e-ISSN 3050-8460
Journal of Dermatology Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Research Article

Effects on Facial Skin Aging After Topical Application of Exosomes with a Microneedling Device

Castillo-Pérez EG[1], Tovilla-Canales JL[1], Rodriguez Cabrera L[1], Gonzalez-Mondragon JE[1], Mejia-Llanes DB[1], Nava-Castañeda A[1*]

[1]Oculoplastic Department, Instituto de Oftalmologia Fundacion Conde de Valenciana, Mexico City, Mexico

***Correspondence author:** Angel Nava Castañeda MD, PhD, Sc.D. and Oculoplastic Surgeon, Oculoplastic Department, Instituto de Oftalmologia Fundacion Conde de Valenciana, I.A.P. Chimalpopoca 14, Colonia Obrera, 06800, Mexico City, Mexico; Email: angellusnc@gmail.com

Citation: Castillo-Pérez EG, et al. Effects on Facial Skin Aging After Topical Application of Exosomes with a Microneedling Device. J Dermatol Res. 2026;7(1):1-8.

https://doi.org/10.46889/JDR.2026.7118

Received Date: 16-03-2026

Accepted Date: 12-04-2026

Published Date: 19-04-2026

Abstract

Introduction: The skin is the largest organ of the body. It is responsible for vital protective functions and has a complex structure and organization. Mesenchymal Stem Cells (MSCs) are a cell lineage extensively studied for their capacity for differentiation and self-renewal, with exosomes proving particularly useful in improving photoaging and chronic dermal inflammatory processes.

Purpose: This study evaluated the extent of reversal of facial dermal aging signs using topical lyophilized exosomes.

Methods: A clinical, experimental, prospective and comparative investigation was conducted in a before-and-after format. Exosomes were applied to the facial area via dripping and subsequently delivered using a microneedling device to enhance dermal penetration. Three sessions, spaced four weeks apart, were performed for each subject. During each session, documentation was performed using photographs and the SAASQ and FaceQ visual scales were utilized for objective and subjective evaluations, respectively. The paired t-test was used for the statistical analysis. SPSS version 31.0 was used for the analysis.

Results: All measured variables, both objective and subjective, demonstrated favorable outcomes for the use of exosomes as a treatment for early signs of aging.

Conclusion: This pilot study provides preliminary results indicating an excellent cosmetic response to exosome treatment utilizing microneedling, accompanied by good user satisfaction and tolerable, harmless adverse effects.

Keywords: Exosomes; Skin; Skin Aging; Rejuvenation

Introduction

The skin, which constitutes approximately 15% of an adult's total body weight, is the largest organ in the human body. It fulfills several essential protective roles against environmental challenges due to its complex structure, composed of tissues of ectodermal and mesodermal origin. These tissues are organized into three distinct layers: epidermis, dermis and hypodermis, each with its respective appendages [1].

Aging is characterized by a continuous decline in functional capacity, leading to increased morbidity and mortality [2]. Human skin is persistently subjected to both internal and external stimuli, which influences its functionality with age and results in manifestations such as wrinkles, xerosis, diminished barrier integrity and epidermal thinning [2]. Barrier dysfunction in aged skin is attributed to defects in the renewal and differentiation of epidermal keratinocytes, which are significantly associated with the altered expression of microRNAs that regulate processes such as cell death and autophagy [3].

Currently, numerous measurement instruments exist for objectively assessing skin characteristics, varying in the parameters they analyze and the grading systems they employ, which limits comparability between them. One recently proposed instrument

is the Scientific Assessment Scale for Skin Quality (SASSQ), introduced by the University of Hamburg, Germany in 2020. Unlike other scales, this tool evaluates pigmentary changes, skin texture and the presence of rhytids, erythema, pore size and elasticity, assigning a sequential numerical value to the degree of each [4].

The Face-Q Aesthetics questionnaire is a patient-reported outcome measurement scale used to assess the results of surgical or minimally invasive facial aesthetic treatments. Currently, it is widely utilized in clinical practice and has been classified by the Food and Drug Administration as a Medical Device Development Tool (MDDT) for research studies. This Face-Q module comprises 37 independent functional scales and six checklists, designed to evaluate patient-reported outcomes. Consequently, clinicians and researchers can select the most appropriate subset of scales for their specific needs [5].

