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Advances in the application of common tissue flaps for the repair of oral and maxillofacial defects

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Abstract: *To review the current status of the application of tissue flaps in postoperative defect repair and reconstruction of head and neck tumors, and to look forward to the prospect of their application. We reviewed the relevant literature at home and abroad to describe the status of tissue flaps in postoperative defect repair and reconstruction of head and neck tumors, and reviewed the history of the development of commonly used new and traditional tissue flaps, summarizing their anatomical bases, indications, advantages and disadvantages, and improvement methods. New tissue flaps, such as the inferior chin artery island flap, the facial artery buccal muscle mucosal flap, and others, showed similar or even superior repair results to free flaps in specific patients. In addition, many improvements have been made in the preparation of traditional pedicled tissue flaps, such as nasolabial groove flap, pectoralis major muscle flap, latissimus dorsi muscle flap, temporalis muscle fascia flap, and temporoparietal fascia flap, which have further broadened the indications for these flaps, especially in patients who are not in good condition.Various tissue flaps still play an important role in the repair and reconstruction of head and neck tumor defects, and even show the advantages of more convenient flap production, faster postoperative recovery, less treatment cost and good repair effect in certain patients.*

Keywords: *Tissue flaps, maxillofacial defects.trauma repair, a review*

1. Introduction

The face is an important anatomical unit of human appearance and function [1], with its exposed location and many important aesthetic organs, so the repair surgery of facial soft tissue defects, not only to restore function, but also to consider the aesthetics, is still a very challenging topic in the field of maxillofacial surgery. The common causes of facial soft tissue defects include trauma, infection, excision of various benign and malignant masses, and second-stage reconstruction of scarring caused by burns or scalds. Maxillofacial soft tissue defects caused by various reasons usually need to be repaired in stage I. Choosing the appropriate repair method is one of the keys to successful treatment. At present, there are more means for repairing maxillofacial soft tissue defects in clinical practice, and the repair of small-area maxillofacial soft tissue defects can be done by submerged separation and direct pulling together and suturing, but for larger-area tissue defects, such as maxillofacial malignant tumors, which have a high incidence of disease[2], the clinic mainly adopts the surgical treatment method, and the progression of the tumors can be controlled by effective and standardized treatments, with a high cure rate of early oral cancer [3]. The cure rate is high, but the head, neck and maxillofacial area, due to its structural peculiarities and the limitation of the amount of tissues, it is often difficult to directly pull together the suture for tissue defects after tumor resection, and the defects often need tissue flap repair[4], and if direct pulling together of the suture is used, it will directly affect the patient's maxillofacial appearance and aesthetics, functional recovery, quality of life, and it will have a great impact on the patient's psychology[5].

Head and neck cancer (HNC) is a clinically frequent malignant tumor, with sites including salivary glands, nasal cavity, sinuses, oral cavity, oropharynx, hypopharynx, larynx, and cervical esophagus[6] Surgery is important in the resection of benign head and neck tumors or verrucous lesions, radical treatment of early-stage NHC, and comprehensive treatment of middle- and late-stage NHC. However, tumor resection often leads to deformity defects or dysfunction[7] , and the types of defects include soft

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tissue defects, bone defects, and organ loss, etc., which need to be repaired and reconstructed in the same period of time by choosing the appropriate surgical procedure in order to improve the patients' quality of life and prognosis.In clinical practice, free perforator flap and pedicled flap are the two most common ways to repair defects after oral and maxillofacial malignant tumors [8] Currently, the flaps applied to the repair of oral and maxillofacial defects mainly include traditional pedicled tissue flaps including pectoralis major muscle flap, latissimus dorsi muscle flap, glabellar sulcus flap, temporalis muscle fascia flap, and temporoparietal fascia flap. With the development of techniques such as microvascular anastomosis and digital surgery, free tissue flaps have become the majority of oral and maxillofacial malignancies. The preferred means of repair for postoperative large and medium-sized defects, the postoperative survival rate of this flap reaches more than 95%, and satisfactory results of shape remodeling and functional reconstruction can be obtained[9] . However, the free tissue flap and the derived perforator flap still have certain limitations, such as long surgical time, high requirements for microsurgical and postoperative monitoring techniques, frequent postoperative complications such as vascular crises, and inapplicability to some patients (e.g., advanced age, poor nutritional status, concomitant diseases, and multiple surgeries or after radiation therapy).With the deeper understanding of the anatomy of some well-known vascular branches, many new types of tissue flaps have emerged, such as the sub-chin artery island flap, supraclavicular artery flap, and facial artery buccal muscle mucosal flap, etc. The progress of the application of new and traditional tissue flaps in the repair and reconstruction of oral and maxillofacial tissue defects is reviewed[10].

