00305 A Materiomics Approach to Pulp Regeneration

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Aims: Recently it has been discovered that material surface topographies uniquely modulate cell behaviour. The determination of functionally architectured surfaces is constrained by experimental limitations in design and testing. Microfabrication techniques coupled with high-throughput screening of biomaterials enable us to overcome these barriers. The aim of the study was to use a screening platform to identify surface topographies that favour multi-lineage differentiation of dental pulp stem cells (DPSCs) in vitro.

Methodology: DPSCs were seeded on micro-fabricated "Cellompic chips" made of Poly (ε-caprolactone), which consisted of 160 algorithmically designed distinct surface topographies. Fluorescent images of the nuclei, cytoskeleton and 4 antibody stains were acquired for the chips using an automated microscope. Machine learning algorithms were employed for quantitative analysis.

Result: Specific surface topographies that favoured cellular and nuclei eccentricity as well as differentiation along odontoblastic, fibroblastic, endothelial and neuronal lineages were revealed by immunofluorescence. Grid-like small and closely spaced rectangular features were found to promote DPSC differentiation. Receiver operating curves revealed the predictive power of the identified topographic parameters.

Conclusion: We were able to demonstrate the use of the Cellompic chip as a screening platform to identify surface topographies that encouraged multi-lineage differentiation of DPSCs. By identification of such "hit" topographies, we plan to selectively replicate such patterned scaffolds for use in animal models. The creation of a functionalized polymeric biodegradable scaffold is promising in terms of accelerated clinical translation, as it does not require the use of growth factors and cumbersome cell transplantation, avoiding potential complications of contamination or tumorigenesis. We foresee that this will accelerate the regeneration of functional pulpal tissue in regenerative endodontic therapy in the future.