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EFFICACY OF REGIONAL FLAPS FOR RECONSTRUCTION OF THE MOUTH CAVITY FLOOR AFTER ONCOLOGICAL RESECTIONS

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In the study, a sequential analysis is presented on the efficacy of various types of regional flap replacement, on the replacement of superficial and deep defects of the mouth floor after oncological resections. It has been shown that the use of a platysma musculocutaneous flap to replace surface defects of the oral cavity floor increases the duration of surgery, but significantly improves the functional status in terms of the completeness of the diet, public nutrition and the quality of life of patients in terms of appearance, chewing and general quality of life in indices of appearance, congestion and the general quality of life comparing to the use of the nasolabial flap. The use of a pectoralis major myocutaneous flap to replace deep defects of the oral cavity floor also increases the duration of the surgical intervention, but significantly improves the functional status according to the indices of the completeness of the diet, public nutrition and the quality of life in patients according to the indices of appearance, chewing, mood and general quality of life in comparison with the use of the sternocleidomastoid myocutaneous flap.

Key words: defect of the oral cavity floor, nasolabial flap, platysma skin-muscle flap, sternocleidomastoid muscle skin-muscle flap, pectoralis major skin-muscle flap.

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ЕФЕКТИВНІСТЬ ЗАСТОСУВАННЯ РЕГІОНАРНИХ КЛАПТІВ ДЛЯ РЕКОНСТРУКЦІЇ ДНА РОТОВОЇ ПОРОЖНИНИ ПІСЛЯ ОНКОЛОГІЧНИХ РЕЗЕКЦІЙ

У роботі представлений порівняльний аналіз ефективності застосування різних типів регіонарних клаптів для заміщення поверхневих та глибоких дефектів дна ротової порожнини після онкологічних резекцій. Показано, що застосування шкірно-м'язового клаптя платизми для заміщення поверхневих дефектів дна ротової порожнини збільшує тривалість оперативного втручання, проте достовірно покращує функціональний статус за показниками повноцінності дієти, харчування на людях та якість життя пацієнтів за показниками зовнішнього вигляду, жування та загальної якості життя у порівнянні із застосуванням носо-губного клаптя. Використання шкірно-м'язового клаптя великого грудного м'яза для заміщення глибоких дефектів дна ротової порожнини також збільшує тривалість оперативного втручання, проте достовірно покращує функціональний статус за показниками повноцінності дієти, харчування на людях та якість життя пацієнтів за показниками зовнішнього вигляду, жування, настрою та загальної якості життя у порівнянні із використанням шкірно-м'язового клаптя кивального м'яза.

Ключові слова: дефект дна ротової порожнини, носогубний клапоть, шкірно-м'язовий клапоть платизми, шкірно-м'язовий клапоть кивального м'яза, шкірно-м'язовий клапоть великого грудного м'яза.

The study is a fragment of the research project "To determine ways to improve treatment results and quality of life in patients with locally advanced cancer of the oral cavity and oropharynx based on optimization of methods for replacing postoperative defects with vascularized transplants", state registration No. 0119U000576.

Modern approaches to the treatment of patients with locally advanced cancer of the mouth floor mucous membrane and the alveolar ridge of the lower jaw (alveolar ridge - NCCN 2018) include surgical intervention – resection with instantaneous reconstruction and adjuvant radiation therapy or chemoradiotherapy [6]. Postoperative defects of the oral cavity floor after removal of the primary tumor can be superficial (with preservation of the muscle) or deep (with resection of the mylohyoid and other suprahyoid muscles). Replacement of the surface defect of the oral cavity floor requires using an elastic and thin epithelial flap to prevent fibrosis and, accordingly, impaired tongue mobility. Plastic removal of a deep defect additionally requires the transplantation of a larger volume of tissue for its complete filling and delimitation of the oral cavity from the dead spaces of the neck and preventing erosive bleeding due to the ingress of saliva.

