

LOGOPEDIA

¹LUDMIŁA HALCZY-KOWALIK, ²MAŁGORZATA STECEWICZ,
³ANDRZEJ WIKTOR, ADAM JAWORSKI

¹Pomeranian Medical University Independent Laboratory of Postoperative Rehabilitation
in Maxillofacial Surgery

²University of Szczecin Department of Special Pedagogy

³Pomeranian Medical University Clinic of Maxillofacial Surgery

Dysfunction of the Mouth Slit as an Indication of Speech Disorders in Patients after the Resection of Oral Cancer

SUMMARY

The article considers the consequences of the section of the orbicular muscle of the mouth in 286 patients treated surgically for oral cancer. Isolated disruption of tissues surrounding the mouth slit, without the loss of their bone support, resulted in a temporary dysfunction of the alimentary, articulatory and aesthetic functions. The excision of the malignant tumor, along with the bones constituting the skeleton of the facial part of the skull, permanently altered the spatial conditions of the mouth slit and limited the possibilities of the compensatory production of speech. Malfunctioning of the lip after the neoplastic tumor excision only slightly affected articulation. Excision of the entire lip and its reconstruction from a compound tissue flap displaced from a remote site limited the ability to produce labial phonemes. The participation of the tissues surrounding the slit in the compensation of the oral cavity function, impaired after the excision of the tumor, stresses the importance of the postoperative performance of this organ.

Keywords: mouth slit, oral cancer, mouth slit dysfunction, dysphasia

The mouth slit located in the lower part of the face has a changeable shape, through the mobility of the surrounding structures. When closed it seals the alimentary tract and, along with the soft palate and the vocal folds, takes part in its separation from the respiratory tract; when open, it is an additional breathing passage. The lower and upper lip, forming a direct delimitation of the mouth slit, are involved in the perception of sensory feelings and in expressing emotions. The tension of those most mobile facial structures reveals, often subconsciously, fatigue, discouragement, disappointment, and age. The position of the upper and lower lips and the relation of the lips to the teeth, the alveolar process and

the tongue during the flow of air through the vocal canal define the articulatory conditions. Production of speech sounds is the best organized function of the oral cavity in individual development.

The muscles surrounding the mouth slit are lips and cheek muscles, they have only one bone attachment, the other one is fixed in the subcutaneous tissue or the mucous membrane, allowing change in the shape of the facial surface integument and enabling the face to assume a specific expression. The central position is occupied by the orbicular muscle of the mouth composed of its own fibers and the fibers of the muscles forming a functional unit together. Two parts can be distinguished: the deep part, that is the border part of the muscle, responsible for the prehensile –sphincteral function and the surface or peripheral part, responsible for the mimical facial movements and expressing emotional states. The tendinous – muscular plate, located laterally from the corner of the mouth, is the place of connection of the orbicular muscle and 13 pairs of muscles called dilators. Maintaining the continuity of the orbicular muscle of the mouth and its anatomical connections with dilator muscles is important for all functions of the mouth slit. The craniofacial skeleton supports the tissues surrounding the mouth slit, it is a guarantee of the stability of their topography, determines the possibility of repeating muscular activity with similar results. The sensory innervation of the mouth slit surroundings comes from the trigeminal nerve, the motor innervation – from the facial nerve, vascularization from the facial artery. Both the innervation and vascularization of the mouth slit surroundings includes the part of the opposite side, close to the medial line. Lymph confluence is directed towards the suprahyoid lymphatic nodes; from the lateral parts of the mouth slit surroundings – to the submandibular nodes, from the middle part – to the nodes above the hyoid bone.

The surroundings of the mouth slit are formed between the third and the twelfth week of fetal life, their definitive shape is affected by the jaw bone growth, teeth eruption, actions repeated many times by the organs of stomatognathic system. Over time, with the loss of teeth, a gradual decrease in the bone mass of the jaws and progressive degenerative changes in the connective tissue of the lips, their considerable laxity develops, combined with the loss of bone support. The shortening of the vertical dimension of the lower part of the face, deepening of the nasolabial sulcus, protrusion and eversion of the lower lip are visible signs of these changes. Adaptability skills allow for the functioning of the stomatognathic system, if the above changes are taking place gradually and smoothly.

