

**Fractional carbon dioxide laser
resurfacing combined with multilayer
hyaluronic acid skinbooster injections
for periocular, neck, and décolleté
rejuvenation:**

A prospective multicenter observational
interim analysis

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Original Article

Fractional carbon dioxide laser resurfacing combined with multilayer hyaluronic acid skinbooster injections for periocular, neck, and décolleté rejuvenation: A prospective multicenter observational interim analysis

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ABSTRACT

Objectives: The objective of the study is to evaluate the short-term clinical outcomes and tolerability of a structured sequential protocol combining fractional carbon dioxide laser resurfacing with multilayer hyaluronic acid (HA) skinbooster injections for rejuvenation of the periocular region, neck, and décolleté.

Material and Methods: This prospective, non-interventional, multicenter observational study enrolled consecutively treated adults with aging-related changes in the periocular, neck, or décolleté regions. Participants underwent a three-phase protocol consisting of HA skinbooster priming, fractional carbon dioxide laser resurfacing, and subsequent refinement injections. The pre-specified interim analysis assessed outcomes at day 42 using patient- and investigator-reported 5-point Likert scales. Paired baseline-to-day 42 comparisons were analyzed using the Wilcoxon signed-rank test.

Results: Thirty-one participants completed the day 42 assessment, with no dropouts. The cohort was 80.6% female, the median age was 55.5 years, the age range was 29–74 years, and all participants had Fitzpatrick skin types II to III. All evaluated patient- and investigator-reported domains improved significantly from baseline to day 42 (all $p < 0.001$). Mean patient scores increased from 2.48–2.74 at baseline to 4.23–4.58 at day 42, and mean investigator scores increased from 2.68–3.13 to 3.97–4.48. Mean patient satisfaction was 4.58/5.0, willingness to recommend treatment was 4.65/5.0, minimal post-inflammatory hyperpigmentation occurred in 1/31 participants (3.2%), and the median downtime was 3 days.

Conclusion: In this interim analysis, the sequential combination protocol was associated with clinically relevant short-term improvement across the assessed skin-quality domains and good tolerability. Because of the single-arm observational design, absence of image-derived endpoints at this interim stage, and lack of region-specific efficacy scoring, the findings should be interpreted as hypothesis-generating real-world data. Controlled comparative studies are required to determine the incremental contribution of HA skinbooster treatment over fractional carbon dioxide laser monotherapy.

Keywords: Combination therapy, Fractional carbon dioxide laser, Hyaluronic acid, Skin rejuvenation, Skinboosters

INTRODUCTION

Chronological aging and photoaging are accompanied by progressive extracellular matrix degradation, reduced fibroblast activity, and declining endogenous hyaluronic acid (HA) content.

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Type I collagen accounts for most dermal collagen, and ultraviolet-induced upregulation of matrix metalloproteinases is a key mechanism of collagen fragmentation and photodamage.¹ Clinically, these processes manifest as fine rhytides, loss of elasticity, textural irregularity, and reduced luminosity.

The periocular region, neck, and décolleté are particularly susceptible to age-related change because they combine relatively thin skin with repetitive motion and chronic ultraviolet exposure.^{2,3} Fractional ablative carbon dioxide (CO₂) laser resurfacing induces controlled microscopic thermal injury and initiates a wound-healing cascade involving re-epithelialization, neocollagenesis, and dermal remodeling.^{2,4}

Injectable HA-based skinboosters are used to improve hydration, skin quality, and dermal support. Experimental and translational data suggest that HA may modulate fibroblast activity and extracellular matrix homeostasis, whereas clinical studies and reviews have reported improvements in hydration, elasticity, texture, and selected neck-line outcomes after HA-based skin-quality treatments, including in the neck and décolleté.^{3,5-9}

The rationale for combining fractional CO₂ laser resurfacing with HA skinbooster therapy is biologically plausible: Laser treatment may create a temporally favorable remodeling milieu, whereas sequential HA administration may support hydration and extracellular matrix reconstitution during recovery.^{10,11} Available literature suggests that combination strategies can improve patient-perceived skin quality and may enhance the magnitude or durability of response compared with single-modality treatment, although direct comparative evidence remains limited.^{6,10,11}

This manuscript reports the preplanned day 42 interim analysis of a prospective observational cohort evaluating the feasibility, effectiveness, and tolerability of a structured sequential protocol combining fractional CO₂ laser resurfacing with multilayer HA skinbooster injections in periocular, neck, and décolleté rejuvenation.

