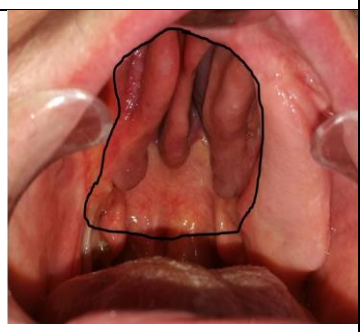
DO YOU KNOW THAT:

- Palatal cancer is a highly malignant cancer - it rapidly infiltrates surrounding tissues. The mortality rate for an advanced lesion is over 70% within 5 years.
-Radical resection of large palatal tumours requires removal of part of the maxilla including the alveolar process. The operation results in the opening of the nasal cavity, with consequent speech disorders and accumulation of food contents into the nasal cavities. In this case, patients are fitted with an obturator - a protrusion from the denture plate that closes the communication opening.



WHAT IS THE PROBLEM?

Due to the numerous infiltrations, surgery is usually insufficient to cure oral cancer. Radiotherapy is most often used supportively, chemotherapy less frequently due to its debilitating effect on the whole body. The possibility of local cytostatic therapy offers the possibility of effective treatment with limited side effects.

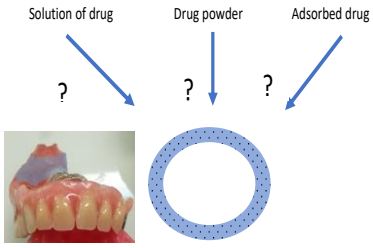
WHAT CAN WE DO ABOUT IT?

The basis of modern chemotherapy is the association of several cytostatics belonging to different classes. We can develop a locally applied carrier of cytostatic drugs whose interaction will give a positive clinical effect. Drug release from a carrier should occur over a relatively long time (several weeks); hence the carrier must be a sufficient reservoir of drug mass for the duration of therapy.

HOW DOES THE PROJECT RELATE TO THIS PROBLEM?

The project proposes to develop a carrier for cytostatic drugs that is also a seal for the obturator. The model cytostatic drugs will be 5-fluorouracil and doxorubicin. The sealing material currently used in oncology prosthetics is a polysiloxane-based gel. Its possible modification could be dictated by increasing the diffusion coefficients of the drug molecules. The drug will be introduced into the carrier as a solution, powder and after adsorption onto the selected sorbent. Additionally, the loading of the carrier with the drug can be increased by dissolving the drug in supercritical CO_2. Flake graphene oxide, resistant (amylose-rich) starch, montmorillonite (aluminosilicate) and mesoporous silica will be considered as sorbents in the project.

The selection of the administered form of the drug will be dictated by the ability (rate) of its release from the carrier, the possibility of loading the carrier with the drug and the mechanical resistance of the structure, which, in addition to the drug reservoir, is the seal of the obturator. A siloxane structure with a shape ultimately matching the obturator and similar to a ring, including the selected form of the drug, will be printed on a 3D printer.



WHAT TASKS DO WE NEED TO ACCOMPLISH?

The project requires, among other things:
- determination of the diffusion rates of the selected cytostatics in structures based on polysiloxanes;
- sorbent selection - determination of sorption equilibrium, desorption kinetics and mechanical strength of polysiloxane structures containing sorbent as well as drug solution and drug powder;
- development of a transport model and its verification for the ring structure together with the indication of the process (resistance) controlling the rate of drug release;
- analysis of drug release under oral conditions - application of computational fluid dynamics (CFD) taking into account saliva flow at the site of obturator attachment;
- assessment of cytotoxicity to normal cells and cancer cell lines;
- tests under near-real conditions during planned therapy on a cancer cell line.