Dysfunction of the surroundings of the mouth slit accompany the stomatognathic system birth defects, CNS diseases, cranial nerves diseases, and neuromuscular facial disorders. Injuries of the lower parts of the face and dental surgeries may cause a temporary dysfunction of the mouth slit. The reasons for this dysfunction are: traumatic damage to the orbicular muscle of the mouth,

peripheral injury to the facial nerve, sensory disturbances in the surroundings of the mouth slit caused by anesthetics for dental procedures.

Cancer of the oral mucosa constitutes less than 5% of human cancers, and cancer of the lip accounts for 3.5% of all cancers of the mouth. The connection between cancer of the oral mucosa with changes in the genotype does not reduce the validity of the statement that it is diet-dependent and tobacco-dependent cancer (L. Didkowska et al. 2007, U. Wojciechowska et al. 2008, A. Actis et al. 2007, J. Lissowska and et al. 2003). The precise qualification of the circumstances of the occurrence of this tumor has not, so far, changed the main principles of its treatment, which is a surgical treatment of choice, supplemented with postoperative irradiation for most patients. The aim of the treatment is a radical resection of the tumor and maintaining the basic functions of the mouth and the aesthetic appearance (E.M. Genden et al. 2010, Y. Kimata et al. 2003, B.R. Paulosky et al. 1994, B.R. Paulosky et al. 1998). A radical tumor resection means resection of the tumor in one block with a wide margin of healthy tissues (in the macroscopic evaluation), along with the lymphatic basin in the cases of suspected metastases in lymphatic nodes. Postoperative mutilation affects all spheres of the patient's life: it interferes with breathing, swallowing, chewing, speech articulation, limits the possibility of performing social, occupational and family functions; it hinders the use of dental care and lowers self-esteem (N.C. Gerlich et al. 2002, H. Schliepchake et al. 1998, C.M. Speksnijder et al. 2010).

The appearance of the visible postoperative aesthetic abnormalities and defective speech often makes the patients suffering from these disorders isolate themselves from the environment and weakens their motivation to continue postoperative rehabilitation. Surgeons focused on complete elimination of the oral neoplasm do not analyze the circumstances concerning the dysfunction of the tissue of the mouth slit surroundings observable during scheduled oncological control visits. The starting of planned, effective actions by a speech therapist must be preceded by a precise surgical damage evaluation, assessment of the patient's adaptive abilities and it should take into account the effects of the time passed since the surgery.

The evaluated group of subjects consisted of the patients of the Clinic of Maxillofacial Surgery of PMU, treated surgically for lip cancer or oral cancer in the years 2001–2011. In all 286 patients the myotomy of the orbicular muscle of the mouth had been made. The analyzed data came from medical records, videoradiological records of deglutition as well as records of articulation made with a digital camera.

In a subgroup of 51 patients (19 women, 32 men, average age – 54.07 years) the lower lip and jaw had been cut to expose and gain access to the tumor of the tongue or the tumor of the oral cavity floor. After the excision of the tumor

the sectioned mandible was connected, the cut circular muscle of the mouth was sutured, paying attention to the anatomy of the muscle and the adjacent tissues, including the vermilion border. The process of healing of the circular muscle of the mouth was disturbed in a few cases by inflammatory reactions, marginal necrosis, or dehiscence of the sutured muscle stumps. With 2 patients it was necessary to re-suture the muscle.

During the early postoperative period the complaints mainly related to patients being unable to swallow saliva, and those located in the vicinity of the mouth slit included: a swelling sensation, the impression of lower lip anesthesia, lack of tight occlusion of the lips and lack of control of the tightening. An objective assessment of the impaired function of the tissues surrounding the mouth slit in that period of time is difficult. Clinical manifestations of the dysfunction of the orbicular muscle of the mouth, such as open mouth slit at rest, with a swollen lower lip away from the dental arches, or with uncontrolled leakage of saliva occurred in a quarter of the patients operated by us, assigned to subgroup I. Among the speech disorders, abnormalities in glossal phonemes dominated, the production of phonemes rated as considerably or moderately incorrect¹. The speech articulation of patients after the excision of the entire, or almost the entire tongue was incomprehensible, or comprehensible limifedly. Those patients in the first days after the operation often used written speech. Labial phonemes production was rated as significantly incorrect in the early postoperative period, 4 weeks after the surgery incorrect medium incorrect or slightly incorrect. That improvement in articulation was possible because of the regression of the postoperative edema, muscle exercises correcting the mouth slit tightness, and progressive return of the saliva flow control. That improvement was accompanied by the return of proportion and symmetry of the lower part of the face at rest and during articulatory activity (except for two patients who retained the lower lip asymmetry, unrelated to the postoperative scar), and also the improvement of the articulation of glossal sounds.



