High-resolution 3D-printed microscaffolds for bottom-up tissue engineering

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INTRODUCTION

Current approaches in Tissue Engineering (**TE**) can be roughly categorized into scaffold-based and scaffold-free. Recently a third TE strategy, combining the advantages of these seemingly opposing approaches, while circumventing their drawbacks was proposed [1]. This novel strategy is based on self-assembly of tissue units (**TUs**) consisting of microscaffolds containing cell spheroids. Realization of such microscaffolds is enabled by high-resolution 3D printing and the recent availability of suitable materials [2, 3].

MATERIALS AND METHODS

Two-photon polymerization (2PP) was utilized to fabricate highly-porous microscaffolds from a commercially available DEGRAD INX X100 photopolymer (BIO INX BV). Immortalized human adipose-derived mesenchymal stem cells (hASC, ASC/TERT1 Evercyte) were expanded in fully supplemented EGM-2 with 10% serum. Each buckyball (**BB**) microscaffold (diameter of 300 µm), residing in an antiadhesive well plate, was seeded with 4000 hASCs in order to form spheroids (see Fig. 1a). Differentiation towards osteogenic and chondrogenic lineages achieved by culturing TUs in according media for 21 days.

RESULTS AND DISCUSSION

It was demonstrated that hASCs rapidly form spheroids directly within the microscaffolds. The resulting TUs maintained high viability and preserved their chondrogenic and osteogenic potential. Multiple TUs were successfully merged to form larger constructs, which offer a great perspective to fill up tissue defects [4].

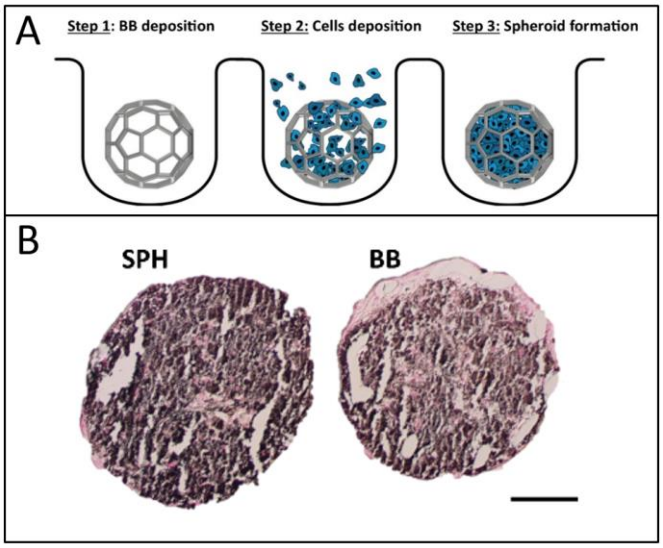

Figure 1: a) schematics of spheroid formation directly within a buckyball (BB) microscaffold; b) Osteogenic potential - comparison of mineral deposition (Von Kossa) in regular spheroids (SPH) and BBs (scale bar is 100 µm).

CONCLUSIONS

The microscaffolds carrying high density of cells are promising building blocks for cartilage and bone TE facilitated by bottom-up assembly.

REFERENCES

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