2. Tipped tissue flap

2.1 Submental Artery Island Flap

The submental artery island flap (SMAIF) was proposed by Martin [11]in 1993, through the cadaveric autopsy summary suggests that the submental artery is in a constant position and has a rich subdermal anastomotic network, which provides a preliminary theoretical feasibility for it to be the donor area for repair of oral and maxillofacial defects, and then researched by several clinicians, which lays a theoretical anatomical foundation for the clinical application of the submental artery island flap [12]. SMAIF is a kind of axial flap tipped by under-chin artery and vein, which is adjacent to the maxillofacial defects compared with other flaps, and is easy to cut [13], which can save the time of vascular anastomosis and avoid the risk of postoperative thrombosis, etc[14]. The under-chin insular hypertrophic muscle flap is located in the under-chin triangle, with the under-chin artery and vein as the tip, which has a richer blood supply and a higher graft survival rate. In addition, the under-chin insular flap is soft, easy to shape, and has a sensory nerve branch, which is more suitable for the repair of maxillofacial defects after resection of tumors of the tongue, floor of the mouth, and buccal region[16]. The sub-chin artery island flap has the following characteristics in the repair of facial soft tissue defects: the color and texture are very similar to the facial soft tissue, and the appearance is more natural; as a retrograde flap, the scope of repair is significantly increased due to the change of the flap's vascular tip; it can provide a large amount of skin tissues; it has a stable branch of the facial artery, sub-chin artery, which provides blood, and has a high viability; it has a hidden scar in the donor area, which does not affect the appearance; the flap is relatively simple to fabricate, and no special instruments and equipment are needed. The flap is relatively simple to fabricate, does not require special instruments and equipment, has a short operation and hospitalization time, less intraoperative bleeding, and faster postoperative recovery, which is very suitable for the repair of medium-sized defects of the head and face[17]. Since the application of SIF in the clinic, after years of refinement and supplementation, it has been proved that it can be prepared as a skin flap and musculocutaneous flap, and has been successfully applied to repair a variety of defects in the oral and maxillofacial region [18].

The flap is currently being used more and more in the head and neck region as people's awareness of SIF increases, but its safety is still a matter of discussion [19].In patients with oral cavity or oropharyngeal cancer, the main concern is that potentially involving lymph nodes may remain in the flap or flap tip[20], and therefore there is a concern that the application of this flap may lead to tumor recurrence as a result of poor clearance of metastatic lymph nodes.In recent years, many authors have investigated the relationship between the use of SIF and the rate of local tumor recurrence. Wang et al [21]further homogenized the study population and concluded that the use of SIF with careful neck dissection and appropriate postoperative adjuvant therapy did not increase the risk of local recurrence in pN+T1~T2 oral cancer patients compared to pN0 T1~T2 oral cancer patients. In conclusion, preoperative and intraoperative evaluation of lymph node metastasis is necessary, and we believe that the use of the sub-chin island flap is safe in patients with pN0, whereas this flap should be used with caution in patients

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with clinically advanced (>N0) cervical lymph node metastasis.

2.2 Pectoralis major myocutaneous flap, PMMF

In 1968, Hueston et al first reported PMMF, and in 1979, Ariyan et al first reported the clinical application of PMMF to repair postoperative defects of HNC. PMMF has the advantages of abundant available tissue, accurate and reliable blood supply, simple operation, easy survival, strong anti-infection ability, and can provide protection for the great blood vessels of the neck after radical neck dissection, etc., and has quickly become a common skin flap for repairing the defects after head and neck malignant tumors[22]. As it sacrifices the functions of pectoralis major muscle and ipilateral sternocleidomastoid muscle, the function of postoperative upper limb and neck movement of patients is affected, and the defect cannot be easily reached due to the length limitation of vascular pedicle rotation, and the postoperative flap necrosis caused by vascular pedicle compression is its main disadvantage [5]. Common complications after PMMF repair of defects are localized skin island necrosis, fistulae and splitting of the operative area [25-27].

