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# Speech recovery in patients after surgical treatment for oral and oropharyngeal cancer

**Relevance:** *Surgical treatment for oral and oropharyngeal cancer leads to severe disturbances in speech or voice, swallowing and breathing, de-socialization of patients. Restoring the communicative function is the main task of such patients' medical rehabilitation.*

The purpose of the study was to develop a speech therapy rehabilitation technique aimed at restoring speech disorders in patients after surgical treatment for oral and oropharyngeal cancer.

**Results:** *The developed speech therapy rehabilitation technique that included a preparatory stage, a speech restoration stage, and independent exercises at home was used in 82 patients who received in-patient treatment at the Head and Neck Department of N.N. Alexandrov National Cancer Centre of Belarus. The experimental group consisted of 52 patients who underwent one-stage reconstructive operations. The control group consisted of 30 patients who underwent standard hemiglossectomy without the postoperative defect replacement.*

**Conclusion:** *Early initiation of speech therapy compensated for speech impairments after surgery on the oral cavity and oropharynx and reduced the severity of disabilities in the field of communication.*

**Keywords:** *oropharyngolaryngeal cancer, surgery, speech therapy.*

**Introduction:** Current special treatment for the tongue, oral mucosa, and jawbone tumors ensures curing but does not provide adequate social rehabilitation of patients. Speech or voice, swallowing, and respiratory function impairments combined with an aesthetic defect after surgical treatment for malignant neoplasms of this location result in problems with verbal communication and social activity [1, 2].

A complete restoration of the patients' quality of life and social status after surgery for malignant neoplasms of the mouth and pharynx requires medical rehabilitation involving doctors of various specialties, psychologists, speech therapists, etc. [3].

**The purpose of the study** was to develop a speech therapy rehabilitation technique aimed at restoring speech disorders in patients after surgical treatment for oral and oropharyngeal cancer.

**Material and Methods:** The study included 82 patients admitted to the Head and Neck Tumors Department of the N.N. Alexandrov National Cancer Centre of Belarus (Minsk, the Republic of Belarus). The

treatment group included 52 patients (48 men and four women aged 21 to 67 years, the median age – 54 years) after reconstructive surgery for post-resection defects conducted simultaneously with oral and oropharyngeal tumors resection. Twelve patients underwent reconstructive surgery using a free radial forearm flap, 23 patients – using a musculofascial pectoral flap, 17 patients – using a musculocutaneous pectoral flap.

The control group included 30 patients (24 men and six women aged 30 to 65 years, the median age – 54,5 years) after hemiglossectomy for lymph node dissection, without postoperative defect replacement.

Keratinizing squamous cell carcinoma, mainly localized in the tongue body (54.88%) and the mouth floor (26.83%), was histologically verified in all patients. The patient distribution by tumor localization is presented in Table 1.

Most patients (81.71%) had locally advanced disease (stages III-IV). The patient distribution by the stage of the tumor process is presented in Table 2.

**Table 1 – Distribution of patients by tumor localization**

Tumor localization	Groups of patients				TOTAL	
	Treatment group (n=52)		Control group (n=30)			
	Abs.	%	Abs.	%	Abs.	%
Base of tongue (C01)	3	5.77	8	26.67	11	13.41
Other and non-specified parts of the tongue (C02)	27	51.92	18	60.00	45	54.88
Mouth floor (C04), other and non-specified parts of the mouth (C06)	19	36.54	3	10.00	22	26.83
Oropharynx (C09, C10)	3	5.77	1	3.33	4	4.88

A speech therapist assessed the voice and speech function in patients with tumor lesions of the oral cavity and oropharynx. The existing disorders and the speech quality were analyzed based on the oral speech subjective perception by such acoustic characteristics as loudness, speech rate, and maximum phonation time. We also assessed the pronunciation parameters – impaired sound pronunciation, speech intelligibility, and speech breathing. Patients were asked to pronounce individual sounds, syllables, phrases and read aloud a standard speech therapy text consisting of 200 words for one minute under the same artificial lighting. The threshold speech rate was 120 words per min-

ute (wpm). The maximum phonation time measured by the duration of phonation of the vowel sound “a” on one exhalation (twice, with an interval of 5 minutes to restore respiratory function) was determined by calculating the half total duration of phonation of the sounds “a1” and “a2” on one exhalation, in seconds. The maximum phonation time was to be 18-20 words [4]. The subjective parameters included speech intelligibility (%) and perceptibility (normal voice, hoarse, monotonous, “metallic,” etc.), the speech flow rate and its decrease, the replacement, absence of sounds in a combination of sibilant, hissing, voiced, posterior palate, and soft consonants due to motor disorders.

