Received: 28 November 2023 | Revised: 18 February 2024 | Accepted: 21 February 2024

DOI: 10.1111/jocd.16261

JCD Journal of Cosmetic Dermatology WILEY

LETTER TO THE EDITOR

Hair repigmentation of poliosis circumscripta in androgenetic alopecia patient treated with exosomes and fractional picosecond laser

To the Editor,

Exosomes, extracellular vesicles, have been shown to play a central role in hair morphogenesis and regeneration,[1] with the potential for use in the treatment of alopecia and other trichologic conditions.[2] The preclinical[3] and clinical evidence support their effectiveness in combination with microneedle therapy.[4] Moreover, exosomes have demonstrated a crucial role in regulating pigmentation, especially in the interplay between keratinocytes and melanocytes within the epidermal melanin unit.[5] Positioned prominently in this unit, keratinocytes secrete exosomes containing soluble factors and microRNAs (miRNAs), influencing pigmentation modulation and skin homeostasis.[6] However, the role of exosomes in hair repigmentation, especially in conditions such as poliosis, remains understudied. Therefore, this research investigates the case of a 38-year-old male with androgenetic alopecia (AGA) and poliosis circumscripta—a localized patch of white hair. The study explores the efficacy of exosomes in combination with fractional picosecond laser (FPL) treatment, focusing on addressing both AGA and promoting repigmentation in white hair patches.

A 38-year-old man with no significant past medical history presented with AGA for 10 years with no underlying diseases and was not currently taking any medication. Additionally, he observed a white patch of hair for 12 years on the right parietal scalp area, which remained in the same shape throughout this period. The dermatologic examination revealed a lock of white hair (poliosis circumscripta) arising from a pigmented cutaneous lesion on the right parietal scalp (Figure 1). The patient was treated for AGA including white hair patch area on the scalp addressed using the novel technique published by Lueangarun and Tempark[7] as using the fractional Nd:YAG 1064-nm picosecond laser with a fractional lens array and a spot size of 8 mm (DiscoveryPICO®; QuantaSystem, S.p.A., Samarate, VA, Italy). The fluence was set at 0.06–0.1 J/cm^2 (resulting in minimal scalp reaction, no hair shaft breakage, and an acceptable pain score), with a frequency of 10 Hz for 3–4 passes. The optimal clinical endpoint was very mild erythema with minimal acceptable pinpoint bleeding. Subsequently, 5 mL of exosomes (ASCE + HRLV-S; ExoCoBio Inc., Seoul, Korea), containing 20 mg of lyophilized Rose Stem Cell Exosomes (RSCEs) with 10 billion exosome particles, was applied to the entire hair thinning area and white hair patch area every 4 weeks for four sessions without any additional treatment. The trichoscopic examination had been evaluated at the frontal and mid-scalp area with the nevus as the point of reference and also at the white patch.

At 4 weeks from the last treatment, the patient showed clinical improvement in hair regrowth. Interestingly, repigmentation of gray hair and poliosis circumscripta, a localized patch of white hair, was observed after four sessions of treatments (Figure 1, Appendix S1) We evaluated the repigmentation of poliosis using both clinical and dermoscopic evaluation. For the dermoscopic evaluation, we employed the method described by Bae et al.,[8] showing a hair shaft with proximal black coloring was observed, whereas the distal part remained white (Figure 2).

This report demonstrates the efficacy of hair loss treatment, and interestingly, it also showcases the repigmentation of localized white hair patches (poliosis) (Appendix S2) following exosomes and FPL treatment. To the best of our knowledge, no previous studies have linked hair depigmentation with exosomes treatment for AGA and poliosis.[9] Poliosis, characterized by patches of white hair, can arise from various factors including inherited defects, autoimmune damage, or follicular harm.[10] Repigmentation, often seen in conditions like alopecia areata (AA) and vitiligo, is facilitated by anti-inflammatory effects and changes in melanocyte stem cells.[8,11] Treatments for poliosis associated with inflammation aim to reduce autoimmune responses, with interleukin-1-beta and related peptides playing significant roles.[11] Radiation therapy and UV light can induce repigmentation, while drugs like Dupilumab stimulate hair regrowth without disrupting melanogenesis.[12] Melanocyte stem cell activation may contribute to repigmentation, supported by successful cases involving epithelial grafting or follicular unit extraction.[8] Hair transplantation has also proven effective in correcting pubic vitiligo.[13] These approaches involve stimulating melanocyte migration to supply hair bulbs with mature melanocytes, highlighting potential mechanisms for repigmentation in poliosis cases.[13,14]

