## Introduction

**Слайд 1**; Hello everyone, today we are going to introduce you to the world of dental lasers,

**Слайд 2**; In this presentation, you are going to hear more about how a laser works, about different interactions between the lasers and various tissues and the uses of different laser technologies in dental medicine and oral and maxillofacial surgery.

And now let's get started

**Слайд 3:** First of all, the word LASER is an acronym for light amplification by stimulated emission of radiation. A laser emits a beam of coherent light through an optical amplification process.

Lasers were introduced into the field of dentistry as they are a precise and effective way to perform many dental procedures. Treatment with lasers provides hope of overcoming the disadvantages of “traditional” dental procedures like imprecision of the hand, pain and recovery time. Laser technology has had an impact on every discipline of dental medicine including oral medicine, oral surgery, pediatric and operative dentistry, periodontics, implantology, and prosthetic dentistry. Unfortunately, there are a few disadvantages of lasers in this field. The main are the disability to treat teeth with fillings, interdental cavities and remove damaged prosthetic restorations. The price could be a problem as well.

**Слайд 4:** There are 4 main types of laser interactions with tissues; The first one is ***absorption***, which is characterised by the absorption of the beam by the tissues. The absorption depends on the wavelength of the laser and the type of tissue. This enables the usage of lasers on different tissues without impacting other neighbouring tissues. ***Transmission -*** depends on the wavelength of the laser beam and is characterising the effect on adjacent tissues, ***Reflection*** - is exactly what it sounds like and is the laser not reaching the targeted tissue and having an impact on other unintended tissues that the beam was reflected to. ***Scattering*** - is occurring when the laser gets scattered, thus the surrounding tissue absorbs heat which can lead to unwanted damage to the bordering tissues.

**Слайд 5:**

**Lyubo:** Lasers are classified into 5 major categories. There are gas, liquid, solid semiconductor and excimer lasers. Here we will present the most commonly used ones.

 **Diode Lasers** which are solid have a wavelength of 800 to 900 nm. *(The diode laser is manufactured from solid semiconductor crystals made from a combination of aluminium (with a wavelength of 800 nm) or indium (900 nm), gallium and arsenic)* These lasers are excellent for soft tissue surgery, as these wavelengths are poorly absorbed by the hard tissues in the mouth. This laser is indicated for gingivoplasty, sulcular debridement and deeper coagulation process on gingival and mucosa. Its biggest advantage is its small size and portability.

**Argon lasers** that belong to the gas ones have two emission argon laser wavelengths used in dentistry: 488 nm (blue) and 514 nm (blue-green). Both wavelengths are poorly absorbed by the hard tissues so just like the diode laser, they are used for sculpting gingival tissues without causing damage to the tooth surface. Another application of the argon laser is an aid for carries detection.

Kris

***CO2 laser;***  is based on discharging a gaseous mixture with CO2, and the whole system is cooled by gas or water. This laser is with a wavelength of about 10 600 nm which falls into the infrared spectrum. This means that this laser can be easily absorbed by water and doesn't have a great penetrating ability. This laser is most often used for coagulation and cutting soft tissues. The post-operative pain is little to none, But on the downside, there can be delayed wound healing. The laser with its properties is used in the treatment of mucosal lesions.

***Nd-YAG laser:*** Is a laser working with a solid diode made from garnet, as well as aluminium and yttrium, these 3 materials are doped by neodymium ions. The length of this laser is around 1060 nm and is used to treat soft tissues. The laser provides great homeostasis, due to which, procedures such as coagulation and cutting of soft tissues are becoming standard. On the downside when there is a decrease in the pulpal function the laser can cause damage to the pulp.

***Erbium, Cr: YSGG;*** they have a diode made of a solid crystal of yttrium scandium and gallet the length of these lasers is 2780 nm

***Erbium: YAG;*** has a diode made of a solid crystal of yttrium aluminium garnet, doped with erbium. These two lasers can be used in caries aid to prepare the cavity. The penetration of this laser is minimal so the effect on the pulp is minimal as well. these lasers are less likely to induce pain in the patient since they act as an anaesthetic.

***Er-Cr:YSGG Laser:*** is widely used in restoration and etching with the ability to provide a rough surface for bonding with no harm to the tissue. Its advantage is that it is safe to use on carious lesions near the gingiva.

**Слайд 6:**

**Любо: hard tissues**

Ok, so we are going to look over the laser procedures that affect the hard dental tissues

**Caries Detection**

The method is called laser-induced fluorescence. When the diode laser irradiates the tooth, the light is absorbed by organic and inorganic substances present in the dental tissues, including bacteria. These bacteria show fluorescence after excitation by red light. Therefore, carious tissue exhibits more fluorescence as compared to the healthy tissue

**Caries Removal and Cavity Preparation**

The Er: YAG lasers are proven to be safe and effective in caries removal and cavity preparation in pediatric and adult patients without significant damage to tooth structure or patient discomfort. This device also aids in the removal of defective composite restoration and ablate the distal carious lesion

**Calculus Removal**

The Er: YAG lasers are effective in removing lipopolysaccharides and other root surface endotoxins and are highly bactericidal

**Assisted Bleaching**

Using the 488-nm argon laser as an energy source to excite the hydrogen peroxide molecule offers more advantages than other heating instruments while avoiding any adverse effects. Lasers can enhance bleaching by photo-oxidation of coloured molecules in the teeth or by interaction with the components of the bleaching gel through photochemical reactions

**Surgical Procedures**

CO2 lasers make relatively deep and precise incisions and thus excellent hemostasis. There is less traumatic bone cutting with the use of Erbium lasers resulting in postoperative discomfort for the patients. The CO2 laser provides a bloodless field, less post-operative discomfort, tissue coagulation and better accessibility in some areas of the oral cavity compared to conventional scalpel surgery.

**Kris:**

***Laser curettage***: is a non-invasive procedure performed with the help of Nd: YAG and diode lasers. They can help improve the outcome of mild and moderate periodontitis. The lasers are so effective because of the antibacterial effect of these lasers, but the advantages end there.

**Laser-assisted incisional and excisional biopsy:** the procedures are done at 100°C with the lasers in cutting or focused mode, following the surgical outline. The procedure works by the laser vapourising intracellular and extracellular water as well as minor parts of soft tissue, but if the temperature rises above 200°C this can result in permanent necrosis of the tissue.

***Photodynamic therapy (PDT):*** is a powerful laser-initiated photochemical reaction. The purpose of this reaction is to treat and remove malignancies of the oral mucosa in particular, multifocal squamous cell carcinoma. These interventions can be damaging to the surrounding tissue resulting in apoptosis and necrosis.

As this method destroys almost all the tumour cells, it is proven that this therapy can lead to activating immune response by activating the anti-tumour immunity by activating macrophages and T lymphocytes. This treatment is well tolerated due to the quite short healing time for ulcerated lesions that take up to 8 weeks without any difficulties.

***Lasers in Pediatric Dentistry:*** The use of lasers in pediatrics helps with fast, precise and selective interventions. The absence of needles and high-speed machines is more comforting for the children, plus there is no need for stitches.

As well as the requirements that need to be fulfilled for a laser to be used. The soft tissues can specifically indicate whether they can be treated with lasers. Such indications include gingival depigmentation gingivectomy and more. The lasers can be easily used to remove benign growths such as fibromas