hydroxylapatite filler with integral lidocaine in correcting volume loss of the jawline-a pilot study. *Dermatol Surg*. 2018 Aug;44(8):1084-1093.
15. Moradi A, Shirazi A, David R. Nonsurgical chin and jawline augmentation using calcium hydroxylapatite and hyaluronic acid fillers. *Facial Plast Surg*. 2019 Apr;35(2):140-148.
16. Juvéderm Vollure XC [Instructions for use]. Irvine, CA: Allergan; 2019.
17. Juvéderm Volbella XC [Instructions for use]. Irvine, CA: Allergan; 2016.
18. Juvéderm Voluma XC [Instructions for use]. Irvine, CA: Allergan; 2013.
19. Restylane Lyft with Lidocaine [Instructions for use]. Fort Worth, TX: Galderma Laboratories; 2018.
20. Restylane-L Instructions for Use [Instructions for use]. Fort Worth, TX: Galderma Laboratories; 2016.

## AUTHOR CORRESPONDENCE

**Gemma Odena PhD**
E-mail:.....gemma.odena@merz.com