ORIGINAL ARTICLE

Deep pyriform space augmentation with high G′ hyaluronic acid for nasolabial fold correction: a retrospective clinical study

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ABSTRACT

Introduction: The nasolabial fold is a primary aesthetic concern associated with facial aging. Traditional superficial filler techniques may correct wrinkles, however they often cause unnatural fullness of the perioral region. Deep structural support of the pyriform space may provide a more natural and anatomically congruent correction.

Objectives: To evaluate the safety and aesthetic efficacy of deep periosteal injections of high G′ hyaluronic acid in the pyriform space for correction of the nasolabial folds. The primary endpoint of the study was patient-reported aesthetic improvement, assessed through a Visual Analog Scale (VAS) at 6 months after treatment. Secondary endpoints included procedural safety, incidence of adverse events, and patient-reported pain during the procedure. In addition, the influence of the presence of a local anesthetic (mepivacaine) in the filler formulation on pain perception was analyzed.

Materials and Methods: A retrospective analysis of 52 patients (21 males, 31 females; mean age 44.5 years) treated between 2022 and 2025 was conducted. Treatments included deep pyriform space injection alone (n=14), combined with superficial intradermal nasolabial fold injections (n=8), or as a complementary procedure for midface enhancement (n=30). HA filler volumes ranged from 0.2–0.4 mL per side. Pain perception was recorded immediately post-procedure. Aesthetic outcomes were assessed using a Visual Analog Scale (VAS) at 6 months.

Results: No vascular adverse events occurred. Transient edema and erythema were observed in all cases, resolving spontaneously within 24–48 hours. Patients reported filler palpability without visible contour irregularities. Mean pain scores were 8.2 for fillers without mepivacaine and 5.8 with mepivacaine. Mean aesthetic satisfaction VAS at 6 months was 8.6. In a subset followed up to 24 months, results remained stable.

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Conclusions: Deep pyriform space augmentation with high G′ HA is a safe and effective approach for the correction of nasolabial folds. By restoring skeletal support, this technique achieves natural, harmonious results while minimizing the risk of unnatural perioral fullness. The inclusion of a local anesthetic significantly reduces procedural pain.

Key words: nasolabial fold, pyriform space, hyaluronic acid, facial aging, deep filler injection

Introduction

Facial aging is a multifactorial and progressive process involving structural, functional, and volumetric changes across multiple anatomical layers[1,2]. Beyond the well-characterized alterations of the skin and dermis, aging results in the deflation of facial fat compartments, loss of bony support, and the remodeling of the underlying skeletal framework. These cumulative changes lead to a loss of facial projection, reduced midface support, and consequent alterations of the nasolabial region[3-5].

The nasolabial fold is one of the most prominent indicators of facial aging and represents a frequent aesthetic concern among patients seeking non-invasive interventions[6]. Traditionally, correction has relied on linear retrograde injections of hyaluronic acid (HA) fillers placed directly along the fold to mechanically efface the crease. Although this technique effectively reduces the visual depth of the fold, it may result in disproportionate volume accumulation in adjacent soft tissues, particularly in the paracommissural region. Such unintended fullness can create an unnatural appearance, often referred to as "hamster syndrome" or "pillow face", and may compromise overall facial harmony[7-9].

Recent advances in anatomical understanding and filler technology have shifted the paradigm from superficial wrinkle filling toward a more anatomically driven, three-dimensional approach[10,11], emphasizing structural projection rather than mere volume replacement, an approach conceptually analogous to the soft tissue projection achieved after maxillary advancement procedures[12,13]. The pyriform space, an osseous and ligamentous region of the midface, plays a pivotal role in supporting the nasolabial fold. Skeletal resorption and loss of maxillary projection contribute to the deepening of this fold by altering the position and tension of the nasolabial and pyriform ligaments, as well as the overlying malar fat compartments[2]. Structural support of the pyriform space, therefore, offers a rational target for filler-based intervention, potentially addressing the root cause of fold formation rather than its superficial manifestation.

High G′ HA fillers, characterized by increased elasticity and lifting capacity, provide the mechanical properties necessary to restore support in deep periosteal planes. When strategically placed in the pyriform space, these fillers exert an upward and lateral vector on the overlying soft tissues, mitigating fold depth while preserving natural contour. This approach also reduces the risk of paracommissural fullness and enhances long-term stability of aesthetic results[14].

