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Autologous Exosomes and Extracellular Vesicles in Skin Health and Rejuvenation: Biological Mechanisms, Clinical Evidence, Translational Challenges, and the Biotex Autologous Exosome Isolation Kit

Structured Narrative Review

Dr. Leroy Rebello[1], Dr. Sreesudha Chepyala[2], Sahithi Polineni[3]*

[1,2,3]*Department of Research and Development, Biotex Life Solutions Pvt. Ltd., Secunderabad, Telangana, India*

*Corresponding author: **Sahithi Polineni**
E-mail: sahithi.biotexlife@gmail.com

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Abstract

Background: Skin ageing and cutaneous injury involve oxidative stress, fibroblast senescence, extracellular matrix fragmentation, altered inflammatory signalling, impaired angiogenesis, and defective intercellular communication. Extracellular vesicles (EVs), including small EV populations frequently described as exosomes, transfer proteins, lipids, metabolites, mRNA, and microRNA between cells and have therefore emerged as candidate cell-free mediators of tissue repair and rejuvenation.

Objective: To critically review the biological and clinical evidence for exosome/EV-mediated improvement of skin health, with emphasis on autologous approaches, photoaging, dermal remodelling, wound repair, scar modulation, and procedure-assisted facial rejuvenation, and to position the Biotex Autologous Exosome Isolation Kit within the existing evidence base.

Methods: A structured narrative review was conducted using PubMed/MEDLINE as the principal biomedical index, with cross-checking against publisher and version-of-record pages where available. Peer-reviewed literature available through 2026 was considered, prioritising studies directly evaluating skin ageing, photoaging, fibroblast biology, cutaneous wound healing, scarring, microneedling, laser-assisted delivery, platelet/blood-derived vesicles, and autologous dermal-fibroblast, serum-derived, or blood-derived EVs. Sixty-five peer-reviewed references were retained for mechanistic, translational, or clinical relevance; two official regulatory sources were included separately for regulatory context.

Results: Preclinical evidence consistently indicates that selected regenerative EV populations can enhance fibroblast and keratinocyte migration, stimulate collagen-associated matrix remodelling, attenuate UV-induced reactive oxygen species and matrix metalloproteinase signalling, modulate inflammatory responses, and promote angiogenic repair. Human evidence is smaller but increasingly supportive, particularly for exosome-containing preparations used adjunctively after microneedling or fractional laser procedures. Direct autologous evidence now includes a 25-participant facial study of intradermally administered autologous

blood-derived EVs that reported short-term improvements across multiple skin-quality parameters, an interventional pilot study of autologous serum-derived EVs in chronic venous ulcers, and experimental work using autologous dermal-fibroblast exosomes. The facial blood-derived study was uncontrolled and followed participants for only three weeks; therefore, controlled evidence for same-patient peripheral-blood-derived EVs in facial rejuvenation remains limited.

Conclusion: Exosome/EV biology provides a credible mechanistic framework for skin repair and rejuvenation. Within this evidence landscape, the Biotex Autologous Exosome Isolation Kit represents a practical patient-matched blood-processing approach that is conceptually aligned with personalised regenerative dermatology. Its same-session workflow uses the recipient's own peripheral blood and does not depend on third-party donor tissue or culture-expanded cells, while the wider skin-EV literature provides mechanistic and early clinical support for local EV-based rejuvenation strategies. Because biological effects are source- and preparation-dependent, evidence from other EV products is interpreted as supporting rationale rather than as interchangeable product-specific efficacy.

Keywords: autologous exosomes; extracellular vesicles; skin rejuvenation; photoaging; fibroblasts; collagen; wound healing; platelet-derived exosomes; microneedling; fractional laser; regenerative dermatology; Biotex.

Abbreviations

ADSC, adipose-derived stromal/stem cell; ALIX, ALG-2-interacting protein X; AP-1, activator protein 1; BMSC, bone-marrow mesenchymal stromal cell; ECM, extracellular matrix; EV, extracellular vesicle; HDF, human dermal fibroblast; MISEV, Minimal Information for Studies of Extracellular Vesicles; MMP, matrix metalloproteinase; MSC, mesenchymal stromal cell; NF-κB, nuclear factor kappa B; Nrf2, nuclear factor erythroid 2-related factor 2; NTA, nanoparticle tracking analysis; PRP, platelet-rich plasma; ROS, reactive oxygen species; sEV, small extracellular vesicle; TEM, transmission electron microscopy; TGF-β, transforming growth factor beta; TRPS, tunable resistive pulse sensing; UCMSC, umbilical-cord mesenchymal stromal cell; UV/UVB, ultraviolet/ultraviolet B.

1. Introduction

Skin ageing is a multilevel process involving epidermal thinning or dysregulation, dermal extracellular matrix deterioration, reduced fibroblast function, altered vascularity, chronic low-grade inflammation, mitochondrial stress, cellular senescence, and cumulative ultraviolet (UV) damage. Photoaging accelerates these processes by increasing reactive oxygen species (ROS), activating mitogen-activated protein kinase (MAPK)/activator protein-1 (AP-1) and nuclear factor-kappa B (NF-κB) signalling, increasing matrix metalloproteinase (MMP) activity, and disrupting collagen homeostasis.

Extracellular vesicles have emerged as an important component of intercellular signalling because they can transfer biologically active proteins, lipids, mRNA and microRNA to recipient cells. Contemporary consensus guidance recommends using the generic term “extracellular vesicle” unless the biogenesis of a vesicle population has been demonstrated; therefore, the term “exosome” should be used cautiously when a preparation is defined primarily by particle size or an isolation method[1–8].

The dermatologic literature has expanded rapidly. A 2026 systematic review screened 1,032 records and included 21 studies, reporting generally favourable effects on elasticity, wrinkle depth, hydration, pigmentation, collagen/elastin-associated outcomes, oxidative stress, and MMP signalling, while emphasising the need for larger and standardised trials[9]. A second 2026 systematic review focused specifically on human studies and reached a similarly cautious conclusion: clinical signals are promising, but source heterogeneity, combined-procedure designs, variable characterisation, and small cohorts limit certainty[10]. A 2026 systematic review and meta-analysis in Aesthetic Surgery Journal synthesised 39 human aesthetic studies, including 26 skin studies, and reported an average 20.2% reduction in facial wrinkles with improvements across pigmentation, elasticity, texture, erythema, and overall appearance,

while noting substantial heterogeneity in protocols[11]. A PubMed-indexed 2026 scoping review of 17 human dermatology studies similarly found improvement signals in most studies but emphasised small cohorts, short follow-up, nonrandomized designs, and safety/regulatory uncertainty[12].

