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Visceral flaps for oral cavity reconstruction and prevention of xerostomia in cancer patients: a case series and morphological study

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ABSTRACT

Objective. To improve treatment outcomes in patients with oral cavity cancers via postoperative reconstruction using visceral flaps.

Material and methods. We present clinical cases of microsurgical reconstruction of oral cavity using free gastro-omental, jejunum and colonic flaps after resection of malignancies. We performed biopsy of colonic mucous fragment in 10 patients and gastric mucosa in 14 patients at various times after reconstruction.

Results. Visceral flaps allow restoring oral cavity with morphotypical tissue that has optimal plasticity, thickness and adaptation to the edges of defect. These flaps do not cause sensations of a foreign body, changes in taste and do not require pre-prosthetic preparation. Intestine and gastric fragments release a secret providing additional moisture to the oral cavity and preventing xerostomia after radiotherapy. Histological analysis of colon and gastric fragments revealed that transplantation into environment of oral cavity with another enzymatic and acid-base composition leads to moderate atrophy without obvious inflammatory infiltration of mucosal base or severe dysplasia.

Conclusion. Autotransplantation of visceral tissues allows restoring oral mucosa by similar morphological tissue and improving the results of social and functional rehabilitation of patients with oral cavity tumors.

Keywords: *oral cavity defects, visceral flap, xerostomia.*

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Introduction

Malignancies of the oral cavity are usually diagnosed at the later stages. For example, 63% of patients were diagnosed with cancer stage III or IV in Russia in 2020 [1]. Surgery and radiotherapy (often adjuvant in patients with unfavorable prognostic factors) are the main methods for locally advanced malignant epithelial neoplasms of the oral cavity.

To date, the main objective in surgical treatment is not only total resection of tumor, but also anatomical and functional rehabilitation via tissue recovery by various plastic materials. Their choice depends on various factors including surgical experience, equipment, somatic status of patients, type of defect, etc. None graft has all characteristics of native tissues, such as sensitivity, plasticity, appropriate thickness, muscle activity and secretory capacity [2].

To eliminate oral defects, surgeons usually apply fasciocutaneous and musculoskeletal autografts from the neck (submental, anterior muscles of the neck, supraclavicular, etc.) [3-5] and chest (pectoral, etc.) [3, 6], free grafts (radial, anterolateral thigh autograft, thoracodorsal, perforator autograft supplied through deep femoral artery, sural autograft, etc.) [6-10], muco-muscular autografts (facial artery muco-muscular autograft [2], temporoparietal fascial autograft [2]).

Oral mucosa repair with cutaneous autografts often causes discomfort, foreign body sensation, unpleasant peeling, taste changes, problems associated with hair and visible damage to the donor site [2]. Another disadvantage of skin autografts is the lack of secretion as addition-

al source of moisture. This is an important factor especially after radiotherapy followed by xerostomia.

An alternative to fasciocutaneous and skin-muscular flaps is visceral grafts. This approach allows restoring the tissue of the oral cavity with a morphotypical tissue, i.e. mucous membrane of the gastrointestinal tract for mucous defects of the upper digestive tract. This tissue has optimal plasticity, thickness and adaptation to defect edges. Secretion provides additional moisture to the oral cavity and improves digestion process [2].

The main visceral autografts for oral tissue reconstruction are gastroepiploic autograft, small and large bowel grafts.

The purpose of the work was to improve treatment outcomes in patients with oral cavity cancers via postoperative reconstruction using visceral flaps.

Material and methods

We report clinical cases of oral cavity repair using three different free microsurgical visceral autografts after surgical treatment of malignancies.

Clinical case 1

Free microsurgical gastro-omental autograft

A 48-year-old patient B. appealed with complaints of pain in the left side of the face and diplopia in December 2017.

In 2015, the patient underwent surgical treatment for the left-sided sarcoma of the upper jaw in Krasnoyarsk. In 2016, tumor recurrence required complex treatment in Tomsk (two courses of MAID polychemotherapy, electrosurgical resection and replacement of the upper jaw followed by adjuvant radiotherapy with total focal dose of 50 Gy).

The next recurrence in 2017 required resection of tumor with photodynamic therapy. Continued tumor growth was found in autumn 2017. In December 2017, the patient appealed to the Hertsen Moscow Research Oncology Institute.

