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Fundamentals and scope of engineering skin tissue

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Skin tissue engineering encompasses cellular culture techniques and biocompatible matrix technology for the regeneration of damaged dermal tissue. The human skin accounts for 16% of the total body weight with a surface area of two square metres, hence injuries and wounds to the skin can produce adverse effects on the whole body. Some of the important properties to be considered for skin alternates include simplicity, ability to deliver vital blockade, spontaneous adherence, ability to have fitting corporeal and mechanical possessions, easy disinfection, no toxicity, nonantigenic and negligible inflammatory effect. Clonogenic keratinocytes, also called holoclones can be obtained from the skin and cultured to about 140 replications into an interconnected layer of the epithelium as they are multipotent stem cells. Keratinocytes are one of the predominant cells present in the epidermis, hence they are either used singly or in combination with other cells in skin implants. They behave as a physical barrier, can produce antimicrobial peptides and take up the function of Langerhans cells in the epidermis under special conditions. Keratinocytes have the ability to express fibroblast-derived growth factors. Thus, a mixture of allogeneic and autologous keratinocytes can be used in the technique to cover a larger surface area. However, the autologous cells, which retain stem cells-like persistent character, remain intact in the epidermis while a large proportion of allogeneic cells are lost.

Another method that can be employed is by producing a cell suspension of largely allogeneic keratinocytes and fresh autologous keratinocytes extracted from the skin or scalp. Cutaneous wound healing in a diabetic pig was studied by injecting the damaged skin with autologous fibroblasts or keratinocytes, and this was compared with wounds treated with normal saline. The concentrations of serum and fluid glucose in the wound were observed daily which indicated that autologous fibroblasts showed a re-epithelialisation rate of 86.75% while autologous keratinocytes showed a re-epithelialisation rate of 91.3%. To date, varieties of skin stem cells have been recognised which can be used to routinely repair the layers of the epidermis. Nowadays, the treatment of cutaneous wounds can be performed by ex vivo gene treatment, referring to genetic modification of the cells outside the body which can then be transplanted back into the host. However, in skin repair methods, gene therapy is a relatively underutilised sector. One of the materials used for wound healing by tissue engineering is chitosan which synthesises collagen and thereby speeds up the healing process by preventing desiccation and infection. Additionally, the use of keratinocytes and fibroblasts for wound healing contributes to greater epithelial stratification, and the expression of growth factors along with increased angiogenic properties. Hence, they provide a promising clinical method for the regeneration of damaged skin through skin tissue engineering.

Keywords: Keratinocytes, Fibroblasts, Epithelium, Re-epithelialisation, Autologous cells, Allogeneic cells

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