**Table 2 – Distribution of patients by tumor process stage**

Disease stage	Patient group				TOTAL	
	Treatment group (n=52)		Control group (n=30)			
	Abs.	%	Abs.	%	Abs.	%
I	2	3.85	0	0.0	11	13.41
II	17	32.69	14	46.67	45	54.88
III	24	46.15	12	40.00	22	26.83
IV	9	17.31	4	13.33	4	4.88

Before the operation, the patients were consulted by a speech therapist and familiarized with speech therapy rehabilitation possibilities. The developed speech therapy rehabilitation technique included a preparatory speech rehabilitation stage, a speech restoration stage, and independent lessons at home.

The preparatory stage started after a full speech therapy examination of patients on Days 4-6 after surgery. It included psychological preparation, an explanation of the need to start restorative therapy, and the breathing and articulation exercises.

The main speech restoration stage was performed in agreement with the attending physician, at least 10-12 days after surgery. In most cases, the correction of speech disorders after surgery for malignant neoplasms of the oral cavity and oropharynx was planned individually depending on the articulation apparatus's actu-

al post-resection defect, the general and psychological status of the patient.

We used speech therapy techniques to restore speech motor skills and correct other articulatory apparatus disorders, aimed at developing the compensatory capabilities of the organs of articulation [5]. Individual sessions with a speech therapist included breathing exercises, training the neck and pharynx muscles, performing articulation exercises for the tongue, lips, and cheeks. A speech therapist supervised the performance of exercises for correct sound pronunciation development and compiled a set of articulation exercises for correcting sound pronunciation to be performed by the patient independently at home after preliminary training.

The postoperative speech disorders were assessed by functional groups (FG) according to the self-developed criteria [6] presented in Table 3.

**Table 3 – Speech disorder assessment criteria with oral cavity and oropharynx post-resection defects**

Parameters	Criteria			
	FG I	FG II	FG III	FG IV
Speech function	Fluent, intelligible speech, the impaired pronunciation of sibilants	Speech intelligibility – below 90%, speech rate – below 120-130 wpm	Whispering speech, speech intelligibility – below 50%	Speech with a tracheostomy tube or no speech

Patients with tracheostomy (FC4) were not included in the voice and speech analysis because the need to close the tracheostomy and swallow air affected the acoustic voice characteristics (volume, speech rate) and speech intelligibility.

The obtained results were statistically processed using the Statistica, version 8.0 software. The significance of differences was assessed using the Wilcoxon–Mann–Whitney test. The  $\chi^2$  test with Yates's correction for continuity was used to compare the relative parameters.

