MCT

SCIENTIFIC RESEARCH DOSSIER

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BASIC RESEARCH ARTICLES

01

- Protocol for Ex Vivo Physicochemical Assessment of Photothermally Preconditioned Platelet-Rich Plasma Laura Cordero, Elena Sánchez-Vizcaíno Mengual and Hernán Pinto. (2026) MethodsX. 6
- Molecular Mechanisms of the Geroprotective Effect of Exosomes in the Simulation of Inflammaging in the Culture of Human Fibroblasts. Y. I. Belova, A. I. Fedorina, A. O. Drobintseva, S. G. Gracheva, R. A. Nasyrov, I. M. Kvetnoy and E. Pinto. (2026) Advances in Gerontology. 7
- Autologous Platelet-rich Plasma Exosome Quantification After Two Thermo-photobiomodulation Protocols with Different Fluences. Cordero, L. et al. (2025). Journal of Photochemistry and Photobiology. 8
- Photothermal Biomodulated Platelet-rich Plasma Improves Preservation of Hair Grafts and Extends Their Viability. Naranjo, P. et al. (2025). Plastic and Reconstructive Surgery - Global Open. 9
- Exosome Secretion Kinetics are Controlled by Temperature. Mahmood, A. et al. (2023). Biophys Journal. 10
- The Effect of Short-Term Refrigeration on Platelet Responsiveness. Kobsar, A. et al. (2022). Sci Rep. 11
- Sustained Release of Growth Factors from Photoactivated Platelet Rich Plasma (PRP). Gülseren, I. et al. (2020). Eur J Pharm and Biopharm. 12
- Photoactivation of Autologous Materials with a New Reliable, Safe and Effective Set-up. Pinto, H. (2020). Aesthet Med. 13
- Thermal Conditioning: Improving PRP Growth Factor Content. Pinto, H. & Melamed, G. (2020). Prime Journal. 14
- Exposure to Blue Light Stimulates the Proangiogenic Capability of Exosomes Derived from Human Umbilical Cord Mesenchymal Stem Cells. Yang, K. et al. (2019). Stem Cell Res Ther. 15
- An Optimised Protocol for Platelet-Rich Plasma Preparation to Improve its Angiogenic and Regenerative Properties. Etulain, J. et al. (2018). Sci Rep. 16

BASIC RESEARCH ARTICLES

MethodsX

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Protocol for Ex Vivo Physicochemical Assessment of Photothermally Preconditioned Platelet-Rich Plasma

Laura Cordero, Elena Sánchez-Vizcaíno Mengual and Hernán Pinto

MethodsX. 2026.

Photothermal biomodulation is used to precondition platelet-rich plasma, but standardized laboratory workflows for monitoring associated physicochemical changes remain limited. This article describes a paired ex vivo protocol for assessing selected physicochemical parameters of platelet-rich plasma before and after photothermal preconditioning.

- Platelet-rich plasma is prepared from donor blood, pooled per donor, and divided into paired control and photothermally preconditioned aliquots.
- The protocol enables time-course monitoring of density/turbidity, pH, and temperature from baseline to 60 min.
- Application in samples from three healthy donors showed that the workflow can detect small time-dependent differences between paired aliquots.

ADVANCES IN GERONTOLOGY

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Molecular Mechanisms of the Geroprotective Effect of Exosomes in the Simulation of Inflammaging in the Culture of Human Fibroblasts

Y. I. Belova, A. I. Fedorina, A. O. Drobintseva, S. G. Gracheva, R. A. Nasyrov, I. M. Kvetnoy and E. Pinto

Advances in Gerontology. 2026.

Inflammaging is considered as a fundamental mechanism of age-related skin involution, mediated by chronic inflammation, fibroblast dysfunction and collagen matrix degradation. The study considers the modulating effect of exosomes on the culture of dermal fibroblasts (DF1) during inflammaging. The experimental model included three groups: intact control, induced inflammaging, inflammaging in the presence of exosomes. The methodology was based on an MTT test to assess the metabolic activity of cells and immunohistochemical analysis with detection of a panel of markers involved in the regulation of inflammation (NF-kB/p65, CCN1), redox homeostasis (superoxide dismutase, prohibitin), cell cycle (p53, Ki-67), as well as endogenous geroprotective factors (Klotho, SIRT6) and receptor apparatus (EGFR). It has been shown that exosomes initiate a multiple cytoprotective response. At the same time, endogenous antioxidant systems are activated (the expression of Klotho and prohibitin increases), which is accompanied by an increase in the activity of superoxide dismutase and a reduction in oxidative stress. There is also suppression of stress-induced signaling cascades - inhibition of p53 correlates with the preservation of the proliferative potential of fibroblasts, while suppression of transduction along the NF-kB/CCN1 axis reduces the pro-inflammatory load and stabilizes the extracellular matrix. Thus, the results of the study indicate that exosomes, acting on the key pathogenetic links of cell aging, can be considered as potential geroprotectors.

BASIC RESEARCH ARTICLES

ELSEVIER

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Autologous Platelet-Rich Plasma Exosome Quantification After Two Thermo-photobiomodulation Protocols with Different Fluences

Laura Cordero, Joan Carles Domingo, Elena Sánchez-Vizcaíno Mengual, and Hernán Pinto.

Journal of Photochemistry and Photobiology. 2025.

Objective: The study aimed to assess the effects on exosome quantification of thermo-photobiomodulation (TPBM) with blue light administered at two different fluences for preconditioning platelet-rich plasma (PRP).

Material and Methods: This was an in-vitro study aiming to compare the number of exosomes released from PRP samples after preconditioning for 10 min with blue light (467 nm) at two different fluences, 1.0 J/cm^2 and 2.0 J/cm^2, and controlled heating at 37 ºC. PRP samples from three healthy donors were obtained after withdrawing 64 mL of blood and were preconditioned following the two protocols using the MCT System®, a TPBM device with different energy, wavelength, temperature, and time combinations settings. Samples were placed in the MCT Kit® during the procedure, a single-use class IIa device with specific optical properties to optimize light scattering and transmittance. Exosomes were isolated by ultracentrifugation and quantified in triplicate using Nanoparticle Tracking Analysis (NTA).

Results: The mean exosome concentration was 2.99 × 10^{11} particles/mL (SD 1.31 × 10^{11}) for the samples exposed to 1.0 J/cm^2 and 2.53 × 10^{11} particles/mL (SD 1.39 × 10^{11}) for the samples exposed to 2.0 J/cm^2 ($p = 0.0262$). The lower light fluence resulted in a 15.4% increase in exosome concentration compared to the highest one.

Conclusions: Different light fluences during the PRP preconditioning resulted in varying exosome concentrations, with the lowest fluence producing the highest yield. Further research is required to determine whether other fluences can improve outcomes and identify the most suitable preconditioning protocol.

PRS GLOBAL OPEN

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Photothermal Biomodulated Platelet-rich Plasma Improves Preservation of Hair Grafts and Extends Their Viability

Pablo García Naranjo and Hernán Pinto

PRS Global Open. 2025.

Hair transplantation effectively treats alopecia, and hair graft viability is crucial for its success. The study aimed to assess the use of preconditioned autologous platelet-rich plasma with photothermal biostimulation as a graft preservation solution to increase the viability time of follicular units before transplantation. The study was conducted as a proof of concept. The platelet-rich plasma photothermal biostimulation was conducted using the MCT System, exposing the sample for 15 minutes to 623 nm red light with an intensity of 0.5 J/cm^2 and a temperature of 4 ºC to obtain the MCT Plasma. Grafts of volunteers were collected and preserved in 2 Petri dishes per preservation solution (MCT Plasma + phosphate-buffered saline, Ringer's lactate, and saline solution). Graft viability was evaluated in 6 random follicular units at 5, 6, 7, and 8 hours with 0.4% Trypan blue stain diluted at 1/6 with NaCl 0.9%. Twenty-eight male volunteers were included with a mean age of 41 (SD 8.14, range 29–59). A total of 240 grafts were collected from each subject and distributed equitably in 2 Petri dishes for each preservation solution. At 8 hours, only grafts preserved in MCT Plasma with phosphate-buffered saline survived. MCT Plasma maintained hair follicle viability more effectively before transplantation than the saline solution or Ringer's lactate, demonstrating its efficacy as a preservation solution. Hair grafts preserved in MCT Plasma with phosphate-buffered saline remained viable for eight hours following extraction, 2 hours longer than with the other tested solutions.

