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Sposób cytowania / Cite Karamon A, Karamon I. Clinical evaluation of the effect of non-crosslinked hyaluronic acid injections on skin parameters with signs of aging. Case study. *Aesth Cosmetol Med*. 2025;14(4):149-156. https://doi.org/10.52336/acm.2025.022

Clinical evaluation of the effect of non-crosslinked hyaluronic acid injections on skin parameters with signs of aging. Case study

Ocena kliniczna wpływu iniekcji nieusieciowanego kwasu hialuronowego na parametry skóry z oznakami starzenia. Studium przypadku

ABSTRACT

One of the most popular methods of reducing the signs of facial aging are injection treatments using non-crosslinked hyaluronic acid.

The study aimed to evaluate the effectiveness of a therapy using injections of two high molecular weight hyaluronic acid preparations and to analyze their influence on the thickness and properties of skin with signs of aging in four women aged 35-46.

The therapy improved skin hydration, elasticity, and firmness, while supporting its natural regenerative processes. This was confirmed by a sustained increase in the thickness and density of the dermis. The effects obtained were long-lasting and visible for at least one month after the end of the treatment series.

Keywords: aging, anti-aging therapies, injections, non-crosslinked hyaluronic acid, skin thickness

STRESZCZENIE

Jedną z najpopularniejszych metod niwelowania oznak starzenia skóry twarzy są zabiegi iniekcyjne z zastosowaniem nieusieciowanego kwasu hialuronowego.

Celem badania była ocena skuteczności terapii z wykorzystaniem iniekcji dwóch preparatów kwasu hialuronowego o wysokiej masie cząsteczkowej oraz analiza ich wpływu na grubość i właściwości skóry z oznakami starzenia u czterech kobiet w wieku 35-46 lat.

Terapia przyniosła poprawę nawilżenia, elastyczności i jędrności skóry, wspierając jednocześnie jej naturalne procesy regeneracyjne. Potwierdzono to utrzymującym się wzrostem grubości i gęstości skóry właściwej. Uzyskane efekty były trwałe i widoczne jeszcze co najmniej miesiąc po zakończeniu serii zabiegów.

Słowa kluczowe: starzenie, terapie przeciwstarzeniowe, iniekcje, nieusieciowany kwas hialuronowy, grubość skóry

INTRODUCTION

Skin aging is a complex process resulting from both intrinsic (chronological aging) and extrinsic factors such as exposure to ultraviolet (UV) radiation, environmental pollution, poor diet, and stress. Of these factors, photoaging is considered as the predominant contributor to skin aging. UVB radiation acts mainly at the epidermal level, causing deoxyribonucleic acid (DNA) damage and accelerating carcinogenesis, whereas UVA penetrates into the dermis, where it disturbs collagen and elastin fibers, leading to the formation of wrinkles, loss of elasticity, and pigmentation changes. UV radiation also generates free radicals, which intensify oxidative stress and degradation of the extracellular matrix (ECM). Reduced skin microcirculation and decreased activity of sebaceous glands exacerbate dryness, while the progressive loss of subcutaneous adipose tissue contributes to the deepening of skin folds, as the skin loses support in areas previously stabilized.

Consequently, the skin becomes flaccid and lacks a firm scaffold, leading to sagging and more pronounced furrows and folds. With aging, basal keratinocytes in the epidermis exhibit decreased proliferation, resulting in thinning of the epidermal layer and impaired barrier function. Chronological aging also leads to altered activity and reduced numbers of melanocytes, contributing to uneven pigmentation. In the dermis, decreased collagen content leads to a loss of elasticity and firmness. Elastin fibers become stiff and fragmented, promoting the development of deep wrinkles and furrows. The number and metabolic activity of fibroblasts also decline with age, limiting the skin's regenerative capacity and synthesis of new ECM components. The content of glycosaminoglycans, including hyaluronic acid (HA), is likewise reduced [1–3].