This review therefore emphasises three questions. First, which biological mechanisms are sufficiently supported to explain potential skin rejuvenation? Second, how much of the existing human evidence can legitimately be extrapolated to autologous approaches? Third, how can a patient-matched Biotex blood-derived preparation be positioned within the present evidence base without conflating it with donor-cell-derived or culture-expanded EV products?

2. Review Scope and Evidence Appraisal

The evidence was organised into five tiers: (i) consensus and EV-methodology standards; (ii) human randomised or prospective aesthetic studies; (iii) direct human autologous cutaneous studies; (iv) human-derived cellular, animal photoaging, wound-healing, and scar-remodelling studies; and (v) systematic or narrative syntheses. Greater weight was given to studies that reported vesicle separation and characterisation, clearly identified the cellular or biofluid source, used objective skin measurements, included a comparator, and separated exosome/EV exposure from the effect of microneedling or laser treatment. Because this is a structured narrative review rather than a registered systematic review, study selection was evidence-prioritised rather than PRISMA-based.

The term “rejuvenation” is used here as an umbrella term for measurable improvement in age-associated skin attributes such as wrinkle topography, dermal elasticity, hydration, pigmentation, collagen-related remodelling, cellular senescence, or post-procedural recovery. It is not used to imply reversal of biological ageing or proven disease modification.

3. Exosomes, Small EVs, and Why Source Matters

EV cargo is source-dependent. Adipose-derived mesenchymal stromal/stem cell (ADSC) EVs, bone-marrow MSC EVs, umbilical-cord MSC EVs, dermal-fibroblast EVs, induced-pluripotent-stem-cell EVs, platelet/platelet-rich-plasma EVs, and serum-derived EV fractions differ in protein, lipid, growth-factor, and microRNA composition. Even within the same source, culture conditions, hypoxia, cytokine exposure, donor age, platelet activation, isolation method, storage, and freeze–thaw history can alter measured composition and biological activity[3–8,13–14].

This is especially important when considering autologous therapy. “Autologous” refers to material obtained from and returned to the same individual. Autologous therapy can reduce donor-recipient immunologic mismatch, but it does not itself demonstrate purity, potency, safety, or clinical efficacy. Blood-derived EV fractions are also analytically challenging because plasma contains abundant albumin, immunoglobulins, lipoproteins, platelet-derived particles, and other nanoscale structures that may co-isolate with EVs.

4. Mechanistic Basis for Skin Rejuvenation and Repair

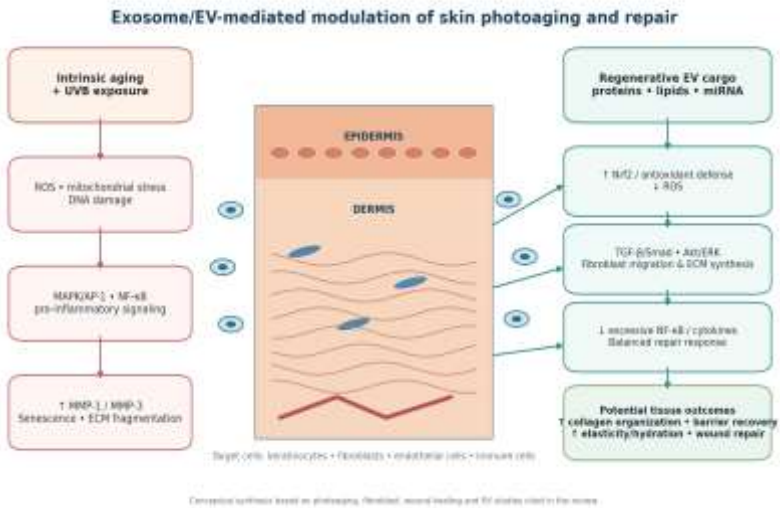

Fig 1: Conceptual mechanisms through which selected regenerative exosome/EV preparations may modulate skin photoaging and tissue repair. UVB-associated oxidative stress and inflammatory signalling increase matrix metalloproteinase activity, fibroblast senescence, and extracellular matrix fragmentation, whereas selected EV preparations have been reported to support antioxidant defence, fibroblast/keratinocyte function, matrix remodelling, angiogenic support, and inflammatory balance. This schematic is a mechanistic synthesis rather than a product-specific efficacy claim [15–50].

4.1 Fibroblast proliferation, migration, and matrix synthesis

Dermal fibroblasts are central to collagen, elastin, fibronectin, and proteoglycan homeostasis. Multiple studies show that MSC-, adipose-, iPSC-, dermal-fibroblast-, platelet-, and serum-derived EV preparations can be internalised by fibroblasts and increase migration and/or proliferation[15–25,33–37,51–52]. Human adipose MSC exosomes increased wound-associated fibroblast activity and accelerated cutaneous repair in vivo, while iPSC-MSC exosomes enhanced collagen synthesis and angiogenesis[33–36].

For ageing skin, the central desired shift is not simply "more collagen," but restoration of balanced matrix turnover. Exosome studies report increased type I collagen or procollagen expression together with reduced MMP-1/MMP-3 signalling and, in some models, a more favourable collagen III: I or TGF-β3:TGF-β1 relationship consistent with organised remodelling rather than uncontrolled fibrosis[15–24,34].

4.2 Oxidative stress and photoaging

UVB-induced ROS activates MAPK/AP-1 and inflammatory pathways, increases MMP expression, damages DNA and mitochondria, and suppresses collagen synthesis. ADSC-EVs, bone-marrow MSC exosomes, umbilical-cord MSC exosomes, and dermal-fibroblast exosomes have repeatedly attenuated UV-associated oxidative stress in fibroblast or animal models[15–22,28–32]. Gao and colleagues reported that ADSC exosomes reduced UVB-mediated DNA damage, ROS and MMP-1 while engaging Nrf2, MAPK/AP-1 and TGF-β/Smad signalling [15]. BMSC-derived exosomes reduced UVB-induced oxidative stress markers in dermal fibroblasts[28,29]; one study additionally showed suppression of TNF-α, IL-6 and IL-1β and of MMP-1/MMP-3 with restoration of collagen I via inhibition of MAPK/AP-1 signalling [29], while another attributed protection to exosomal miR-29b-3p acting on MMP-2[28].