Biophysical Society

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Exosome Secretion Kinetics are Controlled by Temperature

Anarkali Mahmood, Zdenek Otruba, Alan W. Weisgerber, Max D. Palay, Melodie T. Nguyen, Broderick L. Bills, and Michelle K. Knowles.

Biophysical Journal. 2023.

When multivesicular endosomes (MVEs) fuse with the plasma membrane, exosomes are released into the extracellular space where they can affect other cells. The ability of exosomes to regulate cells nearby or further away depends on whether they remain attached to the secreting cell membrane. The regulation and kinetics of exosome secretion are not well characterized, but probes for directly imaging single MVE fusion events have allowed for visualization of the fusion and release process. In particular, the design of an exosome marker with a pH-sensitive dye in the middle of the tetraspanin protein CD63 has facilitated studies of individual MVE fusion events. Using TIRF microscopy, single fusion events were measured in A549 cells held at 23–37 °C and events were identified using an automated detection algorithm. Stable docking precedes fusion almost always and a decrease in temperature was accompanied by decrease in the rate of content loss and in the frequency of fusion events. The loss of CD63-pHluorin fluorescence was measured at fusion sites and fit with a single or double exponential decay, with most events requiring two components and a plateau because the loss of fluorescence was typically incomplete. To interpret the kinetics, fusion events were simulated as a localized release of tethered/untethered exosomes coupled with the membrane diffusion of CD63. The experimentally observed decay required three components in the simulation: 1) free exosomes, 2) CD63 membrane diffusion from the endosomal membrane into the plasma membrane, and 3) tethered exosomes. Modeling with slow diffusion of the tethered exosomes (0.0015–0.004 $\mu m^2/s$) accurately fits the experimental data for all temperatures. However, simulating with immobile tethers or the absence of tethers fails to replicate the data. Our model suggests that exosome release from the fusion site is incomplete due to postfusion, membrane attachment.

BASIC RESEARCH ARTICLES

nature

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The Effect of Short-Term Refrigeration on Platelet Responsiveness

Anna Kobsar, Karina Koehnlechner, Philipp Klingler, Marius Niklaus, Julia Zeller-Hahn, Angela Koessler, Katja Weber, Markus Boeck, and Juergen Koessler.

Scientific Reports. 2022.

Storage of platelet concentrates (PC) at cold temperature (CT) is discussed as an alternative to the current standard of storage at room temperature (RT). Recently, we could show that cold-induced attenuation of inhibitory signaling is an important mechanism promoting platelet reactivity. For developing strategies in blood banking, it is required to elucidate the time-dependent onset of facilitated platelet activation. Thus, freshly prepared platelet-rich-plasma (PRP) was stored for 1 and 2 h at CT (2-6 °C) or at RT (20-24 °C), followed by subsequent comparative analysis. Compared to RT, basal and induced vasodilator-stimulated phosphoprotein (VASP) phosphorylation levels were decreased under CT within 1 h by approximately 20%, determined by Western blot analysis and flow cytometry. Concomitantly, ADP- and collagen-induced threshold aggregation values were enhanced by up to 30-40%. Furthermore, platelet-covered areas on collagen-coated slides and aggregate formation under flow conditions were increased after storage at CT, in addition to induced activation markers. In conclusion, a time period of 1-2 h for refrigeration is sufficient to induce an attenuation of inhibitory signaling, accompanied with an enhancement of platelet responsiveness. Short-term refrigeration may be considered as a rational approach to obtain PC with higher functional reactivity for the treatment of hemorrhage.

BASIC RESEARCH ARTICLES

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Sustained Release of Growth Factors from Photoactivated Platelet Rich Plasma (PRP)

Gülseren Irmak, Tuğrul Tolga Demirtaş, and Menemşe Gümüşderelioğlu

European Journal of Pharmaceutics and Biopharmaceutics. 2020.

The goal of this study is to specify the ability of polychromatic light source (PAC), providing effective wavelengths in the range of 600-1200 nm (near-infrared region, NIR), to activate human platelets in platelet-rich plasma (PRP) and to achieve sustained and controlled release of growth factors from photoactivated platelets. PRP was isolated from human blood and treated with PAC in different time intervals during 1, 5 and 10 min from 10 cm distance to the platelets. ATP secretion and then, calcium release from platelets significantly increased after light application. Photostimulation of platelets triggered lamellipodia extension, numerous filopodia formation, and platelet agglomeration as activation indicators. P-selectin expression was significantly increased after the application of PAC. In conclusion, PRP was successfully activated with PAC for 10 min and realized activation-dependent sustained growth factor release during 28 days. We proved that PAC which has a great potential of activation of PRP enables sustained growth factor release from PRP with a periodic use for therapeutic applications of PRP.

aesthetic medicine

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Photoactivation of Autologous Materials with a New Reliable, Safe and Effective Set-up

Hernán Pinto

Aesthetic Medicine. 2020.

Background: The possibility of improving conditions and pathologies using biological materials prepared with the patient's own tissues has always been an attractive idea. There is a great disparity between the huge amount of preclinical data and the limited research conducted on photomodulation or photoactivation. This is because, for an effective and controlled management of light energy, several obstacles must be overcome.

Aim: The aim of this study is to evaluate the physical obstacles encountered by light in its path from the source to the biological tissue lodged in a receptacle specifically built for this purpose.

Methods: Total reflectance (specular + diffuse for an incidence angle of 80) and total transmittance (regular + diffuse) of a rectangular area of 2 cm^2 corresponding to a 5-cm long, 4-cm wide, 1-mm thick Terlux 2812HD plastic polymer sheet were evaluated.

Results: Showed that, with this set-up, over 90% of emitted light energy reaches the targeted tissue, with less than 10% loss in the process.

Conclusion: Data obtained in this study enable us to establish the suitability of this system as an effective tool to take advantage of the clinical benefit of photoactivation of biological materials.

BASIC RESEARCH ARTICLES

PRiME

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Thermal Conditioning: Improving PRP Growth Factor Content

Hernán Pinto and Graciela Melamed

Prime Journal. 2020.

There is currently great interest in the procedures and handling of patient blood preparations. In recent years, PRP application has been made accessible to all, though the technique has undergone moderate advances, while the end product has not really improved much. To achieve the latter, autologous materials are being subjected to conditioning protocols. In this context, conditioning stands for the controlled exposure of an autologous material to a certain physical and/or chemical stimulus, relying on the fact that the exposure itself will determine changes in the material that will ultimately lead to an enhancement of its clinical capabilities and curative potential. Today, new conditioning protocols are changing the game and there is currently an important corpus of evidence about the positive effects of tissue conditioning. It is a known fact that light and temperature affect organisms in multiple ways and are able to alter all kinds of biological processes. In this exploratory study, we have evaluated the effects of a thermal conditioning protocol in PRP, using an innovative, pioneering set-up. Our results were consistent with those previously reported, achieving statistically significant increments of growth factor concentration in PRP thermo-conditioned samples.

