Journal of Applied Cosmetology

ISSN 2974-6140 (online) ISSN 0392-8543 (print)

Clinical Trial

Treatment of Atrophic Facial Acne Scars with PEG-Crosslinked Hyaluronic Acid–CaHA

P. Kubik[1], W. Gruszczyński[1], A. Pawłowska[1], M. Malinowski[1], B. Baran[2], A. Pawłowska-Kubik[1], Ł. Kodłubański[3] and B. Łukasik[2]

[1]K-LAB Badania i Rozwój, Gdynia, Poland;
[2]Medical Department, Matex Lab Switzerland, Geneve, Switzerland;
[3]University of Gdansk, Department of Human Rights and Intellectual Property Law, Gdansk, Poland

Corresponding author:
Paweł Kubik,
K-LAB Badania i Rozwój,
81-312 Gdynia, Poland,
tel.: +48-515-151-388
e-mail: pawel.kubik@k-lab.com.pl

Keywords: *acne scarring, acne scar management, PEGDE-HA filler, CaHA*

Received: 31 October 2025
Accepted: 07 January 2026

ISSN 2974-6140 (online) ISSN 0392-8543 (print).

DISCLOSURE: ALL AUTHORS REPORT NO CONFLICTS OF INTEREST RELEVANT TO THIS ARTICLE.

ABSTRACT

Acne vulgaris affects approximately 80% of individuals between the ages of 11 and 30 and often results in persistent acne scarring that can negatively impact psychosocial well-being, leading to anxiety and reduced self-esteem. This study aimed to evaluate the safety and clinical outcomes associated with the use of PEG-crosslinked hyaluronic acid with calcium hydroxyapatite in patients with facial acne scars. Twenty healthy female volunteers (aged 18–42) underwent a single session combining subcision with a 22G cannula and the simultaneous administration of 2 mL of PEG-crosslinked hyaluronic acid with calcium hydroxyapatite. Participants with recent retinoid use, excessive tanning, or relevant medical conditions were excluded. Skin elasticity, scar depth, and scar diameter were measured at baseline and on days 28 and 90 after treatment. Significant improvements in skin texture and a visible reduction in acne scars were observed. Cutometric analysis demonstrated increased skin elasticity, while high-frequency ultrasound imaging showed an average 21% reduction in scar diameter and a 61% reduction in scar depth by day 90. No adverse effects were reported. A single session combining subcision with a 22G cannula and the simultaneous administration of PEG-crosslinked hyaluronic acid and calcium hydroxyapatite was shown to be safe and to be associated with clinically and instrumentally observed improvements. The filler provides temporary volumization of atrophic or thinned facial soft tissues, resulting in visible aesthetic improvement and favorable patient-reported outcomes. These findings support the potential role of this minimally invasive approach in the management of patients with acne scars.

INTRODUCTION

Acne vulgaris is one of the most common dermatological conditions, affecting approximately 80% of individuals aged 11-30 years, with nearly all adolescents presenting with at least minimal acne lesions. The condition occurs equally in both genders, with peak incidence observed between the ages of 14–17 in girls and 16–19 in boys. Early onset in prepubescent individuals has become increasingly frequent, while the persistence of acne into adulthood remains unpredictable. Although most adolescents experience resolution within 3–5 years, a subset may continue to suffer from active acne for over a decade (1–3).

The pathogenesis of acne is primarily associated with pubertal changes affecting seborrheic areas. Lesion formation involves excessive sebum production, follicular hyperkeratinisation, proliferation of *Cutibacterium acnes*, and an ensuing inflammatory response (1-3). This inflammation often leads to post-inflammatory hyperpigmentation and scarring—both atrophic and hypertrophic. Atrophic scars are most frequently located on the face and upper back, while hypertrophic scars and keloids are typically found on the chest, shoulders, upper arms, and jawline. Facial scarring may affect up to 95% of patients, and delayed initiation of active acne therapy has been correlated with increased scar severity (1–4).

Residual acne scars present a significant therapeutic challenge, as they do not resolve spontaneously (5–8). Beyond the physical changes, acne scarring carries profound psychosocial consequences, including frustration, anxiety, depression, and reduced self-esteem. Many individuals express concerns that visible scars could negatively influence their academic, social, or professional opportunities—an issue that is amplified in the era of social media exposure (9).