MATERIAL AND METHODS

Study design and participants

This was a prospective, non-interventional, multicenter post-market observational study conducted at two private practice sites in Germany and Austria, one dermatologic practice site, and one plastic-surgical practice site. The overall study period extended from November 2025 to October 2026, and the present report summarizes the interim data available through day 42. This manuscript was prepared in accordance with STROBE (strengthening the reporting of observational studies in epidemiology) reporting guideline for observational studies.

Adults with clinically evident skin aging in the periocular

region, neck, or décolleté and Fitzpatrick skin types I to III were eligible. Participants were recruited consecutively. The target sample size for this interim cohort was 31 participants. No additional selection criteria beyond the predefined eligibility criteria were applied. Exclusion criteria comprised active skin infection, pregnancy, autoimmune disease, and anticoagulant therapy.

Ethics and consent

This prospective, non-interventional, post-market observational study (Anwendungsbeobachtung) was conducted in accordance with the Declaration of Helsinki. All products and devices used in the study were CE (Conformité Européenne)-marked and were applied within their certified intended use. Participation did not alter the treatment indication, treatment decision, treatment conduct, or follow-up schedule and did not involve additional invasive or burdensome procedures beyond routine clinical practice. According to the applicable regulatory framework in Germany and Austria for non-interventional post-market observational studies with CE-marked products used within their intended purpose, formal prospective ethics committee approval or competent authority authorization was not required. All participants provided written informed consent before treatment, data collection, photographic documentation, and the use of anonymized data for scientific analysis and publication. Data handling complied with the general data protection regulation.

Treatment protocol

The intervention followed a three-phase sequence consisting of priming, laser reset, and refinement. In the priming phase at week-1, intradermal papule injections of Teosyal PureSense Redensity 1 and subdermal cannula placement of Teosyal resilient hyaluronic acid (RHA) 1 were performed in the periocular region, neck, and décolleté using a multilayer technique. Teosyal PureSense Redensity 1 is a non-cross-linked HA skinbooster (15 mg/mL) enriched with amino acids, antioxidants, minerals, and vitamins; rheologically, it behaves as a soft, low-viscosity, low-elasticity gel intended for superficial intradermal redensification and hydration support.^{5,6} Teosyal RHA 1 is a lightly cross-linked resilient HA gel (15 mg/mL) manufactured to preserve long HA chains; rheologically, it is characterized by high stretch with relatively low to moderate strength, allowing deformation and adaptation in dynamic superficial tissues.¹² A topical soothing regimen was applied immediately after treatment.

In the laser reset phase at day 0, fractional CO₂ laser resurfacing was performed on the lower eyelid, neck, and décolleté using the Smaxel: radiofrequency (RF) CO₂ laser (Intros Medical Laser GmbH, Heilbad Heiligenstadt, Germany). Although the device name contains “RF,” the

device used in this study is a pure CO₂ laser system without an RF treatment component; no RF-based stimulation was applied. The same device-displayed laser settings were used for all participants, in both centers, and across all three anatomical regions: Depth Level 1, 90 mJ/microbeam, pulse duration 4.0 ms, and Density Level 17. Treatment was performed as a single pass. Pulse stacking, intentional overlap, and confluent ablation were avoided.

The rationale for using a uniform parameter set was to improve reproducibility across centers and reduce operator-dependent variability in this multicenter observational protocol. Zone-specific adjustment was initially considered because of anatomical differences in skin thickness and thermal vulnerability. After investigator consensus and preliminary parameter testing, a uniform lowest-depth, single-pass fractional protocol was selected, while procedural safeguards were adapted to the anatomical site. In the lower eyelid region, smaller scan fields of 5 × 5 mm were used, whereas 20 × 20 mm scan fields were used in the neck and décolleté. The eyelid margin was spared with an approximate safety distance of 3 mm. Certified CO₂-laser ocular protection was used according to site-specific standard operating procedures. One center used intraocular eye shields for periocular treatment, whereas the other center used certified external protective eyewear with careful downward displacement of the lower eyelid.