Currently, there is no consensus in the literature as to which method of reconstruction is optimal for elimination of these defects. Studying the efficacy of various reconstructive approaches will permit to determine the best one, the use of which will provide maximum indices of functional rehabilitation and quality of life with minimal disturbances in the donor area [9] For plastic replacement of surface defects of the oral cavity floor, regional nasolabial flap (NLF) and platysma musculocutaneous flap (PMF) can be used [1, 6]. Removal of deep defects can be performed with a regional musculocutaneous flap of the sternocleidomastoid muscle (SMRMF) and a musculocutaneous flap of the pectoralis major muscle (MFPMM) [3, 10].

The advantages and disadvantages of flaps are analyzed in the literature, but direct comparisons of the efficacy of using nasolabial flap (NLF) and platysma musculocutaneous flap PMF for replacing superficial defects of the oral cavity floor and sternocleidomastoid myocutaneous flap (SMF); SMF and PMMF for the elimination of deep defects have not been performed until now.

The purpose of the study was to compare the efficacy of using different types of regional flaps to replace superficial and deep defects of the oral cavity floor.

Materials and methods. A retrospective comparative analysis of surgical interventions in 70 patients with cancer of the oral cavity mucous floor and of the lower jaw mucosa who were treated in the head and neck tumor department of the National Cancer Institute in the period of 2010–2016 was performed.

The work was carried out in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of the National Cancer Institute.

The criteria for inclusion in the study were as follows: locally advanced cancer of the oral cavity mucous floor and mucous alveolar ridge of the lower jaw without prior radiation or chemoradiation treatment; replacement of isolated or combined with the marginal defect of the lower jaw superficial or deep defects of the oral cavity floor after removal of the primary tumor. Criteria, exclusions: defects of the oral cavity floor combined with a segmental defect of the lower jaw; decompensated heart failure; diabetes mellitus with unstable hyperglycemia; the next 3 months after a heart attack or stroke; the patient's condition is defined as a contraindication to reconstructive surgery.

Among the patients included in the study, there were 67 (96 %) men and 3 (4 %) women. The mean age of the patients was 55.6±9.0 years (from 36 to 75 years). Squamous cell carcinoma of various differentiation degrees was diagnosed in 70 (100 %) patients. According to the spread of the process: III stage (T2N1M0, T3N0-1M0) was diagnosed in 32 (46 %), IV (T2-3N2M0, T4N1-2M0) – in 38 (54 %) patients.

All patients underwent surgical treatment in the scope of resection of the oral cavity floor, bilateral cervical lymphodissection and instantaneous plastic replacement of the defect. After removal of the tumor, defects of the oral cavity floor of two types formed – superficial (with preservation of the mylohyoid muscle) in 21 (30 %) patients and deep (with resection of the mylohyoid muscle and other muscles of suprahyoid group) in 49 (70 %) patients.

Patients with superficial defects of the oral cavity floor were divided into two groups depending on the type of reconstructive technique used for their replacement. The NLF group consisted of 11 patients who were treated with NLF to eliminate the defect, and the platysma musculocutaneous flap PMF group – 10 patients who were used to replace the defect with PMF. Patients with deep defects were also divided into two groups depending on the used reconstructive technique: the sternocleidomastoid myocutaneous flap (SMF) group (23 patients) - sternocleidomastoid myocutaneous flap was used to replace the defect; pectoralis major myocutaneous flap (PMMF) group (26 patients) – PMMF was used to replace the defect.

Groups of patients with superficial and deep defects of the oral cavity floor were compared by age, gender, TNM, disease stage. In addition, the duration of the surgical intervention and the patient's stay in the hospital, complications that occurred during flap transplantation, postoperative complications, functional status and quality of life of patients in the distant postoperative period were compared.

Functional status was assessed using the PSS-HN (Performance Status Scale for Head and Neck Cancer Patients) in 6 and 12 months. after surgical treatment. Quality of life was assessed by the University of Washington Quality of Life questionnaire, UW-QOL v4 (University of Washington Quality of Life questionnaire, version 4) in 6 and 12 months after surgical treatment.

