

# CERTAIN DENTAL ASPECTS IN COMPLEX REHABILITATION OF ONCOLOGICAL PATIENTS

## Niektoré stomatologické aspekty v komplexnej rehabilitácii onkologických pacientov

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### Abstract

A high prevalence of malignant tumors in the world has become a medical and social problem in many countries. Prevention, timely diagnosis, treatment of tumors, palliative care and comprehensive rehabilitation of the patient are extremely important. The role of dental specialist in the comprehensive care of an oncological patient is frequently not perceived. The incidence of oral mucositis reaches 85.0% among patients. The infected osteoradionecrosis of jaws is also a problem after irradiation or chemo-radiotherapy for malignant neoplasms localized in head and neck anatomical region. Such patients need special programs of dental examination and rehabilitation in order to prevent the development of the infected osteoradionecrosis. Risk factors for the infected osteoradionecrosis occurrence: increase of the radiation dose, hyperfractionation of the irradiation, level of surgery invasion, especially segmental mandible resection, tooth extraction after radiotherapy, chronic dental caries, marginal periodontitis, apical periodontitis, mucosa irritation by removable or non-removable dentures, secondary surgery after tumor recurrence, tobacco smoking and alcohol consumption. The dental care and treatment need special approaches and protocols including full diagnostics, urgent sanitation of the oral cavity and special procedures for prevention of secondary lesions in the oral cavity as a response to the complex antitumor therapy (Fig. 3, Ref. 56). Text in PDF [www.lekarsky.herba.sk](http://www.lekarsky.herba.sk).

KEY WORDS: oral cancer, chemo-radiotherapy, secondary lesions, prevention, treatment.  
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### Abstrakt

Vysoká prevalencia malígnych nádorov sa stala medicínskym a sociálnym problémom v mnohých krajinách sveta. Prevencia, včasná diagnostika, ich liečba, paliatívna starostlivosť a komplexná rehabilitácia pacienta je mimoriadne dôležitá. Úloha zubného lekára ako špecialistu v komplexnej starostlivosti o onkologického pacienta sa však často nedoceňuje. Pritom incidencia orálnej mukozitídy dosahuje až 85,0%. Problémom je aj infikovaná osteorádionekróza čelustí po ožiarení alebo chemo-rádioterapii malígnych nádorov lokalizovaných v anatomickej oblasti hlavy a krku. Takýto pacienti potrebujú špeciálne programy vyšetrenia chrupu a rehabilitácie ústnej dutiny, aby sa zabránilo vzniku infikovanej osteorádionekrózy čelustí. Rizikové faktory pre vznik infikovanej osteorádionekrózy: vyššia dávka žiarenia, hyperfrakcionácia ožarovania, stupeň invazivity chirurgického výkonu, zvlášť segmentálna resekcia mandibuly, extrakcia zuba po rádioterapii, chronický zubný kaz, marginálna parodontitída, apikálna periodontitída, iritácia sliznice snímateľnými alebo fixnými zubnými náhradami, sekundárne operácie pri recidíve nádoru, fajčenie a konzumácia alkoholu. Zubnolekárska starostlivosť a liečba potrebujú špeciálne prístupy a protokoly zahŕňajúce kompletnú diagnostiku, urgentnú sanáciu ústnej dutiny a osobitné opatrenia na prevenciu sekundárnych lézií v ústach, ktoré vznikajú ako odpoveď na komplexnú protinádorovú liečbu (obr. 3, lit. 56). Text v PDF [www.lekarsky.herba.sk](http://www.lekarsky.herba.sk).

KLÚČOVÉ SLOVÁ: karcinóm ústnej dutiny, chemo-rádioterapia, sekundárne lézie, prevencia, liečba.

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### Introduction

According to the reports of health services in a number of countries there is evidence of a consistently high prevalence of malignant tumors in the population, and this situation transforms cancer and other non-benign neoplasm as one of the most pressing issues of

health and social well-being. According to the WHO data in the general structure of mortality cancer is in the second place after diseases of the circulatory system. In modern conditions issues of prevention, timely diagnosis, treatment of tumors, palliative care, comprehensive rehabilitation of the patient and ensuring the

appropriate level quality of life are extremely important. The role of dental specialist in the comprehensive rehabilitation of an oncological patient is not perceived by many specialists unequivocally (4,20,52,54).

The incidence of cancer in the world is high and its trends are disappointing - annually more than 10 million new cases are detected in the world. In the structure of mortality of the population of the „first world“ malignant neoplasms occupy the third place. A mortality caused by them reaches 13.0%, there is a negative trend in their spread. According to public health experts, the number of patients living with malignant neoplasms may reach up to 1.4% of the population in many countries (18,19,21,51,52).