The clinical endpoint was uniform fractional erythema with discrete microablative treatment points, absence of confluent ablation, and absence of pulse stacking. Mild punctate bleeding was acceptable. Mild frosting was considered acceptable but was not consistently observed by the treating investigators, possibly because of the preceding HA priming treatment.

Before study initiation, the selected settings were assessed by the investigator self-testing in one investigator (Stefan Bigge) using mobile optical coherence tomography (OCT) (NITID: handheld optical coherence tomography device) after probatory treatment. Ten OCT measurements were obtained per anatomical region. The mean OCT-estimated microablative column depth was 611 µm in the lower eyelid region, 578 µm in the neck, and 625 µm in the décolleté. Because these measurements were obtained in a single individual and were not a pre-specified participant-level endpoint, they should be interpreted only as exploratory platform-specific plausibility data. The zone of thermal damage could not be quantified with the mobile OCT device used; higher-resolution line-field confocal OCT, laser microscopy, or histologic assessment would be required for this purpose. Biopsy-based assessment was not compatible with the non-interventional observational design.

In the refinement phase at day 14–21, Teosyal PureSense Redensity 1 was reinjected intradermally using the papule

technique according to the observed clinical response after laser treatment.

Outcome measures

Patient-reported outcomes were captured at baseline and day 42 on 5-point Likert scales, where 1 indicated very poor and 5 indicated very good. Patient-reported domains included overall aesthetic impression, skin texture, glow/freshness, evenness, overall satisfaction, and willingness to recommend treatment. Investigator-rated parameters comprised global esthetic state, texture, glow, evenness, hydration/elasticity, and tolerability. Post-procedural reactions captured in the safety dataset included erythema, edema, crusting, and pigmentary change or post-inflammatory hyperpigmentation (PIH), using a 5-point scale where 1 indicated absent and 5 indicated severe. Standardized photographic documentation was obtained using the FotoFinder Meesma system (FotoFinder Systems GmbH, Bad Birnbach, Germany). For the present-day 42 interim analysis, photographs were used for documentation and selection of representative clinical examples only. No image-derived endpoint, blinded photographic grading, or quantitative image analysis was pre-specified or performed for this interim analysis. Independent blinded photographic assessment, including region-specific analysis, is planned for the final month 12 analysis, when treatment effects are expected to be more stable and residual signs of recent ablative laser treatment are less likely to compromise temporal masking. All baseline patient-reported outcome scores, including overall satisfaction, were collected at the week-1 pre-priming visit.

Statistical analysis

Descriptive statistics are reported as mean, standard deviation, median, and interquartile range (IQR), as appropriate. Paired within-participant comparisons between baseline and day 42 were performed using the Wilcoxon signed-rank test. A two-sided $p < 0.05$ was considered statistically significant. Analyses were conducted using the statistical package for the social sciences.

RESULTS

Participant demographics

All 31 enrolled participants completed the day 42 follow-up; no dropouts occurred between enrollment and the day 42 assessment. Twenty-five participants were female (80.6%) and six were male (19.4%). The median age was 55.5 years (Q1, 44.75 years; Q3, 65.25 years), with a range of 29–74 years; the mean age was 53.8 years. Fitzpatrick skin type II was present in 29 participants (93.5%) and type III in 2 participants (6.5%).

All 31 participants were treated in all three predefined anatomical regions, namely the lower eyelid/periorcular region, neck, and décolleté. Accordingly, each anatomical region was represented in 31/31 participants. On day 42, patient-reported and investigator-rated outcome scores were collected as global assessments of the treated regions rather than as separate region-specific scores. Therefore, no formal region-specific efficacy comparison was performed in this interim analysis.