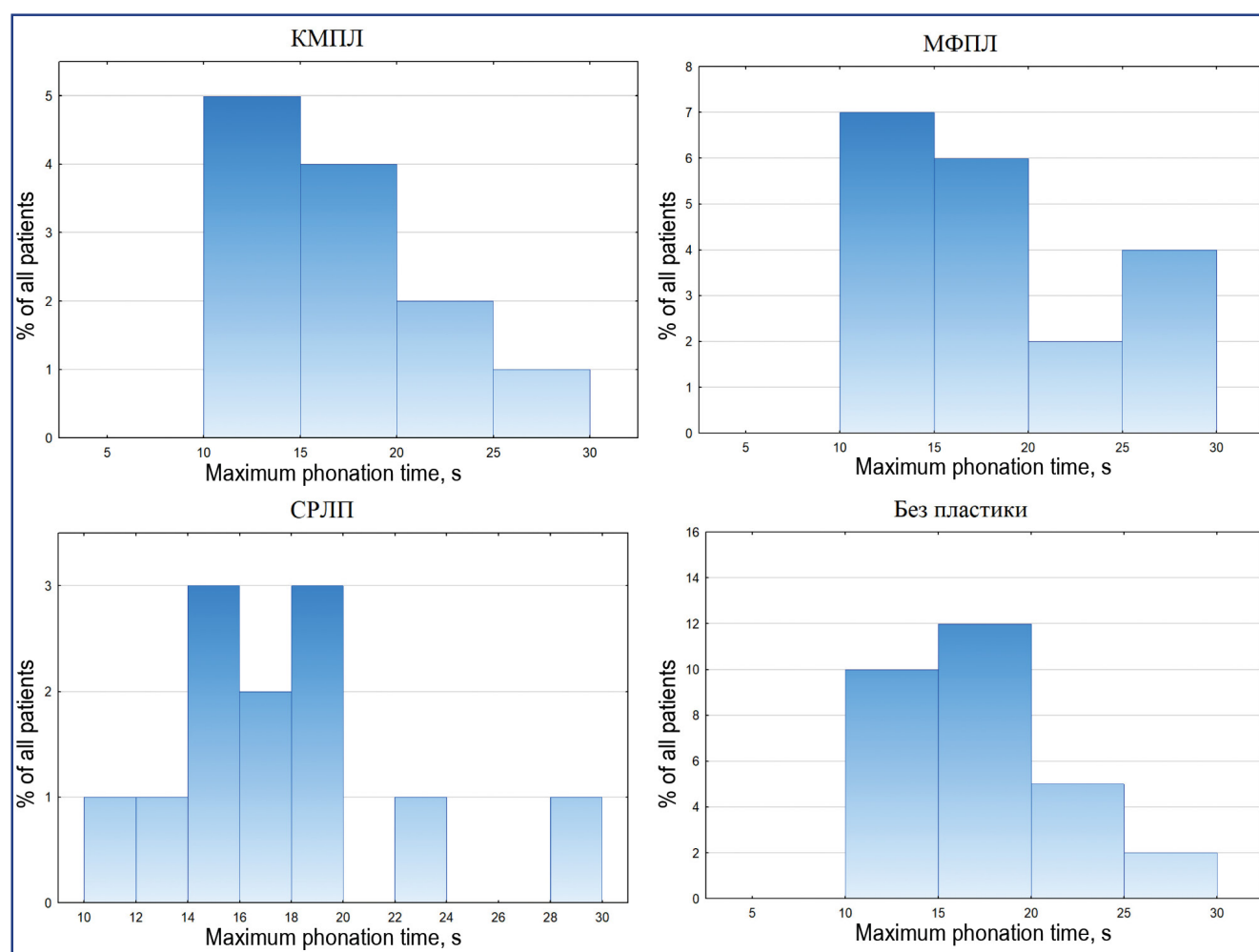
**Results and Discussion:** All control group patients had speech disorders. At the time of discharge, three (5.77%) patients after a free radial forearm flap autotransplantation had a slight defect in pronouncing individual hissing sounds, which was considered as FC0. Speech recovery began on Days 12-18 after surgery (after nasogastric tube and cannula removal) and took up to 7 weeks (upon completion of the speech rehabilitation course).

An early postoperative control examination revealed that the voice volume remained at the preoperative level, while the speech rate changed slightly in all patients. The speech rate was lower than in healthy persons ranging from 78 to 122 wpm in the control group and up to 132 wpm in the treatment group. The median was 100.0 wpm, with no significant differences between the groups (Table 4).

**Table 4 – Median speech rate in the early postoperative period**

Group	No. of patients	Speech rate		
		Median speech rate, wpm	QI	Qu
Control group	29	100.0	94.0	118.0
Treatment group	43	100.0	95.0	111.0

The total maximum phonation time in all operated patients ranged from 10.39 to 29.27 words, with a median of 16.08 words (QI = 13.43; Qu = 19.6). No significant difference in this parameter was noted depending on the type of surgical intervention (Figure 1).



Legend: KMPL – Reconstructive surgery using a musculocutaneous pectoral flap; MFPL – Reconstructive surgery using a musculofascial pectoral flap; SRPL – Reconstructive surgery using a free radial forearm flap; Без пластики – Surgery without postoperative defect replacement

Figure 1 – Maximum phonation time in the early postoperative period depending on the type of surgical intervention

The observed decrease in acoustic characteristics of the voice compared with the normative values for healthy people was due to a large extent of surgical intervention, the resulting breathing disorders after surgery due to the preventive tracheostomy, and the

restoration of physiological respiration after decannulation.