MRI on December 3, 2017 revealed solid tumor 48×41×43 cm with irregular shape and tuberous contours in the left pterygopalatine fossa with spread to the temporal fossa. The neoplasm destructed the lower and outer walls of the left orbit, adjoined to lateral and inferior rectus muscles of the left eye and extended into retrobulbar tissue **(Fig. 1a)**. There was a left-sided exophthalmos. This tumor destructed adjacent parts of the left greater sphenoid wing and had signs of intracranial spread.

Ultrasound revealed left-sided soft tissue hypoechoic heterogeneous tumor 58×30×80 mm with uneven and fuzzy contours involving the lower wall of the orbit.

Histological (No. 3172/17) and immunohistochemical examination dated 12/11/2017 revealed positive reaction with Vimentin in tumor cells. There was negative reaction with other markers (Desmin, Musc. Actin, CD34, S-100, CD68, Ki-67). Low grade fibromyxoid sarcoma was diagnosed.

We found no data on other focal lesions and dissemination of tumor.

The following diagnosis was established (the 7th edition of the TNM classification): "Left-sided sarcoma of the upper jaw G2, previous surgical treatment in 2015, tumor recurrence. Complex treatment (chemotherapy + surgical treatment + radiotherapy) in 2016. Tumor recurrence. Surgical treatment + PDT in 2017. Continued tumor growth".

On January 11, 2018, the patient underwent left-sided cranio-orbito-facial resection (left-sided resection of the upper jaw, soft tissues of the face, tissues of the oral cavity, dura mater, orbital exenteration on the left) with skull base defect closure by aponeurotic scalp flap, microsurgical reconstruction of facial and oral soft tissues by free vascularized gastroepiploic autograft, tracheostomy **(Fig. 1, b–e)**.

Elective morphological analysis revealed myxofibrosarcoma G2.

Clinical case 2

Free microsurgical small bowel autograft

A 55-year-old patient presented with mucous membrane cancer of the floor of mouth T2N1M0, stage III, previous chemo- and radiotherapy (total focal dose 70 Gy) on August 6, 2015, lymphadenectomy on the neck on September 21, 2015, tumor recurrence (the 7th edition of the TNM classification).

Ulceration of the floor of mouth occurred in February 2015. The patient did not appeal for medical case. In April 2015, he presented to the oncological dispensary No. 1 in Moscow due to progressive growth of ulceration and impaired mobility of the tongue where oral cancer with metastases to the lymph nodes of the neck was verified. On May 2015, the patient appealed to the Hertsen Moscow Research Oncology Institute. Repeated analysis of specimens revealed infiltrative squamous cell non-keratinizing cancer. Percutaneous biopsy of lymph nodes in the right submandibular region revealed metastasis of squamous cell carcinoma. Clinical situation was discussed by a team of specialists. Finally, chemo- and radiotherapy (total focal dose 70 Gy) on August 6, 2015 was followed by complete resorption of primary lesion. Right-sided lymphadenectomy on the neck was performed on September 2015. The follow-up examination in December 2015 revealed tumor recurrence.

MRI dated November 2015 visualized local accumulation of contrast agent in anterior parts of the tongue 20×14×12 mm with spread to soft tissues of the floor of mouth. There were no signs of lower jaw destruction.

Ultrasound of the floor of mouth and tongue revealed no additional lesions. Left-sided scanning of the neck revealed a few enlarged lymph nodes with preserved corticomedullary differentiation and clear contours 12×4 mm.

Histological examination revealed squamous cell carcinoma.

