Comparative Study of Coating Textile Knitted Scaffolds with Human Bone Powder vs. Hydroxyapatite Powder for Bone Regeneration

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INTRODUCTION: Hydroxyapatite (HA), which closely mimics the structure of natural bone mineral, has been extensively researched for its potential in bone regeneration [1,2]. The mineral has shown promise in enhancing the osteoconductive properties of implant surfaces, making it a focal point in the field of orthopaedic and dental implants [1]. The present study aims to contribute to this body of research by conducting a comparative investigation into the coating of textile scaffolds with human-derived bone powder and commercially available HA powder. The primary objective is to explore potential differences in the source of the mineral and its implication for bone regeneration.

METHODS: Knitted spacer fabric made of Poly(lactic acid) (PLA) monofilament were coated with powder derived from human femoral heads or commercially available hydroxyapatite (< 200 nm, Sigma-Aldrich Co) in an ethanol (EtOH) solution using an ultrasonic bath. Prior to the coating, the knitted PLA scaffold underwent surface activation using 1M NH_3. The distribution and characteristics of the coating were analysed using scanning electron microscope (SEM) and Fourier transform infrared spectroscopy (FTIR). Subsequently, the cellular attachment was assessed through *in vitro* screening of bone marrow-derived human mesenchymal stem cells (hMSCs) at various time points using fluorescence and confocal microscopy. The differentiation of the hMSCs into osteoblast was evaluated by measuring the alkaline phosphate activity (ALP).

RESULTS: The findings of this study demonstrate the uniform distribution of the coating on the knitted PLA scaffold, as confirmed by SEM and FTIR analysis. Furthermore, the knitted PLA scaffold when coated with human-derived bone powder or HA, supported the attachment and the proliferation of hMSCs (Fig. 1). Additionally, the comparable osteoconductive properties of HA and human-derived bone powder were substantiated through ALP activity assessment.

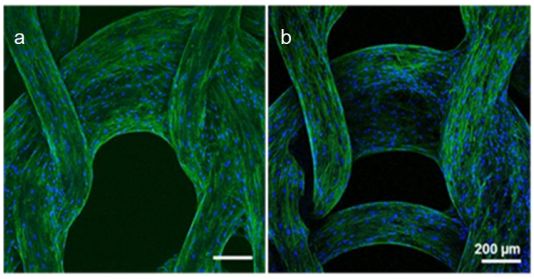

Fig. 1: Morphology of hMSCs cultured in osteogenic induction medium after 21 days as visualized by fluorescent staining of actin filaments (green) and nuclei (blue, a) Human derived bone powder and b) HA coated knitted PLA scaffold. Bar = 200 µm

DISCUSSION & CONCLUSIONS: The results from this study revealed that both human-derived bone powder and commercially available HA effectively enhanced the osteoconductive properties of the knitted PLA scaffold. Notably, no significant difference was observed between the two apatite powders in terms of their osteoconductive effects. However, a notable distinction was identified in the particle morphology of the two types of powder. Specifically, the commercially available HA exhibited a spherical shape, whereas the human-derived bone powder displayed a more irregular shape. Given the substantial impact of particle morphology and topography on cell attachment and proliferation [1], it is advisable to further optimize the shape and size of the particles for a more comparable study in the future.

REFERENCES: [1]M Persson et al (2014) *Colloids Surf. B*, **121**:409-416. [2]M Persson et al (2018) *Sci Rep* **8**:10457.

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