Statistical analysis of the study results was carried out in the package MedCalc v. 18.11 (MedCalc Software bvba, Belgium, 1993–2018).

The mean value of the index ($\overline{X}$) and its standard deviation (±SD) were calculated to represent quantitative traits, and the frequency of the trait (%) for qualitative traits. When comparing quantitative traits, the Student's test was used (in the case of a normal distribution law) or the W-Wilcoxon test (in the case of a distribution law different from normal), the distribution was checked for normality using the Shapiro-Wilk test.

The chi-square test (taking into account the Yates correction) was used to compare qualitative indices. To assess the clinical effect, its magnitude and 95 % probability interval (95 % CI) were calculated. The critical level of significance is $\alpha_{kr.}$=0.05.

Results of the study and their discussion. Reconstruction of the oral cavity floor was performed simultaneously with the removal of the primary tumor and regional lymph nodes in all patients. At the same time, supraomohyoid neck dissection was performed in 30 (43 %), modified radical – in 32 (46 %),

radical – in 8 (11 %) patients. Marginal resection of the lower jaw was performed in 66 (94 %) patients. All 70 (100 %) patients started adjuvant radiation or chemoradiation therapy within 6 weeks after the surgical stage of complex treatment.

47 (67 %) patients received radiation therapy, 23 (33 %) received simultaneous chemoradiation. In the NLF group, 2 (18 %) patients received adjuvant chemoradiation therapy, 9 (82 %) patients received adjuvant radiation therapy. In the PMF group, 2 (20 %) patients received adjuvant chemoradiation therapy, 8 (80 %) patients received adjuvant radiation therapy. No statistically significant differences in adjuvant treatment between groups were found (p>0.99 according to Fisher's exact test).

In the pectoralis major myocutaneous flap (PMMF) group, 9 (39 %) patients received adjuvant chemoradiation therapy, 14 (61 %) patients received adjuvant radiation therapy. In the pectoralis major myocutaneous flap (PMMF) group, 10 (38 %) patients received adjuvant chemoradiation therapy, 16 (62%) patients received adjuvant radiation therapy. There were no statistically significant differences in adjuvant treatment between the groups (p>0.99 according to Fisher's exact test).

Plastic replacement of surface defects of the oral cavity floor. Statistically significant differences between groups of NLF and PMF by age (p=0.21), gender (p=0.34), indices T (p=0.92), N (p=0.95), M (p>0.99) and the stage of the disease (p=0.89) was not established. During the analysis of the surgical intervention duration, it was found that the mean duration of the operation in the NLF group was 4.09±0.20 hours, in the PMF group – 4.28±0.17 hours (p=0.03).

There were no statistically significant differences in terms of inpatient treatment between the groups. The mean duration of inpatient treatment in the NLF group was 9.4±0.8 days, in the PMF group – 9.7±0.9 days (p=0.39). Marginal necrosis of the flap developed in 1 (9.1 %) patient of the NLF group and 1 patient of the PMF group (10 %): the differences are unreliable (p=0.50). Total and partial necrosis of flaps was not observed in patients of both groups.

The separation of the postoperative wound edges, the formation of an orostoma, the formation of hematomas, and the occurrence of infectious complications were not noted in the NLF group; the formation of a salivary fistula was observed in 1 (9 %) patient. In the PMF group, 1 (10 %) patient developed infectious complications. The separation of the postoperative wound edges, the formation of an orostoma, the formation of hematomas and salivary fistulas were not observed in this group. In general, the frequency of postoperative complications in the NLF group was 9 % versus 10 % in the PMF group (p=0.50).