BMC

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Exposure to Blue Light Stimulates the Proangiogenic Capability of Exosomes Derived From Human Umbilical Cord Mesenchymal Stem Cells

Kun Yang, Dong Li, Meitian Wang, Zhiliang Xu, Xiao Chen, Qiao Liu, Wenjie Sun, Jiangxia Li, Yaoqin Gong, Duo Liu, Changshun Shao, Qiji Liu, and Xi Li

Stem Cell Research & Therapy. 2019.

Background: The therapeutic potential of mesenchymal stem cells (MSCs) may be attributed partly to the secreted paracrine factors, which comprise exosomes. Exosomes are small, saucer-shaped vesicles containing miRNAs, mRNAs, and proteins. Exosomes derived from human umbilical cord mesenchymal stem cells (hUC-MSCs) have been reported to promote angiogenesis. However, the efficacy of exosome-based therapies is still limited both in vitro and in vivo. The present study aimed to develop a new optical manipulation approach to stimulate the proangiogenic potential of exosomes and characterize its mechanism underlying tissue regeneration.

Methods: We used blue (455 nm) and red (638 nm) monochromatic light exposure to investigate the processing of stimuli. Exosomes were prepared by QIAGEN exoEasy Maxi kit and confirmed to be present by transmission electron microscopy and immunoblotting analyses. The proangiogenic activity of blue light-treated human umbilical vein endothelial cells (HUVECs), when co-cultured with hUC-MSCs, was assessed by EdU (5-ethynyl-2′-deoxyuridine) incorporation, wound closure, and endothelial tube formation assays. The in vivo angiogenic activity of blue light-treated MSC-derived exosomes (MSC-Exs) was evaluated using both murine matrigel plug and skin wound models.

Results: We found that 455-nm blue light is effective for promoting proliferation, migration, and tube formation of HUVECs co-cultured with MSCs. Furthermore, MSC-Exs stimulated in vivo angiogenesis and their proangiogenic potential were enhanced significantly upon blue light illumination. Finally, activation of the endothelial cells in response to stimulation by blue light-treated exosomes was demonstrated by upregulation of two miRNAs, miR-135b-5p, and miR-499a-3p.

nature

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An Optimised Protocol for Platelet-Rich Plasma Preparation to Improve Its Angiogenic and Regenerative Properties

Julia Etulain, Hebe A. Mena, Roberto P. Meiss, Gustavo Frechtel, Susana Gutt, Soledad Negrotto, and Mirta Schattner

Scientific Reports. 2018.

Although platelet-rich plasma (PRP) is used as a source of growth factors in regenerative medicine, its effectiveness remains controversial, partially due to the absence of PRP preparation protocols based on the regenerative role of platelets. Here, we aimed to optimise the protocol by analysing PRP angiogenic and regenerative properties. Three optimising strategies were evaluated: dilution, 4 °C pre-incubation, and plasma cryoprecipitate supplementation. Following coagulation, PRP releasates (PRPr) were used to induce angiogenesis in vitro (HMEC-1 proliferation, migration, and tubule formation) and in vivo (chorioallantoic membrane), as well as regeneration of excisional wounds on mouse skin. Washed platelet releasates induced greater angiogenesis than PRPr due to the anti-angiogenic effect of plasma, which was decreased by diluting PRPr with saline. Angiogenesis was also improved by both PRP pre-incubation at 4 °C and cryoprecipitate supplementation. A combination of optimising variables exerted an additive effect, thereby increasing the angiogenic activity of PRPr from healthy donors and diabetic patients. Optimised PRPr induced faster and more efficient mouse skin wound repair compared to that induced by non-optimised PRPr. Acetylsalicylic acid inhibited angiogenesis and tissue regeneration mediated by PRPr; this inhibition was reversed following optimisation. Our findings indicate that PRP pre-incubation at 4 °C, PRPr dilution, and cryoprecipitate supplementation improve the angiogenic and regenerative properties of PRP compared to the obtained by current methods.

CLINICAL STUDIES

02

- Efficacy and Safety of Photothermal Biomodulated Platelet-rich Plasma Versus Standard Platelet-rich Plasma for Facial Rejuvenation: A Prospective Split-Face Randomized Study Rungsima Wanitphakdeedecha, Ma. Patricia Gertrude Camille Rojas Ollero, Woramate Bhorntarakcharoen, Sariya Sittiwanaruk, Wilailuck Phokai, Thanakorn Woramongkol, Thanya Techapichetvanich, Pitchaya Maneeprasopchoke, Panwadee Thongjaroensirikul, Ya-Nin Nokdhes, Pornsuk Yamlexnoi and Onjira Meethong, (2026) Scientific Reports. **20**
- Photothermal Biomodulated Autologous PRP Combined with Laser and LED Phototherapy for Acne Sequela: A Report of Three Illustrative Cases. Yosra Labidi Menif and Laura Corder (2026) Case Reports in Dermatology. . **22**
- Microneedling Combined with Photothermal-Biomodulated Autologous PRP to Enhance Exosome Release in Refractory Melasma: A Case Report. Luciana Leite Crivelin and Gabriela Tomasi-Batiston. (2026) Clinical, Cosmetic and Investigational Dermatology. **23**
- Initial Experience with Humanized Allogeneic and Autologous Exosome-Based Therapies in Androgenetic Alopecia: A Case Series. Suruchi Garg, Navnee Jain and Carol Lobo. (2026 Journal of Stem Cells Research, Development & Therapy. **24**
- Facial Rejuvenation with Autologous Exosomes Using the MCT System. Vilà, D. et al. (2025). Dermatology Online Journal. **25**
- Novel Use of Preconditioned Autologous PRP-Derived Exosomes for Partial Achilles Tendon Rupture Repair: A -Week Recovery Case Report. Sánchez Herrera, A. (2025). Journal of Orthopaedic Reports. **26**
- Successful Treatment of Vulvar Lichen Sclerosus Using Microfiltered and Preconditioned Suspension of Autologous Adipose-Derived Stem Cells With Photothermal Biomodulation: A Case Report. Mezzana, P. et al. (2025) Clinical Case Reports. **27**
- Concomitant Use of Autologous Exosomes and Nd:YAG Laser in Post-Reconstructive Treatment of Bell's Palsy: A Case Report. Kozarev, J. (2025). JPRAS Open. **28**
- Combined Treatment of Noninfected Diabetes-Related Foot Ulcerations with Preconditioned Autologous Platelet-Rich Plasma with the MCT System to Enhance Exosomes Release and Phototherapy: A Case Report. Amesty, A. (2025). International Journal of Regenerative Medicine. **29**
- Photothermal Biostimulation of Platelet-Rich Plasma Improves Hand Rejuvenation Clinical Outcome: A Pilot Study. Tejero García, P. et al. (2024). Photobiomodul, Photomed, and Laser Surg. **30**
- Adult-Onset Linear Morphea (*en coupe de sabre*) of the Face Successfully Treated with Photoactivated Low-Temperature Platelet-Rich Plasma: A Valid Therapeutic Option. Mercuri, S. R. et al. (2023). Medicina. **31**
- Efficacy of Photo-Thermal-Bioactivated Platelet-Rich Plasma for Skin Biostimulation in Patients not Eligible for Other Medical-Aesthetic Treatment: A Pilot Study. Hernández Sanz, C. & Pinto, H. (2023). Skin Res and Technol. **32**
- Efficacy and Safety of Photothermal-Bioactivated Platelet-Rich Plasma for Facial Rejuvenation. Beltrán, B. et al. (2022). J Cosmet Dermatol. **33**

CLINICAL STUDIES

nature

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Efficacy and Safety of Photothermal Biomodulated Platelet-rich Plasma Versus Standard Platelet-rich Plasma for Facial Rejuvenation: A Prospective Split-Face Randomized Study

Rungsima Wanitphakdeedecha, Ma. Patricia Gertrude Camille Rojas Ollero, Woramate Bhorntarakcharoen, Sariya Sittiwanaruk, Wilailuck Phokai, Thanakorn Woramongkol, Thanya Techapichetvanich, Pitchaya Maneeprasopchoke, Panwadee Thongjaroensirikul, Ya-Nin Nokdhes, Pornsuk Yamlexnoi and Onjira Meethong

Scientific Reports. 2026.