In recent years, scholars have made many improvements in the preparation technology of PMMF, such as extending to the anterior axillary line [28], crossing the subclavian bone [29], ligation of lateral thoracic artery [30], etc., in order to extend the radius of flap repair, skeletonizing the vascular pedicle [[24], and preserving the position of nipple areola and breast morphology [31]. Combined with other flaps, including free flaps [32] and folded double splicing [30], it is used to repair large or penetrating defects, further expanding the indications of this flap.In patients with high lesion locations, mostly located in the zygatic region, temporal region and orbital region, sufficient vascular pedicle length is required to avoid postoperative complications caused by large local tension. Scholars have improved PMMF, such as vascular pedicle passing through the subclavicle [33]. The vessel pedicle without muscle passes under the clavicle without obvious pressure, and the bony structure of the clavicle protects the vessel pedicle from pressure. This reduces the risk of donor damage and complications. Although free tissue flap has become the most important repair method for head and neck repair, for patients with hypercoagulability, especially patients with recurrence after postoperative radiotherapy, the blood vessels in the donor area of the neck are invaded by tumors, or the recurrence after free flap repair surgery, the donor area is no longer suitable for the recipient area. In patients complicated with severe hypertension and diabetes[34], the intima of blood vessels is not good, and thrombosis is easy to form after microanastomosis. All the above conditions are not suitable for free tissue flap surgery [35], and pectoralis major myocutaneous flap is the first choice. In addition, for medical institutions with poor microsurgical technology, PMMF is still an irreplaceable means to repair postoperative defects after HNC [36].

2.3 Nasolabial flap, NLF

Nasolabial flap is one of the flaps used to repair oral and maxillofacial defects. Nasolabial groove flap is a pedicled axial flap with a well-known vaso-facial artery inside. The incision range is 5mm below the inner canthus, down to the lower margin of the mandible, front to the outer corner of the oral Angle, and back to the anterior masseter edge. The actual usable size is about 3×6 cm2. Nasolabial furrows with pedicled flaps are the best treatment for patients with nasolabial injuries. Nasolabial groove flaps are currently widely used for the repair of small and medium defects in the nose and face (such as nasal alar, nasal column, lower eyelid, upper and lower lip, oral Angle) and in the mouth (such as buccal mucosa, oral floor, tongue, palate, upper and lower jaw) [37]. Nasolabial groove is located at the joint of the nose and the upper lip, curves downward and outward, and gradually vanishes in the outer and lower part of the oral Angle. It's the natural boundary between the cheek and the nose and lips. The skin of nasolabial sulci has an extremely rich and dense subdermal vascular network, and a number of well-known blood vessels are out of shape, such as facial arteries and inner canthus arteries, which are the anatomical basis for the survival of nasolabial sulci flaps [38]. The advantage of nasolabial flap is that the flap is supplied by well-known blood vessels and has abundant blood supply, which is easy to survive.The flap does not need to open a second surgical field, and the color and texture of the adjacent site are similar to the skin in the defect area[39].

With the continuous improvement of the anatomy of the blood supply in the nasolabial fold region and the technique of flap preparation, arbitrary flaps, subcutaneous flaps, axial flaps, and even percutaneous flaps can be prepared in different directions and at different tissue levels[40]. Scholars at home and abroad have improved the traditional flaps and have successively reported the anatomical and clinical applications of nasolabial fold arbitrary flaps, nasolabial fold full-thickness flaps, and nasolabial fold axial flaps (with the facial artery as the tip, the parafacial artery as the tip, the superior labial artery

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as the tip, and the infraorbital artery as the tip). Chen Jie[41] and others further widened the flap aspect ratio by using an upper and lower biplane modified NLF with shared tips, and achieved satisfactory repair results. For buccal cancer tumors with a diameter of 4 cm or less, the use of nasolabial groove flap to repair postoperative tissue defects in buccal cancer is a simple surgery that can well restore the maxillofacial shape and mouth opening with good results, but because nasolabial groove flap needs to form a longer incision in the face and the postoperative scarring is more obvious, it is therefore more appropriate for older people to choose this procedure [42].