Efficacy at day 42

Patient-reported outcomes

All four patient-reported core parameters improved significantly by day 42 [Table 1]. The largest mean change was observed for overall aesthetic impression (change +1.87, $p < 0.001$), followed by evenness (change +1.74), texture (change +1.61), and glow/freshness (change +1.52; all $p < 0.001$). Wilcoxon statistics were 0.0 for all four core patient-reported domains, indicating a uniform direction of change. At day 42, the mean overall satisfaction was 4.58 ± 0.56 and the mean willingness to recommend treatment was 4.65 ± 0.55 .

Investigator-rated outcomes

Investigator ratings showed the same direction of effect and were statistically significant across all assessed domains

[Table 2]. The largest mean improvements were seen for global aesthetic state and glow/luminosity (both change +1.35, $p < 0.001$), followed by texture (change +1.32), hydration/elasticity (change +1.19), and evenness (change +0.84; all $p < 0.001$). Mean tolerability at day 42 was 4.48 ± 0.85 , and mean physician overall satisfaction was 4.23 ± 0.72 . For investigator-rated skin texture, the Wilcoxon signed-rank statistic was $W = 7.0$, as shown in Table 2; this value was verified against the source data and reflects a small negative signed-rank contribution in this domain, while the overall paired change remained statistically significant ($p < 0.001$).

Safety and tolerability

Post-procedural reactions captured in the safety dataset were overall mild to moderate and clinically manageable [Table 3]. Erythema, edema, and crusting were documented as expected treatment reactions. By day 42, erythema and edema had resolved clinically. PIH occurred in 1/31 participants (3.2%) and was rated minimal (score 2), which is notable given the use of an ablative laser modality.^{13,14}

Downtime and qualitative observations

Representative standardized clinical photographs were selected to illustrate typical improvement patterns in

Table 1: Patient self-assessment at baseline and day 42.

Parameter	Baseline mean±SD	Day 42 mean±SD	Mean change	W	p-value
Aesthetic overall impression	2.71±0.46	4.58±0.50	+1.87	0.0	<0.001
Skin texture	2.61±0.50	4.23±0.84	+1.61	0.0	<0.001
Glow/freshness	2.74±0.44	4.26±0.68	+1.52	0.0	<0.001
Evenness of skin surface	2.48±0.51	4.23±0.84	+1.74	0.0	<0.001
Overall satisfaction	3.61±0.50 (Week-1, pre-priming)	4.58±0.56	+0.97	N/A	N/A
Recommendation	N/A	4.65±0.55	N/A	N/A	N/A

Mean±SD is shown. W: Wilcoxon signed-rank statistic, N/A: Not applicable. Baseline refers to the week-1 pre-priming assessment for all baseline patient-reported parameters, including overall satisfaction, SD: Standard deviation, statistical significance was defined as $p < 0.05$

Table 2: Investigator assessment at baseline and day 42.

Parameter	Baseline mean±SD	Day 42 mean±SD	Mean change	W	p-value
Global esthetic state	2.81±0.87	4.16±0.73	+1.35	0.0	<0.001
Skin texture	2.81±0.87	4.13±0.92	+1.32	7.0	<0.001
Glow/luminosity	2.68±1.05	4.03±0.98	+1.35	0.0	<0.001
Evenness	3.13±0.81	3.97±0.84	+0.84	0.0	<0.001
Hydration/elasticity	3.00±0.82	4.19±0.83	+1.19	0.0	<0.001
Tolerability	3.13±0.85 (Day 0)	4.48±0.85	+1.35	N/A	N/A
Physician overall satisfaction	N/A	4.23±0.72	N/A	N/A	N/A

Mean±SD is shown. W: Wilcoxon signed-rank statistic, N/A: Not applicable, SD: Standard deviation, statistical significance was defined as $p < 0.05$

Table 3: Objective adverse events at day 0 after the procedure.

