Cell-Adhesion and Bone Integration on Different Plasma Coatings

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The secondary implant stability is of essential importance for the outcome of cementless joint replacement. Therefore, the implants have to be integrated in the surrounding bone stock. Bone cell on-growth can be supported by modifications of implant surfaces and can contribute a fast integration of the implant into the bone stock. Different plasma coatings on surfaces of endoprosthetic implant are in development to improve their osseous integration. In order to analyse the effects of plasma coatings measurement of the adhesive strength of bone cells on implant surfaces is of high interest and a preclinical possibility to prove surface properties [1]. Furthermore, the in-vitro data have to be validated with appropriate in-vivo models.

Thereby, plasma polymerised allylamine (PPAAm) [2] and plasma polymerised ethylenediamine (PPEDA) [3] coatings were deposited on TiAl6V4 disks samples. For determination of cell adhesion polished disks were used and shear stress of the bone cells, as the parameter for the adhesive strength, was determined after 24 h cell cultivation on uncoated, PPAAm and PPEDA coated samples. For the animal model uncoated, PPAAm and PPEDA coated rough TiAl6V4 samples were implanted in the tibiae of Sprague Dawley rats. After six weeks bone integration of the different samples was analysed via micro-computer-tomography and histology.

Bone cells showed a better early adhesion on PPAAm and PPEDA coated implant surfaces. After 24 h shear stress of MG 63 cells was significant higher on PPAAm ($p \leq 0.05$) and PPEDA ($p \leq 0.05$) coated samples compared to uncoated samples. Between both plasma coatings no significant difference ($p = 0.31$) was observed. After six weeks in the animal model the uncoated and plasma coated samples showed bony integration, whereas no significant difference in the bone-implant contact area between all three surface were found.

The initial better in-vitro adhesion of bone cells on plasma coated implant surfaces showed no influence on bone integration after six weeks in-vivo. However, the better adhesion of bone cells on plasma coated implant surface could be advantageous, concerning the „race for the endoprosthetic surfaces“ against bacterias in order to enable prevention of implant related infections.

This work was supported by the BMBF program Campus PlasmaMed (sub-project PlasmaImp 13N9775, 13N11188).

References

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