The present study aims to evaluate the clinical safety and aesthetic efficacy of deep pyriform space augmentation with high G′ HA filler in the treatment of nasolabial folds.

The primary outcome measure was patient-reported aesthetic satisfaction assessed using a Visual Analog Scale (VAS) at 6 months.

Secondary outcomes included procedural safety and pain perception during treatment.

Furthermore, the study analyzed the impact of the presence of a local anesthetic in the filler formulation on procedural comfort.

Materials and Methods

Study population

A retrospective analysis was conducted on 52 patients treated between January 2022 and January

2025. The cohort included 21 males and 31 females, with a mean age of 44.5 years (range: 29–72 years). All patients presented with moderate to deep nasolabial folds and sought minimally invasive facial rejuvenation. Patients with prior surgical interventions in the midface, active infections, or contraindications to HA were excluded. Follow-up sessions ranged from 6 to 24 months, allowing for the evaluation of both short- and medium-term outcomes.

Treatment groups

Patients were stratified according to treatment modality:

- **Group A (n=14):** deep pyriform space injection alone.
- **Group B (n=8):** deep pyriform space injection combined with superficial intradermal injection of the nasolabial fold (Maschiko technique)[15] (Figure 1).
- **Group C (n=30):** deep pyriform injection performed as a complementary procedure for midface volumetric enhancement.

Filler characteristics

All procedures employed a high G′ HA filler (STYLAGE® XXL, Vivacy Laboratories, Paris, France), with a G′ ranging from 260 to 320 Pa. Of the cohort, 22 patients received a formulation containing mepivacaine, while 30 patients received a non-anesthetic formulation. Volumes ranged from 0.2 to 0.4 mL per side, adjusted to patient anatomy and aesthetic goals.

Pre-procedural assessment and planning

Patients underwent standardized pre-treatment evaluation including:

- Clinical assessment of nasolabial fold depth, midface volume, and soft tissue displacement.
- Photographic documentation (frontal and 3/4).
- Marking of the needle entry point lateral to the nasal ala at the apex of the nasolabial fold. Skin antisepsis was performed using 80% isopropyl alcohol. Patients were counseled on the procedure, potential risks, and post-treatment care.

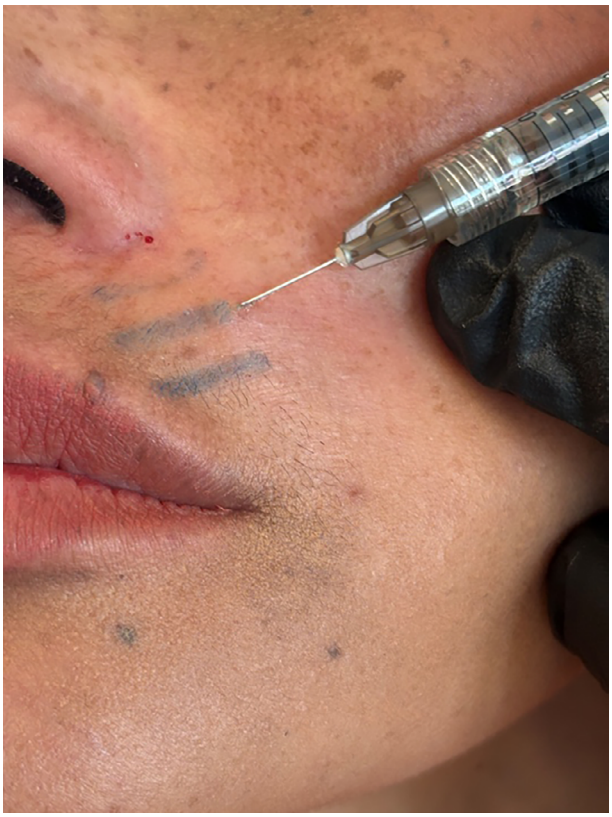

Figure 1. Schematic representation of needle positioning for perpendicular intradermal injection aimed at correction of the nasolabial fold, according to the technique described by Maschiko et al.