Adverse event	n	Mean±SD	Median	Minimum	Maximum
Erythema	31	2.81±0.95	3.0	1	4
Edema	31	2.55±1.06	3.0	1	4
PIH	31	1.03±0.18	1.0	1	2
Crusting	31	2.10±1.11	2.0	1	4

Scale: Scores ranged from 1 (absent) to 5 (severe).
PIH: Post-inflammatory hyperpigmentation, SD: Standard deviation

the lower eyelid/periorcular region, neck, and décolleté [Figures 1-5]. The photographs are provided as illustrative examples only and were not used for quantitative image-derived outcome analysis in this day 42 interim report.

Mean downtime was 3.21 ± 1.76 days and median downtime was 3 days (IQR, 2–3.75; range, 1–10). This appears shorter than recovery intervals often described for fractional ablative CO₂ laser monotherapy, although cross-study comparisons should be interpreted cautiously, given the uncontrolled design and differences in treatment settings.

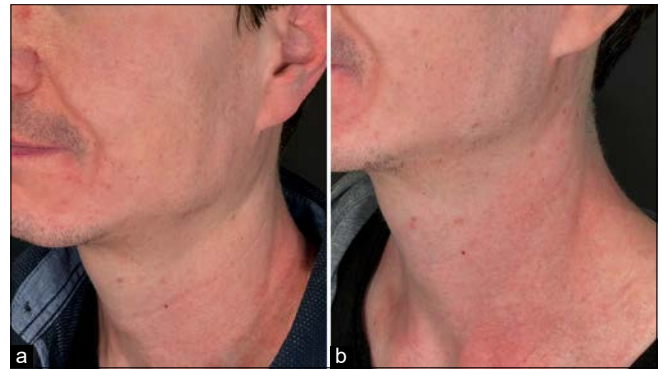
Representative physician comments included “Very short downtime. Treatment result very good” and “Downtime shortened significantly compared to previous treatments with laser alone.” One physician described prolonged downtime in one participant because of a hematoma after HA injection, underscoring the relevance of meticulous injection technique in vascularly sensitive areas.

Representative patient comments at day 42 included “The wrinkles in the eye area are significantly reduced. Clearly better skin appearance” and “Combination of laser and HA, especially in critical zones, is outstanding; very well tolerated with almost no downtime.” One participant noted, “Lower eyelids better, neck difficult,” suggesting potentially heterogeneous regional responses that should be examined in later analyses.

DISCUSSION

This interim analysis suggests that the structured sequential protocol was associated with robust short-term improvement across all assessed patient- and investigator-reported skin-quality domains. Mean changes of more than 1.5 Likert points in several patient-rated domains may be clinically meaningful and are directionally consistent with the literature on HA skinboosters, fractional CO₂ laser rejuvenation, and multimodal treatment concepts.^{2,3,6,10,11}

The biological rationale for a sequential approach is plausible. Fractional CO₂ laser treatment induces controlled microablative injury and initiates tissue repair pathways that

**Figure 1:** (a) Day 0 and (b) Day 42 neck.**Figure 2:** (a) Day 0 and (b) Day 42 lower eyelid/periorcular clinical outcome (patient 1).**Figure 3:** (a) Day 0 and (b) Day 42 décolleté.

support remodeling.^{2,4} HA-based injectables may improve hydration and dermal support and may help optimize the tissue milieu during the recovery phase.^{3,5,6} The refinement treatment at day 14–21 was intended to capitalize on this regenerative window. Because the present study did not include mechanistic endpoints, these considerations should be interpreted as biologically informed hypotheses rather than direct proof.

The low observed PIH frequency (3.2%) is encouraging. This finding should, however, be interpreted in the context



Figure 4: (a) Day 0 and (b) Day 42 additional lower eyelid/periorcular clinical outcome (patient 2).

