In depth study of gelatin immobilisation on porous Titanium scaffolds to improve the biological performance

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INTRODUCTION

The metal of choice to treat critical size bone defects are up to today still titanium (Ti) and its alloys. These biometals possess advantageous characteristics for bone tissue engineering applications. Despite the strong biocompatibility the bone binding capacity and the bioactivity of Ti 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 Ti scaffolds to improve their surface bio-activity.

MATERIALS AND METHODS

A first approach to achieve a homogeneous and stable gelatin coating onto the Ti surface consisted of a four-step procedure: (1) cleaning, (2) oxidation and (3) silanisation of the Ti surface with 3-(trimethoxysilyl)propyl methacrylate followed by (4) immobilisation.of methacrylamide-modified gelatin (Gel-mod) by dipcoating and cross-linking through e-beam irradiation.
An alternative approach comprised the use of an intermediary prime layer to attach non modified gelatin to an oxidised Ti surface, also by a simple incubation process.
The modified surfaces were characterised in depth using static contact angle measurements, X-ray photo-electron spectro-scopy and fluorescence microscopy. The biological performance was assessed through *in vitro* cell adhesion and culture studies with human periosteal derived cells.

RESULTS AND DISCUSSION

The silanisation approach resulted in a gelatin coating that was stable after loss of non bound gelatin chains (during incubation in PBS at 37°C). This apparently low stability of the gelatin coating is probably due to a combination of the low stability of the underlying siloxane layer and an inefficient crosslinking by e-beam.
In case of the immobilisation approach with the intermediary prime layer, a homogeneous and highly stable gelatin coating was obtained. During subsequent *in vitro* cell adhesion and culture studies, we could observe a homogeneous cell distribution and the onset of a mineralisation process.

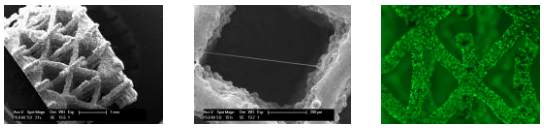

Fig 1. SEM images (left and middle) and live/dead staining (right) of gelatin modified Ti scaffolds after 7 days cell culture.

CONCLUSIONS

In conclusion, we can state that this newly developed coating procedure outperformed the 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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