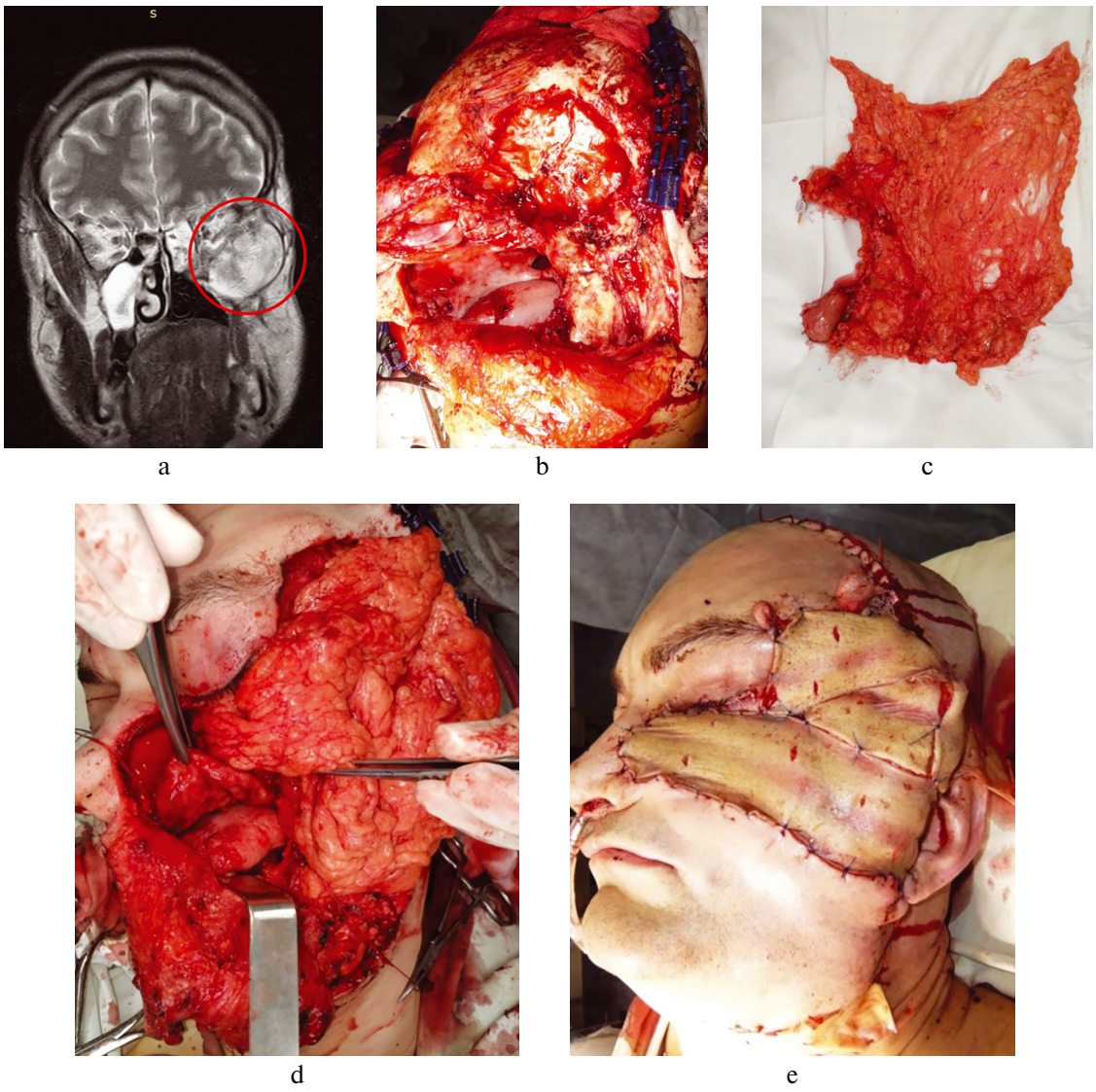


Fig. 1. **Clinical case 1. Patient *B.*, 48 years old.**

a — MRI; b — intraoperative defect, c — gastroepiploic flap; d — oral cavity reconstruction with gastric portion of the flap, soft tissues are restored by omentum; e — final view.

We found no data on other focal lesions and dissemination of tumor.

On December 16, 2015, the patient underwent resection of the floor of mouth with alveolar process of the lower jaw, selective left-sided supraomohyoid lymphadenectomy, simultaneous microsurgical reconstruction of the floor of mouth with free vascularized small bowel autograft, tracheostomy **(Fig. 2)**.

Elective morphological analysis revealed growths of dense elastic whitish-gray tissue without clear boundaries 15×20×10 mm in projection of the frenulum and body of the tongue. Microscopic analysis revealed squamous cell carcinoma with ulceration, infiltration of mucous membrane and alveolar process, tongue muscles to a depth of 8 mm, pathomorphosis grade 1. Alveolar process was intact. We obtained negative resection edge. Sinus histiocytosis, focal fat replacement and no metastases were found in 11 lymph nodes group I-III.

Clinical case 3

Free microsurgical large bowel autograft

A 44-year-old patient presented with mucous membrane cancer of the floor of mouth T3N1M0 stage III and previous neoadjuvant chemo- and radiotherapy (total focal dose 40 Gy).