Fig. 1. Patient after the section of a lower lip and jaw, for the exposure of the tumor of the floor of the mouth and tongue, one week after the surgery.

¹ The quality of phoneme realization was assessed on a four point scale as normative realizations, slightly incorrect (phonetically normative sound, slightly out of norm phonetically, medium incorrect (sound contained within the limits of the phoneme class, realized in a supplementary place of articulation), considerably incorrect (sound phonemically and phonetically out of norm).



Fig. 2. Patient after the section of a lower lip and jaw, for the exposure of a tonsil tumor, four weeks after the surgery.



Fig. 3. Patient after the section of a lower lip and jaw, for the exposure of a tongue tumor, four years after the surgery. The resected tongue was reconstructed from the frontal lobe.

In subgroup II, which consisted of 62 patients (15 women, 47 men, average age 54.9 years), together with a cancerous tumor of the tongue, floor of the mouth, retromolar triangle, mandible or jaw, a bone fragment was removed which was part of the skeleton supporting the tissues of the mouth slit surroundings. The cutting of the upper or lower lip allowed access to the tumor after the excision; while suturing the wound particular attention was paid to the reconstruction of the continuity of the orbicular muscle of the mouth. The continuity of the arch of the mandible was reconstructed with a metal rail in 6 patients: 3 patients after the excision of the anterior part of the mandible and 3 after the excision of the lateral part of the mandible. The defect after the jaw excision was filled intraoperatively with a dressing, replaced every day, and after 2 weeks was closed with a prosthesis obturator.

Early postoperative dysfunctions of the mouth slit surroundings in that subgroup were dominated by the change of the mutual position of the jaws, most often it was a withdrawal of the reduced mandibular arch in relation to the jaw. Despite the change, the lower lip seemed pushed forward while maintaining symmetry (after the excision of the anterior segment of the mandible), or

asymmetrically (after the excision of half of the mandible). Lack of full contact of the lips occurred in almost all cases, leakage of saliva in the majority of them. The course of healing significantly affected the regression of the temporary dysfunction of the mouth slit surroundings, and healing without complications heralded the disappearance of the disorders after 2–4 weeks; the formation of a fistula from the oral cavity, opening in the submaxillary area, delayed functional rehabilitation. The existence of such a fistula found in 8 patients obstructed a tight closure of the oral cavity, accompanied by a leakage of saliva around the submaxillary area. The extent of the mandibular excision significantly affected the function of the tissues surrounding the mouth slit. The dysfunction observed during a clinical examination 4 weeks after the surgery, taking into account of the extent of the ostectomy, is presented in Table 1.

Table 1. Excision of the bone support of the mouth slit surroundings and the mouth slit dysfunction.

Excision with tumor	Anterior part of the alveolar process of the mandible	Lateral part of the anterior part of the mandible	Lateral part of the shaft of the mandible - half of the mandible – mandible branch – jaw -	Half of the mandible – mandible - jaw	Mandible branch - jaw	jaw
	Number of patients					
Mouth slit surroundings dysfunction	2	23	11	7	16	3
Lack of full contact of lips	1	16	2	6	2	-
Lack of tight occlusion of mouth slit	2	20	4	7	12	1
Lack of symmetry of mouth slit at rest	-	-	5	7	11	3
Lack of functional symmetry of mouth slit	-	4	9	7	14	3
Weakening of sensory sensitivity of lips	1	17	10	6	2	1