HA levels in young skin are sufficient to maintain elasticity and a wrinkle-free appearance; however, they decrease with age. The reduction of HA in the skin, along with diminished adipose tissue, collagen, and elastin, results in reduced thickness and smoothness, loss of hydration and elasticity, and the emergence of wrinkles and fine lines [4, 5]. HA is a naturally occurring polysaccharide found in the ECM of various body tissues, including the dermis, which contains approximately 50% of the body's total HA. This compound exhibits strong hygroscopic properties, enabling it to retain water in the extracellular matrix and contribute to dermal volume and resilience. Maintaining proper hydration is essential for the skin's elasticity, firmness, and smoothness. Hydration also leads to increased skin thickness, delays wrinkle formation, and improves already developed deep lines. HA-mediated moisture retention supports cellular turgor, mechanical tension, and key physiological processes within the ECM. As a component of the ECM of basal keratinocytes, HA also plays a vital role in the epidermis—helping to scavenge free radicals and support keratinocyte proliferation and migration, both of which are essential for proper epidermal function [1–3, 6, 7]. HA supports wound healing and tissue repair, playing an important role in every stage of the regeneration process.In the initial phase, it acts as a mediator of the inflammatory response by attracting immune cells and providing a moist environment. In later stages of healing, HA supports proliferation, migration, and differentiation of ECM cells and contributes to the rebuilding of new tissue [8–10]. The skin aging process results from multifactorial changes at both cellular and tissue levels. Understanding these mechanisms is crucial for developing effective therapeutic strategies aimed at slowing aging processes and improving both the function and aesthetics of aging skin.

Consequences of impaired skin regeneration include not only visible signs of deteriorated condition, appearance, elasticity, or hydration, but also disturbances in its fundamental biological functions. Such changes may be reversed through the targeted delivery of deficient components to the skin. One of the most widely used methods for mitigating signs of skin aging and fatigue is mesotherapy and other procedures involving facial microneedling and the administration of active substances. Microneedling stimulates the skin to regenerate and heal in response to micro-injuries while simultaneously enabling the penetration of active ingredients into deeper skin layers, providing intense nourishment. The procedure itself is only the beginning of the regenerative process—injections of active substances trigger a phase of increased collagen and elastin synthesis, which continues for several weeks [11, 12].

The activity of HA in the skin depends on its molecular weight (MW). Low-MW HA stimulates collagen and elastin production and intensively hydrates by attracting water to tissues. Medium-MW HA primarily acts in the epidermis and papillary dermis, supporting the skin's protective barrier, while high-MW HA intensely hydrates the skin surface, protects it from harmful external factors, and smooths its appearance [13]. Due to its wide-ranging effects within the skin, HA is among the most frequently used active ingredients in injectable therapies. Replenishing HA through intradermal injections helps counteract the effects of aging—this compound intensively hydrates, improves elasticity, and strengthens the skin's hydrolipid barrier, thereby protecting against moisture loss and environmental damage [6]. In anti-aging, revitalizing, and nourishing procedures, non-crosslinked HA should be used, as its primary function is water retention, which enhances skin firmness and elasticity. Given the paucity of studies investigating the biological effects of non-crosslinked HA, the present study aimed to evaluate the effectiveness of therapy using this form of HA—with particular emphasis on its impact on skin thickness and the importance of the selected injection technique for the overall efficacy of the procedure.

AIM

The study aimed to evaluate the effectiveness of a therapy using injections of two high molecular weight hyaluronic acid preparations and to analyze their influence on the thickness and properties of skin with signs of aging in four women aged 35-46.

MATERIALS AND METHODS

The observational study was conducted in accordance with Good Clinical Practice (GCP), ISO 14155, and the principles of the Declaration of Helsinki. Although HA injections are not considered highly invasive procedures, they carry a potential risk of adverse health outcomes. Therefore, prior to the procedure, all participants received comprehensive information regarding the study procedures and provided written informed consent to participate. The study included four female subjects aged 35–46 years with dry, lax skin exhibiting signs of aging. Eligibility was determined based on

Table 1 Study timeline and procedures conducted during each visit

Activities	V1	V2 (Day 7)	V3 (Day 14)	V4 (Day 21)	V5 (Day 28)	V6 (Day 35)	V7 (Day 56)
Informed consent form	x						
Medical interview and skin assessment	x	x	x	x	x	x	x
Inclusion/exclusion criteria assessment	x						
Randomization	x						
Skin ultrasound examination	x	x	x	x	x	x	x
Photographic documentation	x	x	x	x	x	x	x
Participant questionnaire	x	x	x	x	x	x	x
Evaluated product injection	x		x		x		
Adverse event monitoring	x	x	x	x	x	x	x

Source: Own elaboration

physical examination and confirmation of all inclusion and exclusion criteria.