Right-sided ulceration of mucous membrane of the floor of oral cavity occurred in April 2005 after previous injury. Ulceration gradually increased over time. Mucous membrane cancer of the floor of mouth with right-sided cervical lymph node metastases was diagnosed after examination at the oncological hospital in Cheboksary. The patient was referred to the Hertsen Moscow Research On-

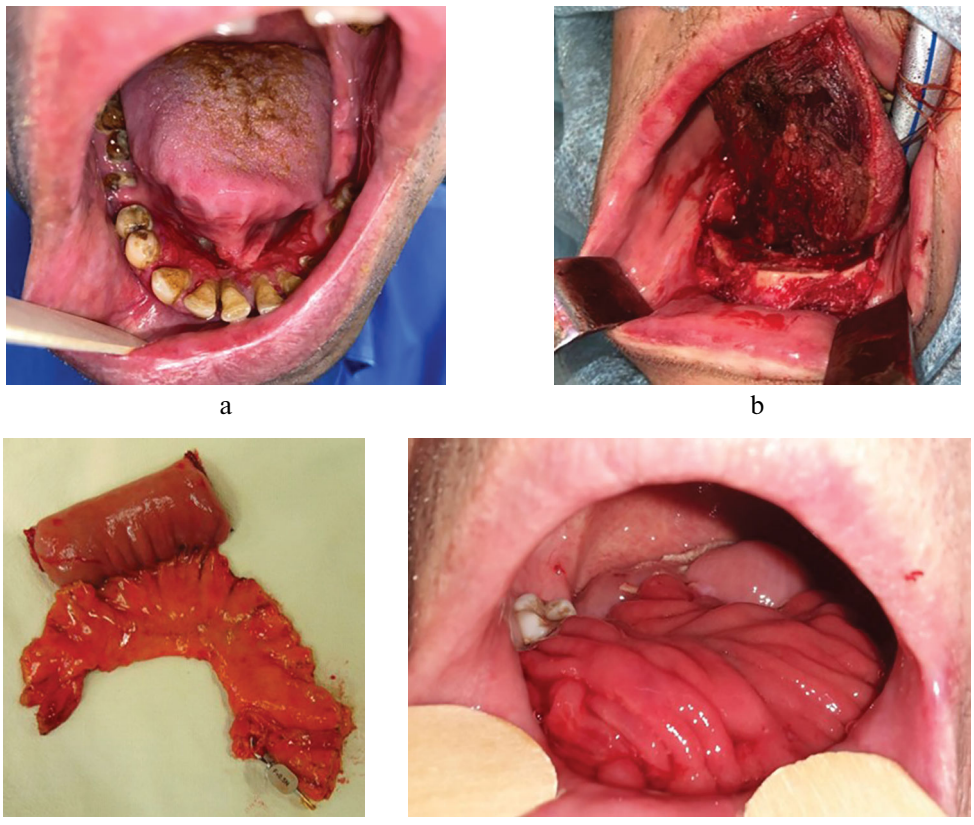


Fig. 2. **Clinical case 2. Patient *Ch.*, 55 years old.**
a — oral cancer; b — intraoperative defect; c — jejunum flap; d — mucous membrane of the oral cavity is restored by the jejunum flap.

cology Institute. Histological examination revealed squamous cell carcinoma. Percutaneous biopsy of the lymph node in the upper third of the neck on the right revealed metastasis of highly differentiated squamous cell carcinoma.

After additional examination, the team of specialists developed a combined treatment plan including preoperative radiotherapy followed by surgical treatment. Preoperative chemo- and radiotherapy was performed between July 15, 2005 and August 24, 2005 (total focal dose of 40 Gy with 5-fluorouracil radiosensitization). After that, the patient was hospitalized to the Department of Microsurgery.

Ultrasound dated September 8, 2005 revealed hypoechoic zone 26×12×10 mm with fuzzy contours within the floor of oral cavity on the right with spread to inferolateral surface of the tongue. In the right upper third of the neck, we found hyperplastic lymph nodes and a single hypoechoic node 13×9×5 mm with almost isoechoic central area up to 3 mm. Hypoechoic node 9×7×5 mm was observed in the right mental area and similar node 5×4×5 mm was localized somewhat anterior to the previous node.

CT revealed deformation of contours 12×18 mm in projection of the floor of the mouth (mainly on the right) with heterogeneous structure at this level. No destruction of the lower jaw was found.

We found no data on other focal lesions and dissemination of tumor.

On September 21, 2005, the patient underwent resection of the floor of the mouth with alveolar process of the lower jaw, total modified cervical lymphadenectomy on the right, removal of the first group of lymph nodes on the left, microsurgical repair with free vascularized large bowel autograft, tracheostomy **(Fig. 3)**.