Dyslalia was the most common speech disorder (94.23%). Thirteen (15.9%) patients had impaired pronunciation of hissing and whistling, anterior lin-

gual, and sonorous sounds due to the nature of surgery [7]. Those patients required individual sessions with a speech therapist for 1-3 months. An individual complex of dynamic and static exercises for the tongue, mouth floor, lips, and cheek muscles was developed for the group of patients after surgical interventions in the tongue body area to improve the mobility and plasticity of the tongue residual limb and mimic muscles. It was combined with probe and manual tongue massage performed by a specialist.

Speech recovery efficiency is directly related to the postoperative wound healing time and the activation of the articulatory apparatus compensatory abilities [8-10]. In our study of speech recovery in 82 patients after surgery for oral and pharyngeal tumors, the decision about initiating the postoperative speech therapy was made by the attending physician together and a speech therapist after a full assessment of the speech defect and the postoperative wound condition. Speech correction followed an individual program, speech therapy sessions were conducted at the in-patient stage for 7-10 days before discharge, with the assessment of initial treatment and rehabilitation results.

The long-term results of this speech therapy method implementation since 2017 has shown a positive effect of speech therapy support from the first sessions. The tongue's mobility improved, and the number of biting of the tongue's lateral parts decreased. The speech correction administered in the early postoperative period accelerated the patients' adaptation to their new living conditions.

After 3-8 months, follow-up examinations revealed a significant improvement of the voice's acoustic characteristics in patients who underwent reconstructive-restorative surgery. The median speech rate increased from 100.0 wpm to 116.0 wpm. The mean speech rate was statistically higher in this group of patients over time ( $p < 0.01$ ). The control group did not show a statistically significant difference in the speech rate in the early and follow-up postoperative period ( $p > 0.05$ ) (Figure 2).

The developed speech rehabilitation technique allowed compensating the speech disorders after oral and oropharyngeal surgery and reducing the severity of communication limitations. Moderate speech disorders associated with a 90-50% decrease in speech intelligibility (FCII) at discharge were observed in 21 (72.41%) patients of the control group and 30 (69.76%) patients of the treatment group.

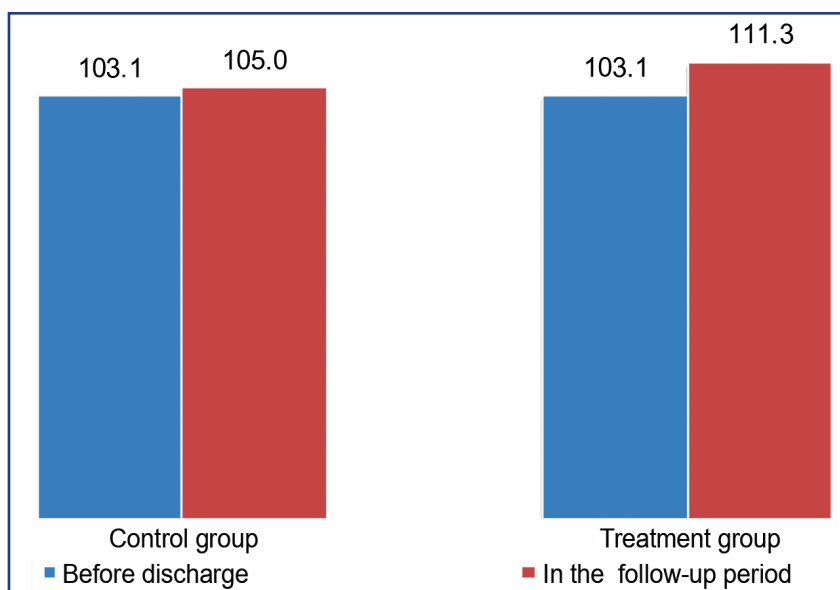


Figure 2 – Median speech rate (wpm) in the compared groups in the early and follow-up postoperative period