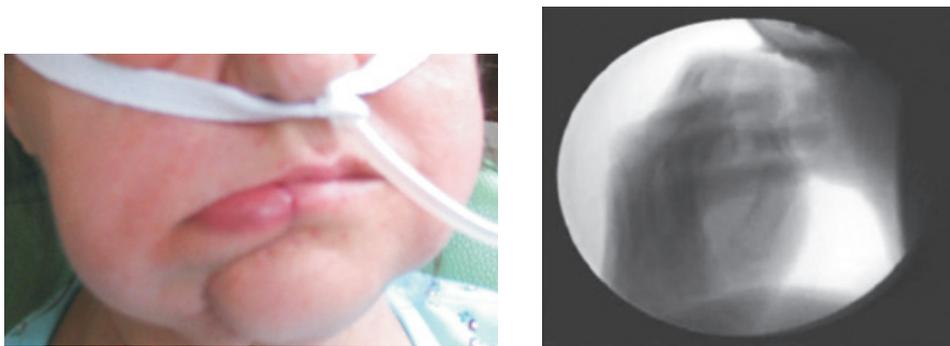


Fig. 4. Patient after the sectioning of the lower lip and the excision of the lateral segment of the mandible shaft, 1 week after the surgery. During the test of swallowing the patient is sealing the leaky mouth slit with her hand.



Fig. 5. Patient after the sectioning of the lower lip and the excision of the mandible branch, without reconstruction, 20 years after the surgery.

Speech disorders were assessed in subgroup II a little later (1-2 weeks later) than in subgroup I, in connection with the frequently longer complicated healing process and lasting problems with swallowing saliva. Articulation difficulties associated with the resected tongue, floor of the mouth and facial bones of the skull included the disorders in the production of glossal phonemes, which were significantly or moderately defective, and labial phonemes, which were medium or slightly defective.

In subgroup III, which consisted of 168 persons (45 women, 123 men, average age - 63.66 years), together with the neoplasm of the lip, tissues of the mouth slit surroundings were excised. The size of the neoplastic tumor and the way of infiltration associated with the histopathological type determined the extent of the excision. Eight changes of the angioma type were excised within the healthy tissue limits: these were small changes, their extent did not exceed the vermilion; in six patients the vermilion of the lower lip, in two patients – the upper lip; their excision did not cause long-term functional changes in the mouth

slit surroundings. The remaining 160 patients had tumors excised with a margin of healthy tissues: a tumor of the lower lip (142 patients), a tumor of the upper lip (13 patients), a tumor of the angle of the mouth (5 patients).

Single-stage tumor excision with a reconstruction of the lip is a reconstruction on vital indications. The choice of the reconstruction method depends on the size of the defect caused by the excision of the tumor, its location, biological properties of the patient's tissues, and on the surgeons' opinion. The expectations concerning the reconstructed lip include the sealing function of the mouth, creating the opening of the mouth slit whose size is large enough for the performance of the function of the oral cavity, maintenance of oral hygiene, and dental procedures. A recurring problem, after the excision of the tumor and reconstruction of the lip, concerns the inadequate mouth slit opening. The decrease in the sensory sensitivity of the lips and reduction of their mobility in the early postoperative period concerned almost all patients, after 1-3 months the sensory resolution visibly improved while motor efficiency improved less significantly. The shallowing of the oral vestibule, impeding the use of prosthetic appliances, was accompanied by a decreased flexibility index of the lips and a reduction of the size of the mouth slit opening. Difficulties in maintaining all the functions of the oral cavity, after the excision of the tumor and reconstruction of the lip, concerned tumors affecting more than half of the lip. In these patients, to reproduce the lips (after the excision of up to 80% of the lip) the Karapandzic method was chosen, using innervated and vascularized buccal lobes. To close larger defects - the whole lower lip or lower lip with adjacent tissues - complex tissue lobes were used, for example the frontal lobe, fronto-temporal lobe, cervical lobe, or nasolabial lobe (Table 2).



Fig. 6. Patient after the excision of the tumor of the lower lip and W-plastic operation, 1 week after the surgery.

Table 2. Extent of the resection of tissues surrounding the mouth slit and the method of lip reconstruction.

Range of tissue excision The method of lip reconstruction with the use of	Vermilion 1/3 lip – 1/2 lip – 2/3 lip – lip and adjacent tissues	1/3 lip – 1/2 lip – 2/3 lip - lip and adjacent tissues	1/2 lip – 2/3 lip – lip and adjacent tissues	2/3 lip - lip and adjacent tissues	lip and adjacent tissues
	Number of patients				
	6	59	40	34	21
Simple suture 10	1	9	-	-	-
Mucosa lobe 6	4	-	-	-	2
Tongue lobe 3	1	-	-	2	-
V-plasty 41	-	41	-	-	-
W-plasty or Y-plasty 39	-	8	31	-	-
Karapandzic method 41	-	-	9	32	-
Abbe-Estlander method 2	-	1	-	-	1
Tissue lobe 8	-	-	-	-	18



Fig. 7. Patient after the excision of 50% of the lip and closing of the defect by Karapandzic method, 3 months after the surgery.