Elective morphological analysis revealed infiltrative growth of squamous cell carcinoma in the oral mucosa with pathomorphism grade 3 and invasion of submandibular salivary gland and underlying skeletal muscles. There was a negative resection edge. We found metastasis of squamous cell carcinoma in one cervical lymph node on the right with partial replacement of lymphoid tissue.

Results

Postoperative period was uneventful in the first case. The patient was decannulated after 5 postoperative days. After 10 days, obturation and dentition repair were performed, and nasogastric tube was removed. The patient started oral

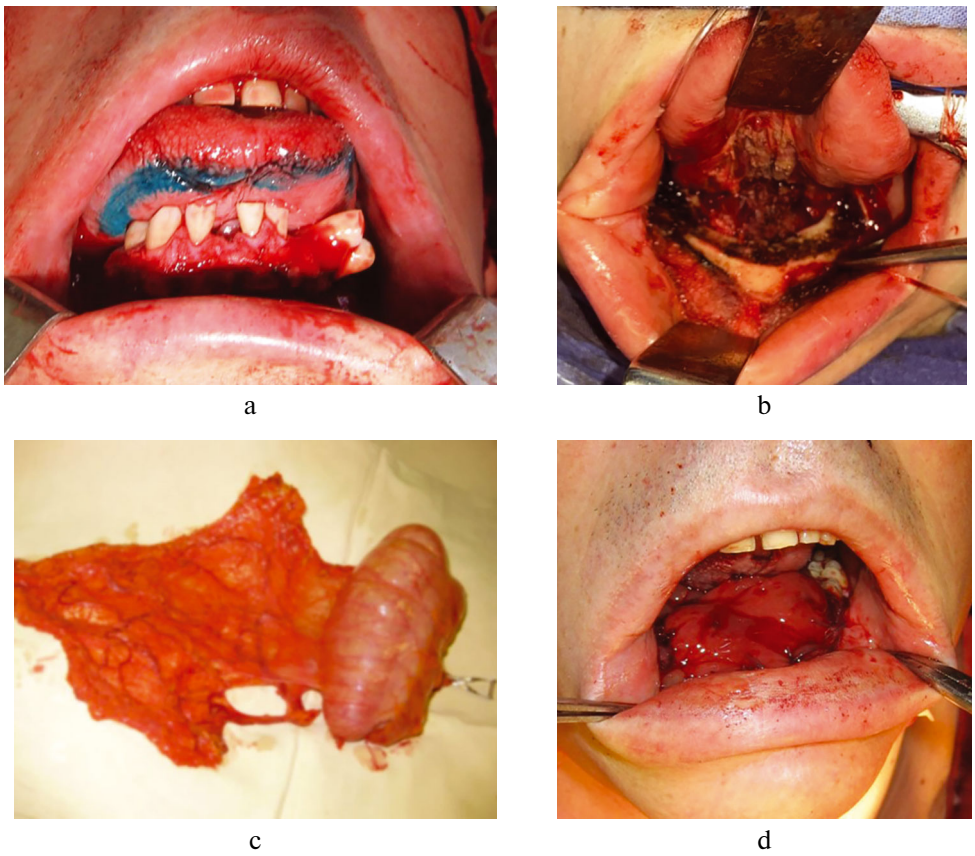


Fig. 3. **Clinical case 3. Patient *K.*, 44 years old.**

a — preoperative marking of resection borders; b — intraoperative defect; c — large bowel flap; d — mucous membrane of the oral cavity is restored by the colon.

nutrition. There were no signs of xerostomia and disturbances in long-term postoperative period. The patient had no discomfort due to the flap in oral cavity **(Fig. 4)**.

Inter-departmental team of specialists discussed treatment strategy after morphological analysis and preferred follow-up.

Postoperative period was uneventful in the second case. The patient was decannulated after 6 days, and nasogastric tube was removed after 18 days. There was satisfactory adaptation of the autograft, and dental replacement was performed. Inter-departmental team of specialists discussed treatment strategy after morphological analysis and preferred follow-up.

The patient eats without problems after surgery and does not complain of xerostomia. Two months later, he returned to work and underwent complete social and functional rehabilitation. There were no taste disturbances, discomfort and sensations of a foreign body in the oral cavity **(Fig. 5)**.

