PP-05

광노화 피부에서 혈장 유래 엑소좀의 주름 개선 효과

Anti-wrinkle Effects of Plasma-Derived Exosomes in Photoaged Skin

1 서울대학교병원 성형외과
2 서울대학교 의과대학 성형외과학교실
3 아이디병원 재생의학 연구소

김소연[1], 이동건[2], 양희웅[1,2], 박상훈[3], 홍기용[1,2], 장학*[1,2]

Purpose

Ultraviolet (UV) radiation induces skin photoaging through extracellular matrix (ECM) degradation and chronic inflammation. Plasma-derived exosomes (PDEs) have emerged as a promising regenerative therapy. This study aimed to evaluate the anti-photoaging effects of PDEs and to compare the efficacy of different delivery routes.

Methods

Dose-dependent effects of PDEs were first assessed in UVB-irradiated human dermal fibroblasts (HDFs) by measuring proliferation, elastin production, and MMP expression to define effective concentrations. In a SKH-1 hairless mouse model of photoaging, low (1×10^{10} particles) and high (1×10^{11} particles) doses were administered weekly via topical application (TA), microneedle therapy system (MTS), or subcutaneous injection (SI). Wrinkle area, epidermal thickness, extracellular matrix (ECM)-related genes (Eln, Col3a1, Fn1), and inflammatory markers (Tnf, Ifng, Il10) were analyzed.

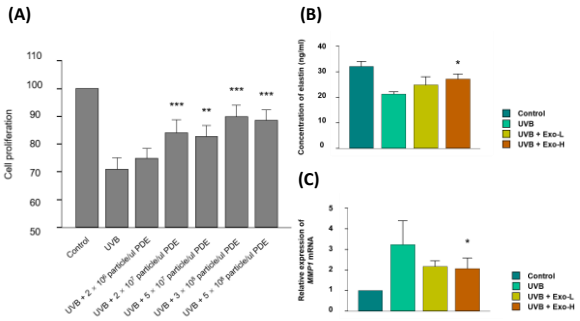

Fig. 1. Effects of plasma-derived exosomes (PDEs) on UVB-irradiated human dermal fibroblasts.
(A) Cell proliferation was significantly restored by PDE treatment in a dose-dependent manner.
(B) Elastin production was increased following PDE treatment compared with the UVB group.
(C) Expression of matrix metalloproteinases (MMP1, MMP7, and MMP12) was suppressed after PDE treatment.
These findings indicate that PDEs improve fibroblast function and preserve extracellular matrix integrity under UV-induced stress.

Results

In vitro, PDEs significantly enhanced HDF proliferation and elastin levels while suppressing MMP1, MMP7, and MMP12. In vivo, TA achieved the greatest reduction in wrinkle area compared with MTS and SI. Both Exo-L and Exo-H significantly decreased epidermal thickness and restored ECM gene expression. Tnf and Ifng were downregulated, whereas Il10 was upregulated. No significant difference was observed between low and high doses.

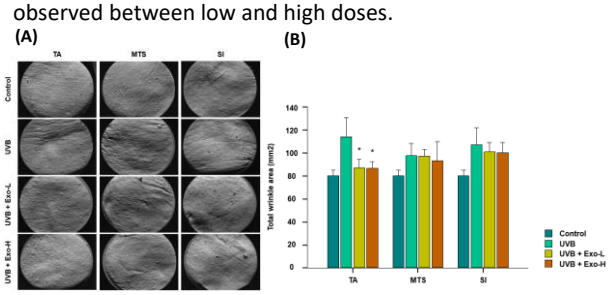

Fig. 2. Effects of PDEs on wrinkle formation in a UVB-induced photoaging mouse model.
(A) Representative images of dorsal skin showing reduced wrinkle formation in PDE-treated groups.
(B) Quantitative analysis demonstrated a significant reduction in wrinkle area, particularly in the topical application (TA) group.
These results suggest that topical delivery provides superior anti-photoaging efficacy compared with invasive methods.

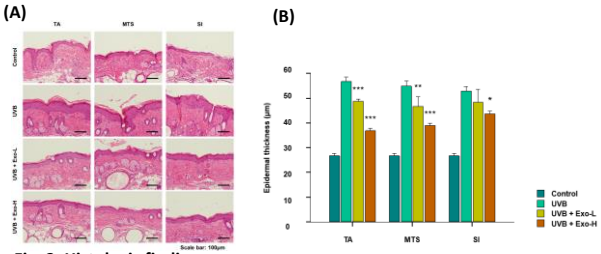

Fig. 3. Histologic findings.
(A) H&E staining showing epidermal thickening after UVB irradiation.
(B) PDE treatment reduced epidermal thickness compared with the UVB group.

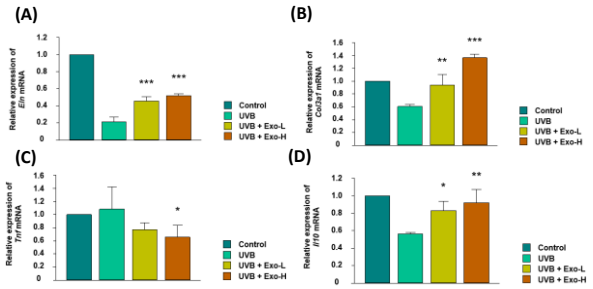

Fig. 4. Effects of PDEs on extracellular matrix and inflammatory gene expression.
(A) Expression of ECM-related genes (Eln, Col3a1, Fn1) was significantly increased after PDE treatment.
(B) Pro-inflammatory cytokines (Tnf, Ifng) were downregulated in treated groups.
(C) Anti-inflammatory cytokine Il10 expression was increased following PDE treatment.
These results demonstrate that PDEs promote skin repair through both ECM regeneration and modulation of inflammatory responses.

Conclusion

PDEs improve photoaged skin by promoting ECM regeneration and modulating inflammation. Among delivery methods, topical application demonstrated superior efficacy, suggesting that non-invasive delivery is an optimal strategy for clinical exosome-based therapy.