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BIORESORBABLE BIOACTIVE BONE SCAFFOLD: A NEW SCAFFOLD FOR REGENERATIVE MEDICINE

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Scaffolds for bone tissue engineering should ensure both mechanical stability and strength. Moreover, their intimate structure should have an adequate interconnected porous network for cell migration and proliferation, while also providing specific signals for bone regeneration.
A composite solution, based on a novel concept of biomaterial assembly, bearing cues from both mineral components and polymeric ones, was here followed to develop a new three-dimensional bone scaffold. A bovine derived mineral matrix was used to provide adequate 3D structure and porosity, while a resorbable biopolymer was used to reinforce it. Bioactive agents were added to promote cell adhesion and proliferation.

Microstructure was evaluated by E/SEM and micro-CT, confirming a strong resemblance with human cortical bone in terms of open mid-sized porosity. Compression tests evidenced a maximum stress capability (20MPa *av.*) three times higher than best available bovine derived bone, with a four-fold improved Young's modulus (0.2GPa *av.*). Overall mechanical behaviour was typical of open cellular structures: a first pseudo-linear and pseudo-elastic behaviour, due to structural resistance, was followed by oscillating behaviour due to progressive breakage of structure and consequent matrix compacting. Moreover, it resulted feasible for reconstructive surgery, being both easy to shape and resistant to screws and fixation manoeuvres.

Citocompatibility and cell viability were positively assessed *in vitro* with standard SAOS-2 and MG-63 line cells. Human adipose tissue derived mesenchymal stem cells were also tested and data showed *in vitro* capability to properly colonize the scaffold and, once induced, to differentiate. Tibial grafts on adult white New Zealand rabbits were performed to assess *in vivo* osteointegration during 4 months observations. Histological analysis proved confirmation of matrix integration with natural bone and showed cells and vessels colonizing pores within it during time.

Data collected represent a complete proof of concept for this new scaffold and its application for bone tissue regeneration.