In the third case, postoperative period was complicated by salivary fistula after 5 days. Conservative and laser therapy was prescribed. Omental part isolated great vessels, and salivary fistula was closed under therapy after 7 days. The patient was decannulated after 20 postoperative days, and nasogastric tube was removed after 30 days. Inter-departmental team of specialists discussed treatment strategy after morphological analysis and preferred follow-up. The patient 6 years after surgery is presented din **Fig. 6**. The patient underwent dental replacement with favorable adaptation of the graft. There were no signs of xerostomia, taste disturbances and sensations of a foreign body in the oral cavity. The patient underwent complete social and functional rehabilitation.

Morphological analysis of large bowel and gastroepiploic autografts

To study the mucous membrane of autografts in the oral cavity at various times after microsurgical reconstruction, we analyzed mucous fragments of large intestine in 10 patients and stomach in 14 patients.

Large bowel graft biopsy was performed in 1, 6 and 12 months after transplantation. We assessed thickness of mucous membrane, epithelium, crypts and stroma of wall. There were no structural changes in colonic mucosa in a month after transplantation **(Fig. 7a)**. Surface of mucous membrane was covered by cylindrical epithelium. Crypts were mostly arranged vertically and adjacent to each other. They were covered by goblet and cylindrical cells. Goblet cells were filled with mucus in most cases. There were a moderate number of lymphocytes in the proper layer of mucous membrane.



a b c

Fig. 4. **Clinical case 1. Patient *B*.**
a — patient in 8 month after surgery; b — gastric portion of autograft in oral cavity; c — palatal obturator.



Fig. 5. **Clinical case 2. Small bowel flap in the oral cavity and dental implants in the patient *Ch*. in 2 years after surgery.**

After 6 months, microscopic pattern was characterized by thinning of mucous membrane, flattening of epithelium, shortening of crypts and decrease in their number (atrophic signs) **(Fig. 7b)**.

No significant changes were observed after 12 months. However, fibrosis was found at the base of mucosa in 3 cases that led to further progression of mucosal atrophy **(Fig. 7c)**.

Thus, transplantation of large bowel autograft into the oral cavity leads to long-term restructuring of mucosa. Atrophy was found in 30% of grafts after 12 postoperative months. There was no severe inflammatory infiltration of the base of mucosa or dysplastic changes in prismatic epithelium.

Kravtsov S.A. et al. [11] analyzed morphological data of mucous membrane of gastric autograft in 14 patients. There was no structural and functional reorganization within a period from 3 days to 3.5 years after transplantation. Histological analysis revealed that transplantation of gastric autograft into the oral cavity in most cases leads to moderate atrophy of fundic glands without severe inflammatory infiltration of mucosal base or epithelial dysplasia **(Fig. 8)**.

Discussion

To date, surgical treatment with reconstruction and radiotherapy are the main components of treatment for locally advanced malignant tumors of the oral cavity. Radiotherapy leads to moderate-to-severe xerostomia in 64% of cases [12]. This complication significantly worsens the quality of life.

Currently, there are various displaced and free autografts for head and neck tumors. Fasciocutaneous and musculocutaneous autografts are the most common for closure of oral soft tissue defects [3, 6, 7].

In 2021, Matsumoto H. et al. [13] analyzed skin flaps in the oral cavity 10 years or more after autotransplantation. The authors found progression of atrophy over time due to constant exposure to moisture and no ultraviolet radiation. In addition, some flaps take on the appearance of mucous membrane, but no transformation of cutaneous segment of the flap in the oral cavity into mucous membrane occurs. The main factor is inflammation [14–19] following fungal infection [17, 19–23], mechanical irritation during eating [19, 24], traumatization with dentures [21], poor oral hygiene [14, 21], smoking and drinking alcohol [14, 19, 21, 23].

Cutaneous segment in the oral cavity is not optimal for restoring the internal lining and can cause discomfort, taste problems. The main disadvantage of cutaneous flaps is impossible mucous secretion by the components of the flap for additional moisturizing. It is an important factor, especially in patients with xerostomia after radiotherapy [2]. In case of visceral autograft, mucous membrane is replaced by mucous membrane. Therefore, there are no



Fig. 6. **Clinical case 3. Patient *K*.**

a — lower jaw dental implants; b — stages of dental replacement; c —final view of colon graft and dental implants in 6 years after surgery.

