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Enhanced osteogenic differentiation of human mesenchymal stromal cells as response to periodical microstructured Ti6Al4V surfaces.

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Abstract

Titanium-based alloys, for example, Ti6Al4V, are frequently employed for load-bearing orthopedic and dental implants. Growth of new bone tissue and therefore osseointegration can be promoted by the implant's microtopography, which can lead to improved long-term stability of the implant. This study investigates the effect that an organized, periodical microstructure produced by an electron beam (EB) technique has on the viability, morphology, and osteogenic differentiation capacity of human mesenchymal stromal cells (hMSC) in vitro. The technique generates topographical features of 20 µm in height with varying distances of 80-240 µm. Applied alterations of the surface roughness and local alloy composition do not impair hMSC viability (>94%) or proliferation. A favorable growth of hMSC onto the structure peaks and well-defined focal adhesions of the analyzed cells to the electron beam microstructured surfaces is verified. The morphological adaptation of hMSC to the underlying topography is detected using a three-dimensional (3D) visualization. In addition to the morphological changes, an increase in the expression of osteogenic markers such as osteocalcin (up to 17-fold) and osteoprotegerin (up to sixfold) is observed. Taken together, these results imply that the proposed periodical microstucturing method could potentially accelerate and enhance osseointegration of titanium-based bone implants.

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Current Knowledge and Future Perspectives on Mesenchymal Stem Cell-Derived Exosomes as a New Therapeutic Agent.

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Abstract

Mesenchymal stem cells (MSCs) are on the cusp of regenerative medicine due to their differentiation capacity, favorable culture conditions, ability to be manipulated in vitro, and strong immunomodulatory activity. Recent studies indicate that the pleiotropic effects of MSCs, especially their immunomodulatory potential, can be largely attributed to paracrine factors. Exosomes, vesicles that are 30-150 nanometers in diameter that function in cell-cell communication, are one of the key paracrine effectors. MSC-derived exosomes are enriched with therapeutic miRNAs, mRNAs, cytokines, lipids, and growth factors. Emerging evidences support the compelling possibility of using MSC-derived exosomes as a new form

of therapy for treating several different kinds of disease such as heart, kidney, immune diseases, neural injuries, and neurodegenerative disease. This review provides a summary of current knowledge and discusses engineering of MSC-derived exosomes for their use in translational medicine.

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An Update on the Progress of Isolation, Culture, Storage, and Clinical Application of Human Bone Marrow Mesenchymal Stem/Stromal Cells.

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Abstract

Bone marrow mesenchymal stem/stromal cells (BMSCs), which are known as multipotent cells, are widely used in the treatment of various diseases via their self-renewable, differentiation, and immunomodulatory properties. In-vitro and in-vivo studies have supported the understanding mechanisms, safety, and efficacy of BMSCs therapy in clinical applications. The number of clinical trials in phase I/II is accelerating; however, they are limited in the size of subjects, regulations, and standards for the preparation and transportation and administration of BMSCs, leading to inconsistency in the input and outcome of the therapy. Based on the International Society for Cellular Therapy guidelines, the characterization, isolation, cultivation, differentiation, and applications can be optimized and standardized, which are compliant with good manufacturing practice requirements to produce clinical-grade preparation of BMSCs. This review highlights and updates on the progress of production, as well as provides further challenges in the studies of BMSCs, for the approval of BMSCs widely in clinical application.

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Mesenchymal stem cells for treatment of musculoskeletal disease in horses: Relative merits of allogeneic versus autologous stem cells.

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Abstract

Mesenchymal stem cells (MSCs) are widely used for treatment of musculoskeletal diseases in horses, but there is ongoing debate regarding the relative safety and efficacy of allogeneic MSC, compared to autologous equine MSCs. This review summarises the currently available published data regarding the therapeutic use of autologous and allogeneic MSCs in horses. Arguments that have been advanced against the use of allogeneic MSCs include higher risk of immunological reactions and shorter cell survival times following injection. Arguments favouring the use of allogeneic MSCs include the ability to bank cells and reduce the time to treatment, to collect MSCs from younger donor animals, and the ability to manipulate banked cells prior to administration. In vitro studies and a limited set of

experimental in vivo studies have indicated that adverse immunological reactions may occur when allogeneic MSCs are administered to horses. However, newer studies lack evidence of inflammatory reactions or adverse clinical responses when allogeneic MSCs are administered and compared to autologous MSCs. Thus, while the relative merits of allogeneic versus autologous MSCs for treatment of musculoskeletal injuries in horses have not been fully established, accumulating evidence from studies in horses suggests that allogeneic MSCs maybe a safe alternative to autologous MSCs. Large, properly designed, randomised trials in addition to careful immunological evaluation of short-term and long-term, local and systemic immune responses are needed to more fully resolve the issue.