In the postoperative follow-up period, speech intelligibility has improved in both groups, as evidenced by an increasing share of patients with mild impairment (FCI) or no impairment (FC0) from 25.0% to 37.29% against a decrease in patients with moderate and severe impairment of the speech function. No statistically significant differences in the two groups were revealed depending on the extent of surgical intervention; however, after re-

constructive surgery, the recovery of speech intelligibility was more significant: the share of patients with speech intelligibility of 90 to 50% in the long-term postoperative period decreased by 17% due to an increase in the number of patients whose speech intelligibility was over 90%. The proportion of patients of the control group with these parameters decreased by 12%, of which 5% were due to decreased speech intelligibility (Figure 3)

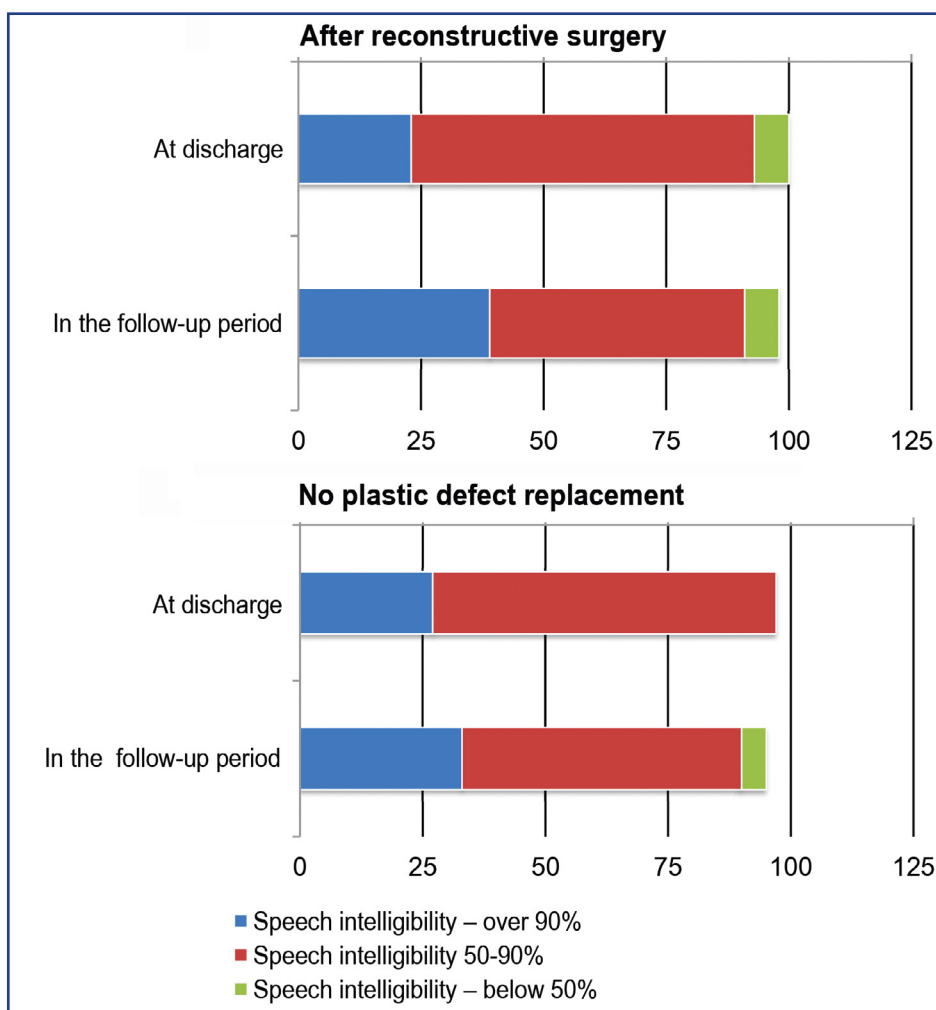


Figure 3 – Speech intelligibility (%) in patients in the comparison groups (words/minute) in the early and late postoperative period

**Conclusions:**

Surgical treatment of malignant neoplasms of the oral cavity and pharynx decreases the voice and speech acoustic characteristics (median speech rate – 100 wpm, median maximum phonation time – 17 words) compared with the normative values for healthy people. 94.23% of patients develop significant speech disorders. An early start of speech therapy sessions 10-12 days after surgery has proven its efficiency in the speech motor restoration and correction of observed articulatory disorders.