Fig. 8. Patient after the excision of the tumor along with the lower lip and the jaw periosteum, after closing of the defect with a frontal flap, 4 weeks after the surgery.

The production of labial phonemes in subgroup III was dependent mainly on the extent of the tumor excision, which influenced the choice of method of the lip reconstruction. Slightly defective labial phoneme realizations were observed after the excision of less than, or equal to, half of the lip. Dysfunction of the mouth slit was usually caused by asymmetry of the position of the lips and lower motor activity of the opposing lip. Moderately incorrect realizations of labial phonemes predominated in patients after the excision of more than half of the lip and closing of the resulting defect with the nearest adjacent tissues (Karapandzic method). In moderately faulty realizations, the limitation or impossibility of obtaining the occlusion or fissure was compensated by the participation of the tongue or the opposing lip, dental/gingivolabial realizations.

Defective labial realizations of phonemes were recorded mainly after the excision of the entire lip with adjacent tissues and reconstruction of the resected complex structures with a tissue flap.

The intersection of the orbicular muscle of the mouth is necessary in the cases of neoplastic infiltration of the muscle, as well as for access to the tumor of the oral mucosa. The principles binding for years in oncology: the best possible access to the tumor and tumor excision with an adequate margin of a macroscopically healthy tissue, justify intervening actions in such a complex, precisely working structurally-functional system, which is the mouth slit surroundings. The surgical technique, allowing the intraoral removal of the tumor and possible restorative treatment without cutting the jaw and the mouth slit surrounding tissues, may be applied, provided that it does not restrict the access to the tumor and the site after its excision (P.J. Bradley et al. 1982, J.C. Devine et al. 2001, G. Cantu et al. 2006). The functional efficiency of the lips after the operations of the cancer of the tongue and the floor of the mouth that did or did not affect the continuity of the

structures surrounding the mouth slit was evaluated in few studies (J.C. Devine et al. 2001, A.D. Rapidis et al. 2001, A. Żebryk-Stopa 2009, Blomqvist et al. 1988). The authors pointed out the limitations of mobility and sensory sensitivity of the lips and the need for its evaluation in patients after the surgery of the tongue and floor of the mouth cancer.

4 weeks after the surgery, a clinical examination of patients we operated by us, showed regression of the early postoperative dysfunction of the mouth slit in patients after splitting the tissues surrounding the mouth slit for the excision of the oral cavity tumor. The normalization of the mouth slit surroundings function in these patients was nearly full: out of 13 patients with those disorders only in 2 the lower lip asymmetry was found when opening the mouth and performing mimic functions.

The loss of the bony support of the cut tissue of the mouth slit surroundings impairs healing conditions despite the precise anastomosis, consistent with their anatomy, furthering and the dislocation of the healing tissues, formation of fistulas, inflammatory conditions. The excision of a malignant tumor along with part of the mandible to varying degrees, depending on the location of excised fragment, disturbs the functions of the stomatognathic system. The most serious structural problems that arise after the excision of the mental part of the mandible can lead to the impairment of the respiratory tract patency and difficulty in breathing in the natural way, to the lack of synchronization of the component parts of swallowing and difficulties in eating in the natural way, to the lack of frontal tightness of the mouth, reduction of the sensory sensitivity of the mouth slit surroundings, difficulties in the realization of labial, anterior, middle and retrolingual phonemes (L. Halczy-Kowalik et al. 2001, J.E. Blomqvist et al. 1998, J.C. Devine et al. 2001, A.D. Rapidis et al. 2001, D.A.Georgian et al. 1982, G. Nicoletti et al.2004).

