DOTTORATO STB E SCIMANO

BONE STEM CELLS AND TISSUE ENGINEERING FOR RARE DISEASES

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Bone is among the organs with the highest regenerative potential, mostly due to the high vascularization and to the presence of stem cells. Bone stem cells are a homogeneous subpopulation of nonhematopoietic self-renewable and multipotent cells residing in different niche domains throughout the skeleton, that are dedicated to bone development, homeostasis, and regeneration. Site-specific differences are found in membranous and endochondral bone-derived stem cell niches, underlying the different osteogenic mechanisms and developmental paths. Skeletal and craniofacial rare diseases often implicate defects in the bone stem cell niches, leading to hypo- or hyper-ossification phenotypes. My talk will describe the main mechanisms involved in these pathophysiological processes, focusing on craniosynostosis, as a paradigm use case due to the premature exhaustion of the suture stem cells niche (Fig.1a-b), and providing examples of gene targeting and tissue engineering approaches (Fig.1c-d) aimed at restoring stem cells homeostasis in this condition.

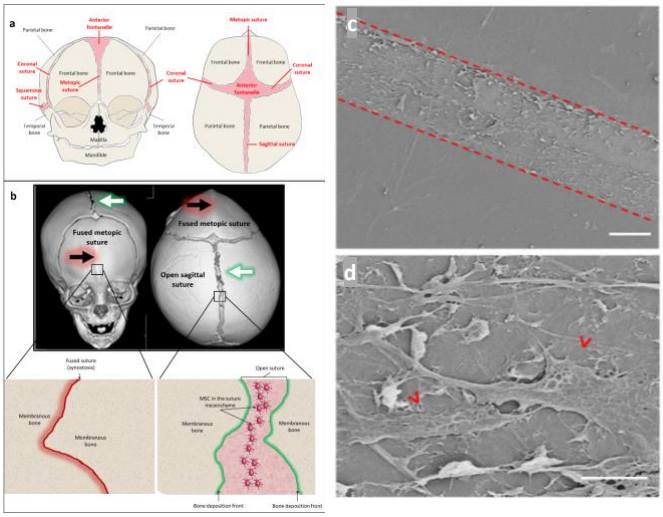

Figure 1. (a) scheme of the newborb skull featuring flat bones joint by fibrous sutures; (b) 3DCT of a craniosynostosis cases showing the premature fusion of the metopic suture, due to the premature ossification of skeletal stem cells in the suture mesenchyme; (c) SEM micrographs of patterned graphene oxide stripes (red dashed lines) performed on biomaterial scaffold to promote adhesion and polarization of skeletal stem cells for bone regeneration; (d) magnification of single cells bridging over the biomaterial surface (modified from *Tiberio et al, 2021, Appl Sci, 11:2649* and *Palmieri et al, 2018, 2D Mater. 5:015027)*

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