Two preparations containing high-MW HA were evaluated, administered through multiple intradermal injections intended to enhance dermal thickness. The study employed class III medical devices consisting of non-crosslinked sodium hyaluronate formulations at concentrations of 1.6% (preparation 1) and 2.2% (preparation 2), respectively. The sodium hyaluronate used in both products was of non-animal origin, obtained by microbial fermentation. The products were supplied as sterile 2 ml pre-filled ampoule-syringes, delivered in blister packaging. The device was intended for injection into the medium and deep layers of the dermis, used in rejuvenating treatments in the course of physiological aging and in skin tissue repair processes.

STUDY PROCEDURE

During the first visit (V1), the participants were provided with information about the study and then signed an informed consent form and the required documents. The investigator conducted a medical interview, assessed the clinical condition of the participant's facial skin, and verified the inclusion and exclusion criteria. Eligible inviduals were randomized into one of two intervention groups: group A – multi-point injection technique using a 30G needle, group B – fan technique injection using a 22G cannula. In this study, the primary endpoint was based on ultrasound (USG) measurements of the dermis. Therefore, prior to the initial injection, the investigator conducted a dermal USG assessment and captured standardized photographic documentation. Additionally, each participant completed a self-assessment questionnaire regarding their skin condition.

If no contraindications were identified by the investigator, the first administration of the evaluated product was performed using the assigned injection technique. Following the injection, the investigator and participant assessed the injection site for local adverse events. Subsequent visits (V2–V7) were conducted in accordance with the schedule outlined in table 1.

ASSESSMENT METHODS

Facial skin condition was assessed using participant-completed self-evaluation questionnaires. The examination included subjective assessment of hydration, elasticity, firmness, wrinkle visibility, and skin tone, each rated on a 10-point scale. Based on these results, post-treatment skin parameters were compared with baseline values recorded prior to therapy. USG measurements were performed using a high-frequency probe that enabled precise visualization of the skin and cross-sectional imaging of its layers. Measurements were taken in two predefined regions: the right cheek and the forehead (used as a control area). Immediately after each injection, USG was used to assess dermal hydration status and the presence of the injected product, as indicated by differences in tissue echogenicity. Following each injection, participants reported their perceived pain intensity at the injection site using the Numerical Rating Scale (NRS). This subjective tool assesses pain on an 11-point scale ranging from 0 (no pain) to 10 (worst imaginable pain). Throughout the study period, the investigator was responsible for monitoring the occurrence of any adverse events (AE). During the final visit, a participant satisfaction questionnaire was administered to evaluate perceived treatment efficacy—specifically in terms of wrinkle filling and smoothing, improvement in facial contours, and longevity of results. This was a pilot study involving four participants (table 2), all of whom completed the full cycle of three injections of the evaluated product. Given the limited sample size, results are presented in the form of individual case descriptions.

Table 2 Participants' characteristics

Participant	Age	Clinical skin presentation	HA concentration in product	Injection method
Participant 1	46	Signs of skin laxity and roughness, visible wrinkles and enlarged pores	1.6%	Multi-point injection using a needle
Participant 2	38	Signs of reduced skin hydration, visible mimic wrinkles	2.2%	Fan technique injection using a cannula
Participant 3	38	Signs of reduced firmness, elasticity, and hydration; visible mimic wrinkles, enlarged pores, uneven tone	2.2%	Multi-point injection using a needle
Participant 4	35	Signs of decreased elasticity and smoothness, uneven skin tone	1.6%	Fan technique injection using a cannula

Source: own elaboration

RESULTS

Following the series of treatments with non-crosslinked HA, participants reported a noticeable improvement in overall facial skin quality, as indicated by questionnaire responses. The most prominent benefits included enhanced hydration, elasticity, and firmness. Participants 1, 3, and 4 demonstrated a 5–6 point improvement on the 10-point self-assessment scale. Positive effects were observed as early as one week after the first injection in participants 2 and 3; however, the degree of improvement at that stage was considered mild. After subsequent injections, the magnitude of improvement varied between the participants, indicating that clinical outcomes were modulated by individual factors such as age, baseline skin characteristics, post-procedure skincare, and lifestyle habits. Data from all four cases suggested that improvements in assessed skin parameters were more pronounced among participants treated with the 1.6% sodium hyaluronate formulation. This may be attributed to the fact that these participants had significantly lower initial dermal thickness (1.35 mm and 1.27 mm) compared to those in the 2.2% group (1.60 mm and 1.69 mm). Participants 3 and 4 also reported a noticeable enhancement in skin tone homogeneity and pigmentation evenness. All participants observed the greatest improvement in the specific skin features they had initially rated as unsatisfactory, leading to a significant increase in overall treatment satisfaction. Scores for assessed skin parameters tended to increase progressively after each injection. However, no clear correlation was found between treatment outcomes and the method of the product administration. In all participants, the observed effects of the injections were durable and persisted for at least one month after treatment.