Mesenchymal Stem Cells (MSCs) are a cell lineage extensively studied for their capacity for differentiation and self-renewal, contributing to their prominence in regenerative medicine. The effectiveness of MSCs in tissue repair depends on their ability to release secretomes, which contain extracellular vesicles termed exosomes-these vesicles carry proteins, lipids, mRNA and microRNA. MicroRNA is a small, non-coding RNA that regulates a series of biological processes, including tumor progression, metabolic diseases, cellular regeneration, development, differentiation and growth [6]. Secretomes derived from adipose stem cells are considered safer and more effective than those from bone marrow due to several factors: 1) the absence of class II major histocompatibility complex expression, 2) the induction of higher levels of anti-inflammatory M2 macrophages and 3) the suppression of cancer cell growth [7].

Among the clinical scenarios with potential impact from exosome application are wound healing, brain injury, liver diseases, cardiovascular diseases, bone regeneration and seborrheic dermatitis, as well as the progression of skin cancer [8-10].

The impact of exosomes on photoaging and chronic inflammatory skin processes remains largely unexplored from a cosmetic perspective. Among these, Hu, et al., described an increase in the amount and density of collagen fibers, a more compact stratum corneum and thinner epidermal layers three weeks after starting topical treatment in a group of rats exposed to UVB radiation for eight weeks [11]. Furthermore, the study described increased synthesis of ceramides, dihydroceramides, sphingosine and S1P, alongside a reduction in multiple inflammatory cytokines [12,13].

In this study, we evaluated the extent of reversal of facial dermal aging signs using topical lyophilized exosomes in patients at Instituto de Oftalmologia F.A.P. Conde de Valenciana, Mexico City, Mexico.

Methodology

This was a clinical, experimental, prospective and comparative investigation conducted in a before-and-after format. As a pilot study, the sample size was determined using the "golden rule" proposed by Browne, which recommends a sample size of 30 and the guideline by Kieser and Wassmer, which suggests a sample size of 20 to 40 [14,15]. Consequently, a sample size of 30 participants was established. Inclusion criteria encompassed men and women over the age of 30 with facial rhytides and a minimum score of 12 on the SASSQ scale. Exclusion criteria included pregnancy or breastfeeding, active acne or rosacea, local infections, lesions suspicious for malignancy and allergy to exosomes. Participants were eliminated if there was loss of follow-up or the occurrence of an allergic reaction or intolerable adverse effects. The SASSQ visual scale 4 was used to objectively assess facial dermal changes. Six skin characteristics-elasticity, wrinkles, roughness, pigmentation, erythema and pore size-were evaluated, each scored from 0 to 4, representing absence (0) mild, moderate, severe and very severe. Clinically significant improvement was defined as a decrease of at least 1 point in the rating of a specific characteristic, without requiring simultaneous improvement across all characteristics. For subjective evaluation of facial dermal changes, the FACE-Q Aesthetics questionnaire was utilized, comprising 37 independent functional scales and six checklists measuring patient-relevant outcomes from their perspective [5]. In this study, the following scales from the questionnaire were employed: expectations (before), satisfaction with skin (before and after), psychosocial distress related to appearance (before and after), assessment of facial lines: general impression (before and after) and satisfaction with the decision (after). An adverse effects scale was also utilized.

The vials containing lyophilized exosomes (human adipose stromal cell exosome) were prepared by diluting the container vial (20 mg) with a diluent (5 mL), resulting in a concentration of 4 mg/mL (BENEV Pharmaceutical, California). Following cleansing of the facial area with an antiseptic and application of topical anesthesia (lidocaine 2.2% and prilocaine 2.5 %), 1 mL was

administered to the skin through dripping and a microneedling device, Dr. Pen Ultima A6® (equipped with a 32-gauge needle, set to a depth of 0.25 mm in the periocular region and 0.5 mm on the remainder of the face), was employed to enhance dermal penetration. This procedure was executed in a single pass with circular movements across the entire facial area, conducted by the same trained professional utilizing a standardized technique. Three sessions, spaced four weeks apart, were performed for each subject. During each session, documentation was conducted using photographs and the SAASQ and FaceQ visual scales. To maintain blinding, the assessments were conducted by the same trained professional who was unaware of the treatment administered to the participants.