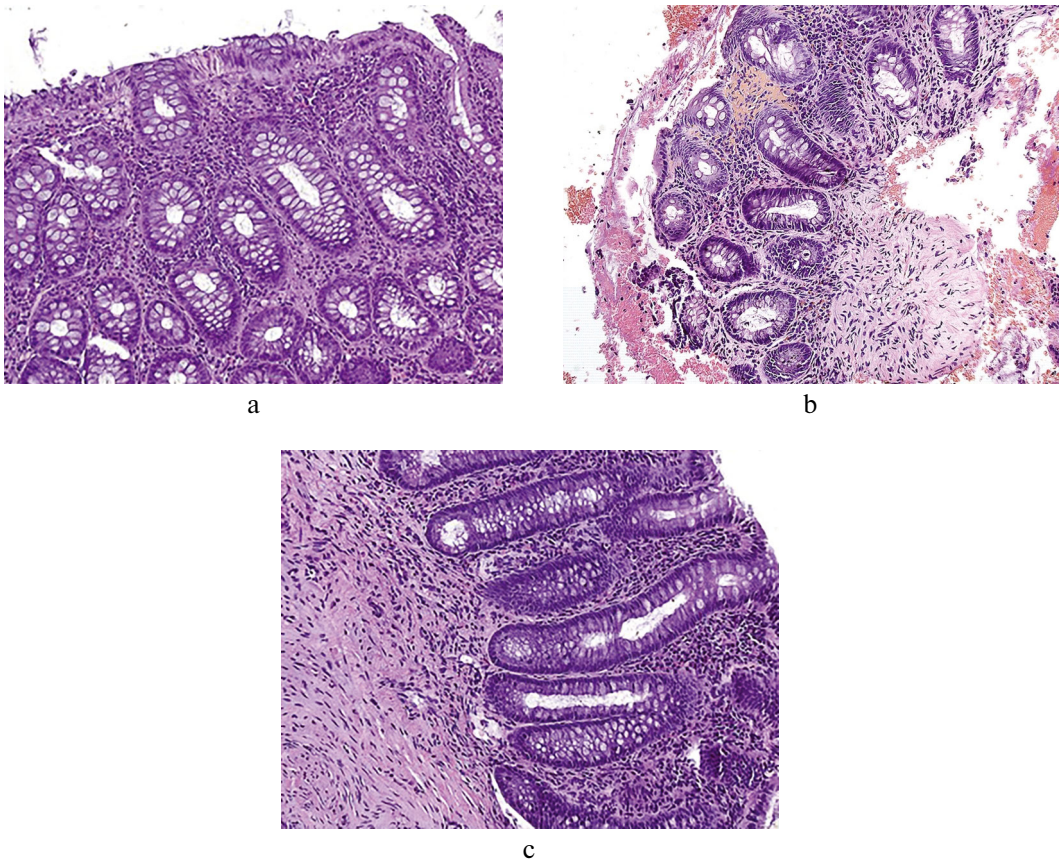
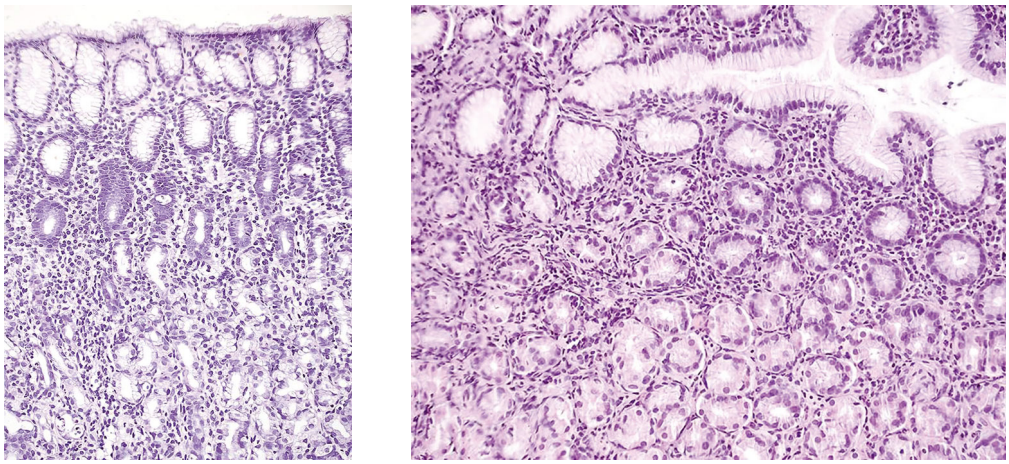


Fig. 7. **Histological examination of colon graft after autotransplantation in a 52-year-old patient *L*.**

a — after a month. Intact epithelium. Hematoxylin and eosin staining, ×200; b — after 6 months. Mucous membrane thinning, flattening of epithelium, shortening of crypts and reduction of their number. Hematoxylin and eosin staining, ×200; c — after 12 months. Colonic mucous membrane with basal fibrosis. Hematoxylin and eosin staining, ×200.

negative effects of skin in the oral cavity. In addition, fragments of stomach and intestines release mucous secrete that contributes to additional moisture of the oral cavity.

