Tissue Engineered Skin Substitute on Biodegradable Honeycomb Collagen Scaffold

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Tissue Engineering has lead to the development of three-dimensional artificial tissues that can be used for various applications including third degree burn wounds. Current dermal substitutes are not ideal because they do not provide the optimal environment for the multiplication and proliferation of the transplanted cells. In the present investigation, honeycomb collagen sponge was used as a scaffold for the three dimensional (3-D) culture of human skin fibroblasts. About 1 mm thick and 10 mm square honeycomb collagen sheets, prepared from bovine dermal atelocollagen, cross-linked by UV-irradiation and sterilized by heat, were placed on the proliferating human skin fibroblasts on the 3rd day of the culture. The cells attached quickly to the honeycomb collagen scaffold, proliferated, and multiplied into several layers and formed a dermal like structure within 30 days of the culture. The 3-D culture of human skin fibroblasts on the honeycomb collagen scaffold was characterized as a tissue engineered skin substitute. Type I procollagen content measured in the serum free media demonstrated that the amount of collagen synthesized by the fibroblasts on the honeycomb collagen scaffold was about 50 fold higher than the corresponding control cultures without the scaffold. Quantification of total cellular DNA in the 3-D cultures revealed a 20 fold higher amount of DNA content compared to respective controls. Scanning electron microscopy of the 3-D cultures depicted a well formed dermal like structure and degradation of the honeycomb collagen scaffold. The results of the present study demonstrated that the honeycomb collagen sponge is an excellent scaffold, which provides optimal environment for the multiplication and proliferation human skin fibroblasts to form a dermal substitute. It also proved that honeycomb collagen scaffold is a suitable biodegradable substratum for tissue engineered skin substitutes, and potentially useful for cell based therapies and tissue engineering applications.

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