In the statistical analysis, paired t-tests were used to compare discrete quantitative variables before and after the intervention. The analysis was conducted using SPSS version 31.0. A statistically significant value of $p < 0.05$ was established.

Ethical Statement

In accordance with ethical considerations, this study employed a before-and-after design, as exosomes are recognized as an intervention validated by previous research. Adhering to the ethical principles outlined in the Declaration of Helsinki, it is imperative that subjects receive this treatment. Consequently, the inclusion of a placebo in this pilot trial is deemed unnecessary, particularly given the minimal risk of harm involved. The study adhered to the tenets of the Declaration of Helsinki, approved by the Institutional Ethics Committee Board (Registration Number: CEI-2024/04/02) and registered at ClinicalTrials.gov, identified by the number NCT07372001.

Results

A total of 30 participants were recruited, of whom 29 (96.66%) were women and 1 (3.33%) was a man. The average age was 51.5 ± 6.94 years. One participant withdrew from the study due to personal reasons unrelated to the treatment. The average phototype was III on the Fitzpatrick skin type scale. Four participants reported a history of atopic dermatitis, while the remaining participants denied any dermatological history (Table 1).

Following comparison of baseline and three-month post-exosome application measurements, the following results were obtained: Using the SASSQ scale, the average pre-treatment mean score was 11.36 points, compared with a mean 6.54 points post-treatment, a difference that was statistically significant ($p < 0.05$) (Fig. 1). Regarding the participants' subjective satisfaction with their skin, there was a statistically significant improvement in the perception score from 40 to 75 points ($p < 0.05$) (Fig. 2).

In terms of psychosocial distress related to skin appearance, the average score improved from 34.93 to 18.10, a change that was statistically significant ($p < 0.05$) (Fig. 3). The participants' subjective evaluation of facial wrinkles showed a decrease in the score from 60.10 to 44.93 points, which was also statistically significant ($p > 0.05$) (Fig. 4).

Six participants (20.68%) reported mild adverse effects, including itching associated with sun exposure (50%), tactile sensitivity (33.33%) and redness (16.66%); however, none of these effects were disabling.

Category	Value
Age	51.1 ± 6.94
Sex n (%)	
Female	29 (96.66)
Male	1 (3.33)
Comorbidities n (%)	
Hypertension	2 (6.66)
Diabetes	2 (6.66)
Fibromyalgia	2 (6.66)
Thyroid disease	3 (10)
Depression	3 (10)
Dermatological history n (%)	
Atopic dermatitis	4 (13.33)

Melasma	1 (3.33)
Allergies	
NSAIDs	1 (3.33)
Aspirin	1 (3.33)
Penicillin	2 (6.66)
Sulfas	2 (6.66)
Phenazopyridine	2 (6.66)
Phototype n (%)	
II	4 (13.33)
III	22 (73.33)
IV	4 (13.33)

Table 1: Demographic variables.

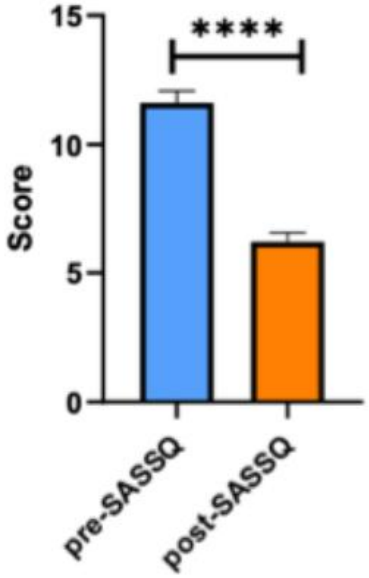

Figure 1: Skin quality comparisson using the SASSQ scale. P value < 0.0001.