Thus, actuality of a special program of oral cavity sanitation and dental rehabilitation is high, and mostly, dental specialists of general practice have insufficient knowledge and practical experience about special approaches of treatment the patients with oral cancer.

#### **The problem of oral mucosa lesions in the complex treatment of malignant tumors**

According to the European Society of Medical Oncology, the incidence of oral mucositis of the 3rd-4th degree according to the WHO scale reaches 85.0% among patients who receive chemotherapy (CHT) and radiotherapy (RT) in the head and neck area, weak degree of mucositis are present among almost every patient obtaining the anti-neoplasm complex treatment (3,5,9,12,17,37).

Nowadays, association of the CHT and the RT has become a standard treatment approach for the head and neck cancer. And in cases of the head and neck tumor localization secondary oral lesions tend to be more severe and complex. Due to a lot of reports oral mucositis is the main side effect of complex antitumor therapy. Severity of the oral mucositis depends on localization of tumor and number of the CHT and the RT sessions. The oral mucositis, as a severe inflammatory reaction, is not a separate pathology. In most cases this is a sign of generalized lesions of the gastrointestinal tract, but usually pathological changes of the entire oral mucosa are the brightest and most visible problem (1,6,11,16,45). Generally, the oral mucositis combined with intense oral pain, need for special nutrition, increase of needs of additional oral cavity treatment and possible interruption of main complex antitumor curative scheme. Dramatically, but the oral mucositis is combined with a risk of unsuccessful cancer treatment (Fig. 1).

These unpleasant side effects may influence the survival rate for the patient and affect the economic sphere of specialized antitumor treatment. Contemporary theories of oral mucositis pathogenesis include direct and indirect effect of antitumor chemical agents, ionizing radiation, genetic factor, presence of local infection, poor oral hygiene and local irritation, caused by different agents (low-quality dentures, tobacco smoking, alcohol etc.). Local reactions in mucosa of all parts of the gastrointestinal tract include inflammation, partially

autoaggressive cytokine-controlled hard secondary reactions with presence of high amount of free radicals. Cascade character of mucositis development does not allow to terminate it totally, but we are able to make some modulation on different stages and pathogenetical chains (15,24,27,29,31,47).

**Figure 1. Patient, 72 years old woman, DG: Radiomucositis after RAT for carcinoma in situ of the tongue.** She underwent irradiation for CIS of the tongue margin on the right side. After seven days of the external radiotherapy a severe degree mucositis developed. The RAT had to be interrupted for one week and finished with diminished total dosis.



Thus, local and general side reactions on special complex anti-tumor therapy are not closed problems for both general oncology and dentistry. The oral mucositis and radiomucositis are wide spread diseases, which may decrease the efficiency of antitumor therapy and affect the life quality of the patient. Nowadays, we have no adopted and approved protocols of prevention and special treatment.

#### **Osteoradionecrosis in maxillofacial area is an undesirable side effect of complex antitumor therapy**

In modern oncology the infected osteoradionecrosis is still a major problem after the RT or chemo-radiotherapy for neoplasms localized in the head and neck anatomical region. Disruption of the chewing and swallowing functions among the patients causes hard discomfort and occurrence of osteoradionecrosis lead to elongation of rehabilitation period and decrease of life quality. During the previous 30-50 years we can find enough huge amount of publication and online sources dedicated to infected osteoradionecrosis as a potential side effect of complex chemo-radiotherapy and separated radiotherapy. In etiology of that side effects we can find different levels of surgical methods of treatment, dosage and fractions of the RT together with the CHT and patient`s dental status and health of oral cavity, whose are regarded significant (38,46). More than 20 years ago, in part of radiotherapeutical oncological clinics and in departments of head and neck tumors of oncological medical centers the special programs of additional control and dental examination and rehabilitation in order to prevent of the development the infected osteoradionecrosis among the patients had been started. The main principles of above-mentioned

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programs are the next: all patients referred to irradiation protocols must be preliminary examined by a dentist (stomatologist) or an oral and maxillofacial surgeon, and some additional diagnostic measures, special procedures and rehabilitation may be performed due to the indications. In fact, combined chemo-radiotherapy or RT alone start for those patients after approval of the oral and maxillofacial surgeon. And during the chemo-radiotherapy/RT alone the patients are regularly observed by radiooncologist, oral and maxillofacial surgeon. Such control (with a lower frequency) must be performed also after the period of active complex treatment (33,46,56).

