The objective of the planned research project is the quantitative, visual representation of the migration process of elements derived from implants and prostheses based on metals and alloys into the surrounding soft tissues by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). This technique allows for mapping the content of elements depending on the examined sample area with a resolution as low as 10 microns and low limits of detection.

LA-ICP-MS is a very useful analytical technique which allows the in situ determination of elements on the surface of the solid sample. The combination of laser microprobing with ICP-MS detection is characterized by minimal sample pretreatment, micro-destructive effect on the sample, multielemental analysis, measurement of isotopic ratios and high sensitivity. This technique offers great opportunities in the elemental bioimaging of clinical samples, investigating the mechanisms of disease, prosthetic material interaction with the surrounding tissue or transport and site of action of a drug. LA-ICP-MS is a comparative method that relies on signals from a set of calibration standards prior to the analysis of the sample. Although treatment of the sample and the measurement itself is relatively fast and easy, the planning, preparation and execution of calibration standards in the quantitative analysis by LA-ICP-MS must be carried out carefully and thoroughly, taking into account the structure, characteristics and composition of the sample, in order to accurately reproduce the actual distribution of elements.

In the present research work it is planned to perform multielemental quantitative analysis of soft tissues collected from patients treated with dental implants. Additionally, visualization will be carried out in the form of two-dimensional plane and three-dimensional space which, as expected, will reveal the variable content of analytes, depending on the distance from the implant. The three-dimensional visualization is time and labour consuming, requires long data processing and is rarely carried out using the LA-ICP-MS. The novelty will be the ablation of the consecutive surface layers which will show the three-dimensional map of the distribution of the analyzed elements in a single measurement on a single sample after proper data treatment. Up to this time, a similar study consisted of ablation of previously cut, separated thin layers of tissue. In addition, statistical inference will be carried out based on the results of studies taking into account the parameters associated with donors, ie. age, sex and place of the oral cavity from which the tissue was collected, and also the type of used implant system.

Information obtained from the planned research will expand knowledge about the processes occurring in the tissues in the vicinity of metal implants, which are placed not necessarily only in the oral cavity, but in the different body parts as well. The elements that are components of alloys can cause allergies leading in extreme cases to a lack of biocompatibility and implant rejection or poisoning of the body. Although titanium is considered the anallergic metal, a certain low percentage of patients experience the allergic reactions after implantation of titanium implants. In addition, the implants, bolts and nuts, which remain in the body of the patient during implantation period, may consist of alloys containing other elements such as aluminum, zirconium or vanadium. The knowledge obtained from planned study may contribute to the improvement of the composition and properties of materials used to produce implants. As a result, this could lead to improvement of the patients’ health and the rate of the successfully ended therapy.