Toward Fully Autologous Tissue Engineering: Human Plasma as a Functional Scaffold in the PLATE Method

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Aims

- Replace collagen scaffolds with human plasma in the Perioperative Layered Autologous Tissue Expansion (PLATE) method
- Develop a fully autologous, xeno-free tissue construct
- Leverage plasma's growth factors to improve biological activity
- Enhance the structural and regenerative potential of PLATE constructs

Material and methodology

Human foreskin micrografts were embedded in three hydrogels: collagen only, plasma collagen hybrid, and plasma only, and cultured in vitro for up to four weeks. Histology, SEM, and immunostaining were used to evaluate cell proliferation, migration, and differentiation. This study was approved by the Capital Regional Ethical Committee (VEK) (No. H-20084445).

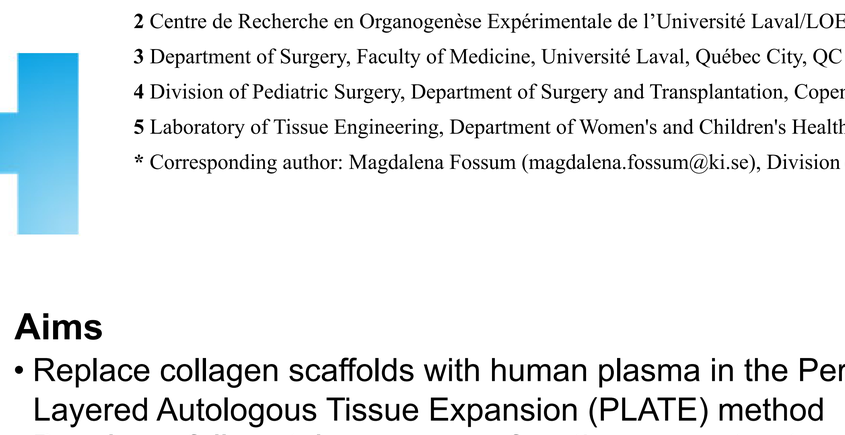


Fig. 2. Photomicrographs of human foreskin stained with hematoxylin and eosin after 4 weeks culture. A: Control; B: Collagen; C: Collagen+Plasma; D: Plasma. Scale bar: 250 µm.