**Risks of the infected osteoradionecrosis development.** Nowadays, in professional literature sources we may find enough lot of information about risk-factors infected osteoradionecrosis occurrence: increase of the radiation dose, hyperfractionation of the irradiation, level of surgery invasion, segmental mandible resection, tooth extraction after radiotherapy, tumor, chronic dental caries, marginal periodontitis, apical periodontitis, mucosa irritation by removable or non-removable dentures, secondary surgery after tumor recurrence, tobacco smoking and alcohol consumption (32,48). The infected osteoradionecrosis of the jaws appears be very hard and dangerous complication of special complex anti-neoplastic treatment. It cannot be controlled totally, but we can consider the list of risk-factors and predictors for its development (50). Role of a dentist prior sanitation of oral cavity is crucial in prevention of the infected osteoradionecrosis in maxillofacial area.

### **Co-morbidity of oral lesions among the oncological patients**

Generally, diseases and lesions of the oral mucosa mostly manifest existing general somatic pathology, they are reflection of the general condition of the body and health status. According to results various authors, the prevalence of diseases of the oral mucosa in the population ranges from 3.0-5.0% to 8.0-20.0% (53). Clinical examination of patients (more than 500 cases) with malignant neoplasms of different localization showed some disruption in health level of the oral cavity. Thus, caries intensity (caries/filled/ extracted) was  $18.23 \pm 1.51$ , hyperplasia of the filiform papillae of the tongue occurred in 52.2% of cases, atrophy of the papillae of the tongue 2.7%, „geographical tongue“ (desquamative glossitis) 30.2%, candidiasis 19.1%, herpetic lesions 5.4% (22,49).

Results presented by Kostenko et al. (2020) showed that the average caries intensity (caries/filled/extracted) among patients with malignant neoplasms of different localizations was  $13.7 \pm 1.0$ , the Green Vermilion index (OHI-S-index)-  $2.2 \pm 0.3$ , the index inflammation of the marginal periodontium (Parma test/PMA)  $41.4 \pm 9.8\%$  (25). In the cohort 76.2% of patients had metal artificial crowns or other dental prostheses installed in the oral cavity. Further, 56.9% of patients had retained roots of severely damaged teeth, 13.1% needed emergency den-

tal care (analgesia or treatment of exacerbation of chronic odontogenic and periodontal infection). In general, patients visited the dentist  $0.8 \pm 0.4$  times during the previous year. Rehabilitation of the oral cavity before admission to the hospital was not performed. Only 9.3% of patients used additional devices for personal hygiene of the oral cavity (53).

Thus, stomatological co-morbidity among patients with malignant tumors is very high. It determined by prior lack of dental health and low level of oral hygiene skills, and also, by side effects of surgical procedures and combined chemo-radiotherapy. This fact works as rationale for developing of special dental protocols for the patients with oral cancer.

### **Dental interventions and complex antitumor treatment**

Nowadays, after the 2-3 decades of clinical observation of the patients with oral cancer revealed that the role of the dental specialist (i.e. doctors and hygienists) in the care of a patient before, during, and after the course of complex anti-tumor therapy is the crucial. Before beginning of complex antineoplastic therapy better to provide for dental specialist the whole complete information about patient's general health status, pathological changes and character of planned treatment (chemical agents, doses, radiotherapy cancer-modulators etc.). During the dental status diagnostic, a number of x-ray studies must be performed to obtain the information about possible periapical changes, defects of present dental restorations and bone lesions. After the clinical evaluation (for dental, endodontic and periodontal status) and analysis of the whole accessible information the dental specialist may provide the correct prognosis of oral cavity changes during the special complex antitumor therapy and to plan a correct special intervention in the due time. It is critical to recognize the potentially malignant signs for future complex treatment plan in order of prevention of unwanted side effects of the main treatment (25).

**Xerostomia prognosis.** Due to high presence of xerostomia and hyposalivation among patients on complex anti-neoplastic therapy it is better to perform special diagnostic (e.g. quantitative sialometry) which will help to evaluate the signs of salivary gland hypofunctions and to predict the potential dry mouth problems. Also, that findings may help to improve the special diet for the patient (47).