The most common gastrointestinal plastic materials for oral mucosa repair are gastric, small or large bowel autografts containing additional soft tissue component (omental or mesenteric portion). These tissues have favorable adhesive properties and effectively cover the anastomoses between the mucosa of autograft and oral cavity, as well as cervical vessels.



a b

Fig. 8. **Histological examination of gastric autograft after transplantation in the oral cavity.**

a — before autotransplantation. Intact epithelium. Mild lymphoid infiltration. Hematoxylin and eosin staining, ×20; b — after 12 months. Gastric mucous membrane with proliferation of fundic glands, incomplete intestinal metaplasia and no lymphoid infiltration. Hematoxylin and eosin staining, ×20.

There are literature data on the use of free jejunal and colonic autografts for xerostomia in cancer patients after appropriate treatment [25, 26]. Lin Y.-S. et al. [25] performed microsurgical autotransplantation of large bowel autograft in 12 patients with oral cancer due to severe xerostomia after surgery and radiotherapy. The follow-up period ranged from 1 to 14 years (mean 63 months). Quality of life, diet and xerostomia improved in 11 out of 12 patients. Unpleasant odor from the transplanted colon tissue disappeared 1 month after surgery. Comparing colonic and small bowel autografts, the authors prefer the first graft due to better resistance to ischemia, more watery secretion from colonic autograft similar to saliva and less number of folds preventing biting the autograft. Colonic autografts release less secretion compared to small bowel autograft with equal area. Amendola F. et al. [26] found sufficient moisture to the oral cavity by jejunal mucosa 3 cm^2 while 6 cm^2 bowel results excessive secretion and constant salivation.

There are literature data on positive effect of mucus release by gastric mucosa on speech, chewing and swallowing [27–29]. However, some authors reported oral ulcerations due to release of hydrochloric acid [29, 30]. In our patients, we found no ulcerations after gastroepiploic autograft transplantation. However, some other authors described ulceration of contact surfaces and progressive dental caries.

Secretion of gastric acid by the graft mucosa caused some unpleasant sensations in 50% (21 out of 42) of patients, burning in the mouth in 61.1%, burns and destruction of tooth enamel — in 22.2% of patients. This required additional fulguration of mucous membrane of the gastric graft [11].

According to literature data, gastroepiploic autograft tolerates adjuvant therapy well without loss of secretory function [30].

All our patients did not complain of discomfort, foreign body sensation and taste disturbances. There were no signs of xerostomia, although all patients underwent radiotherapy. All patients ate well, led an active lifestyle and underwent dental rehabilitation. No preparation was required before dental implantation.

Histological analysis of colonic and gastric grafts revealed that transplantation into the oral environment with another enzymatic and acid-base composition leads to moderate atrophy without severe inflammatory infiltration of mucosal base or dysplastic changes.

In 1998, Wei W.I. et al. [31] performed histological examination for up to 2 years after jejunal autograft transplantation and adjuvant radiotherapy and compared these data with the control group (no radiotherapy). Radiotherapy was followed by edema and loss of villi, which were restored 3 months after therapy. Enhanced fibrosis with focal loss of glands was noted 3 months after radiotherapy and persisted for a two-year period. No effect of radiotherapy on goblet cells was noted.

The main limitations for widespread use of visceral autografts are the need for abdominal intervention and imposing the gastrointestinal anastomoses that may be associated with serious complications [5]. In addition, gastrointestinal comorbidities and previous abdominal surgery may be contraindications for this approach. The disadvantage of reconstruction with gastroepiploic autografts is aggressive secretion.

Conclusion

Visceral autografts close oral defects with a tissue similar in morphological structure and releasing mucous secretion. Therefore, we provide moisture of the oral cavi-

ty and positively affect speech and digestion, especially in patients with xerostomia after radiotherapy.

If we have various options for plastic material in patients without contraindications, it is necessary to choose the most optimal reconstruction method allowing maximum anatomical, functional and social rehabilitation of patients with oral cavity tumors and minimal side effects.

No conflict of interests to declare.

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