The subjective assessments of the participants were reflected in the results of skin thickness measurements taken on the right cheek, always in the same place. As with the survey results, the highest increase was observed in participants whose skin was thinner before the start of therapy (fig. 1).

For participant 1, the average increase in dermal thickness was calculated as 0.23 mm, corresponding to a 17% increase from baseline measurements (fig. 2). For Participant 4, the mean increase was 0.28 mm, representing a 22% gain. No discernible relationship was identified between the injection technique and the degree of dermal thickness enhancement on the cheek. However, ultrasound data demonstrated a progressive increase in dermal thickness with successive treatment sessions (table 3).

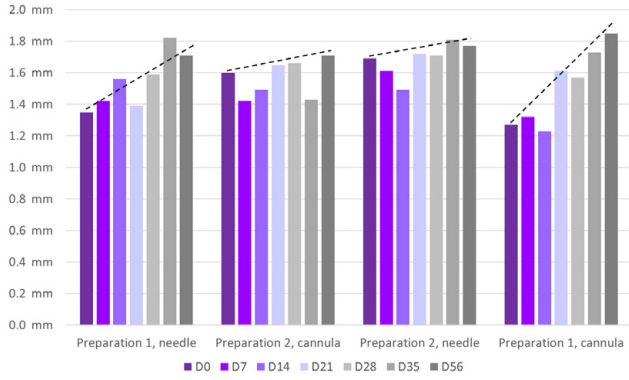

Fig. 1 Changes in dermal thickness on the right cheek, measured across study visits for each participant using high-frequency ultrasound. **Source:** own elaboration

An initial slight reduction in mean dermal thickness was observed following the first injection in all participants. At one and two weeks after second injection, the mean thickness increased to 109% and 112% of baseline, respectively. At one week and one month after the third injection, values reached 117% and 121%, respectively, supporting the presence of a cumulative dermal thickening effect resulting from successive treatment sessions.

In all participants, ultrasound imaging of the cheek skin performed one week after the first injection demonstrated a pronounced reduction in echogenicity relative to baseline values, suggestive of a significant increase in dermal hydration. USG images obtained immediately after injection revealed hyper-echogenic linear structures consistent with HA depositions. These deposits, based on image interpretation,

Table 3 Cheek dermal thickness measurements [mm] and corresponding percentage change from baseline at each study visit

Participant	V1	V2	%	V3	%	V4	%	V5	%	V6	%	V7	%
Participant 1	1.35	1.42	105	1.56	116	1.39	103	1.59	118	1.82	135	1.71	127
Participant 2	1.60	1.42	89	1.49	93	1.65	103	1.66	104	1.43	89	1.71	107
Participant 3	1.69	1.61	95	1.49	88	1.72	102	1.71	101	1.81	107	1.77	105
Participant 4	1.27	1.32	104	1.23	97	1.61	127	1.57	124	1.73	136	1.85	146

Source: own elaboration

appeared to extend partially into the subcutaneous tissue in some areas—likely attributable to the relatively large volume (0.2 ml) delivered per injection site (fig. 3).

Two weeks after the initial procedure, an increase in echogenicity was noted at the same predefined anatomical sites, though this effect was limited to participants with lower baseline dermal thickness. Following the second and third injection sessions, a much more pronounced increase in echogenicity was observed one week after injection, with a mean increase of approximately 32%, indicative of enhanced dermal density in parallel with thickness gains. Although this effect gradually diminished two and four weeks after injection, echogenicity levels remained elevated above baseline in all cases, suggesting that the density of the imaged dermal layers continued to exceed pre-treatment values.