Injection technique

All injections followed a perpendicular needle approach. The needle was advanced to contact the maxillary bone within the deep pyriform space (Figure 2). A “lollipop” technique was used: an initial deep bolus was followed by retrograde filler deposition during needle withdrawal. Volumes were allocated as follows:

- 0.4 mL total per side: 0.25 mL deep, 0.15 mL during withdrawal
- 0.3 mL total: 0.2 mL deep, 0.1 mL during withdrawal
- 0.2 mL total: 0.12 mL deep, 0.08 mL during withdrawal

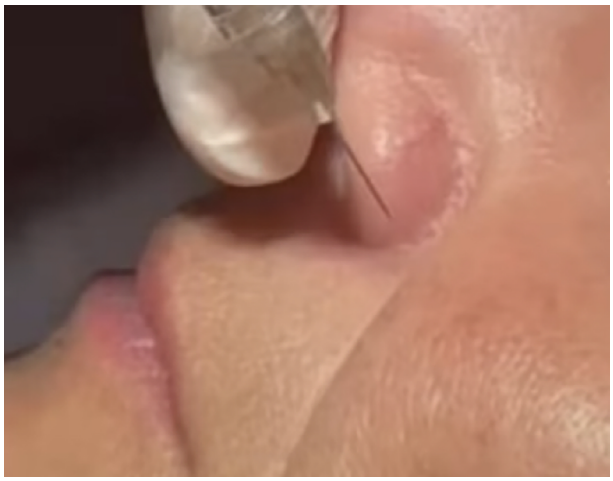

Figure 2. Needle positioning prior to tissue penetration for deep filler placement within the deep pyriform space.

In cases requiring residual superficial correction, an intradermal linear injection was performed along the nasolabial fold with a lower G' filler (STYLAGE® M-lidocaine, Vivacy Laboratories, Paris, France, with a G′ ranging from 170 to 230 Pa).

Outcome assessment

Primary outcome

The primary outcome of the study was a patient-reported aesthetic improvement of the nasolabial fold, assessed using a Visual Analog Scale (VAS: 0–10) at 6 months after treatment. Patients were asked to rate their overall satisfaction with the aesthetic result.

Secondary outcomes

Secondary outcomes included procedural safety and pain perception during the injection procedure.

Pain perception was assessed immediately after treatment using a numeric rating scale (NRS: 0–10).

Pain scores were compared between patients treated with fillers containing mepivacaine and those treated with fillers without anaesthetic.

The occurrence of adverse events, including vascular complications, edema, erythema, and filler palpability, was also recorded during follow-up.

Statistical analysis

Data analysis was performed using descriptive and inferential statistics. Continuous variables were expressed as mean ± standard deviation (SD). Normal distribution was assumed for pain and satisfaction scores.

Comparison of pain scores between patients treated with hyaluronic acid fillers containing mepivacaine and those treated without anesthetic was performed using the independent samples Student's t-test.

Effect size was calculated using Cohen's d to quantify the magnitude of the differences between groups.

A p-value < 0.05 was considered statistically significant. All analyses were two-tailed.

Results

All 52 patients completed a minimum follow-up of 6 months. Among them, 12 patients were followed for up to 24 months (Table 1).

Safety outcomes

No vascular adverse events were recorded in any case. Specifically, no signs of impending skin necrosis, vascular occlusion, or complications involving

Table 1. Patient demographics and treatment characteristics.

Variable	Value
Total patients	52
Male	21 (40.4%)
Female	31 (59.6%)
Mean age	44.5 ± 9.8 years
Age range	29–72 years
Pyriform injection only	14 (26.9%)
Pyriform + superficial NLF	8 (15.4%)
Pyriform + midface enhancement	30 (57.7%)
HA with mepivacaine	22 (42.3%)
HA without anesthetic	30 (57.7%)
Filler volume per side	0.2–0.4 mL

the facial artery or its branches were observed during or after the procedures.

In all cases, patients experienced transient edema and mild cutaneous erythema at the injection site. These reactions resolved spontaneously within 24–48 hours, without the need for medical intervention.

All patients reported palpability of the filler in the treated area for several weeks following the procedure. However, this finding did not result in visible aesthetic irregularities or contour deformities. Despite tactile awareness of the product, patients reported satisfaction with the aesthetic outcome (Table 2).

Pain assessment

Pain perception differed significantly according to filler formulation.

Patients treated with hyaluronic acid filler without mepivacaine reported a mean pain score of 8.2 ± 1.1 on the NRS scale.