Introduction: Autologous platelet-rich plasma (PRP) regenerative properties are used to treat clinical manifestations of skin aging. This study assessed the efficacy and safety of photothermal biomodulated PRP (PTBM-PRP) compared to standard PRP for skin rejuvenation.

Methods: Prospective, split-face, randomized study including Thai volunteers (30–60 years) with Fitzpatrick skin type III-IV and moderate severity photoaging or higher conducted at Siriraj Hospital (Bangkok, Thailand). Face sides were randomized to receive intradermal autologous PTBM-PRP or PRP injections in three sessions at one-month intervals, with follow-up visits at one, three, and six months. PRP was preconditioned using the MCT System (Meta Cell Technology, Sant Cugat del Vallès, Spain) preset with the Exosomes program (467 nm continuous light [1 J/cm2], 37°C, 10 min). We evaluated changes in skin surface characteristics, pigmentation, redness, and biomechanical properties (i.e., firmness, elasticity, and viscoelasticity), perceived facial improvement, and perceived pain.

Results: We included 28 volunteers (96.4% women) with a mean (SD) age of 40.82 (8.95) years and mostly skin type IV (67.86%). PTBM-PRP decreased fine lines maximum depth (p=0.041) and indentation index (p=0.005), folds maximum depth (p=0.032) and indentation index (p<0.001), and wrinkles maximum depth (p=0.024) and indentation index (p=0.041) in the periorbital area. PRP transiently decreased folds indentation index (p=0.008) and wrinkles maximum depth (p=0.0499) (PTBM-PRP vs. PRP wrinkles maximum depth p=0.038 and indentation p=0.018). Improvements in pigmentation, redness, and biomechanical properties were similar for both treatments. Patients perceived both treatment effects mostly as good or excellent improvement, with slightly favorable pain scores for PTBM-PRP vs. PRP, particularly at visit 3 (p=0.006).

Conclusion: Compared to standard PRP, PTBM-preconditioned PRP for facial skin rejuvenation results in greater improvements in fine lines, folds, and wrinkles parameters, with sustained effects for more than six months, supporting a PTBM protocol use to enhance the regenerative capacity of PRP in skin rejuvenation.

Karger

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Photothermal Biomodulated Autologous PRP Combined with Laser and LED Phototherapy for Acne Sequela: A Report of Three Illustrative Cases

Yosra Labidi Menif and Laura Cordero

Case Reports in Dermatology. 2026.

Introduction: Acne vulgaris may lead to persistent sequelae, including post-inflammatory erythema, hyperpigmentation, and atrophic scarring. Multimodal regenerative approaches combining autologous biological therapies with light-based devices are increasingly used in clinical practice, although published clinical evidence remains limited.

Case Presentations: We report three female patients with distinct acne-related skin sequelae: (1) postinflammatory erythema with active inflammatory lesions, (2) post-inflammatory hyperpigmentation with residual acne activity, and (3) atrophic acne scarring. Each patient was treated with a tailored multimodal protocol combining photothermal biomodulated autologous platelet-rich plasma (PRP), laser therapy (nonablative or ablative erbium-doped yttrium aluminium garnet), and light-emitting diode (LED) phototherapy. Clinical outcomes were retrospectively assessed using serial clinical photographs obtained during routine follow-up. Where image quality allowed, approximate inflammatory lesion counts and semi-quantitative ordinal estimates of erythema, hyperpigmentation, scar visibility, and texture change were added post hoc. Follow-up ranged from 1 month to 12 months. All three patients showed photographic improvement in inflammatory activity, pigmentation, skin texture, and/or scar appearance at available follow-up time points. Treatments were well tolerated, with only transient local reactions such as redness and swelling.

Conclusions: These case reports illustrate the feasibility and tolerability of combining photothermal biomodulated autologous PRP with laser and LED therapies for different acne sequelae. Because no validated objective scoring system was applied prospectively, the findings should be interpreted as descriptive and hypothesis-generating. These observations support further controlled studies to evaluate standardized protocols and clinical outcomes.

Dovepress

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Microneedling Combined with Photothermal-Biomodulated Autologous PRP to Enhance Exosome Release in Refractory Melasma: A Case Report

Luciana Leite Crivelin and Gabriela Tomasi-Batiston

Clinical, Cosmetic and Investigational Dermatology. 2026.

Melasma is a challenging condition to treat, requiring multiple therapeutic approaches. Exosomes have been used as regenerative therapies in diverse contexts, including dermatological disorders. A 35-year-old male patient with Fitzpatrick skin phototype II and a longstanding diagnosis of facial melasma, who had undergone multiple prior treatments — including topical agents and laser therapy — with little to no improvement was treated with three monthly sessions of robotic microneedling without radiofrequency on the melasma-affected areas, followed by the injection of preconditioned autologous platelet-rich plasma. The preconditioning consisted of photothermal biomodulation using the Meta Cell Technology technique, applying blue light (467 nm), 1 J/cm2, while maintaining the sample at 37°C for 10 minutes. Intradermal injections of 0.25 mL of the autologous product were administered at each demarcated point (1 × 1 cm). After treatment, the patient showed significant improvement in refractory melasma, with lightening of the malar and temporal regions and improved vascularization in the treated areas. This case suggests that intradermal administration of photothermal-biomodulated platelet-rich plasma combined with microneedling may represent a well tolerated therapeutic alternative for selected patients with resistant melasma.

CLINICAL STUDIES

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Initial Experience with Humanized Allogeneic and Autologous Exosome-Based Therapies in Androgenetic Alopecia: A Case Series

Suruchi Garg, Navnee Jain and Carol Lobo

Journal of Stem Cells Research, Development & Therapy. 2025.

In this prospective interventional study, we enrolled 10 cases after obtaining informed consent and a detailed medical history. Clinical photography and trichoscopy were performed at baseline and subsequent follow-ups.

In this study we aimed to study efficacy, safety of three different variants (derivative source) of exosomes, namely Meta Cell Technology (MCT) blood derived exosomes, Exoxe and AdvancExo, along with 3 different methods of administration - Intradermal Injection, Microneedling and Microneedling Radiofrequency (MNRF), for hair growth in Androgenetic alopecia.

Out of 10 cases, 7 cases were thoroughly evaluated clinically and trichoscopically at follow-up along with routine blood reports and detailed dietary history. Two cases (Pt. 7 and 9) were lost to follow up.

Dermatology Online Journal

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Facial Rejuvenation with Autologous Exosomes Using the MCT System

Dèlia Vilà Rodríguez, Laura Cordero, and Hernán Pinto

Dermatology Online Journal. 2025.

Background: Safe, non-invasive, or minimally invasive techniques are available for facial rejuvenation, and recent research on exosomes has revealed promising avenues for new treatment options. The pilot study objective was to assess the efficacy of a facial rejuvenation treatment with autologous exosomes released from preconditioned platelet-rich plasma with the MCT System. Methods: A prospective, single-center, randomized, controlled pilot study was conducted on patients with facial aging signs who received three sessions of autologous exosomes obtained using the MCT System. Results were assessed by measuring the subepidermal low-echogenic band using ultrasonography, taking photographs with a compact stereophotogrammetric 3D imaging system, and obtaining patients' feedback on skin aspect and improvement in appearance.