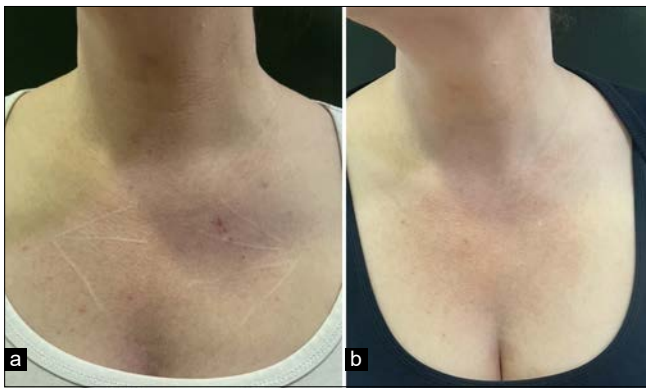


Figure 5: (a) Day -10 and (b) Day 42 décolleté clinical outcome (patient 2).

of the cohort composition, which was overwhelmingly Fitzpatrick type II. The comparatively light phototype distribution likely reduced baseline PIH susceptibility, while the structured photoprotection regimen may also have contributed.¹³

Median downtime of 3 days was short for an ablative laser-based intervention. Although investigator comments support the impression of abbreviated recovery, the present single-arm design does not permit a causal conclusion that HA priming itself reduced downtime. This question warrants formal comparison in controlled studies.

The use of both slightly cross-linked and non-cross-linked HA at different tissue depths reflects a layered treatment concept that is consistent with contemporary multimodal rejuvenation strategies.^{6,11} In rheologic terms, Redensity 1 behaves as a softer, low-viscosity biorevitalizing gel suited to superficial hydration and skin-quality support, whereas RHA 1 represents a lightly cross-linked resilient gel with greater stretch and dynamic adaptability.¹² These complementary properties provide a plausible rationale for combining superficial redensification with subdermal support in highly mobile and structurally delicate treatment areas such as the periorcular region, neck, and décolleté.

Several limitations should be acknowledged. First, the interim analysis is based on a single-arm observational cohort and therefore does not allow causal attribution or direct comparison with laser or injectable monotherapy. Fractional CO₂ laser resurfacing is an established modality for skin rejuvenation, and the present study cannot determine the incremental contribution of HA skinbooster priming and refinement beyond the effect of laser treatment alone. A randomized split-face or split-area study comparing fractional CO₂ laser resurfacing alone with fractional CO₂ laser resurfacing combined with HA skinbooster injections would provide more robust evidence regarding the additive benefit. Such a design would, however, require a controlled interventional study protocol and was beyond the scope of this non-interventional post-market observational study.

Second, the day 42 outcome assessment relied predominantly on patient-reported and investigator-rated 5-point Likert scales. Although standardized FotoFinder documentation was obtained, no blinded photographic grading or quantitative image analysis was performed for this interim analysis. Independent blinded photographic assessment, including region-specific analysis of the lower eyelid, neck, and décolleté, is planned for the final month 12 evaluation. Third, the cohort was small and consisted predominantly of female participants with Fitzpatrick type II skin, which limits generalizability. Fourth, all participants were treated in all three anatomical regions, but the interim outcome scores were collected as global treatment assessments rather than region-specific ratings; therefore, systematic regional differences could not be analyzed at day 42.

These considerations should guide the interpretation of the current results and define the priorities for the planned month 3 and month 12 follow-up analyses.

CONCLUSION

In this day 42 interim analysis, a standardized single-pass fractional CO₂ laser protocol combined with sequential multilayer HA skinbooster injections was associated with significant short-term improvement in patient-reported and investigator-rated skin-quality domains, good tolerability, minimal PIH in one participant, and a median downtime of 3 days. Because of the single-arm observational design, absence of image-derived endpoints in this interim analysis, and lack of region-specific efficacy scoring, these findings should be interpreted as hypothesis-generating real-world data rather than proof of additive efficacy.

These interim findings justify further evaluation of this combination approach for periorcular, neck, and décolleté rejuvenation. Confirmation of durability, regional response patterns, and the incremental contribution of HA skinbooster treatment over fractional CO₂ laser monotherapy will require

the planned month 12 analysis and, ideally, controlled comparative studies.

Authors' contributions: Stefan Bigge: Concept and design, literature search, data analysis, statistical analysis, data interpretation, manuscript drafting, critical revision, and final approval. Carlo Hasenöhl and Frank Mildszus: Clinical data acquisition, manuscript editing and review, and final approval. All authors have read and approved the final manuscript.