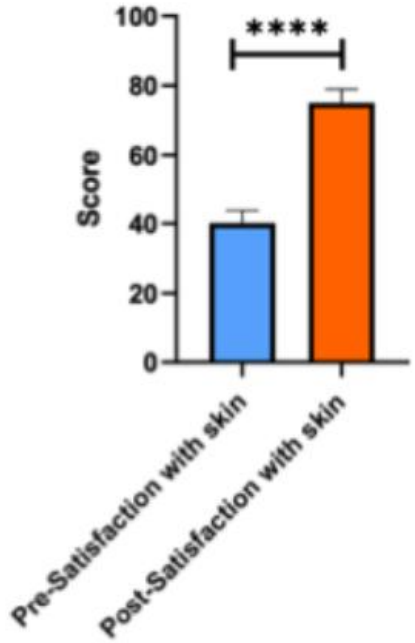

Figure 2: Subjective satisfaction with their skin. P value < 0.0001.

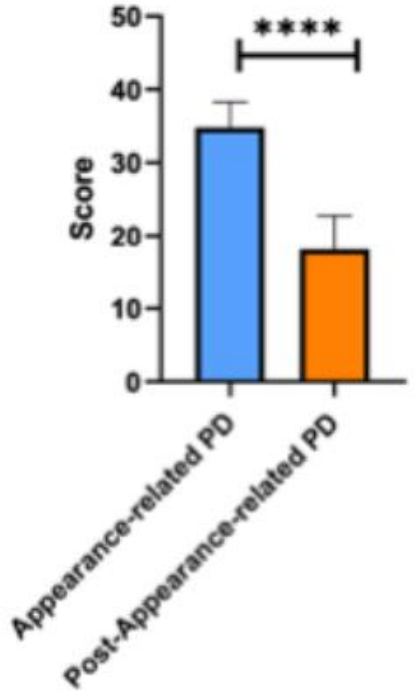

Figure 3: Skin quality comparisson. P value < 0.0001.

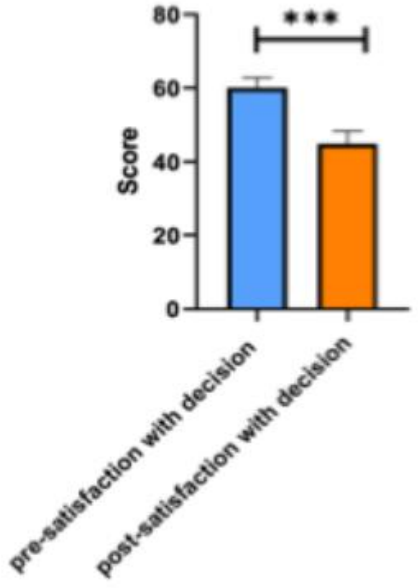

Figure 4: Subjective evaluation of facial wrinkles. P value = 0.0005.

Discussion

In the modern world, the continuous updating and generation of scientific knowledge drive ongoing change and innovation in health technologies. Specifically within cosmetic and regenerative medicine, healthcare professionals must remain current on the uses, indications and contraindications of these therapeutic options. Exosomes, utilized for enhancing cellular communication, have demonstrated relevance in managing pathologies across diverse medical fields. However, their efficacy and safety in cosmetic applications have not been sufficiently documented.

In this study, we evaluated dermal changes associated with the aging process objectively, employing the SASSQ scale to quantify these changes. We also considered participants' perceptions through Face-Q questionnaires, as these are key to determining therapeutic success or failure. All measured variables-both objective and subjective-were favorable for the use of exosomes as a treatment for early signs of aging, aligning with findings from other studies [11,12] (Fig. 5).

The SASSQ evaluation demonstrated significant changes between the initial assessment and three months post-treatment, particularly in elasticity, firmness and skin porosity (Fig. 5). Regarding the subjective assessment questionnaires of the effects obtained, all showed improvement in scores from baseline to three months post-treatment. Special mention should be made of the Skin Satisfaction questionnaire, which, in addition to showing the most noticeable change in comparative scores, highlights the significant importance that, despite modest objective changes, the perception of improved skin quality was undeniable.

Recent studies, including those evaluating outcomes at 22 weeks, suggest the potential for sustained improvements in skin texture and reduction in pore size, with effects persisting for up to 12 weeks following treatment. However, long-term evidence remains limited, necessitating further statistical validation to exclude a potential decline in efficacy once the initial inflammatory stimulus subsides [16].