When studying the functional status, a significantly higher value of the completeness indices of the diet (p<0.001) and public nutrition (p=0.008) was established in the PMF group after 6 months. Significantly higher values of the diet completeness indices (p<0.001) and public nutrition (p=0.01) were observed in the PMF group 12 months after surgical treatment. No statistically significant differences in terms of speech intelligibility were found between the groups after 6 and 12 months (p>0.05) (fig. 1a, 1b).

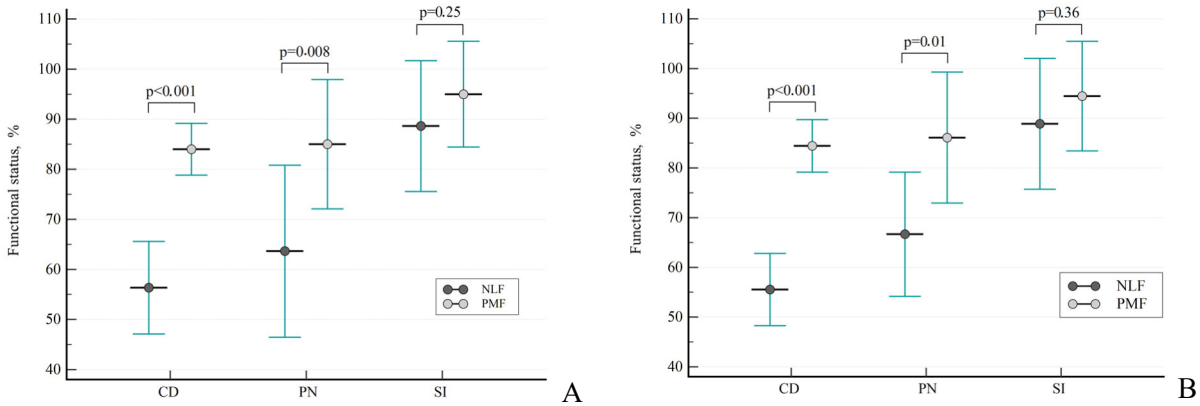

Fig. 1. Assessment of functional status. A – Assessment of functional status: completeness of diet (CD), public nutrition (PN), speech intelligibility (SI) of patients with superficial defects of the oral cavity floor 6 months after reconstructive treatment. The indicated mean value ± standard deviation and p is the level of the index difference significance. B – Assessment of functional status: completeness of diet (CD), public nutrition (PN), speech intelligibility (SI) of patients with superficial defects of the oral cavity floor 12 months after the reconstructive treatment. The indicated mean value ± standard deviation and p is the level of the index difference significance.

After analyzing the quality of life in patients with replaced superficial defects of the oral cavity floor, we established significantly higher values of indices for appearance (p=0.001), chewing (p=0.008), state of health (p=0.04) and general quality of life (p< 0.001) in the PMF group in 6 months after the surgical treatment. Significantly higher values of indices for appearance (p=0.001), chewing (p=0.002) and general quality of life (p<0.001) in the PMF group remained 12 months after the surgical treatment. There were no statistically significant differences between the groups in other indices after 6 and 12 months (p>0.05) (Table 1).

Table 1

Assessment of the quality of life in patients with superficial defects of the oral cavity floor 6 and 12 months after reconstructive treatment