Results: Eleven patients (100% women) with a mean age of 57 (SD 4.1, range 51-65) were recruited; nine (81.8%) completed the study. Ultrasonographic measurements one month after the last treatment showed a mean percentage reduction in the subepidermal low-echogenic band thickness of 61.4% in the cheekbone and 39.35% in the cheek. Regarding patients' perception, 77.8% reported skin improvement.

Conclusions: Treatment with autologous exosomes obtained using the MCT System was well tolerated and yielded substantial results in facial rejuvenation, reducing the subepidermal low-echogenic band and enhancing patients' perceived skin appearance.

ELSEVIER

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Novel Use of Preconditioned Autologous PRP-Derived Exosomes for Partial Achilles Tendon Rupture Repair: A -Week Recovery Case Report

Alberto Sánchez Herrera

Journal of Orthopaedic Reports. 2025.

Background: Partial Achilles tendon ruptures are uncommon, often misdiagnosed, and lack effective regenerative treatments. Exosomes have emerged as a promising therapy to enhance tendon healing. Case report. A 43-year-old male sustained a 5.5 mm partial Achilles tendon rupture during sports. He received autologous platelet-rich plasma (PRP)-derived exosomes using the MCT System (MCT Kit plus MCT Unit). Fifteen milliliters of whole blood were centrifuged at 4000 rpm for 8 minutes to yield 10 mL PRP, which was placed in the MCT Kit and processed with the MCT Unit using the Exosome preset (1 J/cm^2, 467 nm, 37°C, 10 minutes) to prime platelets and stimulate exosome release. The preconditioned PRP was injected intratendinously under ultrasound guidance at approximately 13 mm in depth and at a 45° angle. Ultrasound at one week showed near-complete tendon recovery. By week two, fibers were fully restored, and by week three, initial tendon fiber alignment was observed. The patient then began a controlled loading program. Treatment was well-tolerated, with no adverse effects.

Conclusions: PRP-derived exosome therapy via the MCT System enabled complete recovery of a partial Achilles tendon rupture within three weeks, offering a safe, effective, and innovative regenerative option with potential to improve tendon injury management.

CLINICAL STUDIES

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Successful Treatment of Vulvar Lichen Sclerosus Using Microfiltered and Preconditioned Suspension of Autologous Adipose-Derived Stem Cells With Photothermal Biomodulation: A Case Report

Paolo Mezzana and Hernán Pinto

Clinical Case Reports. 2025.

Vulvar lichen sclerosus is a chronic, inflammatory, autoimmune mucocutaneous disease characterized by hypopigmentation, skin sclerosis, and atrophy. Injections with microfiltered and preconditioned suspension of autologous adipose–derived stem cells are well tolerated and reduce symptoms and skin sclerosis without side effects or technical complications. Results are valid for 5 months after treatment (follow-up period).

ELSEVIER

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Concomitant Use of Autologous Exosomes and Nd:YAG Laser in Post-Reconstructive Treatment of Bell's Palsy: A Case Report

Jasmina Kozarev

JPRAS Open. 2025.

Background: Bell's palsy is the most common paralysis of the seventh cranial nerve. Recently, regenerative procedures have been proven to improve facial nerve function, reduce neuronal damage, enhance natural healing potential, and improve muscle function. Among these procedures, exosomes can be used as an effective regenerative therapeutic tool. This case presents a 49-year-old woman diagnosed with Bell's palsy grade IV with a ten-year history of left-side facial dysmorphia after facial nerve neuralgia and failed treatments.
Methods: The patient was treated with a combination of injected autologous exosomes released from preconditioned platelet-rich plasma (PRP) with the MCT System and Nd:YAG laser pulses. The treatment included three sessions, three months in between, and a follow-up visit one year after the first treatment (three months after the third treatment).
Results: The patient showed significant facial improvement one year after the first treatment. The paralysis degree, according to the House-Brackmann facial nerve grading scale, varied from stage IV to stage II. Changes observed were an increase in facial muscle strength, an improvement in eye closure, and an increase in smile symmetry.
Conclusions: The protocol applied, combining injected preconditioned autologous platelet-rich plasma and Nd:YAG pulses, was safe and well tolerated, and the results showed significant restoration of facial appearance and resolution of Bell's palsy symptoms.

CLINICAL STUDIES

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Combined Treatment of Noninfected Diabetes-Related Foot Ulcerations with Preconditioned Autologous Platelet-Rich Plasma with the MCT System to Enhance Exosomes Release and Phototherapy: A Case Report

Alexandra Amesty

International Journal of Regenerative Medicine. 2025.

Diabetes-related foot ulceration is a common complication in patients with uncontrolled diabetes mellitus and is associated with high mortality. This case report describes an 83-year-old woman with more than 20 years of type Ib diabetes, hypertension, and five noninfected skin lesions on the lower limbs of a one-year evolution. The patient had failed previous treatments. Our treatment protocol consisted of a topical treatment using preconditioned autologous platelet-rich plasma with photothermal biomodulation using the MCT System, combined with phototherapy. The patient underwent three treatment sessions, one per week and a cleaning session four days after each treatment. The protocol applied was intended to increase the exosome released by platelets. After the three treatment sessions, the ulcers had a favorable evolution, reducing depth, size, and pain and allowing for their manipulation. The treatment had no technical difficulties or adverse effects. The patient regained mobility, which could improve her quality of life. Due to the results obtained, it can be concluded that the combined use of the topical application of preconditioned platelet-rich plasma with photothermal biomodulation using the MCT System and phototherapy could be an innovative regenerative option without immunogenic potential and low risk of complications for treating noninfected diabetes-related foot ulceration.

Mary Ann Liebert, Inc.

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Photothermal Biostimulation of Platelet-Rich Plasma Improves Hand Rejuvenation Clinical Outcome: A Pilot Study

Paloma Tejero García, Sheila Mota Antigua, Marta Ortega Zamorano, Rosa María de Lima Monteiro Saraiva, and Hernán Pinto

Photobiomodulation, Photomedicine, and Laser Surgery. 2024.

Objective: This study aimed to evaluate physical skin changes and patients' subjective perception of treatment with photothermal bioactivated platelet-rich plasma (MCT Plasma) for hand rejuvenation. Background: Age-related changes in the dorsum of the hand include volume loss, dyschromia, and soft-tissue atrophy, which result in wrinkles and prominent deep structures.

Methods: We conducted a prospective, single-center, randomized pilot study on 10 healthy female volunteers from 30 to 65 years with hand aging signs. Patients received two sessions of MCT Plasma on the treated hand and two sessions of standard platelet-rich plasma (PRP) on the control hand. Results were assessed through high-frequency ultrasonography, photographs, a patient satisfaction survey, patient perception of skin aspect, and patient perception of amelioration survey.

Results: Ten women with a mean age of 57.5 years (standard deviation 10.5, range 31- 67) were included, and seven (70%) completed the study. The treated hands' skin subepidermal low-echogenic band (SLEB) decreased from 20% to 60%, and 57.1% (n = 4) had better results than control. Twenty percent of patients were very satisfied with the results, 40% were satisfied, 40% were neutral, and none were unsatisfied or very unsatisfied. Patients perceived the skin of the treated hand (MCT Plasma) as "much better" (20%), "better" (60%), and "no changes" (20%) compared with the skin of the control hand (standard PRP). No treatment-related adverse events were reported during the study.

Conclusions: Hands treated with MCT Plasma tended to have better outcomes in reducing SLEB compared with those treated with standard PRP. Patients were satisfied and the treatment was safe with no technical complications. However, further randomized controlled trials with larger sample sizes are mandatory to validate the extent of improvement provided by this device based on photothermal biomodulation.

medicina

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Adult-Onset Linear Morphea *(en coupe de sabre)* of the Face Successfully Treated with Photoactivated Low-Temperature Platelet-Rich Plasma: A Valid Therapeutic Option

Santo Raffaele Mercuri, Matteo Riccardo Di Nicola, Vittoria Giulia Bianchi, and Giovanni Paolino

Medicina. 2023.