Patients treated with filler containing mepivacaine reported a significantly lower mean pain score of 5.8 ± 1.3.

The difference between groups was statistically significant ($p < 0.001$, Student's t-test), with a large effect size (Cohen's $d = 2.0$) (Table 3).

Table 2. Safety outcomes.

Adverse event	n (%)
Vascular complications	0 (0%)
Skin necrosis	0 (0%)
Edema (transient)	52 (100%)
Erythema (transient)	52 (100%)
Filler palpability	52 (100%)
Contour irregularities	0 (0%)

Table 3. Pain perception according to filler formulation.

Filler type	n	Mean pain score (NRS) ± SD
Without mepivacaine	30	8.2 ± 1.1
With mepivacaine	22	5.8 ± 1.3

Statistical test: Independent Student's t-test. $p < 0.001$. Cohen's $d = 2.0$ (large effect).

Aesthetic outcomes

Aesthetic results were evaluated at 6 months post-treatment using a Visual Analog Scale (VAS). Mean patient-reported aesthetic satisfaction at 6 months was: 8.6 ± 0.9 (VAS 0–10).

The improvement was maintained in the subgroup of 12 patients followed up to 24 months (Table 4) (Figures 3 A and B, 4 A and B, 5 A and B, 6 A and B, 7 A and B, 8 A and B).

Discussion

The present study evaluated the safety and aesthetic outcomes of deep pyriform space augmentation using a high G′ hyaluronic acid filler for the treatment of nasolabial folds.

The results of this retrospective analysis demonstrated a high level of patient satisfaction at 6 months (mean VAS score 8.6) with no major vascular complications.

In addition, patients treated with fillers containing mepivacaine reported lower pain scores compared with those treated without anesthetic.

These findings support the role of deep structural augmentation of the pyriform space as an effective strategy for the correction of nasolabial folds.

The role of the pyriform space in facial aging has been widely recognized in plastic and reconstructive surgery[1,2]. The loss of skeletal support in the maxillary and perinasal region represents a key anatomical factor contributing to age-related changes of the midface and the deepening of the nasolabial fold[3,4,16,17]. This concept was extensively described by Mendelson, who emphasized that facial aging results not only from gravitational tissue descent but also from progressive skeletal resorption and loss of facial projection[2].

Table 4. Aesthetic outcome at 6 months.

Outcome	Result
Total patients evaluated	52
Mean VAS satisfaction	8.6 ± 0.9
Patients with follow-up ≥ 24 months	12
Mean VAS at 24 months (subset)	8.4 ± 1.0

Figure 3. A and B: Male patient, 57 years old. Pre-treatment (A) and 6-month follow-up (B) after deep filler injection into the pyriform space. A total volume of 0.4 mL of filler was injected per side. Treatment was exclusively focused on the nasolabial fold.

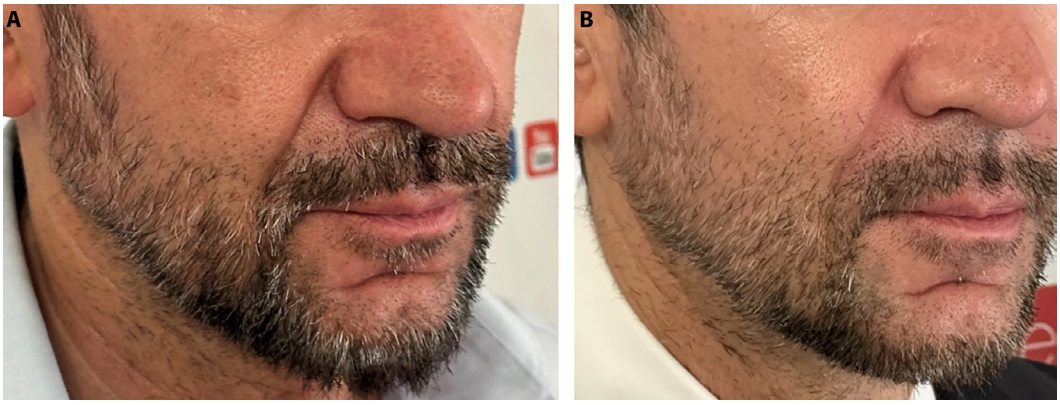

Figure 4. A and B: Same patient as Figure 3, with identical timing. Pre-treatment (A) and 6-month follow-up (B) images in right three-quarter view, showing correction of the nasolabial fold.