4.3 Cellular senescence

Senescent fibroblasts contribute to age-associated dermal decline through reduced regenerative capacity and a pro-inflammatory senescence-associated secretory phenotype. iPSC-derived exosomes reduced senescence-associated β-galactosidase activity and MMP expression while improving collagen and fibroblast function in vitro[19]. Human adipose-derived exosome preparations have also demonstrated anti-senescence effects in fibroblast models[24], and a prospective study of topical platelet exosomes reported reduction of senescence-associated signalling in human skin[53].

4.4 Angiogenesis and microvascular support

Healthy dermal repair requires vascular supply. MSC- and platelet-derived EVs can promote endothelial migration and tube formation through VEGF-related, AKT, ERK, STAT3, Wnt/β-catenin, and microRNA-regulated pathways [33,35–42,47–50]. Umbilical cord blood plasma exosomes accelerated wound healing and angiogenesis via miR-21-3p-mediated inhibition of PTEN and SPRY1[39], while hUCMSC-derived EVs enhanced angiogenesis in diabetic wounds through miR-17-5p acting on the PTEN/AKT/HIF-1α/VEGF axis[42]. These findings are particularly relevant to wound recovery and potentially to post-procedure remodelling, although direct proof that increased angiogenesis is a necessary mediator of cosmetic rejuvenation in humans remains limited.

4.5 Inflammation and immune modulation

Cutaneous rejuvenation requires controlled inflammation rather than complete suppression. In photoaged and wounded skin models, EV treatment can reduce excessive TNF-α, IL-1β, IL-6 and oxidative-inflammatory signalling while modulating macrophage and inflammatory responses [16,28,37–42,49–50]. This may help explain faster post-procedure recovery reported in several clinical studies, but the magnitude and duration of immune modulation depend on source, dose, delivery method, and the accompanying procedure.

4.6 Keratinocytes, re-epithelialization, and barrier repair

Keratinocyte proliferation and migration are essential for re-epithelialization. A comparative study of MSC exosomes from bone marrow, adipose tissue and umbilical cord showed source-dependent effects on target cells, with bone-marrow-derived exosomes most potent on dermal fibroblasts and umbilical-cord-derived exosomes most potent on keratinocytes[47]; bone-marrow MSC exosomes alone likewise enhance keratinocyte and fibroblast proliferation and migration and stimulate angiogenesis[48]. PRP-derived exosomes enhanced re-epithelialization in diabetic wound models through YAP-associated signalling [37]. These findings are relevant to skin barrier restoration after ablative or microneedling procedures, where the stratum corneum is transiently disrupted.

5. Human Clinical Evidence in Skin Rejuvenation

Clinical evidence is encouraging but still heterogeneous. The most informative designs are split-face studies because each patient serves as their own control. Park et al. conducted a 12-week randomised split-face study combining a human adipose tissue stem-cell-derived exosome-containing solution with microneedling and reported greater improvements in several objective facial-ageing parameters than microneedling alone[54]. Kwon et al. used a prospective, double-blind, randomised split-face design in patients with atrophic acne scars and found that adipose-derived exosomes used after fractional CO_2 laser improved scar outcomes and shortened recovery compared with control treatment[55].

Topical platelet-derived exosomes have also entered prospective clinical investigation. Proffer et al. reported favourable six-week tolerability and skin-quality signals after topical platelet exosomes in a single-arm, uncontrolled study[56], while Wyles et al. subsequently demonstrated reductions in senescence-associated signalling in human skin[53]. Nguyen et al. loaded adipose-derived small EVs with nicotinamide riboside and resveratrol and, in an uncontrolled application to the hand skin of three volunteers over eight weeks, reported improvements in skin texture, hydration, elasticity and pore volume[57]. A 2025 split-face observational study in nine patients further suggested additive benefits when exosome preparations were paired with microneedling or laser modalities, but its sample size limits inference[58]. More recent human studies extend this evidence base. Cho et al. retrospectively evaluated 40 patients treated with an exosome-containing skin booster plus microneedling and reported high patient satisfaction and Global Aesthetic Improvement Scale responses, with only mild transient adverse events; the absence of a control group limits attribution to the exosome preparation[59]. Park and Park randomised 75 patients with postoperative facial scars to fractional non-ablative Nd: YAG laser alone or laser combined with human-derived or plant-derived exosome boosters. The exosome groups showed numerically greater short-term improvement in several scar and skin-quality measures than laser alone, without demonstrated statistical superiority, and no serious adverse events were reported[60].

A core interpretation issue is that many trials test a combination—device plus exosome preparation—rather than exosomes alone. Microneedling and fractional lasers independently stimulate wound-healing pathways, collagen remodelling, and permeability. Therefore, the most defensible conclusion is that selected exosome-containing preparations may enhance recovery or augment remodelling after controlled skin injury; evidence that exosomes alone produce the same degree of rejuvenation is substantially weaker[9–12,53–59,61–62]. The 2026 meta-analysis strengthens the overall human signal but does not eliminate source heterogeneity, device confounding, or variation in outcome measurement[11].