Localized scleroderma (also known as morphea) is a chronic autoimmune disorder characterized by depressed, fibrotic, and dyschromic cutaneous lesions. It has a significant impact on the patient's daily life due to the unaesthetic evolution of the cutaneous lesions. Morphea is clinically divided into linear, circumscribed (plaque), generalized, pansclerotic, and mixed forms. Linear morphea *en coupe de sabre* (LM) usually arises in childhood. However, in about 32% of cases, it may arise in adulthood, showing a more aggressive course with also an increased risk of systemic involvement. Methotrexate is the first-line treatment for LM, although systemic steroids, topical agents (corticosteroids and calcineurin inhibitors), hyaluronic acid injections, and hydroxychloroquine or mycophenolate mofetil are valid therapeutic options. In any case, these treatments are not always effective and sometimes can be associated with important side effects and/or not tolerated by the patients. In this spectrum, platelet-rich plasma (PRP) injection can be considered a valid and safe alternative since PRP injections in the skin induce the release of anti-inflammatory cytokines and growth factors, thus reducing inflammation and increasing collagen remodeling. Herein, we describe a successful treatment of an adult-onset LM en coupe de sabre with photoactivated low-temperature PRP (Meta Cell Technology Plasma) sessions, showing an important local improvement of the lesion and patient satisfaction.

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Efficacy of Photo-Thermal-Bioactivated Platelet Rich Plasma for Skin Biostimulation in Patients not Eligible for Other Medical-Aesthetic Treatment: A Pilot Study

Carlota Hernández Sanz and Hernán Pinto

Skin Research and Technology. 2023.

Purpose: To evaluate the efficacy and safety of photothermal bioactivated platelet-rich plasma for reducing laxity in facial rejuvenation in patients not eligible for other aesthetic treatments due to several comorbidities.

Methods: A prospective, nonrandomized study was conducted. Efficacy was assessed through a satisfaction scale and the Facial Laxity Rating Scale. Safety assessments were based on the data of all adverse events and the visual analog pain scale.

Results: Seven patients with a mean age of 51 (standard deviation [SD] 7.46, range 42-63) were included. In six patients (85.7%), the treatment was applied to the face and neck, and in one patient (14.3%), only to the lower half of the face and neck. The physician's perception of laxity decreased, and the procedure was not complex. Patients' and physician satisfaction increased as the study progressed. Adverse effects were not serious and resolved without sequelae. The patients' pain perceived during the treatment was mild in most cases.

Conclusion: The photothermal bioactivated platelet-rich plasma injections were a safe and effective treatment for facial laxity in patients not eligible for other procedures, providing good satisfaction.

CLINICAL STUDIES

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Efficacy and Safety of Photothermal-Bioactivated Platelet-Rich Plasma for Facial Rejuvenation

Beatriz Beltrán, Manuel Antonio Rubio Sánchez, Graciela Melamed, and Hernán Pinto

Journal of Cosmetic Dermatology. 2022.

It is well known that skin aging results from an intrinsic process involving genetic background and an extrinsic process influenced by environmental factors. Many anti-aging cosmetic products are used to prevent and treat it, while others, which are minimally invasive, safe, and effective, have not been so widespread, perhaps due to their characteristics and application method. One example is the intradermal injections with platelet-rich plasma (PRP), whose results are significant, with high patient satisfaction, and without serious adverse effects. A novelty related to these products is the use of light and temperature to activate PRP and produce photothermal-bioactivated platelet-rich plasma (PTBA-PRP), whose promising preliminary results we want to present in this letter.

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REVIEWS

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Erectile Dysfunction and Peyronie's Disease: From Biologics to Nanomedicine-Enabled Therapies

Aris Kaltsas and Dimitrios Hatzichristou

Sexual Medicine. 2026.

Introduction: Erectile dysfunction and Peyronie's disease are prevalent and frequently coexisting disorders in which guideline-based therapies improve symptoms more reliably than they reverse underlying corporal remodeling or tunical fibrosis. Regenerative biologics and nano-enabled delivery systems aim to intervene upstream in inflammatory and fibrotic pathways by improving local exposure, tissue persistence, and target engagement within the emerging field of regenerative sexual medicine.

Objectives: To synthesize current evidence on regenerative biologics and nano-enabled delivery platforms for erectile dysfunction and Peyronie's disease, with emphasis on disease-specific delivery barriers, payload characterization, and translational readiness.

Methods: This article was designed as a narrative translational review informed by a scoping search of PubMed/MEDLINE, Embase, and Web of Science (January 2000 to March 2025), supplemented by hand-searching of reference lists. Evidence was synthesized qualitatively by disease context (erectile dysfunction vs Peyronie's disease), payload class, delivery constraints, and translational maturity.

Results: For erectile dysfunction, platelet-rich plasma has widespread clinical uptake but remains limited by heterogeneous preparation methods, placebo susceptibility, and rapid corporal washout. Early stem cell studies support feasibility, yet converging mechanistic evidence suggests that paracrine signaling predominates, favoring acellular approaches such as extracellular vesicles (EVs) delivered with hydrogels or engineered nanocarriers. For Peyronie's disease, intralesional collagenase clostridium histolyticum (CCH) remains the current clinical benchmark for plaque-targeted minimally invasive therapy in selected stable disease, whereas platelet-rich plasma and cell/vesicle-based approaches remain investigational. Across Peyronie's disease platforms, dense plaque architecture, restricted diffusion, and calcification constrain intralesional exposure, supporting plaque-confined depots, matrix-interactive materials, and targeted antifibrotic nanomedicines.

Conclusion: Regenerative sexual medicine is evolving from empiric biologic injections toward better-characterized, anatomy-aligned, exposurecontrolled therapeutic platforms, where durable clinical benefit will depend on sustained target engagement within penile tissues. Near-term progress is most likely through phenotype-enriched early-phase trials with rigorous sham-aware design and objective hemodynamic or imaging endpoints, whereas longer-term translation will depend on standardized potency assays, reproducible manufacturing, and durable penile tissue targeting.

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Photothermal Preconditioning of Platelet-Rich Plasma: An Emerging Regenerative Strategy

Elena Sánchez-Vizcaíno Mengual, Laura Cordero and Hernán Pinto

Regenerative Therapy. 2026.

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A Reliability Tier Classification System (RTCS) for Marketed Exosome-Based Products to Facilitate Clinical Decision-Making

Hernán Pinto and Elena Sánchez-Vizcaíno Mengual

Clinical, Cosmetic and Investigational Dermatology. 2026.

Background: Exosomes are nanosized extracellular vesicles involved in intercellular communication. The composition, regulatory status, and scientific support of commercially marketed "exosome-based" products are highly variable, creating challenges for clinicians seeking safe and evidence-informed options in dermatology and aesthetic practice.
Objective: The Reliability Tier Classification System (RTCS) was developed to support clinical decision-making. It was designed as a framework-based tool that categorizes exosome-based products and devices intended to enhance exosome release into four reliability tiers.
Methods: The RTCS comprises two components: (A) Descriptive Product Classification, and (B) Hierarchical Categorization Algorithm. The first component assesses four domains: (1) regulatory authorization status; (2) origin; (3) manufacturing transparency; and (4) peer-reviewed scientific evidence. The second component assigns four reliability tiers (I–IV).
Results: RTCS output standardizes nomenclature for regulatory status (DRUG, MD, COS, NA), origin (AUTO, ALLO, XENO, MIM), and manufacturing reliability (composite transparency score: labeling accuracy, certification disclosure, manufacturing conditions, availability of published clinical evidence, regulatory setbacks, and availability of a detailed exosome production protocol).
Conclusion: This clinician-facing tool provides a structured approach to appraising marketed exosome-based products in a rapidly expanding, variably documented marketplace, not yet clinically validated. It is designed to be updateable as regulatory policies and scientific evidence evolve and may serve as a pillar for future implementation and validation. Keywords: regenerative medicine, exosomes, classification, manufacturing, clinical decision-making.