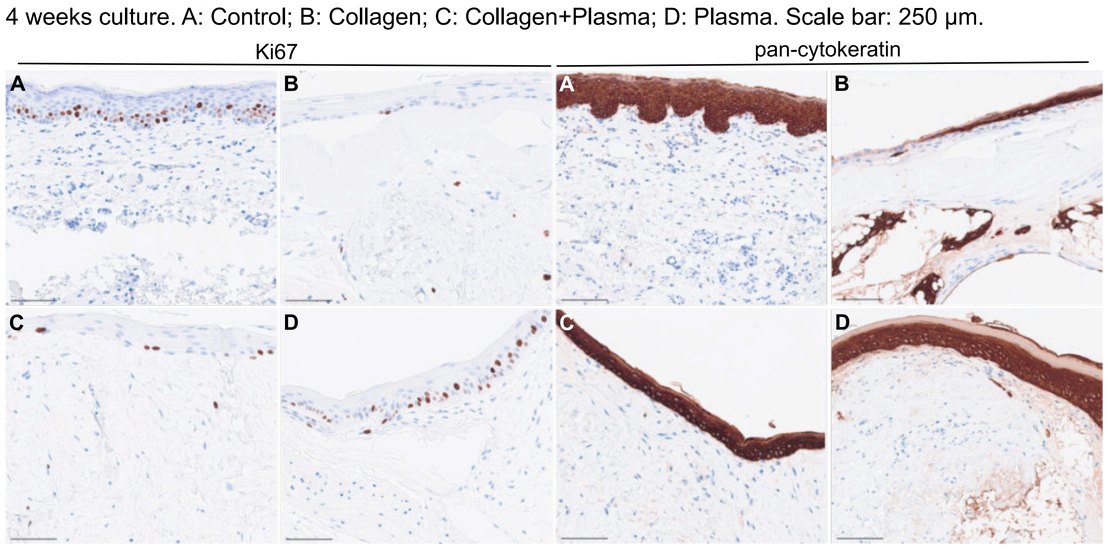


Fig. 3. Photomicrographs of human foreskin stained with Ki67 and Pan-cytokeratin after 4 weeks culture. A: Control; B: Collagen; C: Collagen+Plasma; D: Plasma. Scale bar: 250 µm.

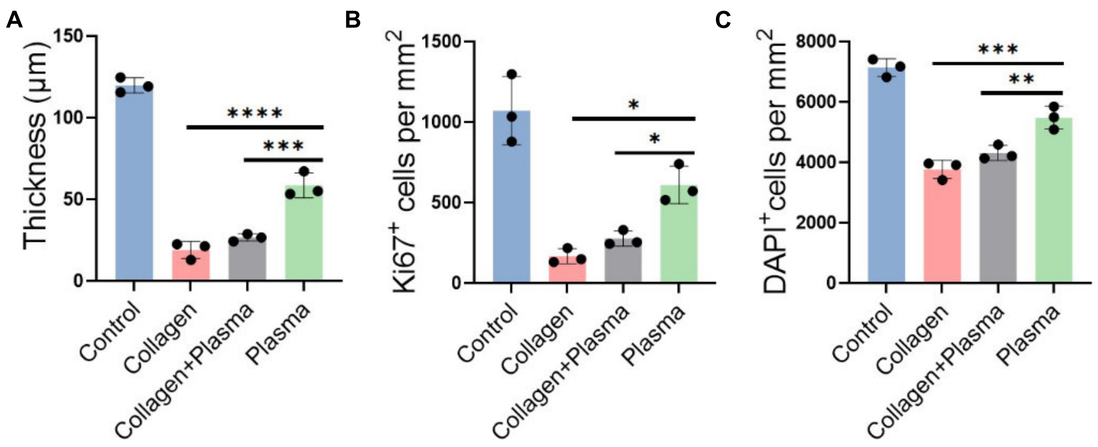


Fig. 5. Sectional comparisons of DAPI (A) and Ki67⁺ positive cells per mm² in epithelium (A) between groups. C: Sectional comparisons of epithelial layer between groups. Values are given as the mean ± SD.

Conclusion

Autologous human plasma provides a bioactive, xeno-free scaffold that could replace collagen in the PLATE methodology. By taking advantage of the growth promoting factors in plasma, this approach may improve biological outcomes and support rapid, intraoperative tissue generation with strong translational potential for reconstructive surgery.

