Mesenchymal Stromal Cells Within Fibrin Gel Stimulate Healing of Full-Thickness Wounds in Mice

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A high paracrine activity of multipotent mesenchymal stromal cells (MSCs) and their multilineage differentiation capacity determine the promise of their application for the restoration of damaged tissues. The realization of MSCs reparative potential in vivo largely depends on the cell injection approach and/or the properties of applied carrier matrix.

The aim of the study was to assess the wound healing effect of MSCs within the fibrin gel obtained from platelet poor blood plasma using the excision full-thickness skin wound model in mice.

Human adipose tissue MSCs from passages 4–6 were used in this study. Fibrin gel (FG) was obtained from the whole blood of adult donors by 2-step centrifugation method. The platelet poor plasma fraction (5×10^6 platelets/μL) was combined with the mixture of blood serum and CaCl2. The MSCs were included into gel in concentration of 5 million cells per 1 mL of FG. Full-thickness excision skin wounds were produced on the backs of male Balb/c mice using a dermal punch (d = 6 mm). The wounds were applied under the general anesthesia, according to ethical guidelines. Animals were divided into the groups, depending on the method of wound treatment: 1 – control (self-healing wounds); 2 – wounds treated with FG; 3 – wounds treated with MSCs within the FG. The wound healing was assessed by macroscopic, planimetric and histological methods according to the concept of wound process staging.

We revealed that the wound healing rates in the control group and group 2 (FG treatment) were not significantly different during the whole course of examination. The application of MSCs within the FG promoted the acceleration of epithelialization and the percentage of wound closure on days 3 and 7 of examination significantly exceeded the parameters of other groups. To day 14, a complete epithelialization was observed in all the experimental groups. The application of MSCs within the FG provided earlier formation and maturation of granular tissue and an active angiogenesis compared to other groups, generating a beneficial environment for the normal skin microrelief reconstruction.

Mesenchymal stromal cells provide acceleration of epithelialization in full-thickness wounds, maturation of granular tissue and complete restoration of dermal and epidermal layers of damaged site of the skin. These findings confirm the promise of using MSCs within the PG for meeting the challenges of regenerative medicine.