In patients whom we treated and evaluated the performing of a scheduled tracheostomy, i.e. a tracheal fistula between the lumen of the trachea and the external environment, ensured unrestrained breathing in the cases of anticipated restraint of the patency after the resection of the mental mandible. The existence of this artificial airway was maintained for 2 weeks on average. During this time, breathing conditions improved, and postoperative swelling, limiting the respiratory track lumen, decreased; it became possible to swallow saliva at any time. The return to natural breathing and oral alimentation, in a favorable course of the postoperative period, was observable in most patients after the excision of the genio-hyo-glossal muscles after 4 weeks. Speech therapy before that time was limited to explaining the pathomechanisms of speech disorders to the patient and familiarizing him with the possibility of maintaining sufficient mobility of the structures responsible for articulation. Exercises improving articulation

were initiated in parallel with teaching how to swallow saliva or after achieving improvement in swallowing saliva.

The loss of the bony support of the tissues surrounding the mouth slit in connection with the excision of the jaw with the palate on one side, causes the collapse of the cheek and lip on that side, lack of the mouth slit tightness, lack of the separation of the oral cavity from the nasal cavity. The role of the glossal-palatal contact in phonation and articulation is emphasized in the justification of the urgent need to restore the contact after the excision of the jaw with the palate (V. Carvalho-Teles et al. 2006, E. Janknegt et al. 2004, L. Lewandowski 2006).

In patients treated by us, thanks to filling the site after the resection of the tumor of the jaw or palate with a dressing material and then with prosthesis-obturator, abnormalities of the function of the tissues surrounding the mouth slit were smaller than it usually followed from the extent of tissue excision. Speech rehabilitation was undertaken with patients who use a prosthesis-obturator.

The sensory sensitivity and mobility of tissues surrounding the mouth slit, after the excision of a lip tumor and its functional reconstitution, was assessed after using different reconstruction methods (M. Bayramicli et al. 2007, J.P. Campbell 1998, M Karapandzic 1974, S. Kowalik 1990, J. Przybysz et al. 2009, A. Włodarkiewicz 1986). Sobczyk conducted a multifactorial analysis of the conditions for the reconstruction of the lower lip to find the most advantageous ones, allowing the patient to undergo a prosthetic treatment. He stated that the degree of impairment of motor functions of the reconstructed lip depends on the extent of tumor excision, and the sensory sensitivity is advantageously affected by the passage of time. He showed that the tissue embryogenetically closest to the mutilated lip, used for its reconstruction, as in the Abbe-Estlander or Karapandzic methods, allows creating the best pre-prosthetic conditions (P. Sobczyk 2003).

In our patients, functions of the lower lip, reconstructed with complex tissue lobes displaced from distant places, or embryogenetically distant, deviate the most from the norm. This method of the tissue defect closure was dictated by its size and location.

Maintaining efficiency of the mouth slit after cutting the orbicular muscle, in a patient operated on for cancer of the mouth, is important for creating a new model of swallowing and a new pattern of articulation. This is difficult, especially in the cases of tumor excision with the bone scaffolding stabilizing the tissues of the mouth slit surroundings. Obtaining lip contact at rest, even through the use of a dressing which keeps the lower lip in a proper position, is the first step in increasing the efficiency of the mouth slit. The control of the direction of the flow of saliva and training in voluntary swallowing of saliva during a prolonged apnea, are the next steps preceding proper speech rehabilitation. Teaching patients after the excision of intraoral structures responsible for the articulation, to produce

speech, is based on the implementation of compensatory mechanisms (C.L.B. Furia et al. 2001, D.A. Georgian et al. 1982, G. Nicoletti et al 2004, S.G. Fletcher 1988, H. Bloomer et al. 1973).

Realization of glossal phonemes in a changed situation after the operation involves the creation of occlusions or slits between the tongue, teeth, gums and the upper or lower lip, or the assistance in the creation of slits by rounding or flattening the lips and obtaining a better friction effect in the realization of fricatives or affricates. The participation of the tissues surrounding the mouth slit in the compensation of the oral cavity functions, impaired after the excision of the tumor, stresses the importance of postoperative performance of this organ. Significant and permanent impairment of that skill, combined with a limited functionality of intraoral articulators, diminishes the ability to create sounds of speech.