Table 1: Representative human evidence relevant to skin rejuvenation

Study	Design	EV/exosome source	Adjunct	Main domain	Interpretation
Kwon et al., 2020[55]	Prospective double-blind randomised split-face	Human adipose-derived stem-cell exosomes	Fractional CO_2 laser	Atrophic acne scars/recovery	Positive adjunct signal; device confounding remains
Proffer et al., 2022[56]	Prospective single-arm	Topical platelet exosomes	Topical treatment	Skin quality/rejuvenation	Feasibility and tolerability; no parallel control
Park et al., 2023[54]	Prospective randomised split-face	Adipose stem-cell-derived exosome-containing solution	Microneedling	Facial aging	Objective improvement vs microneedling control
Nguyen et al., 2024[57]	Exploratory clinical study; very small human component	ADSC small EVs loaded with nicotinamide riboside and resveratrol	Topical application to hand skin	Photoaging	Promising signals; uncontrolled n=3 application to hand skin limits inference
Wyles et al., 2024[53]	Exploratory prospective trial	Platelet exosomes	Topical	Senescence signaling	Mechanistic human skin signal
Vitale et al., 2025[58]	Split-face observational study; n=9	Exosome preparation	Microneedling /lasers	Full-face rejuvenation	Promising adjunct signal; small observational cohort
Kang et al., 2026[62]	Single-arm clinical study; n=25	Autologous blood-derived EVs	Single intradermal facial administration	Facial ageing/skin quality	Closest direct autologous blood-derived facial evidence; significant short-term multi-parameter signal, but no comparator and only 3-week follow-up
Cho et al., 2026[59]	Retrospective single-centre analysis;	Exosome-containing skin booster	Microneedling ; four sessions	Facial aging	High satisfaction/GAIS improvement

	n=40				signal; retrospective and uncontrolled
Park & Park, 2026[60]	Randomised controlled study; n=75	Human-derived or plant-derived exosome boosters	Fractional non-ablative Nd: YAG laser	Postoperative facial scars/rejuvenation	Exosome adjunct groups showed numerically greater short-term improvement in several scar and skin-quality measures than laser alone; statistical superiority not demonstrated; exploratory short-term evidence.

6. What Is Actually Known About Autologous Exosomes for Skin?

The evidence base specifically supporting same-patient autologous exosomes is narrower than the broader "exosome rejuvenation" literature, but it now includes direct facial evidence. Kang et al. evaluated 25 adults (40–59 years) after one intradermal facial administration of autologous blood-derived EVs. Instrument-based and participant-reported assessments at day 5 and week 3 showed significant short-term gains across wrinkle-related measures, skin lifting/biomechanical properties, hydration and barrier indices, complexion, surface texture, and pore appearance, with no adverse reactions reported[62]. This is currently the closest published human source-and-application comparator to an autologous peripheral-blood platform; however, the study was single-arm, and the three-week follow-up is too short to establish durability or isolate the EV effect from injection-related and other short-term procedural effects. Additional direct autologous evidence includes the pilot case-control study by Gibello et al., in which autologous serum-derived EVs were used for chronic venous ulcers[63], and experimental work by Han et al. showing that exosomes derived from autologous dermal fibroblasts enhanced diabetic cutaneous wound healing through Akt/β-catenin signalling [52]. Rasti et al. further demonstrated pro-healing activity of blood-serum-derived exosomes in vitro and in vivo[51]. Together, these observations support patient-derived and blood-derived vesicle strategies while distinguishing direct facial rejuvenation evidence from wound-healing extrapolation.

Platelet and PRP exosome data provide an additional mechanistic bridge because platelets are abundant contributors to circulating EV populations and their vesicles contain regenerative signals. PRP-derived exosomes promoted fibroblast/endothelial activity, angiogenesis, and re-epithelialization in experimental wounds[37], and topical platelet-exosome studies have produced early human skin-rejuvenation signals[53,56]. Nevertheless, commercial platelet-exosome preparations should not be assumed to be autologous unless the study explicitly states same-patient collection and administration.

Accordingly, an autologous review should not present all MSC exosome studies as direct evidence for an autologous blood-derived product. A more rigorous hierarchy is: direct autologous facial/blood-derived human evidence > other direct autologous cutaneous evidence > same-biofluid/source evidence > other human-derived exosome evidence > animal/cellular mechanistic evidence.

6.1 Position of the Biotex autologous blood-derived platform within the evidence hierarchy

Within this source-specific hierarchy, the Biotex Autologous Exosome Isolation Kit occupies a relevant translational position because the starting material is peripheral blood obtained from the intended recipient and processed during the same clinical session. The platform should not be treated as interchangeable with

culture-derived MSC exosome products; rather, the closest published biological comparators now include the human facial study of autologous blood-derived EVs[62], autologous serum-derived EVs[63], blood-serum exosomes[51], and platelet/platelet-rich-plasma-derived vesicles[37,53,56]. Broader fibroblast-, adipose-, bone-marrow-, umbilical-cord-, and iPSC-derived EV studies provide complementary mechanistic support for pathways relevant to skin repair, including fibroblast activity, collagen and extracellular-matrix remodelling, keratinocyte recovery, angiogenesis, and regulation of oxidative and inflammatory stress[15–52]. This placement allows the Biotex platform to be discussed positively based on its patient-matched, non-culture-dependent workflow while keeping efficacy evidence appropriately source-specific.

Table 2: Source-specific relevance of the current skin exosome/EV evidence to an autologous blood-derived platform

Source class	Autologous relevance	Representative skin evidence	Evidence level	Translational interpretation
Autologous blood-derived EVs	Direct autologous human facial evidence	Single-injection facial rejuvenation study; n=25 [62]	Early uncontrolled human clinical	Closest published source/application comparator to a patient-matched blood-derived approach; short follow-up and no control.
Autologous serum-derived EVs	Direct autologous human evidence	Pilot case-control chronic venous-ulcer study [63]	Early human interventional	Supports same-patient cutaneous repair; not facial rejuvenation.
Autologous dermal-fibroblast exosomes	Direct autologous experimental evidence	Diabetic cutaneous wound healing via Akt/β-catenin [52]	Preclinical/direct autologous	Strong source-specific plausibility; no controlled cosmetic trial.
Blood-serum-derived exosomes	Biofluid-relevant; not necessarily an autologous intervention	Pro-healing activity in vitro/in vivo [51]	Preclinical	Supports blood-derived plausibility; source heterogeneity remains.
Platelet/PRP EVs	Potentially autologous depending on study design	Human topical platelet studies [53,56]; PRP wound repair [37]	Early human + preclinical	Mechanistic bridge to blood processing; commercial products are not automatically autologous.

ADSC-derived EVs	Usually non-autologous in cited skin studies	Randomized/prospective aesthetic and photoaging studies [15–17,20,24,33–34,45,54–55,57]	Largest skin evidence base	Important efficacy context, but not direct evidence for Biotex blood-derived fraction.
UCMSC/BMSC/iPSC EVs	Non-autologous in cited studies	Photoaging, wound, angiogenesis and repair models [18–19,26–32,35,38–42,47–48]	Predominantly preclinical	Useful mechanistic evidence; biological activity is source-dependent.

