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Heterogeneous tissue engineering approach for the repair of different tissues

Kadriye Tuzlakoglu
Yalova University, Turkey

Living tissues are composed of biologically and functionally different layers which forms in perfect hierarchy and harmony. To mimic these multilayer structures of the natural tissues, heterogonous tissue engineering term was introduced to the tissue engineering field very recently. Using this approach, different biochemical or topographical cues are localized in micro scale which may provide selective cell differentiation of a common stem cell and thus accelerate a new tissue formation similar to natural one. In our group, we designed many multi-layered structures for the repair of different tissues, including skin, tendon and abdominal wall. For mimicking natural skin tissue, we design two different bilayered constructs. To achieve the desired bilayered structure similar to skin, in both constructs freeze-drying and electrospinning methods were used consecutively. In another study, spiral shape aligned bilayered constructs were targeted to engineer tendon tissue. Nanofiber membranes from two different were obtained by electrospinning. To have the proper mechanical characteristics, these oriented membranes were combined in different forms as the fiber orientations are perpendicular or parallel to each other. The combined membrane layers were then rolled and glued at the edges in order to obtain spiral shape scaffolds. In our recent study, we aimed to develop multifunctional dual mesh for abdominal hernia repair. The developed mesh consists of a nanofibrous layer made of poly(glycerol sebacate)/poly(caprolactone) to support the healing of abdominal wall defect and a non-adhesive polyurethane layer to avoid the viscera. Our results from the studies revealed that, all designed constructs presented morphologic similarity to the targeted tissue.

ktuzlakoglu@yalova.edu.tr

Surface modification and hydroxyapatite coating by laser on zirconia substrate for dental implants

Oscar Samuel Novais Carvalho, S Madeira, F S Silva and **G Miranda**
University of Minho, Portugal

Although titanium and titanium alloys are the materials most often used in dental implants, mainly due to mechanical properties and biocompatibility, ceramics are becoming very attractive as new materials for this area. Zirconia seems to be a suitable dental implant material once it can overcome the main drawbacks of titanium implants like metallic coloration, corrosion and in some cases the cause of allergies. Zirconia seems also be more biocompatibility and avoids some problems found in titanium implants like autoimmunity and cellular sensitization and due to continuous scientific research, ceramic's mechanical strength is improving, becoming more feasible for dental implants. Like titanium, zirconia does not stimulate bone regeneration around the implant, due to its bioinertness. In this context, this work is focused in the development of zirconia substrates doped with hydroxyapatite (HA) in order to promote earlier and stronger fixation. The substrates were prepared with laser CO_2 laser to create cavities, where HA was then introduced, being afterwards sintered by the action of the same laser. This technique brings a huge advantage in materials processing, once by controlling the laser path; velocity and power it is possible to obtain cavities (patterning/machining) and also sinter different materials over the surface and cavities (selective laser sintering/melting). Results showed that the cavities, roughness and laser power influence the adhesion and degradation of HA.

oscar.carvalho@dem.uminho.pt