None of the participants expressed negative opinions regarding the procedure or its outcomes, and no adverse events were reported. Both products were very well tolerated locally, with participant-dependent variability in perceived injection-related discomfort. Participant 2 rated the pain as

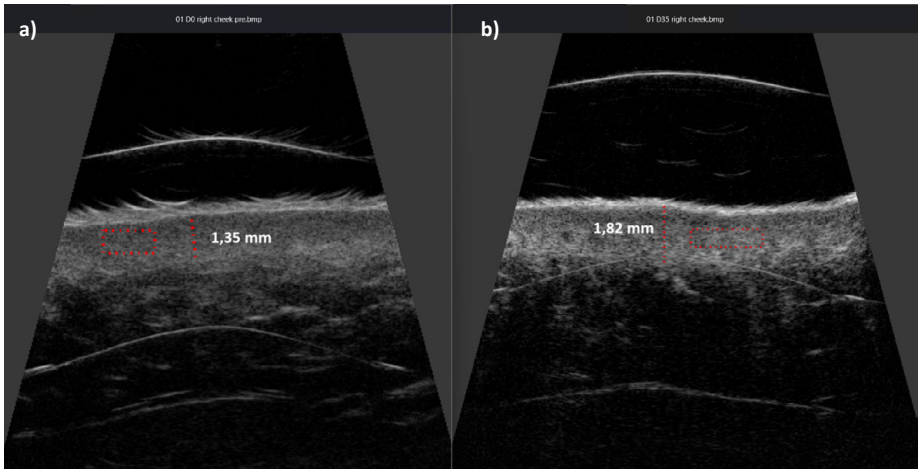

Fig. 2 Participant 1. Ultrasound imaging with DermaMed device, 48 MHz probe: a) baseline image prior to treatment initiation; b) post--treatment image at Visit 6 after three injection sessions. **Source:** Author's own archive

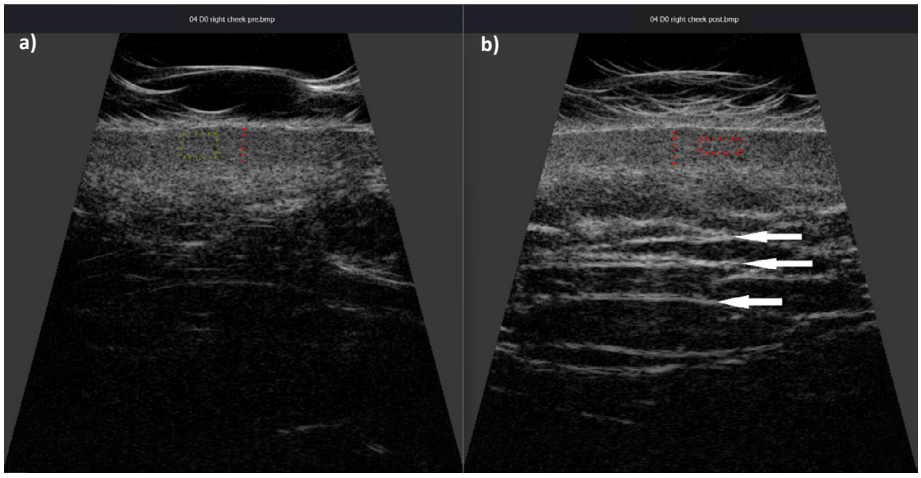

Fig. 3 Participant 1. Ultrasound imaging with DermaMed device, 48 MHz probe: a) prior to injection, b) immediately after injection. The images suggest that in certain areas, the injected product may have partially infiltrated the subcutaneous tissue. **Source:** Author's own archive

low, while Participants 3 and 4 reported moderate pain levels ranging from 2 to 5 on the 11-point Numerical Rating Scale (NRS). Participant 1 noted a gradual intensification of perceived pain with each subsequent injection, ranging from 3 to 9 points. She described the sensation more as a strong feeling of pressure or distention than pain per se, which was presumably related to the progressive increase in dermal density following repeated injections—resulting in greater resistance during administration of the viscous HA formulation. No correlation was observed between the injection technique or product formulation and the level of post-injection discomfort. When asked to evaluate the results of the completed treatment, all participants reported at least a satisfactory degree of wrinkle filling and smoothing, a natural appearance, improved facial contours, reduced visibility of dynamic wrinkles, and a satisfactory duration of results. Moreover, all participants expressed willingness to recommend HA-based treatments as an effective approach to improve the appearance of facial skin showing signs of fatigue and aging.