**Odontogenic infections prognosis.** Except the low frequency of odontogenic infection cases in clinical practice, secondary depression of immunity among the patients who receive antitumor treatment may cause a bacteremia and all sources of oral infection have a potential risk of generalized spreading. That means that chronic marginal and apical periodontitis, poor oral hygiene, primary and secondary dental caries, insufficient dental fillings may act as predictors of future problems. Modern approaches of complex antitumor therapy recommend creating an individual stomatologi-

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cal treatment plan before complex antineoplastic therapy starting due to a short period of preparing the patient to main treatment. Also, dental specialist has to prepare for patient the personal plan of oral cavity care and hygiene maintaining together with curative procedures for period of active antitumor complex treatment and after its finishing. General dental sanitation procedures must be performed prior to main treatment, and they should be done in maximally careful mood. The problem of improper dentures has to be resolved. Tartar removal, enamel fluoridation and chlorhexidine bi-glucuronate rinses are strongly recommended. This chemical substance in concentration 0.05-0.12% water solutions is effective against lot strains of bacteria and fungi, also it is able to decrease gum bleeding and dental plaque accumulation. Endodontic procedures must be performed carefully and optionally only due to the clinical situation and level of oral hygiene. All endodontic procedures must be finished up to 7 days prior to antitumor treatment. In cases of acute periapical infections and for tooth with unclear and questionable curative prognosis extraction of the tooth is preferred. Teeth removal must be performed at least 2-3 weeks before beginning of complex anti-tumor treatment. These procedures have to be followed by primary wound closure and sutures placing, without alveolar socket preservation or hemostatic materials placing. In the cases of thrombocytopenia (less  $40 \times 10^{12}/L$ ) and decrease of neutrophil granulocytes level (less  $2 \times 10^9/L$ ) platelet transfusion and antibiotic administration must be provided. Non-invasive dental and oral procedures should be performed at least 2 weeks and highly invasive manipulations – 4-6 weeks before active antitumor treatment. Patients with bisphosphonates therapy need more careful and atraumatic teeth extraction due to a higher risk of spontaneous osteonecrosis. Anyway, oral hygiene should be saved on high level during the whole period of active treatment and rehabilitation. Some patient may need special ultra-soft toothbrushes and other additional devices. Also, the patient has to avoid a cariogenic food (4,8,42).

**Special dental rehabilitation and preventive treatment.** Some groups of patients also need the manufacturing of special dentures and obturators and permanent or temporary apparatuses to repair the functions of speech, mastication, and breathing. During the active period of antitumor therapy dental and surgical procedures are not recommended, only in the cases of urgency.

According to high risk of the secondary lesions and side effects of complex antitumor therapy, the treatment protocol should include some medications and measures to stabilize oral cavity status and prevent the complications. They may include usage of chlorhexidine solutions, saline oral irrigations, fluoride toothpastes, ice chips applications, benzydamine hydrochloride locally, non-steroid antiinflammatory remedies which act as pain-killers (nimesulid, paracetamol, diclophenac, aceclophenac, metamizol). But anyway, it should be to re-

member about increase of their toxicity for patient on antineoplastic chemotherapy, and also the main treatment may cause cardiotoxicity, hepatotoxicity, nephrotoxicity, ototoxicity or gastrointestinal lesions. Sometimes, the preventive courses of antibiotics and antifungal agents are required due to the high risk of oral and general candidiasis development during the CHT (2,23).

During the period of the chemo-radiotherapy all invasive and traumatic dental manipulations are contraindicated, except the life emergency situations. In cases of extremely needs tooth extraction may be performed but it must be covered by antibiotics, done with atraumatic approach without alveolar socket curettage and finished by sutures placing. As side effects after the completion of the CHT reside may be disruption of feeding, in a lot of clinical cases the patient can eat and drink small frequent meals. This fact has an influence on special diet composition – with high calorizing and special food preparing (30,35,42).

Complication of the complex antitumor therapy may occur during some months after active period of treatment. Due to this fact, the patient has to be observed by a dental specialist regularly during the the first 3-4 months, tooth extractions and other invasive stomatological procedures should be avoided at least up to one year after the active cancer treatment. In the cases of life-threatening situations that procedures may be performed but only with antibacterial coverage (begins from 48 hours before manipulation and lasts till 7 days and more). Usually, patients are not recommended to use removable dentures up to to 1 year after the active oncological treatment. Successful dental implantation is possible for patients with lower doses of the RT – up to 20 Gr and every case is subject for proper planning and decision-making. Inability to use all modern technologies of stomatological treatment may also affect the life quality of patients (8,41).

Quantity of re-examination of patients by dental specialist is appointed on the level one per month during the first three months and one per three months later during first year, and later – two times annually. The special dental management before, during and after chemotherapy is obligatory procedure for patients on antitumor therapy as it associated with a range of side effects, and nowadays, we cannot avoid these effects. The oral cavity is a usual site side effects combining with discomfort and pain statuses, and it engraves the contribution of dental specialist in general rehabilitation of the patient.

Thus, performing of invasive and non-invasive dental procedures for patients with oral cancer during and after special treatment – additional risk for patient and sometimes, determined by hard and acute pathology. Generally, all procedures have to be cancelled or delayed. In modern period the oncology and dentistry have an acute need to clearly define the zones, periods and complexity of possible dental treatment for above-mentioned clinical cases.



