



**Exosome-Based Skin Rejuvenation: Promise, Pitfalls, and Path to
Clinical Integration**

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Abstract

Exosome therapy is a new avenue in regenerative dermatology that uses extracellular vesicles encapsulating proteins, lipids, and nucleic acids to enhance cellular communication, especially in cosmetic dermatology, where exosomes have shown promising results in improving skin texture, elasticity, healing, and pigmentation. Multiple clinical studies involving microneedling and split-face trials have shown beneficial results. However, rare but possibly severe complications have been noted, like skin necrosis after intradermal injection of lyophilized exosomes, which are to be kept in mind.

This paper reviews current evidence, clinical integration possibilities, reliability, outcomes, and challenges.

Keywords: *Exosome therapy, skin rejuvenation, microneedling, safety, methodology, ethics, dermatology.*

Introduction

Exosomes are small extravesicular vesicles that are 30 to 150nm in size and are secreted by most cells and carry biomolecules central to intracellular signaling, like proteins, nucleic acids, and lipids. In cosmetic dermatology, exosomes have become a promising agent for skin regeneration by enhancing collagen production, improving elasticity, reducing inflammation, and accelerating healing [1,2].

Method

A structured literature search was conducted in PubMed, Scopus, Web of Science, and Google Scholar between January 2015 and July 2025. The search terms included: exosome therapy, skin rejuvenation, microneedling, adverse events, and dermatology. Inclusion criteria comprised clinical trials, randomized controlled trials (RCTs), observational studies, and relevant case reports focusing on exosome-based interventions for dermatological applications in humans. Preclinical studies were included for mechanistic insights. Only studies published in English were considered.

Results

Split - Face and Microneedling Trials

A 2023 study demonstrated that human adipose-derived exosomes with microneedling significantly improved facial skin aging while remaining safe [3]. In 2020, it was reported that adipose-derived stem cell exosomes led to effective skin brightening in a prospective, randomized, split-face study. It was also noted that exosomes used as an adjuvant to carbon dioxide(CO₂) laser for acne scars decreased scars significantly and reduced downtime in comparison to other controls [4,5].

Comparative Studies

A 2025 trial showed that adipose mesenchymal stem cell-derived exosomes improved wrinkles, erythema, dyschromia, and texture much better compared to platelet-rich plasma (PRP) [6].

Prencipal and Mechanistic Studies

Exosome therapy has shown great promise in wound healing and reduced scarring by mechanisms like activation of the Hippo pathway and inhibiting TGF- β signaling in animal models [7,8]. The highlight is on how exosomes play a role in regenerative therapies and their therapeutic possibilities [9].

Indications of Exosome Theraphy

As exosome therapy is an emerging regenerative medicine, it has multiple applications, not just in dermatology, but also in cardiology and rheumatology. Studies have shown reduced risk of heart tissue damage and promotion of cardiac muscle cells. In dermatology, exosome therapy promotes tissue repair and aids in the healing of chronic wounds, burns, and even ulcers.

Adverse Effects

A concerning side effect was noted in a case report in early 2024 describing skin necrosis, leukocytoclastic vasculitis, and eccrine necrosis following intradermal injection of lyophilized exosomes. This sheds light on safety risks that need to be kept in mind with such formulations [10].

Difference between Exosomes and Boosters

Exosomes are tiny vesicles that are released by cells that carry proteins and genetic material, which help in cell communication and repair. On the other hand, boosters are given to prolong or enhance a body's response. Basically, they are external enhancers of biological functions, while exosomes are natural cell messengers [11].

Literature Overview

The included studies consisted of 5 randomized controlled trials, 2 non-randomized clinical studies, and 2 case reports. Study interventions ranged from topical application to intradermal injections, often combined with procedures like microneedling or CO₂ laser therapy [Table 1].

S.No	Author & Year	Study Design	Intervention	Sample Size	Follow-up Duration	Major Findings
1	Park et al., 2023	RCT	Microneedling + human adipose-derived exosomes	30	12 weeks	Significant improvement in skin elasticity and texture vs. microneedling alone
2	Cho et al., 2020	Randomized split-face trial	Topical adipose-derived stem cell exosomes	25	8 weeks	Notable skin brightening and reduced hyperpigmentation
3	Kim et al., 2020 (doi:10.2340/00015555-3666)	Double-blind split-face RCT	CO ₂ laser + human stem cell exosomes	25	12 weeks	Greater acne scar improvement, reduced downtime vs. CO ₂ laser alone
4	Estupiñan et al., 2025	RCT	Adipose MSC-derived exosomes vs PRP	40	16 weeks	Comparable wrinkle and texture improvement, better erythema reduction with exosomes
5	Xu et al., 2022	Preclinical + pilot human study	Exosome gel application post-laser	12	4 weeks	Faster healing, less post-inflammatory erythema
6	Sreeraj et al., 2024	Review + in vitro	Compilation of dermatology exosome studies	N/A	N/A	Summarized mechanisms: collagen stimulation, reduced inflammation
7	Tawanwongsri et al., 2024	Case report	Intradermal lyophilized exosomes	1	3 weeks	Skin necrosis and leukocytoclastic vasculitis post-treatment

Table 1 : Literature Review Findings

Discussion

Exosome therapy, when combined with microneedling or laser treatments, has become popular in cosmetic dermatology for improving skin aging, scarring, and texture with minimal downtime. There have been multiple positive reports from controlled and comparative trials.

Recognized trials have shown moderate-level evidence for efficacy. Yet differences in exosome source, dosage, preparation, and application limit reproducibility. Standard manufacturing and administration protocol is essential [1].

Clinical studies reported consistent enhancements in brightness, texture, a decrease in scars, and good recovery time, performing better than traditional known treatments like PRP or laser alone [10].

Regulatory bodies such as the FDA have made it clear that exosomes are drug products that require pre-market approval. In the United Kingdom and the European Union, human-derived exosome therapies are banned due to the potential risk of disease transmission and public safety.

While exosome therapy shows a lot of promise for skin rejuvenation, its cons need to be noted too. There is a high risk for skin necrosis and disease transmission, hence the need for proper standardized protocols for dosing and preparation [3].

Conclusion

Exosome therapy in dermatology has great potential in enhancing skin rejuvenation, scar reduction, and healing with less downtime. However, safety concerns related to the administration route and product quality, along with regulation gaps is need to be kept in mind. To ensure safe and effective use, properly defined protocols, comprehensive clinical trials, and clear regulatory oversight are needed.

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Institutional review board approval is not required.

Declaration of patient consent:

A declaration of patient consent is not required.

Conflicts of interest:

There are no conflicts of interest.

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