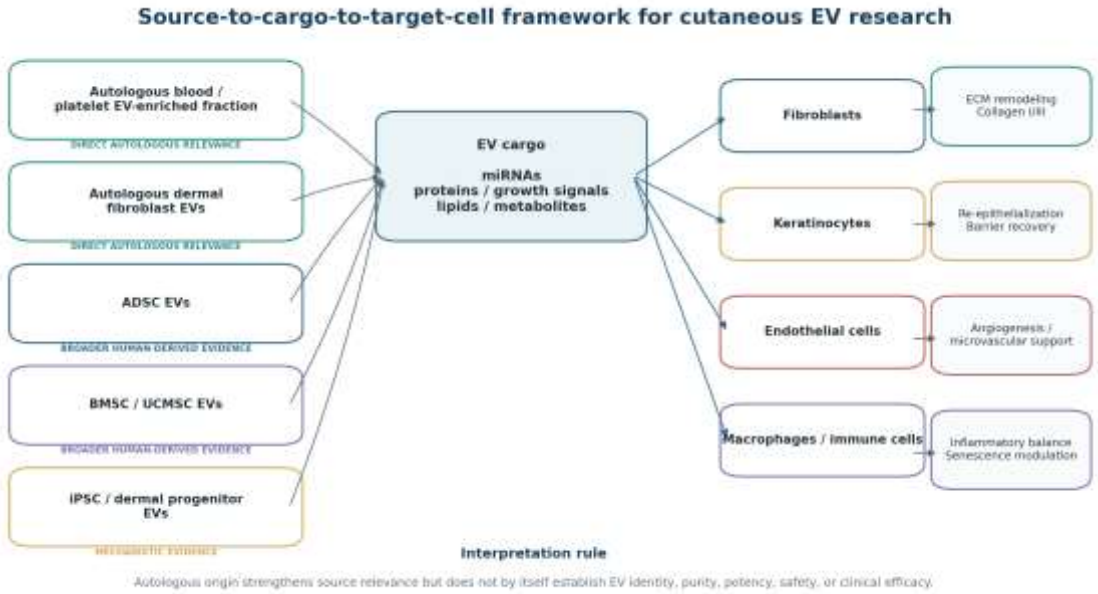

Fig 2: Source-to-cargo-to-target-cell framework for exosome/EV-mediated skin repair. Autologous serum/platelet and dermal-fibroblast sources have the closest conceptual relationship to same-patient therapy, whereas ADSC-, BMSC-, UCMSC-, and iPSC-derived EVs provide broader mechanistic and clinical context. Source-specific cargo, processing, and disease state can alter biological activity; evidence from one source should therefore not be treated as interchangeable with another [15–58,63–64].

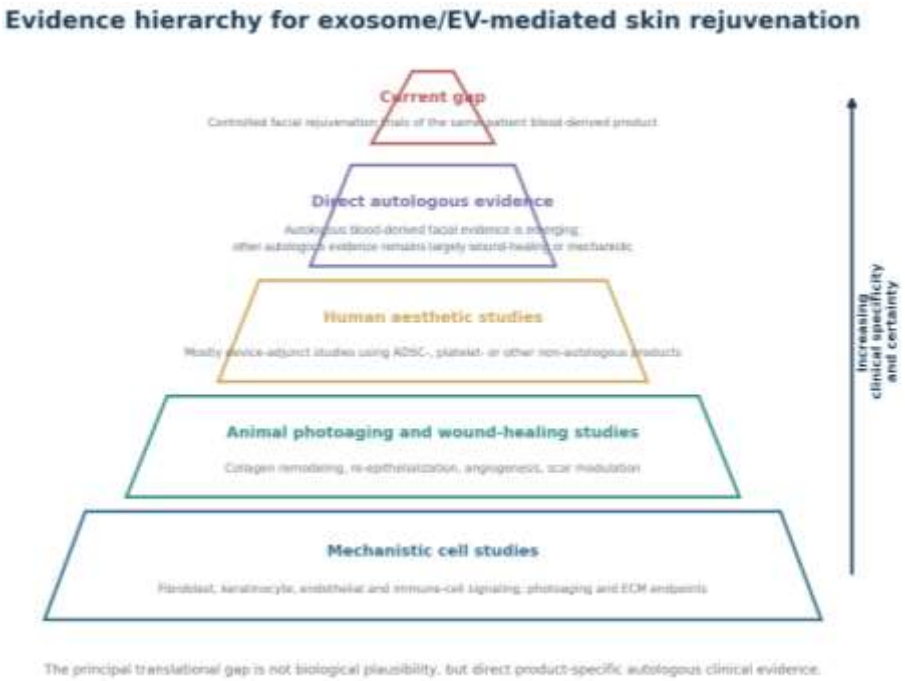

Fig 3: Evidence hierarchy for exosome/EV-mediated skin rejuvenation. Mechanistic and animal evidence is substantial, and several human device-adjunct studies report favourable signals. Direct autologous cutaneous evidence now includes an uncontrolled human facial study of autologous blood-derived EVs[62] and autologous serum-derived EVs used in chronic venous ulcers[63]; controlled trials of same-patient peripheral-blood-derived EV fractions for facial rejuvenation were not identified in the literature evaluated in this review.

7. Delivery Strategies and the Importance of the Skin Barrier

Intact stratum corneum is a major delivery barrier for nanoscale biological preparations. Most clinical aesthetic protocols therefore combine exosome-containing products with microneedling, fractional CO_2 laser, other resurfacing modalities, or local/intradermal administration. Microneedling and fractional lasers create transient microchannels while independently initiating wound-healing and collagen-remodelling responses [53–58,61]. For a same-patient autologous preparation, the route, timing after device treatment, volume per unit area, needle depth or laser parameters, maximum exposure window, and repeat-treatment schedule should be protocol-defined rather than extrapolated from unrelated commercial formulations.

This combination creates both an opportunity and a methodological problem: improved clinical outcomes may reflect exosome biology, device biology, or synergy. Accordingly, clinical findings are most interpretable when studies incorporate device-only comparators, standardised exposure reporting, defined application timing, and objective measurements of erythema, barrier recovery, elasticity, hydration, pigmentation, and wrinkle topography.