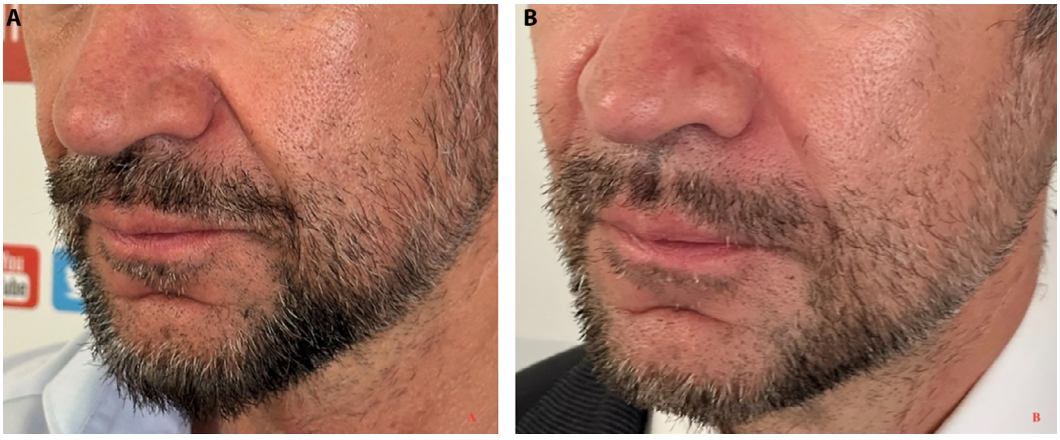

Figure 5. A and B: Same patient as Figures 3 and 4, with identical timing. Pre-treatment (A) and 6-month follow-up (B) images in left three-quarter view, showing correction of the nasolabial fold.

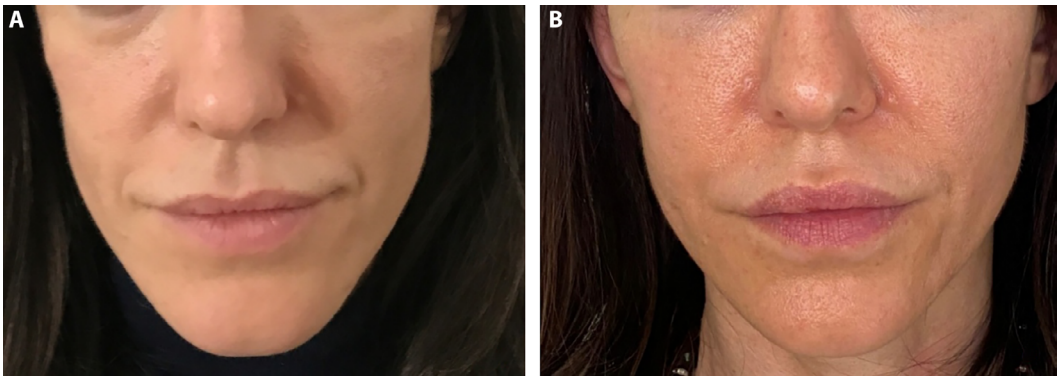

Figure 6. A and B: Female patient, 48 years old. Pre-treatment (A) and 36-month follow-up (B) after deep hyaluronic acid filler injection into the pyriform fossa (0.3 mL per side). Additional treatments included deep injections for projection of the maxillomalar complex, volumization of the facial fat pads, nonsurgical rhinoplasty, mandibular line and chin contouring, and lip enhancement.

Figure 7. A and B: Same patient as Figure 6, with identical timing. Pre-treatment (A) and 36-month follow-up (B) images in right three-quarter view.

Figure 8. A and B: Same patient as Figures 6 and 7, with identical timing. Pre-treatment (A) and 36-month follow-up (B) images in left three-quarter view.

In surgical facial rejuvenation, including facelift and midface lift procedures, he advocated for structural augmentation of the deep pyriform space, for example through the use of calcium hydroxyapatite grafts, to restore lost projection and counteract facial aging.