Quality of life according to the questionnaire UW-QOL v4, %	$\overline{X}$ ±SD				Level of differences significance between groups, p	
	NLF Group		PMF Group			
	After 6 months, (n=11)	After 12 months, (n=9)	After 6 months, (n=10)	After 12 months, (n=9)	After 6 months	After 12 months.
Pain	79.5±18.8	86.1±13.2	82.5±16.9	86.1±13.2	0.74	>0.99
Appearance	61.4±13.1	61.1±13.2	90±12.9	94.4±11	0.001	0.001
Activity	86.4±13.1	88.9±13.2	87.5±13.2	91.7±12.5	0.85	0.66
Rest	84.1±12.6	86.1±13.2	90±12.9	88.9±13.2	0.31	0.66
Swallowing	88.6±13.1	86.1±13.2	85±12.9	88.9±13.2	0.53	0.66
Chewing	59.1±20.2	55.6±16.7	90±21.1	94.4±16.7	0.008	0.002
Speaking	83.6±15.7	83.3±15.8	91±14.5	93.3±13.2	0.29	0.18
Shoulder	86.4±15.7	86.7±15.8	82±15.5	80±15	0.53	0.38
Taste	55.5±20.2	56.7±20	54±20.7	65.6±13.3	0.87	0.31
Saliva	49.1±25.5	56.7±20	47±25.8	56.7±20	0.85	>0.99
Mood	72.7±17.5	72.2±19.5	80±10.5	86.1±13.2	0.29	0.12
Anxiety	75.5±12.1	73.3±10	79±14.5	80±15	0.56	0.31
General questions: A	52.3±7.5	55.6±11	55±10.5	58.3±12.5	0.54	0.63
B	49.1±10.4	53.3±10	58±6.3	62.2±6.7	0.04	0.07
C	47.3±10.1	46.7±10	76±8.4	77.8±6.7	<0.001	<0.001

Note: A - Compared to the month before you were diagnosed with cancer, how would you rate your health? B – How would you rate your health over the recent 7 days? C – General quality of life during the recent 7 days

Plastic replacement of deep defects of the oral cavity floor. Statistically significant differences between the groups of SMF and PMMF by age (p=0.82), gender (p=0.93), indices T (p=0.93), N (p=0.96), M (p> 0.99) and the stage of the disease (p=0.99) were not established. The mean duration of the operation in the SMF group was 5.49±0.24 hours, in the PMMF group – 5.78±0.23 hours (p<0.001). The mean duration of inpatient treatment in the SMF group was 16.0±1.2 days, in the PPMF group – 15.4±1.3 (p=0.09).

In 1 (4 %) patient of the SMF group, marginal necrosis of the flap developed, in 2 (9 %) – partial necrosis. In the PMMF group, marginal necrosis of the flap developed in 2 (8 %) patients, partial necrosis was not observed. The frequency of complications after flap transplantation in the SMF group was 13 %, in the PMMF group – 8 %; these differences for the given number of observations were unreliable (p=0.89).

The separation of the edges of the postoperative wound and the formation of the orostoma are not observed in both groups of patients. A salivary fistula developed in 1 (4 %) patient of the SMF group, a hematoma in the postoperative wound area occurred in 1 (4 %), and infectious complications occurred in 1 (4 %). In the PMMF group, 1 (4 %) patient developed a salivary fistula, 2 (8%) developed a hematoma, no infectious complications were observed. In general, the frequency of postoperative complications in the PMMF group was 13 % versus 11 % in the PMMF group (p=0.78).