8. Safety, Quality, and Regulatory Considerations

The absence of living cells eliminates certain risks of cell transplantation, but EV products are not automatically risk-free. Critical risks include microbial contamination, endotoxin, residual cellular material, co-isolated lipoproteins and protein aggregates, batch variability, uncontrolled bioactive cargo, incorrect storage, and unvalidated administration routes. Blood-derived preparations also require attention to hemolysis, platelet activation, coagulation-related constituents, and the distinction between vesicles and non-vesicular nanoparticles. These practical and safety challenges are emphasised in contemporary cosmetic-dermatology reviews[65]. A 2026 scoping review of 17 human dermatology studies reported that adverse events were uncommon overall, while noting published injection-associated events including

granulomas, necrosis, and allergic reactions; these observations reinforce the need to interpret safety according to the specific preparation and route of administration[12].

MISEV2023 emphasises transparent reporting of source, pre-analytical handling, separation, characterisation, and functional testing[1]. In the EV literature, characterisation of plasma/serum-derived preparations commonly incorporates orthogonal particle sizing/concentration (for example NTA or TRPS), morphology (TEM or cryo-EM), membrane-associated EV markers such as CD9/CD63/CD81, cytosolic EV-associated proteins where appropriate (for example ALIX/TSG101), and assessment of likely co-isolates such as albumin and apolipoproteins.

Regulatory status is jurisdiction-specific. In the United States, the Food and Drug Administration states that exosome products intended to treat diseases or conditions in humans generally require FDA approval and that no exosome products are currently FDA-approved[66]; the agency has separately reported serious adverse events in patients treated with unapproved products marketed as containing exosomes[67]. The regulatory classification of an autologous blood-derived preparation depends on how it is processed, intended, and administered and must be evaluated under the rules of the jurisdiction in which it is used.

9. Skin-Specific Translational Framework for the Biotex Autologous Exosome Isolation Kit

9.1 Device architecture and preparation sequence

The Biotex Autologous Exosome Isolation Kit is included as a practical example of a patient-matched blood-processing platform with direct relevance to regenerative dermatology. The system uses the intended recipient's own peripheral blood, a defined same-session preparation sequence, proprietary gel-containing collection tubes, and a separate membrane-processing stage. This autologous format differs operationally from many published aesthetic EV products that originate from cultured adipose-, umbilical-cord-, or other donor-derived cells. The technical parameters below are manufacturer-described characteristics of the Biotex system and are discussed alongside, but not conflated with, the peer-reviewed skin-EV literature.

Preparation begins with approximately 40 mL of peripheral venous blood apportioned among eight Biotex collection tubes. Each tube has a nominal capacity of about 8 mL and receives roughly 5 mL of blood; a proprietary gel is present within the tube, and the sample is maintained in a non-clotted state during the specified processing interval. The sealed tubes are held at approximately 38 °C for about 30 minutes and are then centrifuged. Across the eight tubes, the clarified upper phase provides approximately 12–15 mL of plasma. This plasma is transferred to the kit's downstream filtration assembly and passed through a proprietary circular membrane using the three-way syringe manifold. Approximately 3 mL of processed, patient-matched material is collected at the outlet for subsequent protocol-defined use or investigation. The gel used during blood collection and the membrane used during filtration are separate functional elements of the kit.

9.2 Scientific interpretation of the recovered autologous fraction

The approximately 38 °C holding interval is described here as a defined processing condition within the Biotex workflow. It is not interpreted in this review as proof of de novo exosome biogenesis during incubation. Its scientific relevance is that it forms part of a reproducible same-session sequence that precedes centrifugation, clarified-plasma recovery, and proprietary membrane processing.

For academic precision, the approximately 3 mL output is referred to as an "autologous blood-derived EV-enriched fraction" or "small-EV/exosome-enriched fraction." This terminology identifies the patient-matched source and enrichment process without assuming that every nanoscale component belongs to a single vesicle subtype. Importantly, conservative nomenclature does not diminish the translational value of the platform. A small human study has now reported short-term facial skin improvements after intradermal administration of autologous blood-derived EVs[62], while blood-serum, platelet/PRP, autologous fibroblast, and other regenerative EV studies support effects on fibroblasts, keratinocytes, extracellular-matrix remodelling, oxidative stress, inflammatory signalling, angiogenesis, and tissue repair[1–2,37,51–53,56,63]. These findings are source-proximal biological support rather than product-specific efficacy evidence for the Biotex preparation.

9.3 Dermatologic application and translational relevance

Existing dermatologic studies provide a clinically relevant context for local use of EV-containing preparations. In human facial-ageing and scar studies, exosome-containing products have been incorporated after microneedling or fractional laser treatment, platelet-derived preparations have been evaluated topically, and more recent controlled and observational studies have extended the clinical evidence for device-assisted use[53–61]. Most directly relevant to the Biotex concept, Kang et al. reported short-term improvements across multiple facial skin parameters after a single intradermal administration of autologous blood-derived EVs[62]. That study strengthens the source-specific translational rationale for a patient-matched blood-derived approach, although its EV preparation is not the Biotex product and its uncontrolled, short-duration design does not establish product equivalence. The Biotex platform therefore remains distinct in its defined same-session workflow, while the expanding human literature provides increasingly relevant clinical context.