The microneedling depth employed is the recommended level for optimizing the absorption of topical medications, thereby enhancing the therapeutic efficacy of exosomes without compromising their effectiveness. While greater depths can stimulate collagen production in the skin, they may also interfere with the desired outcomes [17,18].

Topical application alone results in suboptimal dermal bioavailability, characterized by inconsistent cellular penetration limited to the superficial layers of the epidermis or hair follicles. Microneedling serves as a crucial physical enhancer by creating transient aqueous microchannels that traverse the keratinized barrier. This technique facilitates direct access to the dermoepidermal junction and the papillary dermis, enabling interaction *in-situ* with target fibroblasts [19]. The principal limitation of this study was the absence of a control group for comparison. Future research should incorporate larger and more epidemiologically diverse cohorts, as well as a comparison of the effects of exosomes with other treatments or with the microneedling device alone, to ascertain the efficacy of the treatment.

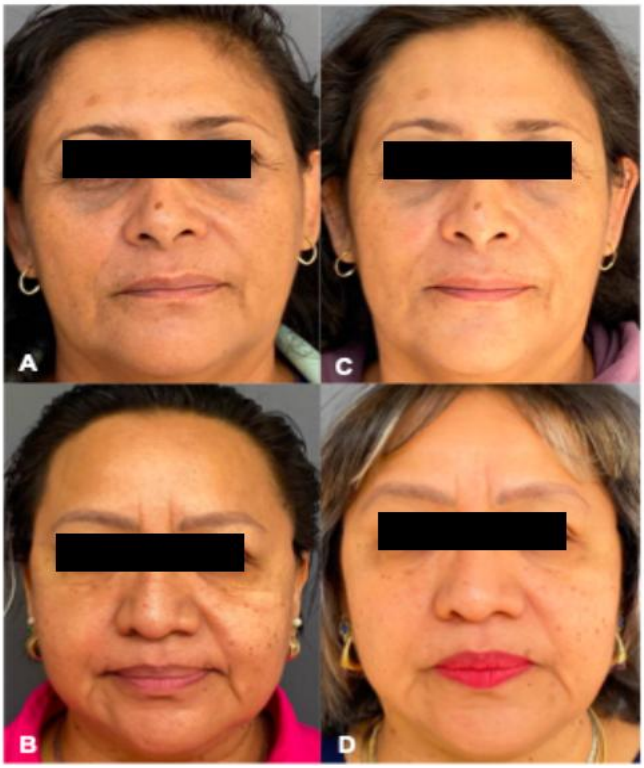

Figure 5: A and B. Pre-treatment. C and D. After treatment, there is a noticeable reduction in the depth and discoloration of the lower eyelid, decreased perinasal pores and a more even skin tone.

Conclusion

This study presents preliminary results demonstrating an excellent cosmetic response to exosome treatment utilizing a microneedling device, accompanied by high user satisfaction and tolerable adverse effects. Within the emerging field of cellular regeneration engineering, exosomes offer a significant advantage due to their ease of handling and application, facilitating rapid and comfortable patient recovery.

Conflict of Interest

The authors declare no conflict of interest. The authors are solely responsible for the content and writing of this manuscript.

Funding Statement

The authors declare that they have not received any financial support for this study.

Acknowledgement

None.

Data Availability Statement

Data will be available from the corresponding author on reasonable request.

Ethical Statement

In accordance with ethical considerations, this study employed a before-and-after design, as exosomes are recognized as an intervention validated by previous research. Adhering to the ethical principles outlined in the Declaration of Helsinki, it is imperative that subjects receive this treatment. Consequently, the inclusion of a placebo in this pilot trial is deemed unnecessary, particularly given the minimal risk of harm involved. The study adhered to the tenets of the Declaration of Helsinki, approved by the Institutional Ethics Committee Board (Registration Number: CEI-2024/04/02) and registered at ClinicalTrials.gov, identified by the number NCT07372001.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

All authors contributed equally to this paper.

