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Surface functionalized titanium scaffolds for orthopaedic application: learning from nature

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The metal of choice to treat critical size bone defects are up to today still titanium (Ti) and its alloys. These biometals posses advantageous characteristics for bone tissue engineering applications including excellent corrosion restistance, superior biocompatibility and appropriate mechanical properties. Despite the strong biocompatibility the bone binding capacity and the bioactivity of Ti(-alloys) are not sufficient to realise a true bond between the implant and the surrounding bone tissue, implying a non-optimal osseointegration.
In the present work, we studied the immobilisation of the biopolymer gelatin type B onto the surface of three dimensional regular Ti6Al4V scaffolds to improve their surface bio-activity. Gelatin is derived from collagen, one of the main constituents of the extracellular matrix, and has already been used for numerous industrial, parmaceutical and biomedical applications. The successful immobilisation of the gelatin coating was due to a polydopamine interlayer, a polymer coating inspired by the adhesive nature of mussels. The presence of both coatings was demonstrated by different techniques including X-ray photelectron spectroscopy, surface energy determination and fluorescence microscopy. Results show homogeneous coatings that are stable for at least 24h in PBS at 37°C. During subsequent in vitro cell adhesion and culture studies with human periosteal derived cells we could observe a homogeneous cell distribution and the onset of a mineralisation process. This newly developed coating procedure outperformed the previously reported silanisation procedure for immobilising gelatin.
The bio-activity of these stable gelatin coatings will be further enhanced by applying a secondary coating using the cell-attractive protein fibronectin. The reproducible immobilisation process developed will allow for a controlled biomolecule presentation to the surrounding tissue.

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