SKIN HEALTH AND DISEASE

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Photothermal Conditioning of Platelet-Rich Plasma: Mechanisms and Emerging Applications in Hair Regeneration

Ilknur Nihal Ardic and Nurittin Ardic

Skin Health and Disease. 2025.

Photothermal conditioning of platelet-rich plasma (PRP) is an emerging innovation in regenerative medicine, particularly in the field of hair restoration. By using controlled electromagnetic energy, this technique modulates the biological activity of PRP, potentially enhancing the release of growth factor, production of exosomes and communication between cells. This review aims to explore the mechanisms behind photothermal PRP, summarize current preclinical and clinical findings, and evaluate its applications in hair regeneration. A comprehensive literature review was conducted across multiple databases to evaluate mechanistic data, clinical outcomes and technology platforms. Preliminary evidence suggests that photothermal conditioning enhances the bioactivity of PRP, leading to potential increases in hair density and follicular regeneration. Additionally, it may help reduce inflammation and prolong the anagen phase of the hair cycle. However, there is currently a lack of standard protocols, dosage regimens and clear understanding of the mechanisms involved. Despite these limitations, photothermal PRP shows promise as an adjunctive or alternative treatment for androgenic and inflammatory alopecia. Future clinical studies with standardized protocols and larger cohorts are necessary to confirm its efficacy, optimize treatment parameters and ensure long-term safety.

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Human Blood Exosomes: Isolation and Characterization Methods, Variability, and the Need for Standardized Protocols—A Review

Elena Sánchez-Vizcaíno Mengual, Laura Cordero, and Hernán Pinto

Biomedicines. 2025.

Background/Objectives: As bioactive extracellular vesicles, exosomes participate in cellular communication and disease mechanisms, yet their structural complexity continues to challenge standard analytical methodologies. This review summarizes published studies reporting exosome concentrations in human plasma, serum, and platelet-rich plasma from healthy individuals and highlights methodological differences.

Methods: A comprehensive PubMed search (1986–31 August 2025) was performed using terms related to exosomes and their quantification, excluding cancer- and disease-related studies. Eligible articles reported exosome concentrations in plasma, serum, or platelet-rich plasma using particle-counting techniques such as nanoparticle tracking analysis, flow cytometry, or tunable resistive pulse sensing.

Results: Twenty-two articles, including 167 healthy donors, met the inclusion criteria. The following mean concentration ranges were reported: plasma (n = 18), ranged from 4.50×10^{8} to 6.70×10^{11} particles/mL with differences by quantification method; serum (n = 10), from 5.30×10^{8} to 2.13×10^{11} particles/mL; non-activated platelet-rich plasma (n = 1), 7.52×10^{9} particles/mL; activated platelet-rich plasma (n = 3), 4.87×10^{10} to 7.16×10^{10} particles/mL; and preconditioned platelet-rich plasma with photothermal biomodulation (n = 2), 2.53×10^{11} to 2.99×10^{11} particles/mL.

Conclusions: Isolation and quantification methods exhibit high variability, which strongly influences the overall quantity and quality of the exosomes obtained. Characteristics, including cargo composition, purity, and exosome integrity, must be considered when developing validated methods. Furthermore, emerging evidence suggests that PTBM preconditioning can increase exosome release from cells. In summary, rigorous standardization of protocols is essential to advance the scientific understanding and the clinical potential of exosome-based therapies.

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How to Choose an Exosome-Based Product? Four Areas That The Aesthetic Doctor Must Analyse Before Deciding Which Product to Use in His Practice

Hernán Pinto

SEME. 2025.

The topic of exosomes has been deliberately brought into the arena of disqualification or invention, rather than into that of evidence. Therefore, the aim of this manuscript is not to give opinions but to review facts. To address these issues, we will divide this brief into four subsections: a) compliance with law and regulation, b) safety, c) effectiveness, and d) marketing claims. Likewise, there are four issues that you should never lose sight of when evaluating an exosome-based product: i) autologous exosomes and non-autologous exosomes have nothing to do with each other, ii) products can be injectable or topical, iii) products can be legal or not, iv) products can be evidence-based or marketing-based.

REVIEWS

aesthetic medicine

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Nuts and Bolts of Exosomes in Aesthetic Medicine

Hernán Pinto

Aesthetic Medicine. 2024.

Over the past decade, the body of knowledge about the behavior and properties of exosomes has grown exponentially, resulting in an overwhelming number of published scientific articles. Exosomes are constitutively synthesized and released by many human cells, plants, animal cells, and even bacteria. Exosomes can be derived from the patient's tissues (autologous exosomes), from other human tissues (allogenic exosomes), and plants, animals, or bacteria (xenogenic exosomes). Exosomes offer innovative treatment options in medical aesthetics, such as repairing, regenerating, and rejuvenating skin tissue, preventing and reducing scarring, regulating pigmentation, promoting hair growth, and increasing the survival of fat grafts in aesthetic treatments. However, the significant cost of production is a clear indication of the industry's first steps in its development. Furthermore, performing these therapies in a private medical office is expensive, and the technical requirements need an in-depth analysis. The key points identified as corrupting, misleading, or confusing concepts (source, cargo, process of origin, and quantity) should be clarified. For all the above, more clinical trials need to be conducted for regulatory approval because, to our knowledge, no exosome-based products or therapies have been approved by any regulatory agency. Nonetheless, exosome treatments undoubtedly represent a breakthrough for aesthetic regenerative medicine.

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Exosomes in the Real World of Medical Aesthetics: A Review

Hernán Pinto, and Elena Sánchez-Vizcaíno Mengual

Aesthetic Plastic Surgery. 2024.

Background: Exosomes are cell-derived nanovesicles that transport proteins, nucleic acids, and lipids and play a significant role in almost every physiological process in the human body. They have generated great interest, especially in the field of tissue regeneration. Studies in the last decade support their great regenerating and rejuvenating potential. However, the lack of standardized procedures, limited knowledge regarding their action mechanism, and little clinical evidence impair their implementation and approval in the medical setting. This review aimed to identify published studies and clinical trials using exosomes in human patients for clinical treatments in aesthetic medicine.

Materials and Methods: A systematic search was conducted in the PubMed database using the search term "exosomes" and 25 terms related to aesthetic medicine treatments in human patients. Additionally, a search was conducted in the ClinicalTrials.gov database for interventional clinical trials using exosomes for aesthetic treatments in adults 18 to ≥ 65 years of age.

Results: Nine articles were selected after debugging the initial list of published articles in which exosomes were related to Aesthetic Medicine (633 articles). Nine studies were identified from the initial search on ClinicalTrial.gov (104 trials with exosomes).

Conclusions: There is no doubt about the scientific basis of exosome regenerative potential and the growing interest in exosomes in Aesthetic Medicine. However, companies must spend more on research to develop standardized and reliable procedures to obtain exosomes for their approval and application in clinical practice.

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Role of Opsins and Light or Heat Activated Transient Receptor Potential Ion Channels in the Mechanisms of Photobiomodulation and Infrared Therapy

Sulbha K. Sharma, Sakshi Sardana, and Michael R. Hamblin

Journal of Photochemistry and Photobiology. 2023.