In this case, we use the novel technique of fractional picosecond laser (FPL)[7] to treat hair disorder with the non-thermal

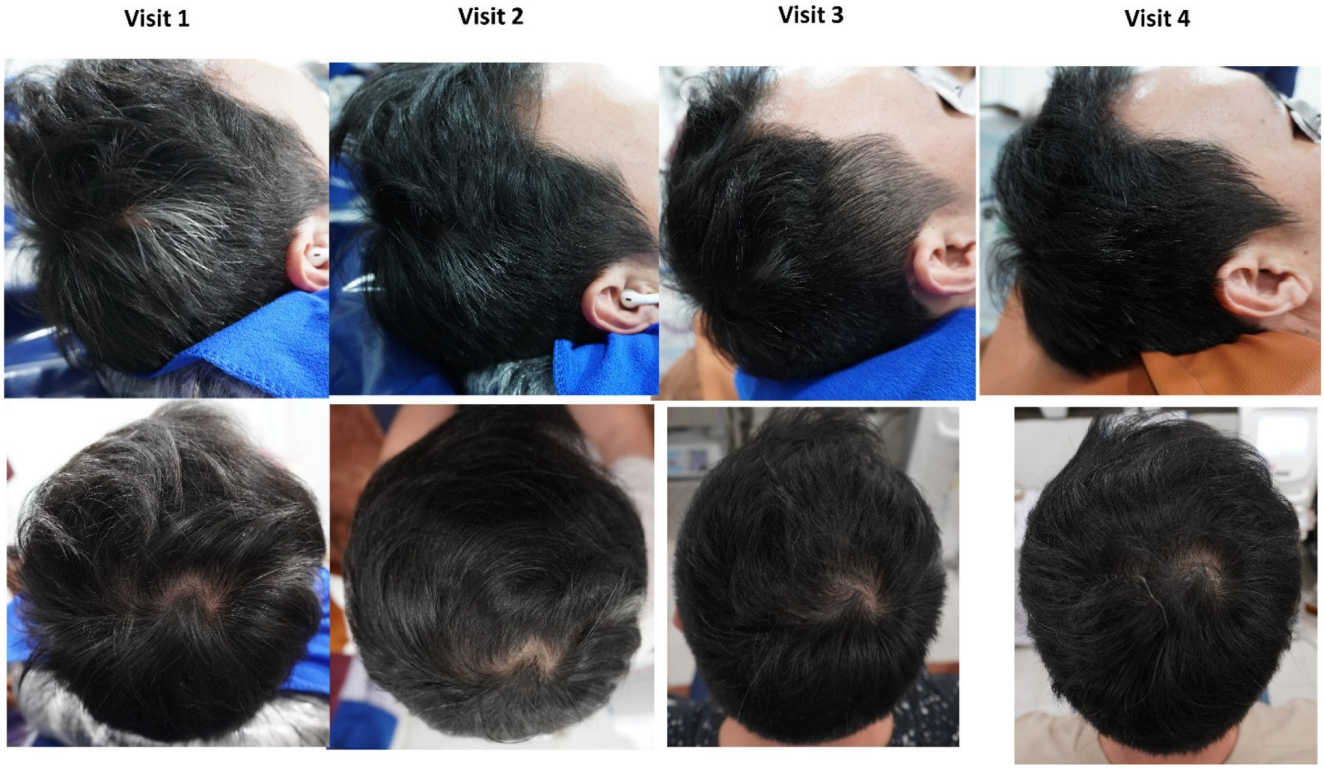

FIGURE 1 Photographs of the right parietal scalp area with a patch of white hair (poliosis). The upper row represents the right lateral view, whereas the lower row represents the vertex view from visit 1 (before treatment), visit 2 (1 month after the first treatment), visit 3 (1 month after the second treatment), and visit 4 (1 month after the third treatment), showing improvements in hair regrowth and hair repigmentation.

