Thesis Summary (Abstract)

Experimental research on the interactions that occur at the biomaterial-tissue interface

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By this thesis one aimed to obtain new results on phenomena occurring at the biomaterial-tissue interface, the interface parameter analysis being performed according to the biomaterial type, the surface roughness and the implantation time. The obtained results have allowed the recommendations for the use of implants with a certain chemical composition, prepared with a certain roughness, to be used a prescribed period of time, depending on the specific requirements of each patient. The most representative approach to the problems of the interactions between the biomaterial and the tissue in which is implanted consists of the study of phenomena and processes occurring exactly at the interface between this material and the living organism in which it was inserted, which is also the subject study of the thesis. The implant surface microstructure significantly affects the cell configurations as well as the tissue quantity formed in the interface. Therefore, the biocompatibility of an implant is just one of the parameters that influence tissue response to metal implants; the surface morphology of the microscopic structures is also important, since the main problem limiting the application and operation of metal implants is the lack of implant viable anchoring within the tissue. On this basis, experimental studies were carried out on implants having different microstructures and macrostructures that have been used in order to achieve a better long-term anchoring and stability of the implant support.

Experimentally, in order to make a relevant study regarding the interactions that occur at the biomaterial-tissue interface, to approach the subject from different perspectives was necessary. A first step was the selection of metallic biomaterials classes covering a large range of materials commonly used in implantology, followed by their characterization from compositional and microstructural point of view. Since corrosion is still one of the major limitations of the use of metallic biomaterials in implantology, experimental research on electrochemical corrosion resistance in artificial physiological solution environments were conducted.

Taking into account the results of the preliminary characterization cytotoxicity tests were performed (to test the in vitro interaction) by implantation of the metalic samples prepared with different roughness surfaces in animals (in order to obtain significant results of the in vivo interactions that occur at the interface Biomaterial-tissue). The experiments made in order to quantify the interactions of biomaterial-tissue interface were of passive type.

The results led to the conclusion that regardless of the type of alloy, there is a direct proportionality between the implant surface roughness and the speed of transformation of the periimplantar tissues in mature bone. Metallic implant surfaces must be exactly characterized by standard procedures with respect to height, width and surface finish, as well as those relating to the chemical composition, since impurities can be detected based on the implant obtaining method. The surface structure must be irregular and to allow the mechanical fixation between bone and surface irregularities. Depending on the surface roughness and structure, the amount of biological tissue from the implant surface increases with the increase of the surface roughness. Implants structured surfaces that allow mechanical fastening ensures a better and faster incorporation of the implants in hard tissues. However, a smaller contact of the bone with the interface is required in order to allow a better fixation of the implant and obtaining elasticity of the achieved couples.