Data availability statement

The data supporting the findings of this study are not publicly available because of privacy and data-protection restrictions under the General Data Protection Regulation. De-identified aggregate data may be made available from the corresponding author upon reasonable request, subject to applicable legal and ethical requirements.

Ethical approval: Institutional Review Board approval was not required because, according to the applicable regulatory framework in Germany and Austria, this was a non-interventional post-market observational study using CE-marked products and devices within their intended use and without additional invasive or burdensome procedures beyond routine clinical practice.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given consent for their images and other clinical information to be reported in the journal. The patient understands that the patient's names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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REFERENCES

- Liu H, Dong J, Du R, Gao Y, Zhao P. Collagen study advances for photoaging skin. *Photodermatol Photoimmunol Photomed* 2024;40:e12931.
- Wu HH, Chen MQ, Liu JH, Song LL, Luo DQ, Lu JF, et al. Combination of fractional carbon dioxide laser with recombinant human collagen in periocular skin rejuvenation. *J Cosmet Dermatol* 2024;23:124-33.
- Pino A, Torrecilla J, Alonso JM, Tovito L, Pérez R. Clinical and biometric assessment of a hyaluronic acid-based skin booster for face, neck and décolleté rejuvenation: A prospective study. *J Cosmet Dermatol* 2025;24:e70547.
- Qi Y, Sun C, Zhou Y, Luo L, Wang C. Low energy ultrapulse CO₂ fractional laser combined with autologous platelet-rich plasma in periorbital rejuvenation treatment. *J Invest Surg* 2025;38:2484543.
- Bezpalco L, Filipskiy A. Clinical and ultrasound evaluation of skin quality after subdermal injection of two non-crosslinked hyaluronic acid-based fillers. *Clin Cosmet Investig Dermatol* 2023;16:2175-83.
- Rosso P, Colina J, Jarne C, Garrigós E, Magalhães B, Da Costa MA, et al. Enhancing skin quality with a sequential treatment using 2 hyaluronic acid dermal fillers: A prospective, multicenter, interventional study. *Aesthet Surg J* 2025;45:1051-64.
- Majewska L, Dorosz K, Kijowski J. Facial skin density enhancement using hyaluronic acid-based bioactive hydrogel: Cannula-assisted delivery and ultrasound evaluation in a retrospective controlled study. *Pharmaceutics* 2025;17:553.
- Chahine S, Marozzi B, Valle A, Michellini L, Lazzari T. Efficacy and safety of non-cross-linked hyaluronic acid injections for facial skin biorevitalization. *Cureus* 2025;17:e90005.
- Wong ZY, Limbu S, Karanasios G, Monks F, Faderani R, Kanapathy M, et al. Efficacy and safety of hyaluronic acid fillers for horizontal neck lines: A systematic review and meta-analysis. *Aesthet Surg J Open Forum* 2026;8:ojaf163.
- Oku M, Oku K. The efficacy and safety of combining cross-linked hyaluronic acid filler VYC-12L and energy-based devices for facial skin quality improvement in Asians. *J Cosmet Dermatol* 2025;24:e70485.
- De Sanctis Pecora C, Corduff N, Carroll J, Muniz M, Sattler S. Multimodal treatment combinations and layering to restructure the aging face: Recommendations from an expert panel. *Plast Reconstr Surg Glob Open* 2025;13:e6873.
- Faivre J, Gallet M, Tremblais E, Trévidic P, Bourdon F. Advanced concepts in rheology for the evaluation of hyaluronic acid-based soft tissue fillers. *Dermatol Surg* 2021;47:e159-67.
- Wongdama S, Yenyuwadee S, Li JB, Saokaew S, Kanchanasurakit S, Manuskiatti W. Interventions to prevent postinflammatory hyperpigmentation after laser and energy-based device treatments: A systematic review and network meta-analysis. *Lasers Surg Med* 2026;58:157-68.
- Zhang J, Xu F, Lin H, Ma Y, Hu Y, Meng Q, et al. Efficacy of fractional CO₂ laser therapy combined with hyaluronic acid dressing for treating facial atrophic acne scars: A systematic review and meta-analysis. *Lasers Med Sci* 2023;38:214.

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