References

1. Kanitakis J. Anatomy, histology and immunohistochemistry of normal human skin. Eur J Dermatol. 2002;12(4):390-401.
2. Csekes E, Račková L. Skin aging, cellular senescence and natural polyphenols. Int J Mol Sci. 2021;22(23):12641.
3. Rorteau J, Chevalier FP, Fromy B, Lamartine J. Functional integrity of aging skin, from cutaneous biology to anti-aging strategies. Med Sci (Paris). 2020;36(12):1155-62.
4. Eiben-Nielson C, Kerscher M. Development and validation of a global photonumeric scale for evaluating skin quality of aged female facial skin. J Cosmet Dermatol. 2021;20(12):4032-9.
5. Ottenhof MJ, Veldhuizen IJ, Hensbergen LJV, Blankensteijn LL, Bramer W, Lei BV, et al. The use of the FACE-Q aesthetic: Aa narrative review. Aesthetic Plast Surg. 2022;46(6):2769-80.
6. Ma J, Yong L, Lei P, Li H, Fang Y, Wang L, et al. Advances in microRNA from adipose-derived mesenchymal stem cell-derived exosomes: Focusing on wound healing. J Mater Chem B. 2022;10(46):9565-77.
7. Ha DH, Kim HK, Lee J, Kwon HH, Park GH, Yang SH, et al. Mesenchymal stem/stromal cell-derived exosomes for immunomodulatory therapeutics and skin regeneration. Cells. 2020;9(5):1157.
8. Hade MD, Suire CN, Suo Z. Mesenchymal stem cell-derived exosomes: Applications in regenerative medicine. Cells. 2021;10(8):1959.
9. Lueangarun S, Tempark T. Rose-derived stem cell exosomes for recalcitrant seborrheic dermatitis: A case report. 2023.
10. Liu M, Wang H, Liu Z, Liu G, Wang W, Li X. Exosomes from adipose-derived stem cells inhibits skin cancer progression via miR-199a-5p/SOX4. Biotechnol Genet Eng Rev. 2024;40(4):3950-62.

11. Hu S, Li Z, Cores J, Huang K, Su T, Dinh PU, et al. Needle-free injection of exosomes derived from human dermal fibroblast spheroids ameliorates skin photoaging. ACS Nano. 2019;13(10):11273-82.
12. Shin KO, Ha DH, Kim JO, Crumrine DA, Meyer JM, Wakefield JS, et al. Exosomes from human adipose tissue-derived mesenchymal stem cells promote epidermal barrier repair by inducing de novo synthesis of ceramides in atopic dermatitis. Cells. 2020;9(3):680.
13. Alzahrani FA. Melatonin improves therapeutic potential of mesenchymal stem cells-derived exosomes against renal ischemia-reperfusion injury in rats. Am J Transl Res. 2019;11(5):2887-907.
14. Browne RH. On the use of a pilot sample for sample size determination. Stat Med. 1995;14(17):1933-40.
15. Kieser M, Wassmer G. On the use of the upper confidence limit for the variance from a pilot sample for sample size determination. Biom J. 1996;38(8):941-9.
16. Alzahrani A, Alghamdi S, Alahmadi M, Alhussaini S, Alamry L, Alrashoud J, et al. Exosomes in skin rejuvenation: Systematic review of anti-aging effects and clinical applications. Dermatol Pract Concept. 2026;16(1):6462.
17. Aldawood FK, Andar A, Desai S. A comprehensive review of microneedles: Types, materials, processes, characterizations and applications. Polymers (Basel). 2021;13(16):2815.
18. Singh A, Yadav S. Microneedling: Advances and widening horizons. Indian Dermatol Online J. 2016;7(4):244-54.
19. Flores Rodríguez JC, Toledo Avelar LE, Yi K, Merino Arellano R, López Rodríguez JA, Garza Vargas MS. Efficacy of exosome-based therapies for skin rejuvenation: A systematic review of human studies. Cureus. 2026;18(2):e104182.

About the journal

ATHENAEUM SCIENTIFIC PUBLISHERS

Journal of Dermatology Research is an international, peer-reviewed, open-access journal published by Athenaeum Scientific Publishers. The journal publishes original research articles, case reports, editorials, reviews and commentaries relevant to its scope. It aims to disseminate high-quality scholarly work that contributes to research, clinical practice and academic knowledge in the field.

All submissions are evaluated through a structured peer-review process in accordance with established editorial and ethical standards. Manuscripts are submitted and processed through the journal's online submission system.

Manuscript submission: https://athenaeumpub.com/submit-manuscript/