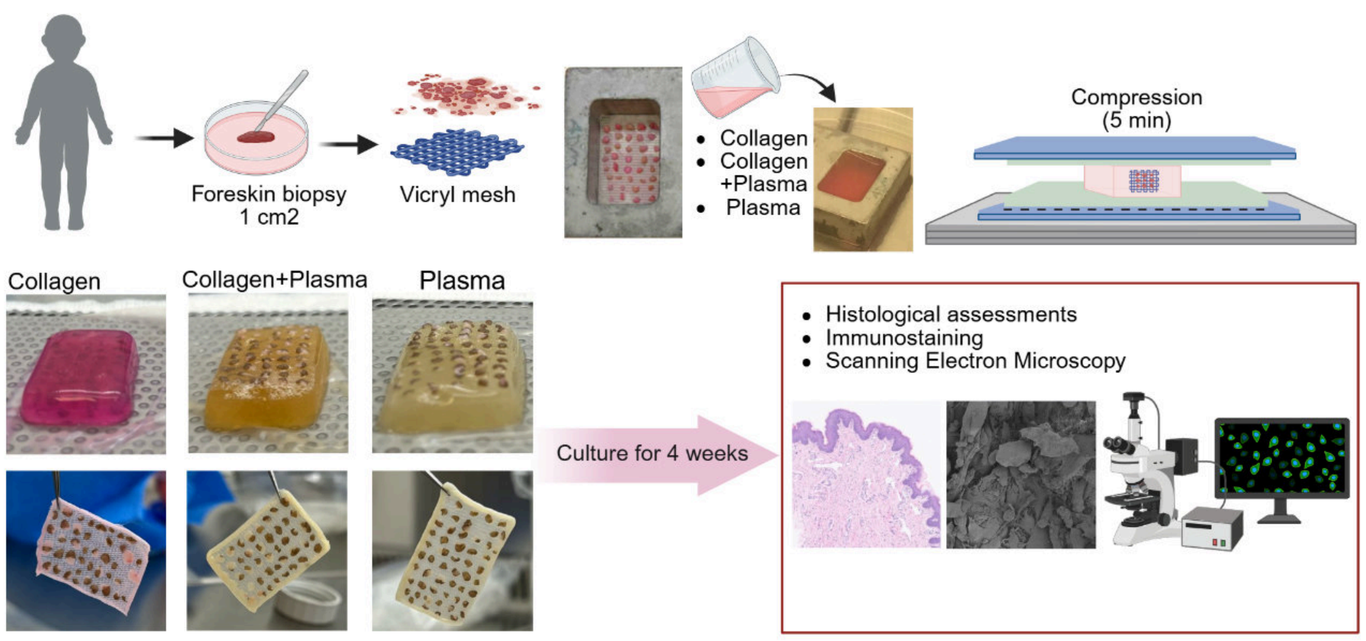


Fig. 1. Schematic illustration of the experimental (Presented in Annual day of the Cell Therapy Network 2025).

Results

Plasma-only constructs demonstrated markedly enhanced cell proliferation and migration, early signs of epithelial differentiation, and higher epithelial layer thickness compared to collagen-based controls. The plasma-collagen hybrid exhibited intermediate results. Scanning electron microscopy revealed improved matrix integration and early tissue stratification in plasma-based constructs, consistent with enhanced biological activity of the autologous