The use of logopaedic methods to correct speech disorders impacted the pronunciation of speech and improved speech intelligibility, as evidenced by an increase in the share of patients with mild (FCI) or no impairment (FC0) – 25.0% to 37.29%. In contrast, the number of patients with moderate (FCII) and severe (FCIII) speech impairments has decreased. There was an improvement in some acoustic characteristics: median speech rate increased from 100.0 wpm to 116.0 wpm in patients after reconstructive surgery (p<0.01).

The study has proven the necessity of professional speech therapy support at all stages of treatment and rehabilitation of patients with malignant tumors of the oral cavity and oropharynx. The obtained positive results confirm the feasibility of introducing a speech therapist into the staff of Head and Neck Tumor units and outpatient departments and the need for in-depth training of these specialists.

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## ТҰЖЫРЫМ

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### Ауыз қуысы мен жұтқыншақтың қатерлі ісіктерін хирургиялық емдеуден кейін пациенттердің сөйлеу функциясын қалпына келтіру

Өзектілігі: ауыз қуысы мен жұтқыншақтың қатерлі ісіктерін хирургиялық емдеу дыбыстық сөйлеудің немесе дауыстың, жұтылу мен тыныс алудың, науқастардың де-социализациясының айқын бұзылуына әкеледі. Коммуникативті функцияны қалпына келтіру науқастардың осы санатын медициналық оңалтудың негізгі міндеті болып табылады.

Зерттеудің мақсаты: Ауыз қуысы мен жұтқыншақтың қатерлі ісіктерін хирургиялық емдеуден кейін науқастардағы сөйлеу бұзылыстарын қалпына келтіруге бағытталған логопедиялық оңалту әдістемесін жасау.

Нәтижелері: логопедиялық оңалтудың әзірленген әдісі, оның ішінде дайындық логопедиялық оңалту кезеңі, қалпына келтіру кезеңі және үй кезеңіндегі өзіндік сабақтар Н.Н. Александров атындағы Республикалық онкология және медициналық радиология ғылыми-практикалық орталығының бас және мойын ісіктері бөлімінде стационарлық емделуде жүрген 82 науқасқа қолданылды. Негізгі топқа бір мезеттік реконструктивті операциялар жүргізілген 52 науқас кірді. Бақылау тобына операциядан кейінгі ақауды ауыстырмай стандартты гемиглоссэктомия жасайтын 30 науқас енгізілген.

Қорытынды: Сөйлеу терапиясының ерте басталуы ауыз қуысы мен жұтқыншаққа жасалған хирургиялық операциялардан кейін сөйлеу бұзылыстарының орнын толтыруға және қарым-қатынас санатындағы өмірлік шектеулердің ауырлығын азайтуға мүмкіндік берді.

**Түйінді сөздер:** ауыз қуысы мен жұтқыншақтың қатерлі ісіктері, хирургиялық емдеу, сөйлеу терапиясы.

## АННОТАЦИЯ

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### Восстановление речевой функции у пациентов после хирургического лечения опухолей полости рта и ротоглотки

Актуальность: Хирургическое лечение злокачественных новообразований полости рта и глотки приводит к выраженным нарушениям звуочной речи или голоса, глотания и дыхания, де-социализации пациентов. Восстановление коммуникативной функции является основной задачей медицинской реабилитации этой категории пациентов.

Цель исследования – разработать методику логопедической реабилитации, направленной на восстановление речевых нарушений у пациентов после хирургического лечения опухолей полости рта и ротоглотки.

Результаты: Разработанная методика логопедической реабилитации, включающая подготовительный логореабилитационный этап, этап логовосстановительной работы и самостоятельные занятия на домашнем этапе, применена у 82 пациентов, находившихся на стационарном лечении в отделении опухолей головы и шеи РНПЦ онкологии и медицинской радиологии. Основную группу составили 52 пациента, которым проводились одномоментные реконструктивные операции. В группу сравнения включены 30 пациентов, которым выполнена стандартная гемиглоссэктомия без замещения послеоперационного дефекта.

Заключение: Раннее начало логопедических занятий позволило компенсировать речевые нарушения после хирургических операций в полости рта и ротоглотке и уменьшить степень выраженности ограничений жизнедеятельности в категории обциения.

**Ключевые слова:** злокачественные опухоли полости рта и ротоглотки, хирургическое лечение, логопедическое сопровождение.