Acne scars are commonly categorized into rolling, icepick, and boxcar types. Rolling scars manifest as shallow, wave-like depressions; icepick scars are narrow and deep; and boxcar scars present with sharp edges and a round, polygonal, or linear appearance. Management should be individualized based on scar morphology, combining modalities such as resurfacing, dermal fillers, and collagen remodelling. Among

available techniques, laser therapy has demonstrated considerable efficacy in reducing scar visibility, though it is generally less effective for deep icepick scars (10, 11).

The purpose of this study was to assess the safety and clinical outcomes associated with the use of PEG-crosslinked hyaluronic acid with calcium hydroxyapatite in patients with acne scars.

MATERIALS AND METHODS

Neauvia Stimulate (MatexLab, Geneva, Switzerland) is a cross-linked monophasic polymeric hydrogel composed of stabilized sodium hyaluronate (26 mg/mL) and 1% calcium hydroxyapatite (CaHA), enriched with glycine and L-proline in a pyrogen-free buffered solution.

Neauvia Stimulate is a biodegradable, PEG-crosslinked hyaluronic acid hydrogel designed for injection into the subdermal and/or supraperiosteal plane to restore soft-tissue volume loss. When administered at these levels, the filler provides temporary volumization of atrophic or thinned soft tissues of the face. Neauvia hydrogels are based on PEGDE (polyethylene glycol diglycidyl ether) cross-linking technology, which ensures excellent biocompatibility, biointegration, and optimal rheological performance (12, 13). PEG is known for its high safety profile and lower toxicity compared to other crosslinking agents. Importantly, it possesses the ability to shield the bound molecule from the host immune system, thereby reducing both immunogenicity and antigenicity (12, 13). Neauvia Stimulate combines pure hyaluronic acid crosslinked with PEG and calcium hydroxyapatite (CaHA) microparticles (10–12 μm, 1%), representing a fully biocompatible and biodegradable filler. The product exhibits volumizing properties characteristic of crosslinked hyaluronic acid fillers and provides structural support within the treated tissue (12, 13).

A total of 20 patients with facial acne scars were enrolled in the study. Of these, 19 participants completed the study, while one was excluded due to an unrelated health condition that developed during the study period. High-frequency ultrasound (Dramiński, Poland, 48 MHz) was used to evaluate two representative scars per patient. Measurements were taken before treatment and during follow-up visits.

In addition, skin parameters were assessed using the Courage + Khazaka Multi Skin Test Center MC 1000 (Courage + Khazaka electronic GmbH) at three randomly selected points within the treated areas.

- Scar depth: Vertical distance from the epidermal surface of healthy skin to the deepest point of the scar (accuracy ± 0.01 mm).
- Scar diameter: Horizontal distance between the farthest edges of healthy epidermis across the scar (accuracy ± 0.01 mm).
- Success rate: Defined as achieving a measured scar depth of zero.

Achieving structural success does not necessarily imply a complete aesthetic result but represents the most objective parameter of improvement. Even when the scar depth reaches zero, the skin surface texture may still differ from the surrounding tissue.

All participants provided written informed consent. The study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Ethics Committee of the Medical Chamber in Gdańsk, Poland (KB-(10)17/2023).

TREATMENT PROTOCOL

Participants in the study underwent a single treatment consisting of subcision of fibrotic adhesions performed using a 22G blunt cannula at the deep dermal to superficial subcutaneous level. The cannula was introduced through a limited number of entry points, and controlled fanning movements were used to release tethered tissue mechanically. During the same session, 2 mL of Neauvia Stimulate was administered subcutaneously to promote tissue remodeling.

Treatment effects were evaluated using cutometric measurements to assess skin elasticity in the treated areas, together with clinical assessment, standardized medical photography, and high-frequency ultrasound analysis of skin structure. Potential adverse events were monitored throughout the study period.

Data on measured parameters, including scar depth, scar diameter, and skin elasticity, were collected at baseline and at Days 28 and 90 following the procedure.

RESULTS

Clinical and Functional Outcomes

Following the procedure, patients demonstrated a clinically noticeable improvement in skin texture and acne scar appearance over the course of follow-up. These changes were consistent with the expected effects of temporary volumization of atrophic or thinned soft tissues of the face. No adverse events were recorded, and all participants completed the study without interruption.

Cutometric Assessment (Skin Elasticity)

Cutometric measurements were performed using the Courage + Khazaka Multi Skin Test Center MC1000 device under standardized environmental conditions (temperature: 22–23°C, relative humidity: 55–60%). Prior to assessment, makeup was removed without the use of alcohol-based products at least one hour before measurement. All measurements were conducted on the buccal skin area.