The authors acknowledge several limitations of the present study. The findings should be confirmed in high-quality, randomized controlled trials with larger sample sizes that also include a control group. The follow-up duration in this study was limited to 8 weeks, which is sufficient to assess short- to medium-term benefits and risks, but future studies should include longer-term follow-up—ideally extending to 6 months. Additionally, the current study was designed as an observational pilot and the results are presented as a case study. In order to draw more robust conclusions, the number of participants should be increased to reach a sample size capable of producing statistically significant results. Despite these limitations, the preliminary findings are considered to offer meaningful insights into the use of HA injections for reducing visible signs of facial skin aging.

DISCUSSION

Age-related deterioration in the viscoelastic properties of the skin becomes most noticeable after the age of 50, although insufficient hydration is more frequently observed in younger age groups [1]. Due to the significant social impact of skin aging, modern methods of slowing down this process have been intensively developed in recent years. HA injections are increasingly used to rejuvenate and improve skin quality. This technique involves multiple microinjections of bioactive compounds into the superficial dermis to stimulate cellular activity, ECM synthesis, and enhance hydration. Due to its unique tissue-regenerative properties, injectable HA is one of the most commonly used agents in such rejuvenation procedures [4]. There is a relative paucity of well-designed studies assessing the efficacy and safety of intradermal injections of non-crosslinked HA. In one such study, 55 women with signs of skin aging received blinded intradermal microinjections of HA on one cheek and physiological saline on the other. Injections were administered in three monthly sessions. Dermal thickness and elasticity increased significantly after HA injections, and facial radiance improved compared to the control side. The study demonstrated that the applied therapy could restore elasticity, firmness, hydration, and collagen fiber entanglement, thereby restoring mechanical properties similar to youthful skin [4]. In another study, 100 participants aged 40 to 70 years with visible signs of premature facial aging received non-crosslinked HA at concentrations of 1.6% or 2% in three monthly injection sessions. Both groups showed improvements in firmness, elasticity, radiance, and reduction of folds and wrinkles in the treated areas. A higher HA concentration prolonged the skin revitalization effect and increased the filling effect. The products were well tolerated, and no adverse events were reported [14]. Another study demonstrated significantly reduced transepidermal water loss (TEWL), improved facial skin texture, reduced pore size, and improved wrinkle appearance after therapy with native HA compared to baseline values [15].

Findings from the present study corroborate previously reported outcomes, with improvements observed in skin hydration, elasticity, and firmness following treatment with HA-based products. The participants reported that the therapy led to a clear progress in facial skin condition. Participants' subjective evaluations of skin parameters improved progressively after each injection. The observed effects were sustained and remained visible for at least one month after the final treatment. The most noticeable effects, as perceived by the participants, included improved hydration, elasticity, and firmness—an expected outcome given that the applied products contained non-crosslinked (native) HA, which primary function is water retention in the skin, thereby improving its turgor and resilience. Depending on the individual case, the effects were more or less pronounced, indicating that treatment outcomes are influenced by multiple factors such as the skin's regenerative capacity, initial thickness and condition, post-treatment skincare, age, and lifestyle. The findings suggest a greater clinical response in participants receiving the 1.6% sodium hyaluronate formulation, although this is more likely attributable to the noticeably lower baseline skin thickness in this group. The small number of participants limited the ability to draw statistically significant conclusions or to formulate more detailed interpretations.

Several published studies have also described the impact of intradermal HA injections on skin thickness and density [16, 17]. One such study showed that the use of non-crosslinked HA resulted in thickening of the dermis and rejuvenation effects confirmed by participant self-assessment [16]. Although epidermal thickness decreased, a more pronounced glow effect and improved firmness were observed [16]. Another study, in which women received three HA injections at two-