## Usage of dentures and osteoradionecrosis

Problem of prediction of osteoradionecrosis among patients on special antitumor complex therapy and wear non-removable, partially removable and total removable dentures is still unclear and opened (Fig. 2).

**Figure 2. Patient, 73 years old man, DG: Infected osteoradionecrosis of lower jaw on the left side.** He underwent multiple extractions in the mandible and chemo-radiotherapy for squamous cell carcinoma of the tongue. He had fabricated a lower total denture after one year. Despite of pains in the lower jaw the patient did not attend his dentist. The figure 2 shows the situation at dental visit realized two years from end of the cancer treatment.



In world specialized professional literature we can find an information about less amount of complications in maxillofacial area among totally edentulous persons. The main idea of authors is that presence of untreated caries and performed endodontic therapy may hide chronic odontogenic infection which may arise during the temporary immunosuppression caused by chemo-radiotherapy. Additional factors of complication – bad quality of dentures and chronic irritation of oral mucosa and alveolar bone by basis and sharpen margins of dentures. Performed analysis in different available sources shows that osteoradionecrosis may not be associated with denture use, especially well fitted dentures which do not cause trauma. No evident information about such correlations has been found. However, very little evidence exists about risk of secondary chemo-radiotherapy complications for patients who begin to wear dentures early after finishing of main antitumor therapy, nowadays, this problem and statement are questionable (40,50).

According to Semin (2011), in the etiology of the development of pathological changes in the oral cavity there are three of the main groups of factors: 1. Status and metabolic products in dental plaque and dental plaque; 2. Factors of the oral cavity that can enhance or weaken the pathogenic potential of microorganisms and their metabolic products; 3. General factors regulating the metabolism of the tissues of the oral cavity, on which the response to pathogenic influences depends (44).

At the same time, the RT leads to damage to blood vessels and microcirculatory disorders, as a result of

which dystrophic changes in the periodontal tissues occur. The microflora of the oral cavity works against the background of a reduced barrier function of the periodontium which causes an inflammatory process, that, in the presence of primary dystrophy, contributes to the progression of destructive changes in the periodontal tissues and bone structures (fig.3) (44).

**Figure 3. Patient, 62 years old woman, DG: Odontoradionecrosis of residual frontal teeth in the lower jaw.** She was treated for squamous cell carcinoma of floor of the mouth on the left side. After surgery (intraoral resection, neck dissection) and external radiotherapy odontoradionecrosis of the residual frontal teeth developed there 10 months after irradiation. The incisors required additional endodontics and conservative treatment.



Thus, usage of removable and non-removable dentures for patients during special antitumor therapy – is not clear question at all. Modern prosthetic dentistry has to define the conditions and terms of modern dentures usage.

## Conclusions

Reviewing analysis of the specialized literature on the peculiarities of dental treatment among patients during the stages of complex antitumor treatment performed by principles of an information search in depth of 5-10 years (depending on the type of information source) showed that currently malignant tumors of different localization and oncohematological diseases are an urgent and complex problem for the practical health care in all the world. Also, this direction has a prominent medical and social aspect, the oral lesions in the cancers cause disability of a significant number of members of the society, and high percentage of affected patients are of economically active segments of the population. World statistics show an increase in the incidence of tumors of orofacial localization and hemoblastoses, and in the overall structure of the incidence, such indicators exceed the growth rate of tumors in other localizations. The vast majority of patients with malignant tumors of the head and neck belong to the age group of 30-59 years. Despite the simplicity and availability of visual diagnosis of tumors of this location, they are diagnosed correctly enough late – up to 75.00% of patients at the stage of referral to a specialized health care institution

already have a severe stage III-IV of the disease (9,37,55).

High aggressiveness of modern methods of antitumor treatment leads to the development of a wide range of local and general complications and side effects. Regarding the frequency of local complications of specialized treatment in the oral cavity, such as infectious, hemorrhagic, destructive, ulcerative and necrotic changes of mucous membranes (mucositis), it reaches almost 100.00%. Therefore, the urgent problem of stomatology is the prevention and treatment of mucositis and radiomucositis of oral mucosa. The attitude to the problem and the formation of treatment tactics for which are far from unambiguous. Such medical and diagnostic technologies require the use of expensive equipment and long-term training of medical and paramedical personnel (10,26). In addition, the presence of untreated periodontal diseases, lack of proper oral hygiene care skills among patients, some bad habits contribute to the development of mucositis, osteomyelitis of the jaws during the CHT and RT and afterwards. Accordingly, modern practical health care and oncological care needs a scientific substantiation of the oral rehabilitation of the oncological patient and the improvement of algorithms for its implementation (7).