BIBLIOGRAPHY

- Actis A., Perovic N., Bigliani V., Bertolotto P.: Association between the dietary lipid intake and the development of oral precancerous lesions in university students. *Journal of Food Lipids*, 14, 2007: 97-109.
- Bayramicli M., Numanoglu A., Dezel E., The mental V-Y island advancement flap in functional lower lip reconstruction. *Plast.Reconstr. Surg.*, 100, 7, 1997:1682-1690.
- Blomqvist J.E., Alberius P., Isaksson S., Sensibility following Sagittal Split Osteotomy in the Mandible: A Prospective Clinical Study. *Plast. And Reconstr. Surg.*, VIII, 1998: 325-333.
- Bloomer H., Hawk H., Speech considerations: Speech disorders associated with ablative surgery of the face, mouth and pharynx – Ablative approaches to learning ASHA Rep 8, 1973:42-61.
- Bradley P.J., Stell P.M., A modification of the 'pull through' technique of glossectomy. *Clin. Otolaryngol.*, 7, 1982: 59-62.
- Campbell J.P., Surgical management of lip carcinoma. *J.Oral Maxillofac. Surg.*, 56 (8), 1998: 955-961.
- Cantu G., Bimbia G., Colombo S. et al., Colombo S., Compana A., Gilardia R., Pompilio M., Riccio S., Rossia M., Squadrellia M., Lip-splitting in transmandibular resections: Is it really necessary? *Oral Oncology*, 42, 2006: 619-6
- Carvalho-Teles V. de, Pegoraro-Krook M.I., Lauris J.R.P., Speech evaluation with and without palatal obturator in patients submitted to maxillectomy. *J. Appl. Sci.*, 14, 2006: 421-426.
- Devine J.C., Rogers S.N., Mc Nally D., Brown J.S., Vaughan E.D., A comparison of aesthetic, functional and patient subjective outcomes following lip-split mandibulotomy and mandibular lingual releasing access procedures. *Int. J. Oral. Maxillofac. Surg.*, 30, 2001: 199-204.
- Didkowska L., Wojciechowska U., Tarkowski W., Zatoński W., Nowotwory złośliwe w Polsce w 2005 roku, Centrum Onkologii – Instytut im. Marii Skłodowskiej-Curie, Warszawa, 2007.
- Fletcher S.G., Speech production following partial glossectomy. *J. Speech Hear. Disord.*, 53, 1988: 232-238.
- Furia C.L.B., Kowalski L.P., Latorre M.R.D.O., Angelis E.C., Martins N.M.S., Bartos A.P.B., Ribeiro K.C.B., Speech intelligibility after glossectomy and speech rehabilitation. *Arch. Otolaryngol. Head Neck Surg.*, 127, 2001: 877-883.