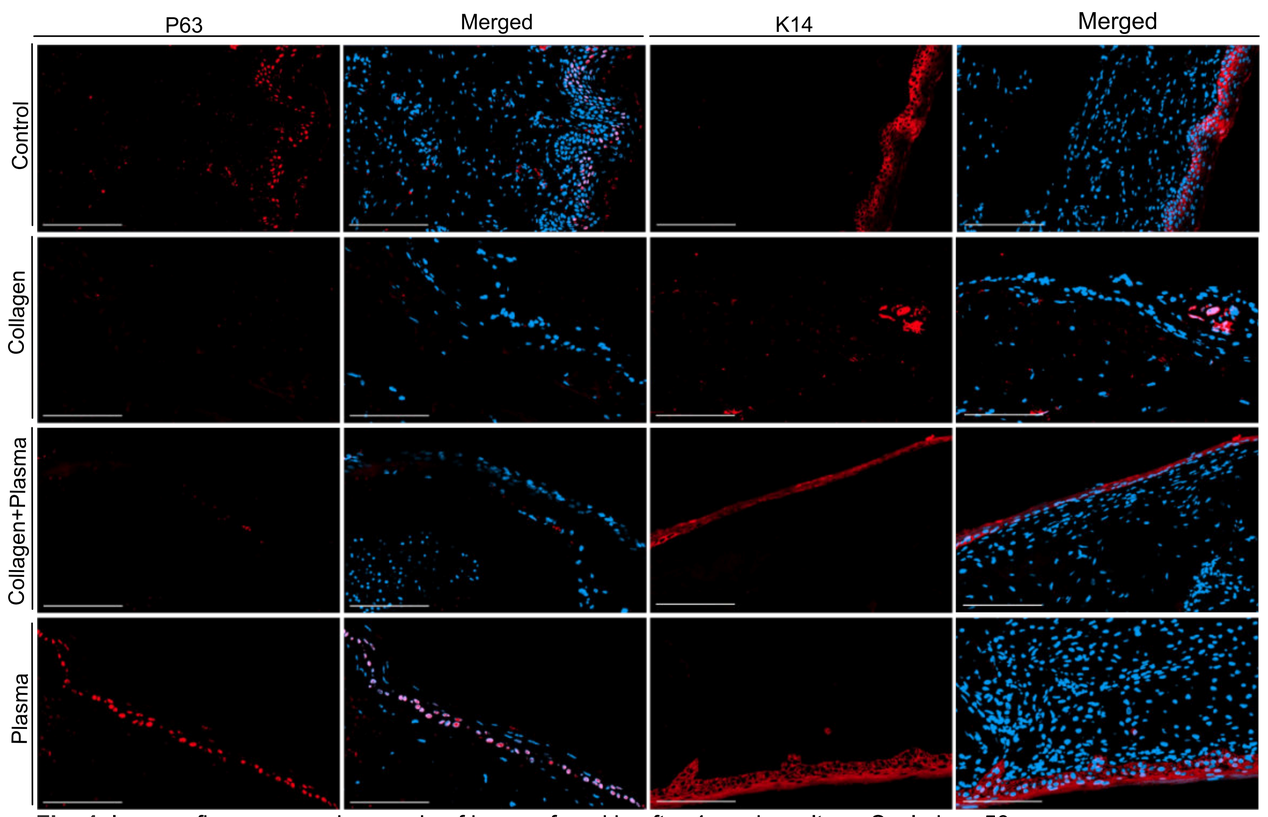


Fig. 4. Immunofluorescence images in of human foreskin after 4 weeks culture. Scale bar: 50 µm.

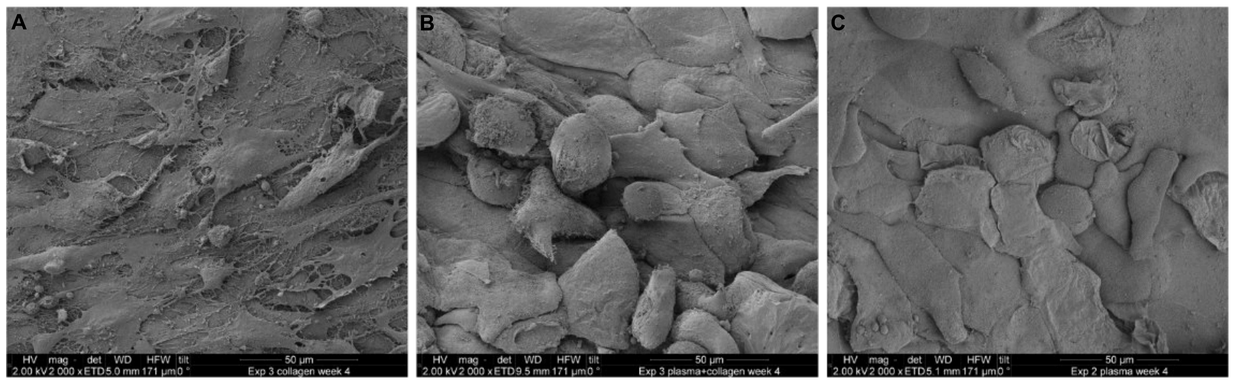


Fig. 6. Scanning electron microscopy images of human foreskin after 4 weeks of culture. (A) Collagen; (B) collagen+plasma; (C) plasma. Scale bar: 50 µm.

References

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2. Chamorro CI et al. (2016) Minced tissue in compressed collagen: a cell-containing biotransplant for single-staged reconstructive repair. J Vis Exp.

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