Skin elasticity was evaluated on a scale from 1 to 100, where 1 represents the lowest and 100 the highest elasticity value. For each evaluation, three point-by-point measurements were obtained, and mean values were used for analysis.

Mean skin elasticity at baseline was 60.28. At Day 28 following treatment, mean elasticity increased to 66.50, corresponding to a 10.3% improvement compared with baseline. At Day 90, mean elasticity further increased to 71.37, representing an 18.4% improvement from baseline (Table I, Fig. 1). These findings indicate a progressive increase in skin elasticity over time following treatment.

Table I. *Mean skin elasticity variations during treatment.*

Mean skin elasticity (cutometer, 0-100)	
before treatments	60.28
day 28 (28 days after the treatment)	66.50
change vs baseline	10.3%
day 90 (90 days after the treatment)	71.37
change vs baseline	18.4%

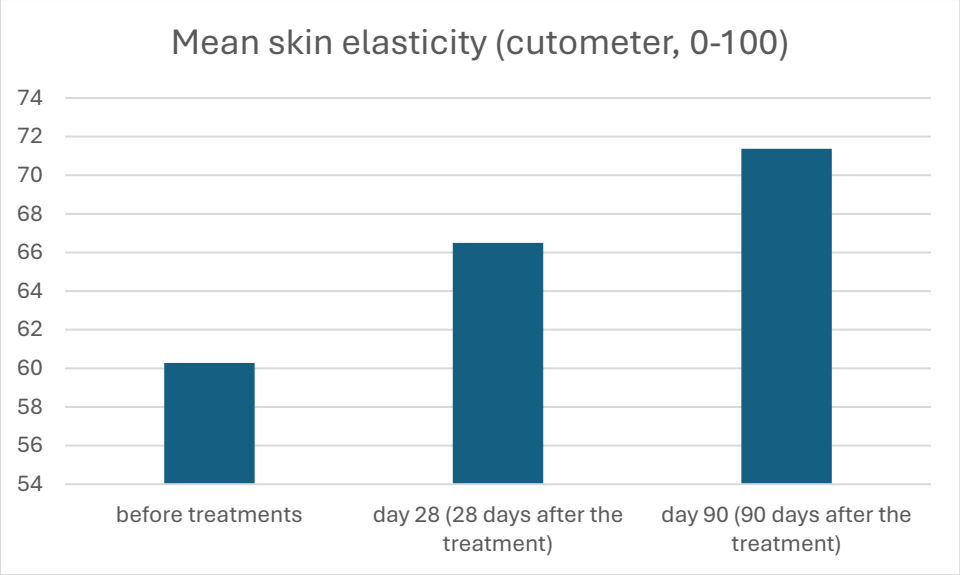

Fig. 1. *Skin elasticity variations during treatment, demonstrating progressive improvement up to day 90.*

High-Frequency Ultrasound Outcomes

High-frequency ultrasound was used to evaluate changes in acne scar morphology before and after treatment. Scar depth and width were measured in millimetres (mm), with an accuracy of 0.01 mm. At least one representative scar per patient was assessed. Repeated measurements were performed using a 48 MHz ultrasound device (Draminski, Draminski Technology, Poland).

Scar Depth

Mean scar depth at baseline was 0.23 mm. At Day 28 post-treatment, mean depth decreased to 0.15 mm, corresponding to a 35% reduction from baseline. By Day 90, mean scar depth further decreased to 0.09 mm, representing a 61% reduction compared with baseline (Table II, Fig. 2). These results demonstrate a progressive reduction in scar depth over the follow-up period.

Table II. *Mean scars depth variations during treatment.*

Mean scars depth [mm]	
before treatments	0.23
day 28 (28 days after the treatment)	0.15
change vs baseline	-35%
day 90 (90 days after the treatment)	0.09
change vs baseline	-61%