- Gellrich N. C., Schimming R., Schramm A., Schalohr D., Kugler J., Pain, function, and psychologic outcome before, during, and after intraoral tumor resection. *J. Oral. Maxillofac. Surg.*, 60, 7, 2002: 772-777.
- Genden E.M., Ferlito A., Silver C.E., Takes R.P., Suarez C., Owen R.P., Haigentz M. Jr., Stoeckli S.J., Shaha A.R., Rapidis A.D., Rodrigo J.P., Rinaldo A., Contemporary management of cancer of the oral cavity. *Eur. Arch. Otorhinolaryngol.*, 267, 2010: 1001-1017.
- Georgian D.A., Logemann J.A., Fisher H.B.: Compensatory articulation patterns of a surgically treated oral cancer patient. *J. Speech Hearing Disord.*, 47, 1982: 154-159.
- Halczy-Kowalik L., Mierzwa A., Kowalik S., Posio V., Stecewicz M., Zaburzenia polykania i mowy po wycięciu zespołu bródkowo-językowo-gnykowego z powodu nowotworu. *Czas. Stomatol.*, 54, 3, 2001: 177-184.
- Janknegt E., Koczorowski R., Świdziński P., Lewandowski L., Spektrograficzna analiza mowy protetycznie rehabilitowanych pacjentów po resekcji szczęki. *Prot. Stom.*, 54, 2, 2004: 79-85.
- Karapandzic M., Reconstruction of lip defects by local arterial flaps. *British J. Plast. Surg.*, 27, 1974: 93.
- Kimata Y., Sakuraba M., Hishinuma S., Ebihara S., Hayashi R., Asakage T. et al., Analysis of the relations between the shape of the reconstructed tongue and postoperative functions after subtotal or total glossectomy. *Laryngoscope*, 113, 5, 2003: 905 – 909.
- Kowalik S., Rekonstrukcja czerwienu wargi platem z języka. *Czas. Stomatol.*, XLIII, 1, 1990 : 30-32.
- Lewandowski L., Palato- i lingwogramy w ocenie zaburzeń artykulacji głosek po operacjach nowotworów języka i dna jamy ustnej. *Ann. Acad. Med. Stetin.*, 52, Suppl. 3, 2006: 13-16.
- Lissowska J., Pilarska A., Pilarski P., Samolczyk-Wanyura D., Piekarczyk J., Bardin- Mikołajczak A., Zatoński W., Herrero R., Munoz N., Franceschi S., Smoking, alcohol, diet, dentition and sexual practices in the epidemiology of oral cancer in Poland. *Eur. J. Cancer Prev.*, 22, 2003: 195-203.
- Nicoletti G., Soutar D.S., Jackson M.S., Wrench A.A., Robertson G., Robertson C., Objective assessment of speech after surgical treatment for oral cancer : experience from 196 selected cases. *Plast. Reconstr. Surg.*, 113, 2004: 114-125.
- Pauloski B.R., Rademaker A.W., Logemann J.A., Colangelo L.A., Speech and swallowing in irradiated and nonirradiated postsurgical oral cancer patients. *Otolaryngol. Head Neck Surg.*, 118, 5, 1998: 616-623.
- Pauloski B.R., Logemann J.A., Rademaker A.W., McConnel F. M., Stein D., Beery Q., Johnson J., Heiser M.A., Cardinale S., Shedd D., Speech and swallowing function after oral and oropharyngeal resections: one-year follow-up. *Head Neck*, 16, 4, 1994: 313-22.
- Przybysz J., Dąbrowski J., Pietka T., Domański W., Krzymański G., Chirurgiczne leczenie nowotworów złośliwych wargi metodą Karapandzica – doświadczenia własne. *Czas. Stomatol.*, 62, 2, 2009: 126-133.
- Rapidis A.D., Valsamis S., Anteriotis D., Skouteris D., Functional and aesthetic results of lip-splitting incisions: A clinical analysis of 60 cases. *J. Oral Maxillofac. Surg.*, 59, 2001: 1292-1296.
- Schliephake H., Schmelzeisen R., Schönweiler R., Schneller T., Altenbernd C., Speech, deglutition and life quality after intraoral tumour resection. A prospective study. *Int J Oral Maxillofac. Surg.*, 27, 2, 1998: 99-105.
- Sobczyk P., Możliwości poprawy warunków protetycznych po wycięciu raka wargi dolnej. *Rozpr. Doktorska, Szczecin, PAM*, 2003.
- Speksnijder C.M., van der Glass H.W., van der Bitt A., van Es R.J., van der Rijt E., Koole R., Oral function after oncological intervention in the oral cavity: a retrospective study. *J. Oral Maxillofac. Surg.*, 68, 6, 2010: 1231-1237.

- Włodarkiewicz A., Ocena wyników rekonstrukcji wargi dolnej neuro-waskularnymi płatami wargowymi oraz wybranymi wyspowymi płatami policzkowymi. Rozpr. Habilitacyjna, Gdańsk, 1986.
- Wojciechowska U., Didkowska J., Zatoński W., Nowotwory złośliwe w Polsce w 2006 roku. Centrum Onkologii, Inst. M. Skłodowskiej-Curie, Warszawa, 2008.
- Żebryk-Stopa A., Ocena motoryki obwodowego narządu mowy i wyniki rehabilitacji logopedycznej po operacjach nowotworów jamy ustnej. Rozprawa doktorska. UM Poznań, 2009

INFORMATION ABOUT THE AUTHORS:

Ludmiła Halczy-Kowalik MD, assistant professor, Pomeranian Medical University, Independent Laboratory of Postoperative Rehabilitation of Maxillofacial Surgery PMU, address: ul. Orawska 24/17, 70-131 Szczecin

Małgorzata Stecewicz MA, University of Szczecin, Department of Special Pedagogy, address: ul. Szpitalna 12/9, 70-116 Szczecin, e-mail: gosia@sto.home.pl

Andrzej Wiktor MD, Pomeranian Medical University, Clinic of Maxillofacial Surgery PMU

Adam Jaworski, Pomeranian Medical University, Clinic of Maxillofacial Surgery PMU