Organization of specialized dental blocks at all oncological departments and specialized hospitals staffed not only by a qualified dentist who knows the specifics of changes in the oral cavity during the chemo-radiotherapy, but also by a specialist in the prosthetic dentistry who should participate in planning of the main treatment and develop measures for the rehabilitation of patients, will help improve quality of life of the affected patients (13, 39).\*

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## References

1. ACHARYA S, PAI KM, BHAT S, et al. Oral changes in patients undergoing chemotherapy for breast cancer. *Indian J Dent Res* 2017, 28: 261–268.
2. ARANTES D, COSTA N, RESENDE T, et al. Dental approach of orofacial pain in head and neck cancer patients. *Journal of Clinical and Experimental Dentistry* 2018, 10 (11): 1082–1090.
3. AVANESOV AM, GVOZDIKOVA EN. Determination of dental risk groups for the development of radiation mucositis in patients with squamous cell carcinoma of the oropharyngeal region on the background of radiation therapy. *Lučevaya diagnostika i terapiya* 2017, 2 (8): 66–68.
4. BOWEN JM, ELAD S, HUTCHINS RD, LALLA RV. Methodology for the MASCC/ISOO mucositis clinical practice guidelines upda-

- te. *Support Care Cancer* 2013, 21: 303–308. Doi.org/10.1007/s00520-012-1592-7.
5. CARNEIRO-NETO JN, DE-MENEZES JDS, MOURA LB, et al. Protocols for management of oral complications of chemotherapy and/or radiotherapy for oral cancer: systematic review and meta-analysis current. *Med Oral Patol Oral Cir Bucal* 2017, 22 (1): e15–23.
6. CINAUSERO M, APRILE G, ERMACORA P. New Frontiers in the Pathobiology and Treatment of Cancer Regimen-Related Mucosal Injury. *Front Pharmacol* 2017, 8: 354–356.
7. CLOUGH S, BURKE M, DALY B, SCAMBLER S. The impact of pre-radiotherapy dental extractions on head and neck cancer patients: a qualitative study. *Br Dent J* 2018, 225 (1): 28–32. Doi: 10.1038/sj.bdj.2018.442
8. CROWDER SL, DOUGLAS KG, YANINA PEPINO M, et al. Nutrition impact symptoms and associated outcomes in postchemoradiotherapy head and neck cancer survivors: a systematic review. *J Cancer Surviv* 2018, 12(4): 479–494.
9. DECIK OZ, RUDKO IV. Analysis of morbidity and mortality from malignant neoplasms of the lip and mouth in Ukraine and Ivano-Frankivsk region for 2007–2016. *Ukrayina. Zdorov'ya nacyi* 2017, 3 (44): 95–100.
10. DELEEMANSJ M, CHLEILAT F, REIMER RA, et al. The chemo-gut study: investigating the long-term effects of chemotherapy on gut microbiota, metabolic, immune, psychological and cognitive parameters in young adult Cancer survivors; study protocol. *BMC Cancer* 2019, 19 (1): 12–43. Doi: 10.1186/s12885-019-6473-8.
11. ELAD S. The MASCC/ISOO mucositis guidelines 2019: the second set of articles and future directions. *Support Care Cancer* 2020, 28 (5): 2445–2447. Doi: 10.1007/s00520-019-05153-w.
12. GEVORKOV AR. Basic principles of management of patients with mucositis and dermatitis during radiation treatment with drug modification of patients with squamous cell carcinoma of the oropharyngeal region. *Opuholi golovy i shei* 2016, 3: 12–21.
13. GOTFREDSEN K, ABDULLAH S. Oral prosthetic rehabilitation with and without implants after radiation therapy and ablative surgery. *Int J Dentistry Oral Sci* 2015, 2: 21–25.
14. GOYAL S, KANSAL G. Complete dentures in cancer patients undergoing radiotherapy treatment. *Int Dent Med J Adv Res* 2015, 1: 1–3.
15. GVOZDIKOVA EN. Features of the tactics of treating oral mucositis in cancer patients on the background of radiation treatment and / or chemotherapy. (Thesis). Moscow: RUDN 2017, 152 p.
16. HONG BY, SOBUE T, CHOQUETTE L, et al. Chemotherapy-induced oral mucositis is associated with detrimental bacterial dysbiosis. *Microbiome* 2019, 7 (1): 66. Doi: 10.1186/s40168-019-0679-5.
17. <https://oralcancerfoundation.org/complications/mucositis/>
18. <https://www.cancer.gov/about-cancer/understanding/statistics>
19. <https://www.news-medical.net/news/20210204/Report-estimates-cancer-incidence-and-mortality-at-the-global-level.aspx>
20. <https://www.who.int/health-topics/cancer>
21. <https://www-dep.iarc.fr/whoddb/whoddb.htm>
22. IORDANISHVILI AK, FILIPPOVA EV, LIEBIKH DA, et al. Optimization of the treatment of diseases of the oral mucosa resulting from the combined treatment of 129 malignant tumors of the oropharyngeal zone in people of older age groups. *Biomedical journal Medline RU* 2013, 13 (89): 1054–1065.
23. IVANOVA OV. Substantiation of complex therapy of dental diseases in patients with locally advanced cancer of the oral mucosa (Dissertation). Saratov 2016, 411 p.
24. KHAV A. Radiation-induced oral mucositis and periodontitis – proposal for an inter-relationship. *Oral Diseases* 2014, 20: 7–18.
25. KOSTENKO YY, RUSYN AV, HELEY VM, et al. Features of the dental status of patients during anti-cancer chemotherapy (Transcarpathian antitumor center experience). *Georgian medical news* 2020, 309 (12): 32–37.
26. LALLA RV, SAUNDERS DP, PETERSOND E. Chemotherapy or radiation-induced oral mucositis. *Dent Clin North Am* 2014, 58 (2): 341–349.
27. LIBIK TV, GILEVA OS, DANILOV KV, et al. Management of cancer therapy-induced oral mucositis pain and xerostomia with extra- and intra oral laser irradiation. *AIP Conference Proceedings* 2017, 1882 (1): id.020044. Doi: 10.1063/1.5001623
28. LIONEL D, CHRISTOPHE L, MARC A, JEAN-LUC C. Oral mucositis induced by anticancer treatments: physiopathology and treatments. *Ther Clin Risk Manag* 2006, 2 (2): 159–168. Doi:10.2147/tcrm.2006.2.2.159
29. LOGAN RM, AL-AZRI AR, BOSSI P, et al. Mucositis Study Group of the Multinational Association of Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO). Systematic