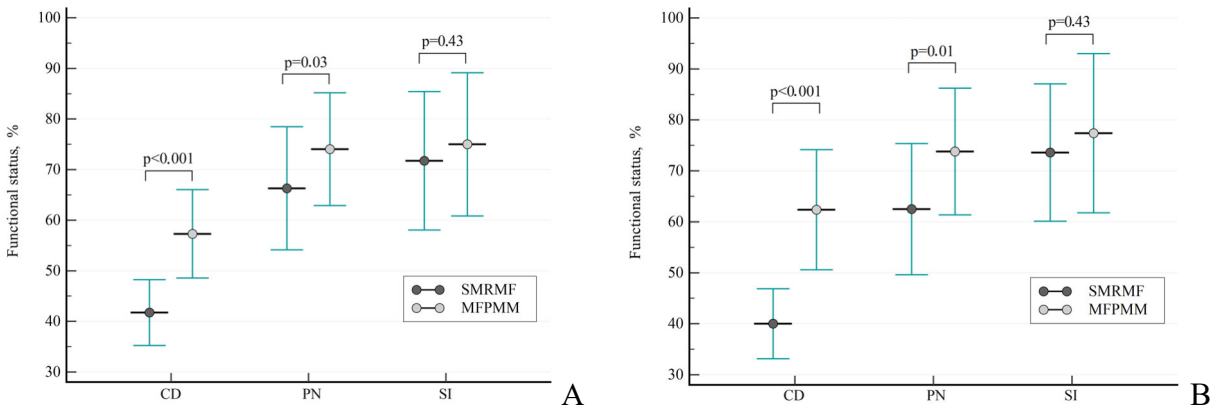

Fig. 2. Assessment of functional status. A – Assessment of functional status: completeness of diet (CD), public nutrition (PN), speech intelligibility (SI) of patients with deep defects of the oral cavity floor 6 months after the reconstructive treatment. The indicated mean value ± standard deviation and p is the level of the index difference significance. B – Assessment of functional status: completeness of diet (CD), public nutrition (PN), speech intelligibility (SI) of patients with deep defects of the oral cavity floor 12 months after the reconstructive treatment. The indicated man value ± standard deviation and p is the level of the index difference significance.

When studying the functional status, it is determined to be significantly higher than the values of indices of completeness of the diet ($p<0.001$) and public nutrition ($p=0.03$, $p=0.01$, respectively) in the PMMF group 6 and 12 months after surgical treatment. No statistically significant differences in speech intelligibility were found between the groups after 6 and 12 months ($p>0.05$) (fig. 2a, 2b).

The analysis of the quality of life showed significantly higher values of appearance ($p<0.01$), chewing ($p<0.05$), mood ($p<0.01$) and general quality of life ($p<0.001$) indices in the PMMF group in 6 and 12 months after the surgical treatment. No statistically significant differences in all other indices between the groups were found after 6 and 12 months ($p>0.05$) (table 2).

Table 2

Assessment of the quality of life in patients with deep defects of oral cavity floor 6 and 12 months after the reconstructive treatment

Quality of life according to the questionnaire UW-QOL v4, %UW-QOL v4, %	$\overline{X}$ ±SD				Level of differences significance between groups, p	
	SMF Grup		PMMF Group			
	After 6 months, (n=23)	After 12 months, (n=18)	After 6 months, (n=26)	After 12 months, (n=21)	After 6 months	After 12 months
Pain	70.7±16.3	72.2±19	69.2±17.8	73.8±20.1	0.73	0.81
Appearance	60.9±18.2	52.8±16.9	76.0±8.6	75±7.9	0.001	<0.001
Activity	70.7±16.3	75±14.9	72.1±14.7	73.8±12.4	0.72	0.8
Rest	69.6±10.5	72.2±14.6	68.3±11.3	71.4±12	0.69	0.89
Swallowing	69.1±15.5	71.4±16.2	73.5±14.5	77.4±7.5	0.26	0.23
Chewing	41.3±19.4	41.7±19.2	55.8±16.3	59.5±20.1	0.01	0.01
Speaking	68.3±21.2	70.6±18.6	70.8±21.7	76.7±17.4	0.66	0.31
Shoulder	74.3±19.3	72.2±19.9	72.3±20.1	71.4±21.5	0.73	0.95
Taste	52.6±20.3	63.3±15.3	54.6±19.8	62.4±16.1	0.73	0.86
Saliva	48.3±24.6	61.1±17.1	48.1±25.8	58.6±18.5	0.99	0.67
Mood	63.0±21.1	61.1±12.8	78.8±11.6	79.8±10.1	0.003	<0.001
Anxiety	69.1±15	70.0±0.0	71.5±16.4	72.6±14.5	0.56	0.23
General questions: A	54.3±12.3	52.8±8.1	55.8±12.9	53.6±12	0.69	0.78
B	53±9.7	53.3±9.7	55.4±8.6	55.2±8.7	0.38	0.53
C	50.4±16.9	47.8±12.2	63.1±9.3	64.8±8.7	0.004	<0.001

Note: A – Compared to the month before you were diagnosed with cancer, how would you rate your health? B – How would you rate your health over the recent 7 days? C – General quality of life during the recent 7 days

More than 50 % of oral mucosa cancer cases are detected at stages III–IV. Locally spread malignant neoplasms are an indication for extended surgical resections, which lead to significant impairment in the functions of speech, chewing, swallowing, breathing, and social adaptation [8].

