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ORIGINAL ARTICLE

EVALUATION OF EFFICIENCY OF CHEWING IN PATIENTS WITH ONCOPATHOLOGY OF THE ORAL CAVITY

DOI: 10.36740/WLek202212118

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ABSTRACT**The aim:** The aim of this work is assessment of masticatory efficacy in patients with oral tumors with different localization and severity.**Materials and methods:** The analysis of masticatory efficiency in dynamics was carried out with the help of two-color chewing gum in 29 patients with tumors of the tongue, oral mucosa and mandible. The study was performed at the time of hospitalization and on day 7 after surgery.**Results:** After surgery, masticatory parameters decreased compared to baseline and did not recover on the 7th day after surgery. In patients diagnosed with stage I-III mandibular cancer, masticatory values are below 0.5 (0.34 ± 0.04 ; 0.28 ± 0.03 ; 0.24 ± 0.03), indicating poor food bolus formation ($p < 0.05$).**Conclusions:** This method is informative for the formation of the food bolus, which takes into account not only the presence of teeth, but also the function of the muscles involved in chewing. The extent of soft tissue defects plays a more important role in chewing than the presence of dentition and jaw defects. The presence of even 8-10 teeth on the upper and lower jaws may be sufficient for satisfactory grinding and chewing, with a mixed fraction of up to 0.75.**KEY WORDS:** masticatory efficiency, defects of the oral cavity, tumors of the tongue, the bottom of the oral cavity, the jaw

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INTRODUCTION

Surgical treatment of patients with tumors of the oral cavity, regardless of its type (surgical, radiation, chemotherapy) is quite traumatic. This leads to damage to surrounding tissues, disruption of their functions - chewing and swallowing [1].

The function of chewing plays an important role in maintaining normal living conditions of the human body. To assess the function of chewing use the concept of «chewing efficiency». It evaluates the function of grinding and preparation of food for the swallowing stage [2]. It is the methods of determining masticatory efficiency that remain the most informative for assessing masticatory function depending on different degrees of severity [3]. Dysfunction of chewing leads to changes in many body systems, affects the general health of patients and quality of life.

Masticatory efficiency depends on various factors. Such factors may be the condition of the teeth, the integrity of the dentition, the intensity of occlusal surfaces of the teeth, the presence and type of dentures in the mouth, performance of masticatory muscles, the amount and viscosity of saliva, the nature of food, consistency, volume of postoperative defect [4].

There are a number of methods for static and dynamic measurement of masticatory efficiency. When using static methods, the coefficients of functional significance of each tooth are used. Dynamic methods involve direct chewing tests by SE. Gelman, IS. Rubinov, chewing effect by OM Ryahovsky [5]. Accordingly, the use of such direct methods

is time-consuming but is not always justified. This has led to the development of indirect methods for evaluating the efficiency of chewing, including methods of computer evaluation of test material. With the application of the latest technical advances in the medical field, there appeared methods based on the analysis of occlusiograms processed in a certain way in computer programs - graphic editors, such as Adobe Photoshop, etc. [6]. Typically, these methods are also time consuming and do not always lead to an accurate result, as there is no clear correlation between the area of occlusal contact which they estimate and the value of masticatory efficiency, they do not take into account the function of the masticatory muscles either.

THE AIM

The aim of this work is improving the definition of masticatory efficiency in patients with oncopathology of the oral cavity before and after surgery.

MATERIALS AND METHODS

The study included 29 patients aged 38-55 years (men) with malignant tumors of the tongue, oral mucosa and cancer of law jaw who were treated in the Department of Head and Neck Tumors of the Podolsk Regional Oncology Center. Among them, there were 12 patients with cancer of the tongue, 9 - with cancer of the oral mucosa and 8 - with cancer of the law jaw (Table I). The diagnosis was

Table I. Distribution of patients depending on diagnosis and stage of disease, n=29

Stage of disease	Ca of the tongue (n)	Ca of the oral mucosa (n)	Ca of the law jaw (n)
I	6	2	2
II	4	4	4
III	2	3	2

Table II. Value of masticatory indices (MI) for 20 masticatory cycles n=29, M±m.