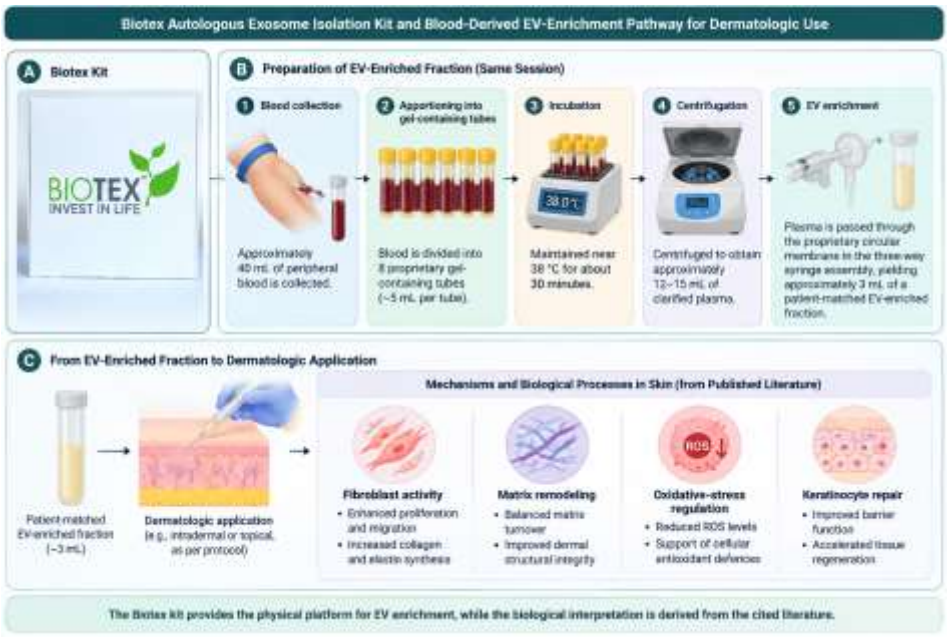

Fig 4: Biotex Autologous Exosome Isolation Kit and blood-derived EV-enrichment pathway for dermatologic use. (A) Manufacturer-supplied photograph identifying the Biotex Autologous Exosome Isolation Kit. (B) Same-session preparation pathway: approximately 40 mL of peripheral blood is distributed among eight proprietary gel-containing tubes (~5 mL per tube), maintained near 38 °C for about 30 minutes, centrifuged to recover approximately 12–15 mL of clarified plasma, and processed through the proprietary circular membrane in the three-way syringe assembly to yield approximately 3 mL of a patient-matched EV-enriched fraction. (C) Dermatologic application context and skin processes associated with EV therapy in the literature, including fibroblast activity, matrix remodelling, oxidative-stress regulation and keratinocyte repair. The kit image and workflow document the Biotex platform; biological interpretation is derived from published EV evidence, including emerging human autologous blood-derived facial data[15–16,23,37,39,42,51–63].

Table 3: Operational sequence of the Biotex kit and dermatologic relevance

Processing phase	Biotex procedure parameter	Dermatologic/translational relevance
Initial blood handling	Peripheral blood divided among eight proprietary gel-containing tubes (~5 mL/tube; ~40 mL total)	Autologous, patient-matched starting material; avoids third-party donor tissue and requires only venous blood collection.
Warm conditioning	Sealed tubes maintained near 38 °C for ~30 min	Defined same-session preprocessing step within the standardised Biotex workflow.
Plasma recovery	Centrifugation followed by	Produces a clarified patient-derived plasma fraction

	collection of ~12–15 mL clarified plasma	for downstream enrichment while preserving the autologous source.
Membrane processing	Clarified plasma passed through the proprietary circular membrane using the three-way syringe manifold.	Provides a dedicated membrane-enrichment step before final collection in the patient-matched workflow.
Collected output	Approximately 3 mL patient-matched EV-enriched preparation	Compact final volume suited to protocol-defined local dermatologic use within the same clinical encounter.
Dermatologic integration	Local application in the procedural context described for EV-based skin rejuvenation	Conceptually aligned with published microneedling/fractional-laser EV literature and with broader fibroblast, keratinocyte, matrix-remodelling and wound-repair mechanisms[37,51–58,61,63].

10. Translational Advantages and Clinical Relevance of the Biotex Autologous Skin Preparation

Within the broader exosome/EV field, the Biotex platform has several features that are particularly relevant to regenerative and aesthetic dermatology. Foremost is its autologous source: the preparation begins with peripheral blood from the intended recipient and returns a patient-matched fraction within the same treatment session. This removes donor-source mismatch inherent to allogeneic EV preparations and avoids dependence on cultured third-party cells.

The workflow is also operationally compact. A defined blood input is distributed among eight proprietary gel-containing tubes, followed by a short controlled conditioning period, centrifugation, recovery of clarified plasma, proprietary membrane processing and collection of a small final fraction. In contrast with cell-culture-derived EV manufacturing, the Biotex pathway does not require donor-cell expansion, prolonged culture, conditioned-medium collection, bioreactor processing or cryopreserved cell banks. For procedural dermatology, this same-session format is a practical advantage because preparation remains linked to the individual patient and treatment encounter.

The biological rationale is supported by the wider dermatologic EV literature. Human studies using adipose-derived or platelet-derived exosome-containing preparations have reported favourable signals in facial ageing, acne-scar recovery, texture, elasticity, pigmentation and senescence-associated skin biology, particularly when EV preparations are combined with microneedling or fractional laser procedures[53–61]. Importantly for an autologous blood-derived platform, a 2026 clinical study in 25 adults reported short-term improvement in multiple facial skin parameters after intradermal autologous blood-derived EV administration[62]. Autologous serum-derived EVs have also shown a clinical wound-healing signal, while blood-serum-derived and autologous dermal-fibroblast exosomes support source-relevant effects on tissue repair[51–52,63]. These findings do not make different EV sources or processing systems biologically identical, but together they provide a progressively stronger translational basis for patient-matched blood-derived approaches.

From a skin-rejuvenation perspective, the principal attraction of the Biotex approach is the convergence of patient-specific sourcing with mechanisms repeatedly described across the EV literature: fibroblast migration and proliferation, collagen-associated matrix remodelling, keratinocyte repair, modulation of oxidative and inflammatory stress, angiogenic support, and wound-healing responses[15–52]. These pathways are relevant to photoaging and post-procedural recovery, and the new autologous blood-derived human facial evidence provides a closer clinical bridge than was previously available[62]. Accordingly, a freshly prepared autologous EV-enriched fraction is conceptually aligned with regenerative mechanisms and source-specific clinical observations reported in the wider EV literature.

The patient-matched nature of the system also offers practical advantages in positioning. It avoids third-party tissue sourcing and the interpretive complexities associated with donor age, donor health, culture media and cell-expansion conditions that can influence EV cargo in cell-derived products. At the same time, the use of peripheral blood makes source acquisition considerably less invasive than adipose-

tissue harvesting. These characteristics support a personalised, same-session model that is readily understandable within autologous regenerative medicine.

