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Adipose-derived stem cells and their multi-lineage differentiation in skin tissue engineering

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Loss of skin in particular areas due to burning traumas or skin irritations as a result of some disorders is a common health problem among people. As science provides new techniques for wound healing processes, artificial skin development with tissue engineering takes the lead in the methods used for the treatment of dermal problems. One way to generate artificial skin substitutes is to use stem cells, which are known for their ability to differentiate into various cell types. Due to their abundance in tissue and ability to expand in vitro rapidly, adipose-derived stem cells (ASCs) have become one of the most popular stem cells preferred for tissue engineering. ASCs may be isolated from lipoaspirates, which consist of three layers (an oil layer on top, an adipose tissue layer in the middle, and a liquid infranatant layer at the bottom) by using enzymatic digestion and differential centrifugation methods or from discarded burned tissue obtained from patients. After a successful harvest of ASCs, without the remaining possible contaminants such as red blood cells, ASCs can expand and sustain their multipotency in vitro. Multipotent adipose-derived stem cells can differentiate into mesenchymal lineages, which are abundant in multiple tissues, such as bone marrow and fat tissue. Thus, they can secrete immunosuppressive cytokines, and their lack of human leucocyte antigen expression makes them less immunogenic, which is extremely advantageous in terms of skin transplants. Another advantageous part of ASCs is that one can induce multi-lineage differentiation of ASCs in vitro by using appropriate culture media and culture conditions after harvesting them from lipoaspirates or discarded tissues. For example, by using osteogenic media, along with phosphate-buffered saline (PBS) and chemicals, such as silver nitrate and paraformaldehyde, osteogenic differentiation of ASCs can be induced after 14 days of the culture period. Likewise, adipogenic media along with PBS can induce adipogenic differentiation whilst using chondrogenic media with PBS and paraformaldehyde leads to chondrogenic differentiation of ASCs. In addition to those mentioned, skeletal myogenic, smooth myogenic, endodermal and ectodermal differentiation of ASCs can also be induced with appropriate culture techniques. After inducing such multi-lineage differentiations, those cells can be used to treat skin wounds. Overall, it is possible to state that artificial skin development using ASCs is a simple but effective way of tissue engineering to treat dermal problems.

Keywords: Adipose stem cells, Multipotency, Osteogenic differentiation, Adipogenic differentiation, Chondrogenic differentiation, Tissue engineering

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