technology using laser-induced optical breakdown (LIOB) to promote hair growth by creating petechiae, aiding wound healing, releasing growth factors, and enhancing Wnt/β-catenin signaling.[15] In this study, we isolated Exosome-like Particles from Rose stem cell culture supernatant (RSCEs) using advanced techniques. RSCEs, ranging from 90 to 200 nm, were rich in peptides and microRNAs. They showed noteworthy effects like promoting dermal fibroblast growth, aiding wound healing, reducing melanin in melanocytes, and acting as anti-inflammatory agents. These findings highlight the potential of RSCEs in skin regeneration, pigmentation disorders, and inflammation treatment.[16]

Exosomes have been identified in literature reviews as having a diverse and significant impact on hair repigmentation and overall hair health. First, they exhibit an anti-inflammatory effect,[17] reducing hair loss and inflammation, particularly in conditions like alopecia areata (AA). Mesenchymal stem cell-derived exosomes from adipose tissue notably decrease pro-inflammatory cytokines while increasing anti-inflammatory ones in various inflammatory disease models.[16,18] Second, these exosomes show antioxidative stress properties, which are beneficial in conditions like vitiligo, helping to regulate the body's defense system[19] and mitigate oxidative stress-induced skin damage.[20] Third, exosomes are crucial in regulating pigmentation processes. They influence melanogenesis by affecting signaling pathways, melanocyte proliferation, and tyrosinase activity, an enzyme vital for melanin production.[19,21] This suggests that they could modulate skin and hair pigmentation by acting on melanocyte precursors in the hair follicle.[22] Last, exosomes promote the hair growth cycle. They carry Wnt proteins, which activate the β-catenin pathway, essential for hair morphogenesis and regeneration.[23,24] Additionally, RSCEs contain specific miRNAs (such as miR-8485, miR-574-5p, and miR-1246) that regulate cell proliferation and the Wnt signaling pathway, crucial for hair growth but not affecting cancer cells.[25–28]

Hair repigmentation has been linked to various medications, including monoclonal antibodies (e.g., anti-PD-1/PD-L1, Dupilumab, Adalimumab), tyrosine kinase inhibitors (e.g., imatinib, nilotinib), and immunomodulatory drugs (e.g., lenalidomide, thalidomide). Other treatments like cyclosporine A, high-dose thyroxine, and latanoprost are also associated with this effect. The exact mechanisms are not fully understood but involve inflammatory and immune-modulating pathways.[29,30] For micro-injury techniques, like Mohs surgery,[31] can promote hair repigmentation by activating Melanocyte Stem Cells in hair follicles.[32] This process is driven by the Wnt/β-Catenin pathway, crucial for repigmentation in conditions like vitiligo,[33] and EDN3/EDNRB signaling,[34] as seen in procedures like epilation. These findings suggest that these pathways play a significant role in hair repigmentation following microinjuries, offering potential treatment options. Hence, the repigmentation could not be conclusively attributed solely to the exosomes, due to the concurrent treatment with FPL.