Diagnosis	Tongue cancer			Cancer of oral mucosa of mouth floor			Law jaw cancer		
Stage of disease	I	II	III	I	II	III	I	II	III
MI before surgery, k-means (M±m)	0,89±0,04	0,78±0,04	0,73±0,04	0,92±	0,87±0,04	0,82±0,04	0,76±0,04	0,72±0,04	0,69±0,03
MI 7 days after surgery, k-means (M±m.)	0,78±0,04	0,61±0,03	0,42±0,04	0,75±0,04	0,72±0,04	0,68±0,03	0,34±0,04	0,28±0,03	0,24±0,03

Note: * - Statistically significant difference before and after treatment ($p < 0.05$).

**Fig. 1.** Mixed gum with thickness of 1mm.

established on the basis of clinical data and additional research methods.

To study masticatory efficiency, a chewing test with Orophys Hue-chek gum (Switzerland) was used [6, 7]. The test has features that distinguish it from other methods, it provides universality, lower time costs, as well as ease of research and high individualization for each subject. All tests were performed with the consent of each subject and in accordance with the above principles.

The study was performed at the time of hospitalization and on day 7 after surgery.

The chewing test with Orophys Hue-chek gum (Switzerland) is based on mixing two-color gum in 20 chewing movements. Patients were allowed to change the chewing side during the test. Chewing movements were counted and patients were asked to stop during a certain chewing cycle.

Software evaluates each pixel in a specific area according to its properties, such as color, intensity, or texture, to distinguish it from neighboring areas.

According to the proposed computer analysis, the mean value is 0.5-0.9, the values less than 0.5 indicate poor mix-

ing and food bolus formation, from 0.5 to 0.75 - moderate, from 0.75 to 0.9 - good and more than 0.9 - excellent mixing of gums and food bolus formation.

Statistical processing of the obtained data was performed using a mathematical statistical method on a PC using Excel software from Microsoft Office 2003, STATISTICA 5.5 (owned by of VNMU named after MI Pirogov, licensed № AXXR910A374605FA) according to Mann-Whitney U test. Differences between groups were considered statistically significant at $p < 0.05$.

RESULTS

The gum is placed in a plastic bag and leveled to a thickness of 1 mm (Fig. 1). In the future, a color gradation scale (Fig. 2) or software that runs for 24 hours was used to assess masticatory efficiency.

The results of the analyzed image are automatically transmitted to Excel, where the mean value just for this image is specified (Fig. 3).

Images of samples were analyzed, a total of 29 images. For each patient, the mixed proportion of the two colors was calculated after 20 cycles of chewing (Table II).

Analyzing the obtained data, a decrease in masticatory indices in oncopathology of the oral cavity was noted, but all of them corresponded to good and moderate food bolus formation. Thus, in cancer of the tongue stage I-II, cancer of the oral mucosa of mouth floor stage II-III and cancer of the low jaw stage I before surgery, food bolus formation is good. In cancer of the tongue stage III and cancer of the low jaw stage II-III - mixing of the food bolus is moderate.

After surgery, masticatory indices decreased compared to baseline and did not recover on day 7 after surgery. In patients diagnosed with the low jaw cancer stage I-III, masticatory indices are below 0.5 (0.34 ± 0.04 ; 0.28 ± 0.03 ; 0.24 ± 0.03) which indicates poor food bolus formation ($p < 0.05$). This is due to the volume of postoperative defects, where the low jaw is resected together with the teeth. Patients with cancer of the tongue stage III on day 7

