BIOGLASS-DERIVED SOL-GEL HYBRID SCAFFOLDS FOR BONE AND CARTILAGE REGENERATION: FROM DESIGN TO IN VIVO STUDIES

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ABSTRACT:

The aim of the work is to 3D print an innovative device to treat osteochondral defects, which involve damage to both articular cartilage and underlying bone. The subchondral bone is the deeper tough vascularised tissue that transitions to articular cartilage, the bearing surface that permits smooth motion between opposing bones in joints. Articular cartilage is characterised by a viscoelastic behaviour and a smooth outer surface with extremely low coefficient of friction.

We designed an osteochondral implant that exploits the potential of an innovative patented silica/polytetrahydrofuran/polycaprolactone sol-gel hybrid, named "bouncy hybrid".[1] This material, consisting of an interpenetrating co-network of organic and inorganic components, was proven to be 3D printable into 3D porous scaffolds with controlled porosity and tuneable mechanical properties, with great potential to stimulate articular cartilage regeneration[2]. The addition of calcium ions in the inorganic component made it tough and bioactive, with the ability to stimulate the apatite deposition *in vitro*. The final aim is to develop a device that can improve microfracture surgery by 3D printing a chondral device, with a bulk articular surface bonded to a 3D printed scaffold both made of the bouncy hybrid, joined to a bone scaffold, made of the bouncy hybrid including calcium ions. Challenges are: 1) achieving a successful bond of the three components; 2) having the lowest possible friction coefficient against living cartilage; 3) guidance of stem cells to produce high quality articular cartilage or bone in the corresponding part of the device.

The talk will explore the research from the invention of the material to the translation into a device, including: the mechanical characterisation of the cartilage and the bone components; the tribological properties of the bearing surface[3]; the biological response *in vitro* of the hybrid scaffolds with and without calcium; the *in vivo* study in sheep of the chondral component.

References

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