week intervals, demonstrated increased skin elasticity and reduced surface roughness [17]. High-frequency ultrasound examination showed an increase in skin thickness, while density initially decreased during treatment and slightly increased above baseline five months after the last injection [17]. Repeated injections of non-crosslinked HA have also been shown to reduce the depth of crow's feet and cheek wrinkles [6]. Improvements in radiance, hydration, and firmness were observed as well. The product significantly enhanced the aesthetic appearance in 82% of cases, while no improvement was observed on the side of the face treated with saline. To conclude the native HA injections could permanently restore skin elasticity, increase collagen fiber entanglement, and improve the mechanical behavior of the skin, with effects maintained three months post-treatment. The hypothesis is that in contrast to saline, HA injections induced secondary stimulation of elastin and collagen synthesis, which might also account for the extended duration of the therapeutic effect. The newly formed fibers might be more elastic, and their increased number and entanglement may enhance the structural integrity of the dermis [6]. The primary objective of the current study was to evaluate and compare the efficacy of intradermal injections of non-crosslinked (native) sodium hyaluronate at concentrations of 1.6% and 2.2% in increasing dermal thickness. A significant effect on skin elasticity was observed, with persistent thickening of the dermis four weeks after the final injection session. The highest increases were recorded in participants who had the lowest baseline skin thickness prior to treatment. Ultrasound measurements also showed that each subsequent injection progressively enhanced the dermal thickening effect. While a slight decrease in mean skin thickness was observed after the first session, a moderate increase to 109% and 112% of baseline was noted one and two weeks after the second injection, respectively. One week and one month after the third injection, the mean increase reached 117% and 121%, respectively. Because dermal thickening and rejuvenating effects were still present four weeks after the final injection, i.e., after the complete degradation of exogenous HA, this supports the hypothesis that non-crosslinked HA might act as a biological cue activating fibroblasts, which secondarily induces the synthesis of dermal components and might contribute to the observed and sustained increase in dermal thickness.

This effect was demonstrated in another study, which hypothesized that HA injections (in that case, crosslinked) stretch the dermis, triggering fibroblasts to respond to mechanical stress by producing more collagen and less matrix metalloproteinases (MMPs) [18].

The application of mechanical tension to the dermal extracellular matrix may further stimulate collagen production. However, the increase in dermal thickness observed in the present study might also be attributed to the restoration of optimal hydration following repeated injections, with new tissue remodeling occurring gradually. The injections themselves cause micro-injuries that stimulate regenerative processes, including the synthesis of collagen and elastin as part of the skin's natural wound-healing response. Such regenerative processes typically evolve over a period of several weeks to months.

Many prior studies have emphasized the correlation between dermal thickness and the skin's biomechanical properties, recommending normalization of thickness measurements by ultrasound. For this reason, USG-based dermal thickness assessment was selected as the primary endpoint in the present study. One publication hypothesized that the thickness of the superficial skin layer and its biomechanical behavior might be linked to ECM density [16]. The available information indicates that in skin USG examinations, a stronger ultrasound reflection means higher echogenicity of a given layer. In ultrasound imaging, tissues with higher hydrophilicity and fluid content appear darker, whereas tissues with lower fluid content appear brighter [16, 19]. In the present study, one week after the first injection, a marked decrease in echogenicity was observed in the cheek skin ultrasound images compared to baseline, which might indicate a substantial increase in dermal hydration. In contrast, increased echogenicity was observed after the second and third injections, which may reflect an increase in dermal density accompanied by dermal thickening. This effect slightly diminished two and four weeks after injection, but in all cases, echogenicity remained higher than baseline, indicating that dermal density was still greater than before the treatment. These findings suggested that intradermal injections of highly hygroscopic HA initially led to ultrasound-detectable signs of tissue rehydration, followed by increased thickness and density of the dermis.

CONCLUSIONS AND SUMMARY

The aging of facial skin continues to exert a significant burden in contemporary society. Intradermal injections of non-crosslinked HA formulations have emerged as one of the most widely adopted therapies for skin rejuvenation and quality enhancement. This observational pilot study demonstrated promising efficacy and good tolerability of non-crosslinked (native) HA formulations in increasing dermal thickness, hydration, firmness, and elasticity. Considering the rapid onset of effects, favorable safety profile, and high levels of participant satisfaction, these injections may offer a viable, minimally invasive approach for individuals aiming to improve skin condition by enhancing its density and thickness. Multiple injection sessions resulted in greater improvements in skin firmness than those observed after a single treatment session. The data suggested that non-crosslinked HA might promote dermal regeneration and counteract clinical signs of

facial skin aging by supporting collagen and elastin synthesis. Intradermal injections are minimally invasive, and HA-based products generally exhibit a favorable safety profile, however, it remains essential to use high-quality, contaminant-free formulations that are properly processed to minimize the risk of adverse reactions. Thanks to its physicochemical properties, intradermally administered HA helps maintain a youthful and healthy appearance of the skin while supporting its natural regenerative processes.

ACKNOWLEDGMENTS

The authors acknowledge Biovico (Gdynia, Poland) for providing the products used in the pilot clinical study.

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otrzymano / received: 03.04.2025 | poprawiono / corrected: 09.04.2025 | zaakceptowano / accepted: 13.05.2025