- review of growth factors and cytokines for the management of oral mucositis in cancer patients and clinical practice guidelines. *Support Care Cancer* 2020, 28 (5): 2485–2498. Doi: 10.1007/s00520-019-05170-9.
30. MAHERONNAGHGH M, TOLOUEI S, DEHGAN P, et al. Identification of *Candida* species in patients with oral lesion undergoing chemotherapy along with minimum inhibitory concentration to fluconazole. *Adv Biomed Res* 2016, 5: 132–135.
  31. MERCADANTE S, AIELLI F, ADILE C, et al. Prevalence of oral mucositis, dry mouth, and dysphagia in advanced cancer patients. *Support Care Cancer* 2015, 23 (11): 3249–3255.
  32. NIEWALD M, MANG K, BARBIE O. Dental status, dental treatment procedures and radiotherapy as risk factors for infected osteoradionecrosis (IORN) in patients with oral cancer – a comparison of two 10 years' observation periods. *Springerplus* 2014, 3: 263. Doi:10.1186/2193-1801-3-263.
  33. PATEL V, ORMONDROYD L, LYONS A, McCGURK M. The financial burden for the surgical management of osteoradionecrosis. *Br Dent J* 2017, 222 (3): 177–180.
  34. PENG H, CHEN B.B, CHEN L, et al. A network meta-analysis in comparing prophylactic treatments of radiotherapy induced oral mucositis for patients with head and neck cancers receiving radiotherapy. *Oral Oncol* 2017, 75: 89–94. Doi: 10.1016/j.oraloncology.2017.11.001
  35. PETROVIC I, ROSEN EB, MATROS E, et al. Oral rehabilitation of the cancer patient: a formidable challenge. *J Surg Oncol* 2018, 117: 1729–1735. Doi: 10.1002/jso.25075
  36. POPELO YV, TKACHENKO PI, BILOKON SO. Impact of polychemotherapy on the oral soft tissues in children with malignant abdominal tumors. *Wiadomosci Lekarskie* 2019, 72 (5) cz. III: 978–983.
  37. POULOPOULOS A, PAPAPOPOULOS P, ANDREADIS D. Chemotherapy - oral side effects and dental interventions. A review of the literature. *Stomatological Dis Sci* 2017, 1: 35–49.
  38. RAGUSE J.D, HOSSAMO J, TINHOFFER I, et al. Patient and treatment-related risk factors for osteoradionecrosis of the jaw in patients with head and neck cancer. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2016, 121 (3): 215–221. e211.
  39. RAHNAMA M, MADEJ-CZERWONKA B, JASTRZĘBSKA-JAMROGIEWICZ I, et al. Analysis of the influence of parenteral cancer chemotherapy on the health condition of oral mucosa. *Contemp Oncol (Pozn)* 2015, 19: 77–82.
  40. SAID MM, OROMARU T, SUMITA Y, et al. Systematic review of literature: Functional outcomes of implant-prosthetic treatment in patients with surgical resection for oral cavity tumors. *Journal of Investigative and Clinical Dentistry* 2017, 8: e12207. Doi: 10.1111/jicd.12207
  41. SCHIEGNITZ E, AL-NAWAS B, KAMMERER P, WGROTZ KA. Oral rehabilitation with dental implants in irradiated patients: a meta-analysis on implant survival. *Clin Oral Investig* 2014, 18 (3): 687–698.
  42. SCHWEYEN R, KUHN T, WIENKE A, et al. The impact of oral rehabilitation on oral health-related quality of life in patients receiving radiotherapy for the treatment of head and neck cancer. *Clin Oral Investig* 2017, 21 (4): 1123–1130.