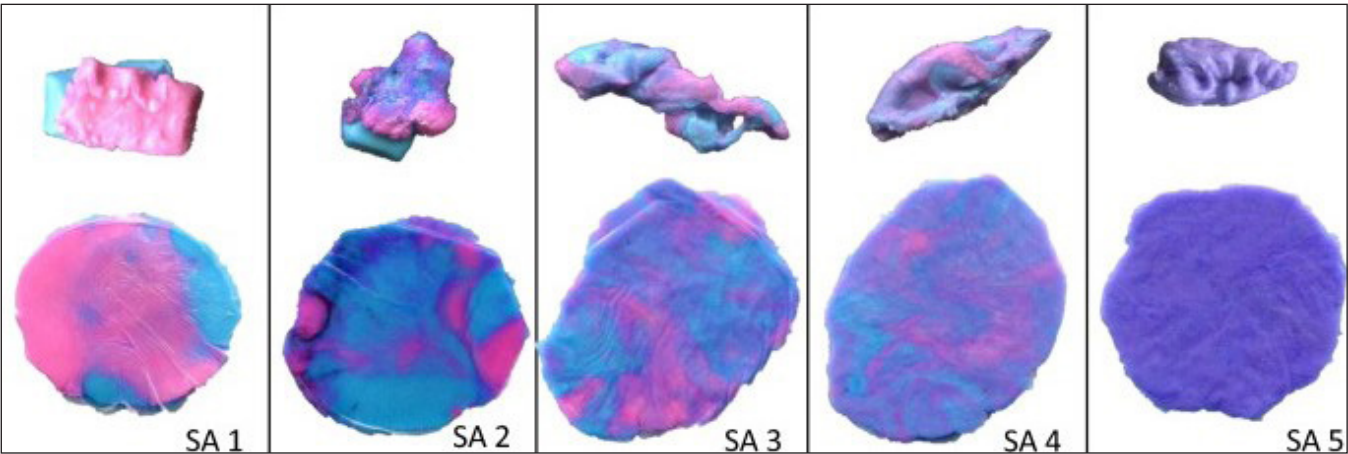


Fig. 2. Assessment Scale (SA) of chewing efficiency: SA 1 - chewing gum is not mixed, there are impressions of dental cusps; SA 2 - large parts of the chewing gum are not mixed; SA 3 – food bolus is slightly mixed, but the color is not uniform; SA 4 - food bolus is well mixed, but the color is not uniform; SA 5 – food bolus is perfectly mixed, color is uniform.

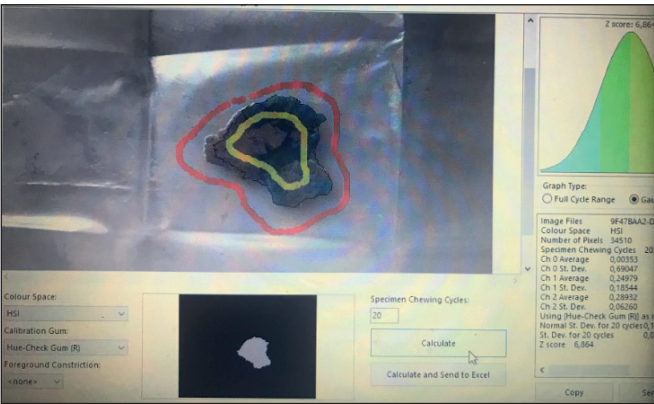


Fig. 3. Software study of mixed gum

after surgery were also unable to form a bolus, masticatory parameters being 0.42 ± 0.04 , which corresponds to poor food bolus formation ($p < 0.05$). Patients with cancer of the tongue stage I and cancer of the oral mucosa of moth floor were able to mix chewing gum and the masticatory index corresponded to good food bolus formation (0.78 ± 0.04 ; 0.75 ± 0.04). Patients with cancer of the tongue stage II, cancer of the oral mucosa of mouth floor stage III did not completely mix chewing gum and masticatory indices corresponded to moderate bolus mixing (0.61 ± 0.03 ; 0.72 ± 0.04 ; 0.68 ± 0.03).

DISCUSSION

The study proposed and described a new method for assessing masticatory efficiency. Masticatory efficiency was evaluated by mixing two-color chewing gum for 20 chewing cycles. There are a number of methods for determining masticatory efficiency. However, all the proposed evaluation methods described in the literature require laboratory equipment, sieves, software for digital images. In addition, not all methods for determining masticatory efficiency can be used in patients with postoperative oral defects.

