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Electrical stimulation as a tool to accelerate cutaneous regeneration and wound repair

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Electrical stimulation (ES) in its various forms has been shown to promote wound healing by increasing the migration of keratinocytes and macrophages, enhancing angiogenesis and stimulating dermal fibroblasts. Delivery of ES to the wound can be through biocompatible conductive biomaterials such as conductive membranes made of 5% polypyrrole (PPy) and 95% polylactide (PLA), as well as an electronic system that enables cells to be cultured on the surface of the conductors and then electrically stimulated. One of the key cells in wound healing is fibroblast contributing to extracellular matrix synthesis and interaction with epidermal cells thus contributing to wound closure. Fibroblast activities during wound healing were reported to be modulated by multiple agents including ES. However, the underline molecular mechanisms are not clear and the approach to apply electrically activated fibroblasts to assist skin wound healing needs to be explored. With this conference, we will be presenting cell response/cell signaling pathway following exposed to ES; demonstrating the advantages of ES on *in vitro* and *in vivo* skin tissue regeneration. To generate original data related to ES promoting wound healing we used a sophisticated conductive membrane that combines polylactide (PLLA) or polyester fabrics (PET) with polypyrrole (PPy) as a conductive polymer. With these conductive membranes, we demonstrated that both continuous and pulsed ES-induced fibroblast adhesion and proliferation. Furthermore, ES promoted fibroblasts to myofibroblast differentiation confirming what has been reported previously. Interestingly, the myofibroblast phenotype acquired following ES can be transferred to daughter cells. The effects of ES on human fibroblasts lead to an increased production of TGFβ1 by activating ERK and NF-κB signaling pathway. The ES-modulated fibroblasts adequately interacted with keratinocytes leading to a well-structured EHS tissue expressing basement membrane (BM) glycoproteins, including laminin and type IV collagen. Tissue organization was superior under 200 mV/mm of ES compared to 50 mV/mm. This confirms the previously reported study suggesting that exogenous ES maintains the ex vivo epidermal integrity and cell proliferation of a human skin explants. Following 20 and 30 days of grafting, the newly regenerated skin was well vascularized, showing BM formation through laminin and type IV collagen secretion and was wholly formed by the implanted human cells. In conclusion, we demonstrated that electrically activated fibroblasts interacted with keratinocytes leading to *in vitro/in vivo* well-structured engineered skin. This study thus provides an innovative way to use electrically activated cells for skin regeneration and wound repair.

Biography

Mahmoud Rouabhia is a full Professor at the Faculty of Dentistry of Laval University. He is a Senior Scientist in the field of Immunology, Cell Biology and Tissue Engineering. He has obtained his PhD in France, followed by a Postdoctoral training for four years in Canada. His research interest includes wound healing under chemical and physical stimulations that include growth factors but also electrical stimulation, stem cell differentiation for tissue regeneration, the interaction between host & oral microorganisms related to the oral cavity, the role of local innate immunity reducing oral infections, etc. He has more than 130 pair reviewed scientific publications. He is the Editor/Co-editor of three books. He has published over 15 book chapters/review articles and two patents.

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