Regeneration of a critical size mandibular defect by using an innovative bone engineering strategy

Hutmacher D / Lynham A / Saifzadeh S / Schuetz M / Rohner D
Queensland University of Technology, Kelvin Grove (Australia)

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Mandible keeps the integrity of maxillofacial complex for mastication and speech in oral-maxillofacial region. Repair of large mandibular bone defects caused by trauma, infection, cancer or congenital malformation remains a big challenge in reconstructive surgery. Tissue engineering has become a new approach for repairing maxillofacial bony defects. Protein therapeutics, including bone morphogenetic proteins (BMPs), have become promising alternatives to conventional grafting techniques (auto- and allografts). Electrospinning has recently emerged as a technique to produce polymeric scaffolds for tissue engineering, with fiber diameters ranging from tens of nanometers to as large as 10 µm. The electrospun nanofiber mesh is a unique scaffold membrane that possesses structural features have similarity scale to extracellular matrix (ECM) components (biomimesis), which allow for enhanced cellular attachment and spreading. By biomimetic strategy, medical-grade electrospun polycaprolactom (PCL) nanofiber meshes loaded with BMP might provide an enhanced osteogenic environment for bone-related outcomes. In this proposal we will develop large, tubular, dual-layered nanofiber scaffolds, capable of sustained growth-factor delivery. We have previously shown significant bone regeneration capacities of this system in small animal models. We aim to bring this innovative bone engineering technology a step closer to the clinic by using large animal models. Extensive histological and micro-computed tomography analyses will be used to assess bone regeneration. This may ultimately provide a therapeutic solution to the thousands of terminal maxillofacial fractures and bone defects people face each year. This is particularly relevant when one considers the increasing aging population.