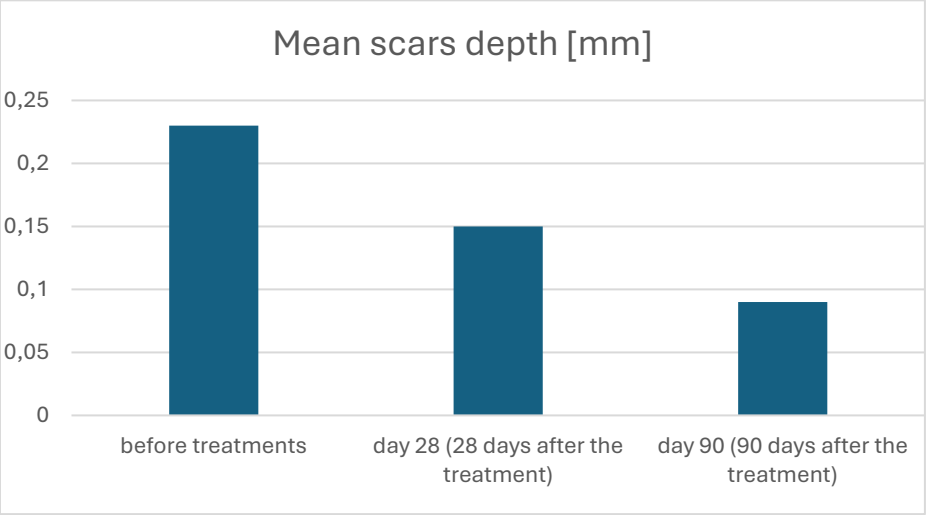

Fig. 2. *Reduction in scar depth observed by high-frequency ultrasound at baseline, day 28, and day 90.*

Scar Width

Mean scar width at baseline was 3.53 mm. At Day 28, mean scar width decreased to 3.15 mm, corresponding to an 11% reduction from baseline. At Day 90, mean width further decreased to 2.79 mm, representing a 21% reduction (Table III, Fig. 3). In one out of 38 evaluated scars (2.6%), complete alignment with the surrounding healthy skin surface was observed at the final follow-up visit.

Table III. *Mean scars width variations during treatment.*

Mean scars width [mm]	
before treatments	3.53
day 28 (28 days after the treatment)	3.15
change vs baseline	-11%
day 90 (90 days after the treatment)	2.79
change vs baseline	-21%

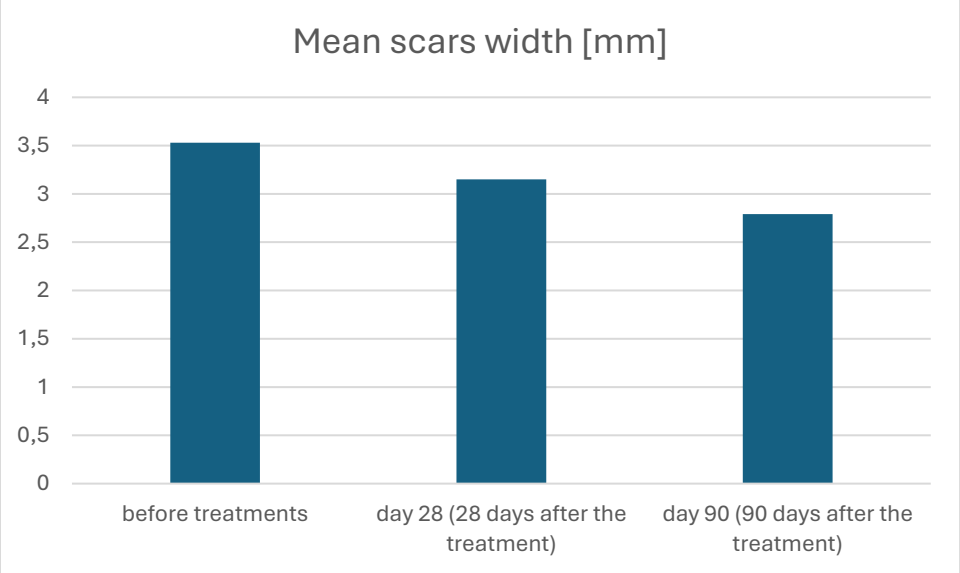

Fig. 3. *Reduction in scar width observed by high-frequency ultrasound at baseline, day 28, and day 90.*

DISCUSSION

Based on the findings, treatment with Neauvia Stimulate was associated with clinically noticeable improvements in skin texture and acne scar appearance over the course of follow-up. These effects are consistent with the expected impact of temporary volumization of atrophic or thinned soft tissues of the face, as well as procedure-related tissue remodeling.

A single session resulted in a 11–35% reduction in both the diameter and depth of acne scars 28 days post-treatment. This reduction further increased over time, reaching an average of 21% reduction in scar diameter and 61% reduction in scar depth 90 days after the treatment ceased, indicating a continuous process of skin remodelling.

