Reconstruction surgery is one of the most dynamically developing area of medicine. In the literature it can be found, that it is very important to find proper material, constructions and preparation technologies. Exploitation durability of medical construction is mostly connected with their resistance on tribological and corrosion wear. Increase of exploitation durability has crucial economic and social meaning.

Friction and wear of implant biomaterials is very important problem of multielemental conjunctions of medical constructions. Extremely dangerous are friction processes in conditions of fretting (which happens while vibrational movements, lower than 100 μm, are present), and also accompanying corrosion (fretting-corrosion). This type of friction (in micromovements conditions) occurs in majority of nominally permanent kinematic conjuctions of medical constructions: reconstruction surgery (implants, bone fracture), stomatology prosthetics and orthodontics. Fretting causes friction destruction (fretting-wear) and leads to intensification of fatigue destruction processes of materials (fretting-fatigue). Wear of prosthetic constructions in many cases leads to need of its exchange, because only this allows to reconstruct their primary properties. At the same time, excessive wear of biomaterials which work in tissue environment, may cause adverse influence on human body, and be a reason of many diseases (inflammations, allergic reactions, metalosis) or even cancer.

The main goal of this project are friction and wear studies of biomaterials used in reconstruction surgery, mostly metallic implant alloys and ceramic biomaterials in fretting environment. Very important element of this research are methodology aspects and better knowledge of fretting and fretting-corrosion phenomenon of biomaterials. Many existing studies concerns fretting and fretting-corrosion, but only few of them focus on the role and influence of body fluids on these processes. Very interesting seems to be the fact of creation of biofilm and boundary layers on the biomaterial surface. When surface layer is made of metal oxides, it is called adsorption layers, when organic components of body fluids creates on the biomaterial surface, adhesive layers occurs. Those layers, can limit or intensify destruction processes. It depends on the environment conditions, and body fluids promotes their creation.

Studies realized in the project in the first case assumes estimation of friction and wear of chosen metallic and ceramic biomaterials in fretting conditions. As a second task, we would like to estimate influence of saliva environment, synovial fluid, and model body fluids on mentioned processes. Fretting studies will be done on special tester, designed and made at the Department of Materials and Biomedical Engineering of Bialystok Technical University. Connection of tester with potentiostat allows to realize corrosion and fretting-corrosion processes, with special methodology, described in full presentation of this project. Because of character of fretting wear, there will be also made fatigue tests with universe testing machine. Surfaces of tested biomaterials will be observed with use of scanning electron microscope, and confocal microscope. Possibility of 3D imaging allows for detailed measurements of volume wear, and also for supplement estimation of destruction of friction surface. During realization of the project, there will be also done primary characterization of physicochemical (pH, surface tension, conductivity), rheological (viscosity, viscoelasticity) properties of model body fluids, saliva and synovial fluid. Use of special measurement apparatus allows for characterization of chemical composition of the samples and wear products, created during friction. Results of this studies will be used for interpretation of the tribological tests.

Main reason of adoption of this subject is lack of the literature information of mechanisms of creation of boundary layers formed in environment of biological fluids, and also their influence of friction processes in fretting conditions. Realization of this project will contribute for broadening of knowledge of biomaterials degradation. Except many important cognitive advantages, obtained results will have great utilitarian meaning, especially in case of increase of durability and reliability of medical devices, and at the same time, improvement of quality of patient treatment.