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Femtosecond laser microstructuring and bioactive nanocoating of titanium surfaces in relation to chondrocyte growth

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Introduction

Titanium implants can be regarded as the current gold standard for restoration of sound transmission in the middle ear following destruction of the ossicular chain by chronic inflammation. Many efforts have been made to improve prosthesis design, while less attention had been given to the role of the interface. We present a study on chemical nanocoating on microstructured titanium contact surface with bioactive protein.

Materials and methods

Titanium samples of 5mm diameter and 0,25mm thickness were structured by means of a Ti:Sapphire femtosecond laser operating at 970nm with parallel lines of 5µm depth, 5µm width and 10µm inter-groove distance. In addition, various nanolayers were applied to PVDF foils, while bone matrix protein 7 (BMP-7) was linked to the outer coating layer.

Results

Chondrocytes could be cultured on microstructured surfaces without reduced rate of vital / dead cells compared to native surfaces. Chondrocytes also showed contact guidance by growing along ridges particularly on 5µm lines. On PVDF foils, chondrocyte growth was doubled in contact with BMP-7 compared to hydrogel layer or native surface.

Discussion

According to these results, relative preference for cell growth on titanium prosthesis contact surfaces compared to non-contact surfaces (e.g. prosthesis shaft) can be achieved by nanocoating. Relative selectivity induced by microstructures for growth of chondrocytes compared to fibrocytes is subject to further evaluation.

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