Photobiomodulation (otherwise known as low level light therapy) is an emerging approach for treating many diseases and conditions such as pain, inflammation, wound healing, brain disorders, hair regrowth etc. The light used in this therapy generally lies in the red and near-infrared spectral regions. Despite many positive studies for treating different conditions, this therapy still faces some skepticism, which has prevented its widespread adoption in clinics. The main reasons behind this skepticism are the lack of comprehensive information about the molecular, cellular, and tissular mechanisms of action, which underpin the positive effects of photobiomodulation. Moreover, there is also another therapeutic application using longer wavelength infrared radiation, involving either infrared saunas or heat lamps which are powered by electricity, as well as infrared emitting textiles and garments which are solely powered by the wearer's own body heat. In recent years, much knowledge has been gained about the mechanism of action underlying these treatments, which will be summarized in this review. There are three broad classes of primary chromophores, which have so far been identified. One is mitochondrial cytochromes (including cytochrome c oxidase), another is opsins and light or heatsensitive calcium ion channels, and a third is nanostructured water clusters. Light sensitive ion channels are activated by the absorption of light by the chromophore proteins, opsin-3 and opsin-4, while mitochondrial chromophores are activated by red or near-infra red (NIR) light up to about 850 nm. However, NIR light at 980 nm or longer wavelengths can activate transient receptor potential (TRP) ion channels, probably after being absorbed by nanostructured water clusters. Heat-activated TRP channels undergo a conformational change triggered by only small temperature changes. Here we will discuss the role of opsins and light or heat activated TRP channels in the mechanism of photobiomodulation and infrared therapy.

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The Novel Mechanisms and Applications of Exosomes in Dermatology and Cutaneous Medical Aesthetics

Mingchen Xiong, Qi Zhang, Weijie Hu, Chongru Zhao, Wenchang Lv, Yi Yi, Yichen Wang, Hongbo Tang, Min Wu, and Yiping Wu

Pharmacological Research. 2021.

Exposure to the external environment may lead to instability and dysfunction of the skin, resulting in refractory wound, skin aging, pigmented dermatosis, hair loss, some immune-mediated dermatoses, and connective tissue diseases. Nowadays, many skin treatments have not achieved a commendable balance between medical recovery and cosmetic needs. Exosomes are cell-derived nanoscale vesicles carrying various biomolecules, including proteins, nucleic acids, and lipids, with the capability to communicate with adjacent or distant cells. Recent studies have demonstrated that endogenic multiple kinds of exosomes are crucial orchestrators in shaping physiological and pathological development of the skin. Besides, exogenous exosomes, such as stem cell exosomes, can serve as novel treatment options to repair, regenerate, and rejuvenate skin tissue. Herein, we review new insights into the role of endogenic and exogenous exosomes in the skin microenvironment and recent advances in applications of exosomes related to dermatology and cutaneous medical aesthetics. The deep understanding of the mechanisms by which exosomes perform biological functions in skin is of great potential to establish attractive therapeutic methods for the skin.

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Platelet-Rich Plasma-Derived Extracellular Vesicles: A Superior Alternative in Regenerative Medicine?

Jiuping Wu, Yingxin Piao, Qinyi Liu, and Xiaoyu Yang

Cell Proliferation. 2021.

Platelet-rich plasma (PRP), due to its promising therapeutic properties, has been used in regenerative medicine for more than 30 years and numerous encouraging outcomes have been obtained. Currently, by benefiting from new insights into PRP mechanisms and the excellent performance of extracellular vesicles (EVs) in the field of tissue repair and regeneration, studies have found that a large number of EVs released from activated platelets also participate in the regulation of tissue repair. A growing number of preclinical studies are exploring the functions of PRP-derived EVs (PRP-EVs), especially in tissue regeneration. Here, we summarize the latest progress in PRP-EVs as a superior alternative cell-free therapeutic strategy in regenerative medicine, clarify their underlying molecular mechanisms, and discuss the advantages and limitations of the upcoming clinical applications. This review highlights the potential of PRP-EVs to replace the application of PRP or even become a superior alternative in regenerative medicine.

aesthetic medicine

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Effect of Photobiomodulation on Platelet-Rich Plasma: Review Series on New Tools in Regenerative Medicine

Hernán Pinto and Elena Sánchez-Vizcaíno Mengual

Aesthetic Medicine. 2021.

Objective: platelet-rich plasma is one of the blood-derived autologous biological products, that has now become a therapeutic tool. Though its properties have not been fully elucidated yet, the ease of its sample obtention, product processing, and patient application, along with the good results obtained, has extended its application to many medical specialties such as orthopedics, sports, and aesthetic medicine, or gynecology. Lately, photobiomodulation has been presented as an effective PRP activator, resembling what occurs on mesenchymal cells that have been widely studied. This article aims to give a modern view on PRP and its activation through photobiomodulation.

Methods: A review series was carried out in PubMed, Cochrane, and Scopus to find articles about studies done on humans on PRP and photobiomodulation.

Results: a total of five studies with small samples were found. In all of them, the activation with photobiomodulation had positive results.

Conclusion: photobiomodulation showed great potential for PRP activation. However, more studies must be carried out to establish the appropriate protocols with which all potential clinical benefits can be obtained.

REVIEWS

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The Effect of Photobiomodulation on Human Mesenchymal Cells: A Literature Review

Hernán Pinto, Paloma Goñi Oliver, and Elena Sánchez-Vizcaíno Mengual

Cell Proliferation. 2021.

Background: Mesenchymal stem cell-based therapy is known to have the potential to induce angiogenesis. However, there are still some limitations regarding their clinical application. Photomodulation/photobiomodulation is non-invasive and non-toxic phototherapy able to stimulate cell viability, proliferation, differentiation, and migration, when the right irradiation parameters are applied. A review of the published articles on human conditioned-by-photobiomodulation mesenchymal cells in an in vitro set up was carried out. Our aim was to describe the studies' results and identify any possible tendency that might highlight the most suitable procedures.

Methods: A search in English of the PubMed database was carried out with the search criteria: photobiomodulation or photoactivation or photomodulation, and mesenchymal cells. All irradiations applied in vitro, on human mesenchymal cells, with wavelengths ranged from 600 to 1000 nm.

Results: The search yielded 42 original articles and five reviews. Finally, 37 articles were selected with a total of 43 procedures. Three procedures (7.0%) from 620 to 625 nm; 26 procedures (60.5%) from 625 to 740 nm; 13 procedures (30.2%) from 740 to 1000 nm; and one procedure (2.3%) with combinations of wavelengths. Of the 43 procedures, 14 assessed cell viability (n = 14/43, 32.6%); 34 cell proliferation (n = 34/43, 79.1%); 19 cell differentiation (n = 19/43, 44.2%); and three cell migration (n = 3/43, 7.0%).

Conclusions: Photobiomodulation is a promising technology that can impact on cell viability, differentiation, proliferation, or migration, leading to enhance its regenerative capacity.

Science

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The Biology, Function, and Biomedical Applications of Exosomes

Raghu Kalluri and Valerie S. LeBleu

Science. 2020.

The study of extracellular vesicles (EVs) has the potential to identify unknown cellular and molecular mechanisms in intercellular communication and in organ homeostasis and disease. Exosomes, with an average diameter of ~100 nanometers, are a subset of EVs. The biogenesis of exosomes involves their origin in endosomes, and subsequent interactions with other intracellular vesicles and organelles generate the final content of the exosomes. Their diverse constituents include nucleic acids, proteins, lipids, amino acids, and metabolites, which can reflect their cell of origin. In various diseases, exosomes offer a window into altered cellular or tissue states, and their detection in biological fluids potentially offers a multicomponent diagnostic readout. The efficient exchange of cellular components through exosomes can inform their applied use in designing exosome-based therapeutics.

PENDING PUBLICATIONS

04

- Patient-Reported Recovery After Fractional Radiofrequency Microneedling with Autologous Photothermal Biomodulated PRP Versus Standard Topical Care: A Prospective Sequential Intra-Patient Pilot Study. Orsini, O.

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