A Novel Biological Dermal Matrix for Skin Reconstruction

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Skin and soft tissue defects resulting from trauma, burns, or surgical resection remain a major clinical challenge. Biological dermal substrates have become an important component of modern reconstructive surgery by providing temporary structural support and promoting tissue regeneration, neovascularization and wound healing [1]. Despite their clinical success, there remains a need for accessible biological alternatives with comparable clinical performance.

In this study, we developed a novel biological dermal substrate derived from rabbit skin, a sustainable agri-food by-product, with preserved tissue integrity and extracellular matrix (ECM) organization. The processed purified dermal substrate retained the collagen-elastin network and structural features that closely resemble human dermis, providing a biologically instructive microenvironment for skin regeneration [2][3]. Its performance was benchmarked against two commercially available skin substitutes, Matriderm® (MedSkin) and NovoSorb® (PolyNovo). Matrix preservation was evaluated, as well as residual DNA, endotoxin levels, degradation profile, wound fluid absorption, water vapor transmission rate (WVTR), and their ability to support the formation of a dermo-epidermal skin substrate using human dermal fibroblasts and keratinocytes.

The developed dermal matrix preserved its native ultrastructure and high collagen content, with endotoxin levels below the FDA acceptance limit. The biological matrices exhibited a comparable performance with a balanced fluid management, high wound exudate absorption and controlled water vapor exchange, whereas the synthetic NovoSorb® presented lower permeability. A similar trend was also observed on cell performance as the dermo-epidermal models established on the biological substrates showed significantly enhanced metabolic activity over the 30 days of culture.

In conclusion, the developed dermal substrate combines the preservation of the native dermal ultrastructure with an excellent in vitro performance, matching the clinically established reference Matriderm® while outperforming the synthetic NovoSorb®. mportantly, preserving the native dermal architecture helps maintain the matrix's mechanical integrity and long-term structural stability. It also retains a high collagen content and biologically active elastin, creating an instructive microenvironment that supports tissue integration and skin regeneration.

References

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