

Abstract

This dissertation thesis deals with the evaluation of biocompatibility and osseointegration of nanostructured titanium materials used for dental implants. Bulk material topography and surface modification of titanium are currently of intense research mainly due to the significant impact on biocompatibility and improvement of osseointegration of dental implants.

In the theoretical part are described types of titanium material and different methods of its surface modification. *In vitro* and *in vivo* biocompatibility and osseointegration tests are described as well.

The experimental work consists of two parts of experiments. In the first experiment, we examined how grain size of nanostructured titanium material influences the behaviour of fibroblastic as well as osteoblastic cells growth on its surface. The experimentally obtained data were statistically analysed and discussed. Grain size was proven to be an important factor that influenced not only the strength of material but also its interactions with cells.

The second experiment describes current methods used in the experimental evaluation of osseointegration of dental implants. The results of histological staining methods are illustrated and compared. A standardized and reproducible technique for stereological quantification of bone-implant contact is proposed and demonstrated. Surface modifications were verified to play a very important role in biocompatibility and osseointegration. Surface roughness significantly increases the contact area between implant and peri-implant bone. Practical recommendations for the experiment, harvesting of samples, tissue processing and quantitative histological evaluation are provided.