  43. SEKANDARZAD M, VAN ZUNDERT AJ, LIRK PB. Perioperative anaesthesia care and tumor progression. *Anesthesia and Analgesia* 2017, 12 (5): 1697–1708.
  44. SEMIN DY. Interstitial neutron therapy in the complex treatment of tumors of the oral mucosa and oropharynx. II Eurasian Congress on Head and Neck Tumors (abstracts). April 30 – May 3, 2011 Almaty, Kazakhstan 2011, p. 128.
  45. SHIGEISHI H, OHTA K, FUJIMOTO S, et al. Preoperative oral health care reduces postoperative inflammation and complications in oral cancer patients. *Exp Ther Med* 2016, 12 (3): 1922–1928. Doi: 10.3892/etm.2016.3532
  46. SOBUE T, BERTOLINI M, THOMPSON A, et al. Chemotherapy-induced oral mucositis and associated infections in a novel organotypic model. *Mol Oral Microbiol* 2018, 33 (3): 212–223. Doi: 10.1111/omi.12214.
  47. SONIS ST. Oral mucositis. *Anti-Cancer Drugs* 2011, 22 (7): 607–612.
  48. SPIJKERVET FK, BRENNAN MT, PETERSON DE, et al. Research frontiers in oral toxicities of cancer therapies: Osteoradionecrosis of the jaws. *Journal of the National Cancer Institute Monographs* 2019, 53, lgz006. Doi.org/10.1093/jncimonographs/lgz006.
  49. SROUSI HY, EPSTEIN JB, BENSADOUN RJ, et al. Common oral complications of head and neck cancer radiation therapy: mucositis, infections, saliva change, fibrosis, sensory dysfunctions, dental caries, periodontal disease, and osteoradionecrosis. *Cancer Med* 2017, 6 (12): 2918–2931.
  50. STEBEL A, HOCKOVA B, STORCELOVA D, ABELOVSKY J, SLAVIK R, STANKO P. Osteonecrosis of the jaw – treatment of terminal stage disease with microvascular free fibula flap. *Lek Obz* 2020, 69 (12): 473–482.
  51. STUANI VT, SANTOS P, DAMANTE CA, et al. Oral health impact profile of head and neck cancer patients after or before oncologic treatment: an observational analytic case-control study. *Support Care Cancer*. In: Soerjomataram I, Jemal A, Bray F. *Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries*. *CA Cancer J Clin* 2021. Doi: 10.3322/caac.21660.
  52. SUNG H, FERLAY J, SIEGEL RL. Laver manifestations in children and adolescents with cancer submitted to chemotherapy. *BMC Oral Health* 2017, 17: 49–55.
  53. USPENSKAYA OA, FADEEVA II. Features of the dental status in patients with oncological diseases. *Problemy stomatologii* 2019, 15 (1): 63–67.
  54. VELTEN DB, ZANDONADE E, MONTEIRO DE BARROS MIOTTO MH. Prevalence of oral manifestations in children and adolescents with cancer. *Chemotherapy* 2018, 26 (7): 2185–2189.
  55. VOSELMAN N, ALBERGA J, WITJES MHJ. Prosthodontic rehabilitation of head and neck cancer patients – Challenges and new developments. *Oral Dis* 2021, 27: 64–72. Doi: 10.1111/odi.13374.
  56. ZIMMERMANN C, MEURER MI, GRANDO LJ, et al. Dental treatment in patients with leukemia. *J Oncol* 2015, 571739. Doi:10.1155/2015/571739.

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