Acellular human dermis as a dermal matrix of tissue engineered substitute for regenerative medicine

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Background

Regenerative medicine is an emerging interdisciplinary field of research and clinical application, focusing on the repair, replacement or regeneration of cells, tissue or organs. Tissue-engineered skin substitutes are an innovative therapeutic option for the treatment of acute and chronic skin wounds. Bioengineered skin replacements are not only supposed to substitute the major physiological functions by providing a rapid and reliable cover of the defect but also should be easily applicable under routine use conditions and reduce pain and discomfort for the patient. Moreover, they should induce the regeneration process in the wound bed without causing inflammation or rejection

Acellular dermal matrix is created from cadaveric skin using proprietary processing techniques that are reported to preserve the biochemical and structural components of the extracellular matrix, thereby promoting tissue regeneration. Acellular human dermis (AHD) is extremely useful in burn care and reconstructive surgery, such as breast reconstruction, abdominal hernia repair, and cleft palate repair.

Hypothesis

AHD is an attractive tissue engineered substitute to test novel concepts of regenerative medicine, with a particular emphasis on skin regeneration for acute or chronic wounds.

Methods

In this work, the optimal technique was used to decellularize the allograft human dermis, and was verified the procedure using histological staining. The AHD framework was obtained as shown in Figure 1. For the effects of the AHD over the cell morphology, cell spreading, cell attachment, a SEM analysis was conducted on the sample incubated with human dermal fibroblast cells (hDF).

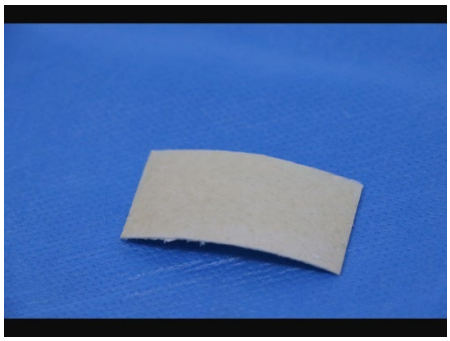

Figure 1. Acellular human dermis

Results

Histological examinations of the AHD sample before and after the decellularization process are shown in Figure 2. Figure 2A shows a dense structure of collagen fibers with many fibroblast cells among them, while Figure 2B shows no epidermis and a looser meshwork of the collagen with no fibroblast cells among them. Figure 3 shows the SEM images of hDFs cultured on scaffolds after 1, 7, 14, 21 days. It's observed an increased cell density and cell spreading during the time. The micro-architecture of human connective tissues is dictated by the controlled cellular arrangement which regulates the biological and mechanical function of the tissue. Figure 3D shows improved cell spreading, cell to cell communication and controlled extension of fibroblasts in comparison to first day of cell culture.

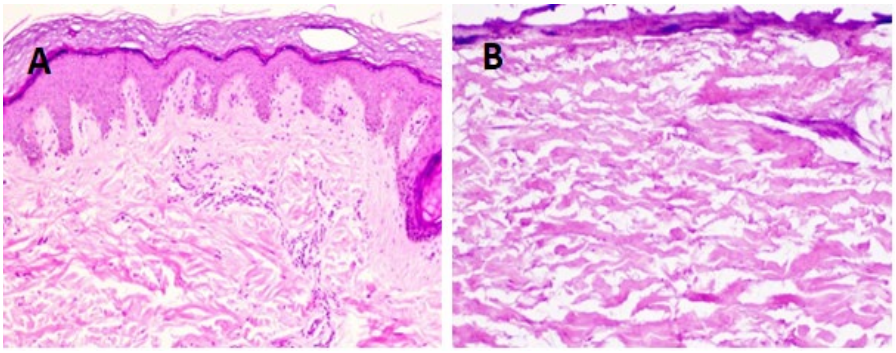

Figure 2. Histological photographs of samples. A) Normal human skin (×4 magnification) and B) Acellular human dermis (×10 magnification).

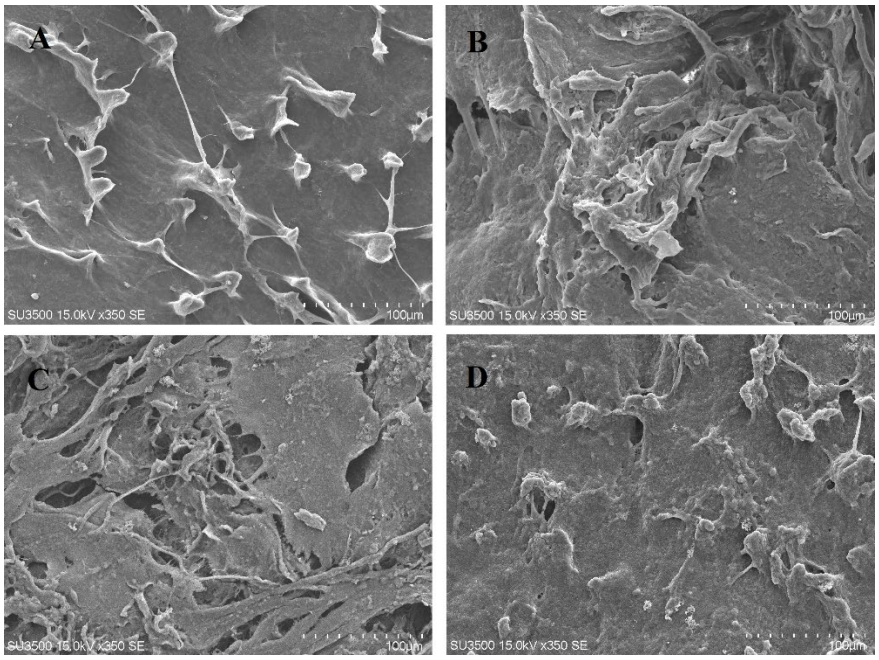

Figure 3. SEM images of fibroblast on the Acellular Human Dermis on day 1 (A), 7(B), 14(C), 21(D).

Conclusion

The optimum technique was used in this work to prepare AHD, and the procedure was verified using histological staining. The outcomes showed this treatment's removal of the epidermis was advantageous for a future procedure to eliminate cells from the dermal structure. Based on the cell-scaffold interaction, the AHD product appears to have suitable potential as a substitute in wound healing by overcoming the rejection of allograft products by cells.