Full functional rehabilitation and quality of life are of crucial importance in the surgical treatment of patients with the mucous membrane cancer of the mouth floor and the alveolar ridge of the lower jaw.

There is a large number of studies that evaluated the duration of surgical intervention, the length of patients' stays in the hospital, complications after flap transplantation, other postoperative complications, functional status and quality of life in patients when using certain regional flaps to replace defects of the oral cavity floor after oncological resections [4, 7].

However, there is very little comparative clinical data on the efficacy of using different regional flaps to eliminate postoperative defects of the oral cavity floor, depending on the size and other characteristics of the defects. We found that the use of PMF in comparison with NLF to replace surface defects of the oral cavity floor provides reliably better values of indices of completeness of diet and nutrition in public according to the PSS-HN functioning scale and indices of appearance, chewing, general quality of life according to the UW-QOL quality questionnaire.

In our opinion, the lower values of chewing indices and, accordingly, the completeness of the diet and nutrition in public when using NLF, are related to the fact that the pedicle of the flap passed through the buccal tunnel deforms the oral cavity in the distal part and causes significant discomfort while chewing and also complicates the use of dentures. Pronounced fibrosis and tongue motility disorders were not observed both when using NLF and PMF, so there were no significant differences in speech intelligibility between the compared groups.

We have also established that the use of PMMF in comparison with SMF for the elimination of deep defects of the oral cavity floor provides significantly higher values of indices of completeness of diet and nutrition in public according to the PSS-HN functioning scale and indices of appearance, chewing, mood, general quality of life according to the quality questionnaire UW-QOL. We believe that the lower

values of indices of mastication, completeness of the diet and nutrition in public in the case of the use of SMF are due to a more pronounced shrinkage of the flap with the formation of a recess in the area of the oral cavity floor ("the sump effect"). A significant shrinkage of SMF caused the depression of the lower lip and, accordingly, lower values of the appearance index.

There are no data on the comparison of the efficacy of using NLF and PMF for replacing surface defects, as well as SMF and PMMF for the elimination of deep defects of the oral cavity floor in the literature. J. Barret and J. Roodenburg performed a comparative analysis of using a radial forearm flap, PMMF, NLF and anterolateral thigh flap for the replacement of large defects of the oral cavity floor in 35 cancer patients.

The comparative criteria were the possibility of using dental prostheses and the completeness of the diet. In the study, significantly higher rates of functional rehabilitation were established when using a radial flap of the forearm and NLF compared to PMMF and an anterolateral thigh flap [2]. However, the authors do not divide defects of the oral cavity floor into superficial and deep, and this, in our opinion, is one of the determining factors in the choice of a flap.

A promising direction of further research is the comparison of the results of replacing superficial and deep defects of the oral cavity floor using regional and free flaps.

Conclusion

1. The use of PMF to replace surface defects of the oral cavity floor increases the duration of surgery, but significantly improves the functional status according to the indices of completeness of the diet, public nutrition and the quality of life in patients according to the indices of appearance, chewing and general quality of life in comparison with the use of NLF.

2. The use of PMMF to replace deep defects of the oral cavity floor also increases the duration of surgical intervention, but significantly improves the functional status according to the indices of completeness of the diet, public nutrition and the quality of life in patients according to the indices of appearance, chewing, mood and general quality of life in comparison with the use of SMF.

3. There were no statistically significant differences in the frequency of complications after flap transplantation, postoperative complications, and the duration of inpatient treatment between the groups of patients whose surface defects of the oral cavity floor were replaced by NLF and PMF, and deep defects by SMF and PMMF.

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