In our study, masticatory efficiency was assessed using k-means parameters of mixing different parts of the food

bolus. Mixed areas were evaluated for each chewing gum plate. This segmentation system with using color information provided high resolution for the different areas present in each image, reducing errors caused by manual segmentation. In particular, this method expresses masticatory efficiency as the percentage of mixed areas, where masticatory efficiency 1 indicates optimal chewing, and masticatory efficiency 0 indicates its complete absence. Using the k-means clustering method, masticatory efficiency was assessed for each food bolus by evaluating mixed and unmixed sites. This clustering system can provide high resolution of the areas present in each image using color information. In addition, one can reduce errors caused by manual segmentation [2].

In general, the results of the study showed that the proposed software could objectively and automatically assess masticatory efficiency. However, this study has some limitations. Low quality images may affect the accuracy of the results of this study, which will not allow to make definitive statements about the control values of masticatory efficiency The algorithm is freely available, and the user only needs to download the food bolus image [8].

In addition, this method is informative as for the formation of the food bolus, it takes into account not only the presence of teeth, but also the function of the muscles involved in chewing. This is of importance for patients with postoperative defects of the oral cavity (incised jaw, incised muscles), as well as in the preoperative period, because all patients had reduced masticatory indices due to the presence of a tumor process.

CONCLUSIONS

- 1. This method is able to automatically quantify the percentage of mixed color area, providing quantitative data with minimal human interaction.
- 2. The method makes it possible to determine the change in masticatory parameters in the dynamics of patients with tumors of the oral cavity with different localization and varying degrees of importance.

3. The extent of soft tissue defects plays a more important role in chewing than the presence of dentition and jaw defects.
4. The presence of even 8-10 teeth on the upper and lower jaws may be sufficient for satisfactory grinding and chewing, with a mixed fraction of up to 0.75.
6. Yousof Y., Salleh N.M., Yusof F. Quantitative Evaluation of Masticatory Performance with Two-Color Mixing Ability Test: Development of a New Digital Method. *Int. J. Prosthodont.* 2020; 33: 224–228.
7. Elgestad Stjernfeldt P., Sjögren P., Wårdh I., Boström A.M. Systematic review of measurement properties of methods for objectively assessing masticatory performance. *Clin. Exp. Dent. Res.* 2019; 5: 76–104.

REFERENCES

1. Pachet A.I. Opukholi golovy i shei [Head and neck tumors]. M.: Prakticheskaya meditsina. 2013? 41p. (In Russian).
2. Mitin N.E., Vasilyeva T.A., Vasilyev E.V. Metod opredeleniya effektivnosti zhevaniya na osnove primeneniya originalnoy computernoy programy s ispolzovaniem mnogomernogo analiza dannich [The chewing efficiency determining method based on application of original computer program using multivariate data analysis]. *Rossiiskii mediko-biologicheskii vestnik im. akad. I.P. Pavlova.* 2016; 24(1):129-133. (In Russian). doi:10.17816/PAVLOVJ20161129-133.
3. Tokarevich I.V., Naumovich Y.A., Bogush A.L. Metod opredeleniya zhevanoj effektivnosti s ispolzovaniem razrabotannogo zhevatel'nogo obrazca [Method for determining chewing efficiency using a developed chewing sample]. *Voennaya medicina.* 2016; 11(2):106-109. (In Russian).
4. Mitin N.E., Vasilyeva T.A., Grishin M.I. Sovremennyye metody otsenki zhevatel'noy effektivnosti na etapah ortopedicheskogo lecheniya. [A modern method for assessing chewing efficiency at the stages of orthopedic treatment] *Vestnik medicinskih tekhnologiy. Elektronnyy zhurnal.* 2015; 14: 43. (In Russian).
5. Mashkov A.V., Patrushev A.S., Zubkov K.A. Sravnitel'naya harakteristika dinamicheskikh zhevatel'nykh prob. [Comparative characteristics of dynamic chewing problems] *Volgogradskiy nauchno-medicinskij zhurnal.* 2017; 3: 20-23. (In Russian).

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