Macroscopic evaluations of a single treatment session involving the subcutaneous administration of 2 mL of Neauvia Stimulate, combined with simultaneous subcision of subcutaneous adhesions using a 22G cannula revealed a consistent and predictable skin healing process.

While the exact in vivo mechanisms underlying the observed effects remain to be fully elucidated, the clinical outcomes observed in this study may be explained by a combination of immediate volumetric support provided by the PEG-crosslinked hyaluronic acid component and longer-term tissue adaptation processes following the procedure. These effects are likely influenced both by the mechanical disruption associated with subcision and by the presence of an injectable PEGylated dermal filler within the treated tissue. In this context, the filler provides a three-dimensional structural framework that supports tissue stability and local mechanical conditions during the healing and remodeling process (14).

Although a mild post-treatment inflammatory response was observed, the overall cellular infiltration tended to decrease over time. This modulation is likely associated with the specific properties of the PEGDE–HA-based dermal filler, which not only provides a mechanical framework supporting tissue remodeling and may be associated with a more controlled local tissue response.

Based on our observations and previously published data, PEG, when used as a crosslinking agent, helps to reduce the intensity of the inflammatory response at the application site (13, 14).

The observed remodelling dynamics suggest that mechanical subcision combined with PEG-crosslinked HA and low-concentration CaHA may offer a more physiological alternative to ablative methods, with minimal downtime and high patient acceptance.

From a broader perspective, acne scar management encompasses a range of minimally invasive techniques, including non-ablative laser therapies, microneedling, platelet-rich plasma (PRP), and emerging energy-based modalities such as atmospheric plasma. Each of these approaches targets distinct biological pathways involved in scar remodeling and may therefore contribute differently to clinical outcomes. Studies on non-ablative fractional laser therapy, including 1470 nm devices, have reported progressive reductions in scar depth and diameter, accompanied by gradual improvements in skin elasticity, achieved through controlled dermal thermal stimulation and typically requiring multiple treatment sessions (15).

Similarly, microneedling and PRP may promote dermal regeneration primarily through repetitive micro-injury and growth factor–mediated mechanisms, leading to gradual collagen reorganization and tissue renewal over time.

In this context, the treatment approach evaluated in the present study combining mechanical subcision with PEG-crosslinked hyaluronic acid and low-concentration CaHA may be viewed as a complementary, non-ablative strategy that integrates immediate mechanical release of fibrotic adhesions with subsequent biologically driven tissue remodeling. Although direct comparative studies between these modalities are currently lacking, future investigations directly comparing or combining different techniques may help to further clarify their relative and synergistic roles in the comprehensive management of acne scars.

CONCLUSIONS

Acne scarring remains one of the most frequent and distressing sequelae of acne vulgaris. Addressing scar management as an integral component of comprehensive acne care is essential, complementing primary treatments aimed at controlling both inflammatory and non-inflammatory lesions. The psychological burden associated with visible scarring—often reflected in reduced self-esteem and social confidence—drives many patients to seek aesthetic improvement. Effective management typically begins with the treatment of residual erythema, followed by correction of generalized atrophic changes and a scar-type–specific therapeutic approach. Individual scars should be managed using techniques appropriate to their morphology. In this context, subcision combined with PEG-crosslinked hyaluronic acid fillers may be considered for selected, well-defined atrophic scars, while more extensive or complex cases often benefit from combined or sequential treatment strategies.

In the present study, the sustained improvement observed over time suggests that dermal repair and remodeling processes continue for several weeks following treatment. These findings support the concept that a personalized, stepwise, and evidence-based approach—tailored to scar type and individual patient characteristics—may provide more consistent aesthetic outcomes and contribute to long-term patient satisfaction (16).

A single session combining subcision with a 22G cannula and the simultaneous administration of PEG-crosslinked hyaluronic acid with calcium hydroxyapatite was safe and associated with clinically and instrumentally observed improvements. Through temporary volumization of atrophic or thinned soft tissues of the face, this minimally invasive approach was associated with visible aesthetic improvement and favorable patient-reported outcomes. Overall, these findings suggest that this procedure may have a potential role within the broader clinical management of patients with acne scars.

Author Contributions

Conceptualization, P.K. and B.Ł.; methodology, W.G. P.K.; software, A.P.-K.; validation, A.P., M.M.; formal analysis, Ł.K., B.Ł., B.B.; investigation, P.K.; data curation, W.G., M.M.; writing—original draft preparation, P.K.; writing—review and editing, B.Ł., B.B.; project administration, P.K.

All authors have read and agreed to the published version of the manuscript

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