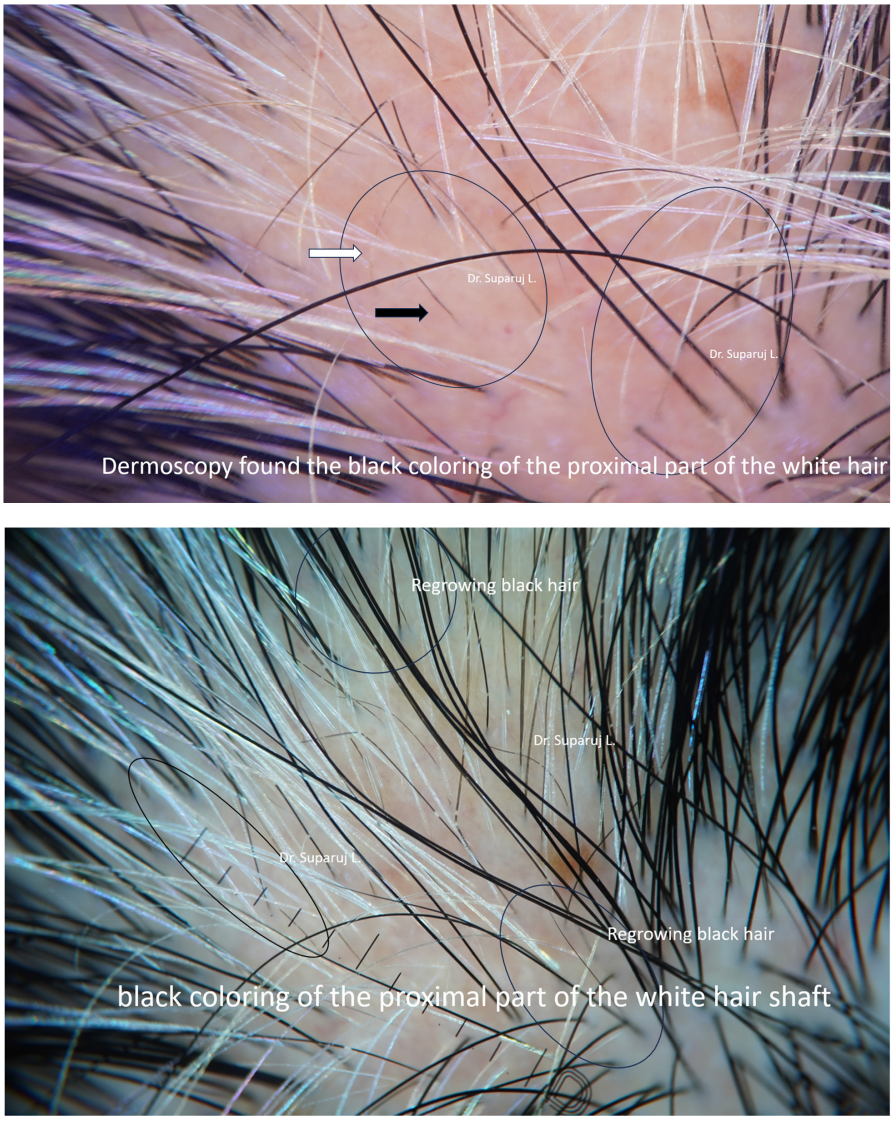

FIGURE 2 Dermoscopic evaluation of the poliosis lesion (with the nevus as the landmark) showed repigmentation of poliosis. A hair shaft with proximal black coloring was observed, whereas the distal part remained white. Repigmentation of poliosis. Dermoscopy found the black coloring of the proximal part of the white hair shaft (black arrow).

The study's limitations include its basis on a single case report of a new topical exosome product and the concurrent use of FPL therapy, limiting the generalizability of the results. The observed hair regrowth and repigmentation, while promising, require cautious interpretation due to the small sample size and potential laser therapy effects. More extensive, controlled research is needed for definitive conclusions. Further studies are also suggested to understand the treatment's efficacy and safety, its broader application, and the role of exosomes in treating pigmentary conditions.

This report highlights the successful hair regrowth and repigmentation in a patient with AGA and poliosis circumscripta through FPL and exosome treatments. The combination of these treatments effectively addressed both hair loss and localized white hair patches, offering a novel approach. The study proposes several mechanisms by which exosomes may contribute to hair repigmentation, including anti-inflammatory effects, antioxidative stress properties, pigmentation regulation, and promotion of the hair growth cycle. Despite the promising results, the research acknowledges the need for further studies to fully understand the role of exosomes in hypopigmentary conditions and advance future treatments.

CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

PATIENT CONSENT

The patient signed the informed consent form after understanding the nature of the trial.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.