Accordingly, this review positions the Biotex Autologous Exosome Isolation Kit positively as a practical autologous processing technology with a plausible and literature-supported role in skin-health and rejuvenation strategies. Its contribution is best understood through the combination of patient-matched sourcing, streamlined same-session preparation and compatibility with local dermatologic application paradigms already described for EV-containing preparations. Evidence from other EV sources is used to support biological plausibility and therapeutic context rather than to claim that all preparations are interchangeable.

Table 4: Translational characteristics of the Biotex autologous platform relevant to dermatologic use

Attribute	Dermatologic relevance
Autologous source	Patient-matched peripheral blood avoids donor-source mismatch and aligns with personalised regenerative approaches.
Same-session preparation	Collection, processing and recovery can be completed within a single clinical encounter.
No cell-culture expansion	The workflow does not depend on culture-expanded donor cells, conditioned media, bioreactors or cryopreserved cell banks.
Peripheral-blood acquisition	Uses routine venous blood collection rather than adipose or other tissue harvesting.
Defined processing sequence	Standardised input volume, controlled conditioning, centrifugation, clarified-plasma recovery, proprietary membrane processing and ~3 mL final collection.
Compact final fraction	A small patient-matched output is compatible with protocol-defined local dermatologic application.
Alignment with EV skin biology	Published EV literature supports biologically relevant effects on fibroblasts, keratinocytes, extracellular matrix, photoaging, oxidative stress and tissue repair.
Procedural compatibility	The platform can be discussed within the same dermatologic context in which EV-containing preparations have been used with microneedling and fractional laser procedures.
Scientific positioning	A practical personalised autologous platform whose broader rationale is supported by human and mechanistic EV literature while source-specific outcomes remain distinct.

11. Limitations of the Current Evidence

- Many publications use “exosome” without proving endosomal biogenesis; some products are more accurately described as small-EV-enriched preparations.
- Clinical studies are small, often single-centre, and frequently combine EV products with microneedling, laser, or other active procedures.
- Cell source, donor characteristics, culture conditions, isolation method, particle dose, excipients, storage, and administration route vary substantially.
- Objective endpoints are inconsistent, and follow-up is often too short to establish durable dermal remodelling.
- Direct autologous peripheral-blood evidence for cosmetic facial rejuvenation remains sparse: current human evidence includes a small, uncontrolled, short-term study rather than replicated controlled trials[62].
- Blood-derived fractions may contain lipoproteins, soluble proteins and platelet-derived particles that contribute to activity and complicate attribution specifically to exosomes.
- Long-term safety data for repeated therapeutic administration are limited.

12. Evidence Interpretation and Source-Specific Reporting

Across the broader EV dermatology field, unresolved questions concern source-specific potency, dose reporting, nomenclature, and the extent to which observed outcomes reflect the EV preparation versus an

associated procedure. These are field-wide issues and should not be conflated with the practical description of any single processing platform. In this review, the Biotex kit is positioned according to its established workflow attributes and the biological relevance of the published autologous, blood-derived, platelet-derived and skin-rejuvenation EV literature.

Continued refinement of EV nomenclature and source-specific reporting will improve comparison across the skin literature. Mechanistic and clinical findings should remain linked to the preparation actually studied. At the same time, autologous blood-derived platforms can be discussed on the basis of their patient-matched sourcing, operational characteristics and the closest available biological evidence.

13. Conclusion

The exosome/EV field has developed a strong mechanistic foundation for skin regeneration. Across preclinical models, regenerative EV populations improve fibroblast and keratinocyte function, reduce UV-induced oxidative injury, suppress MMP-mediated matrix degradation, promote collagen-associated remodelling, stimulate angiogenesis, and modulate excessive inflammation. Human studies now provide early evidence that selected exosome-containing preparations can improve facial-ageing parameters and may enhance recovery after microneedling or fractional laser procedures[9–12,53–59,61–62]. Recent evidence syntheses strengthen the overall clinical signal while continuing to identify heterogeneity in source, processing, adjunctive procedures, dosing, and outcome assessment[11–12].

The evidence for explicitly autologous skin rejuvenation remains smaller than the broader EV literature, but it is no longer limited to wound-healing extrapolation. Kang et al. reported significant short-term changes in multiple facial skin-quality parameters following a single intradermal administration of autologous blood-derived EVs in 25 adults[62]. The absence of a comparator and the three-week follow-up limit causal and durability inference. Autologous serum-derived EVs have produced an early human wound-healing signal[63], while blood-serum-derived exosomes and autologous dermal-fibroblast exosomes add source-relevant biological support[51–52]. No controlled study of same-patient peripheral-blood-derived EV fractions for facial rejuvenation was identified in the literature evaluated in this review.

Within regenerative dermatology, the Biotex Autologous Exosome Isolation Kit offers a practical route to a fresh, patient-matched blood-derived EV-enriched preparation through a defined same-session sequence. The combination of autologous sourcing, absence of culture-expanded donor cells, compact processing and a small final volume is particularly compatible with personalised procedural dermatology. The wider skin-EV literature provides biological support for fibroblast and keratinocyte activity, extracellular-matrix remodelling, oxidative-stress control, angiogenic signalling and tissue repair, while autologous serum-, blood-serum-, platelet- and fibroblast-derived EV studies provide a closer source bridge to a patient-derived approach. Accordingly, the Biotex platform can be positioned positively as an autologous translational technology with practical relevance to skin rejuvenation, while evidence from other EV preparations is used as supporting biological context rather than treated as interchangeable product-specific proof.

Declarations

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Conflict of Interest: All authors are employees of Biotex Life Solutions Pvt. Ltd., the company that developed the Biotex Autologous Exosome Isolation Kit discussed in this review. This employment and institutional relationship is disclosed as a potential conflict of interest. The manuscript is a scientific review of the published literature, and references to the Biotex Autologous Exosome Isolation Kit are presented within a translational framework without implying product-specific clinical efficacy. The authors declare no other conflicts of interest.

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Data Availability: No new clinical dataset was generated for this review. The evidence synthesised is available in the cited peer-reviewed literature. Manufacturer technical information is presented as process description and is not treated as independent clinical-efficacy evidence.

Use of AI-Assisted Tools: Generative AI tools were used for language refinement and schematic figure development. Scientific interpretation, evidence appraisal, reference verification, claim assessment, and final manuscript content remain the responsibility of the authors.

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