These principles have progressively influenced non-surgical aesthetic medicine. In the early 2000s, facial fillers were primarily considered dermal fillers, aimed at correcting superficial wrinkles and fine lines. Over time, advances in filler technology and

the development of products with different rheological properties—particularly high G′ fillers—have expanded their indications. Fillers are now increasingly used as structural tools, allowing three-dimensional facial remodeling in anatomically demanding areas such as the nose, jawline, chin, and deep midface, where skeletal support is required[14,18-23]. In addition, its use for reconstructive purposes has been well documented[24-26].

In this context, the treatment of the nasolabial fold through deep injection into the pyriform space represents a paradigm shift from simple wrinkle filling toward a more anatomically driven aesthetic rehabilitation. Traditional linear retrograde injections along the nasolabial fold often result in visible wrinkle effacement; however, this approach may produce unnatural fullness of the paracommissural region, contributing to the so-called "puffy face" or "hamster syndrome". This effect is caused by the volumization of mobile soft tissues rather than the restoration of deep structural support[1,7].

Deep augmentation of the pyriform space better addresses the pathophysiology of nasolabial fold formation. Aging is associated with widening and remodeling of the pyriform aperture due to skeletal resorption, resulting in loss of maxillary projection. This process alters the position and tension of the nasolabial and pyriform ligaments, which may shift cranially and contribute to the bulging of the nasolabial fat compartment over adjacent tissues[1,2]. By placing a high G′ hyaluronic acid filler directly onto the periosteum within the pyriform space, structural support is restored, exerting an upward and outward vector on the overlying ligaments and soft tissues. This mechanism leads to a more natural attenuation of the nasolabial fold compared to superficial filling alone.

Our findings support the concept that deep structural support, rather than superficial wrinkle filling, is the cornerstone of effective nasolabial fold correction. Moreover, pyriform space augmentation demonstrated additional benefits when combined with midface treatment, contributing to a more harmonious restoration of the maxillomalar projection and overall facial balance. In selected cases with residual dermal creasing, a dual-plane approach—combining deep pyriform injection with a superficial intradermal linear technique—may be indicated, particularly when the nasolabial fold is shallow to moderate in depth.

Longevity of results represents another advantage of deep periosteal injections. Previous studies, including those by Maschiko et al., have demonstrated that hyaluronic acid deposited close to the skeletal surface tends to remain stable over time, providing prolonged aesthetic benefits[14]. This observation aligns with our clinical experience, where patient satisfaction remained high at 6 months and, in a subset of cases, up to 24 months.

Pain perception emerged as a relevant clinical aspect in this study. Although the injection technique and anatomical plane were identical, patients treated with fillers containing mepivacaine reported significantly lower pain scores compared with those treated without anesthetic. This finding suggests that the inclusion of a local anesthetic can substantially improve patient comfort during deep periosteal injections, particularly in anatomically sensitive regions as already proven by the systematic review and meta-analysis published in medical literature[27].

Despite the anatomical complexity of the pyriform area and its proximity to the facial artery, no vascular adverse events were observed in our series. This favorable safety profile may be attributed to the perpendicular needle approach and the deliberate placement of filler in direct contact with the periosteum, a plane where the facial artery is not present. While emerging literature supports the use of ultrasound guidance in high-risk anatomical areas[28], careful anatomical knowledge and strict adherence to safe injection planes remains fundamental to minimizing complications.

Limitations

This study has several limitations, including its retrospective design and the absence of objective three-dimensional measurements of volume changes. In addition, the sample size was relatively limited.

Future prospective studies with standardized outcome measures and larger patient populations are required to further validate these findings.

Conclusion

Deep injection of a high G′ hyaluronic acid filler into the pyriform space represents a safe and anatomically sound approach for the treatment of the nasolabial fold, restoring lost structural support and potentially leading to a more natural and harmonious aesthetic outcome compared to traditional superficial filling techniques. The procedure demonstrated a favorable safety profile, high patient satisfaction, and prolonged aesthetic benefits. When necessary, a complementary superficial intradermal injection may be performed to address residual dermal creasing. The inclusion of a local anesthetic significantly reduced procedural pain, improving patient comfort without compromising results.

Pyriform space augmentation should be considered a key component of modern facial aesthetic rehabilitation, particularly in patients seeking natural correction of the nasolabial fold and global midface rejuvenation.

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