3. Free tissue flap

3.1 Free forearm flap

The common free flaps used for defect repair in oral cancer patients are forearm, anterior femoral and peroneal muscle flaps. The advantages of these three types of flaps are that they are rich in quality and can basically satisfy the repair of large oral and maxillofacial soft and hard tissue [43], and they are far away from the primary foci, which can reduce the chance of recurrence of the lesion. The free forearm flap is also known as the "Chinese flap". The main advantages of this flap are its thinness, long vessel tip, thick diameter, and high anastomotic success rate. The forearm flap belongs to the arterial trunk mesh flap, and the anatomy of blood vessels is constant. The forearm flap has a rich blood supply, shallow position, constant anatomy, moderate thickness, and moderate length of the vessel tip, etc. Its plasticity and operability are good, and it can be anastomosed to the corresponding diameter of the vessels in the neck, with a low probability of variation and constant vessels, easy to survive [44], and easy to anastomose, which makes it an ideal material for repairing the maxillofacial defects after oral cancer surgery . ideal material [45].The forearm flap is thin and anatomically constant and is used to repair most of the oral mucosa and tissue defects of the floor of the mouth and tongue, but after the forearm flap is cut, it is necessary to cut a skin slice from the abdomen to repair it, and the healing scar of the arm incision is obvious after the operation and easy to be hyperpigmented. Zhang's study found [46] that patients had a better prognosis and higher surgical accuracy after using the forearm free flap graft repair technique. The patients' prognosis of swallowing function was improved to a greater extent, and the surgical success rate was high, which is one of the important flaps for the repair of oral and maxillofacial defects.

3.2 Free anterolateral femoral flap

At present, there are many flap repair methods available in clinic, among which the anterolateral thigh flap was proposed and applied in clinic by Chinese scholars in the 1980s. The descending branch of the lateral circumflex femoral artery anastomosis free flap is the most commonly used, and the clinical effect is ideal. The posterior medial femoral flap is a method of wound reconstruction and repair applied in clinic in recent years, and the free flap is the perforator of the deep femoral artery [47]. From an anatomical point of view, there are many perforating branches of anterolateral femoral flaps, mainly musculocutaneous perforating branches, and some cutaneous branches of intermuscular space, with sufficient and constant blood supply, and two pedicles longer than 8 cm and larger in diameter than the accompanying veins of the perforating branches of arteries, which are very conducive to the reconstruction of blood circulation [48].The anterolateral femoral perforator flap has a large donor area and flexible preparation, which can better meet the needs of the recipient area. Besides, no important blood vessels or nerves pass through the flap, the flap is concealed in position, which is sufficient to ensure functional reconstruction and repair of oral and maxillofacial tissue defects, and postoperative scars are not exposed. Although the main blood vessels are stable, there are variations in the perforator vessels. Preoperative color ultrasound and other auxiliary examination and positioning are required. The flap can be sutured directly after preparation, which has little influence on the motor and sensory function of limbs, and can achieve ideal reconstruction effect of oral and maxillofacial defects in clinical application.

4. Conclusions

Surgical treatment is still the most important means for the treatment of oral and maxillofacial malignant tumors, which can completely eradicate tumor lesions, but at the same time may damage the oral soft tissues of patients. Improper treatment of facial soft tissue defects may lead to facial scar, appearance deformity and other adverse prognosis, causing serious physical and mental trauma to patients. Skin flap transplantation to repair facial soft tissue defects can effectively help patients recover

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facial function.

Individualized selection and design of flaps is an important part of reconstruction faced by oral and maxillofacial surgeons after resection of oral and maxillofacial malignant tumors. The patient's preoperative condition, the site and size of the tumor, matching flaps, postoperative results, and the patient's subjective requirements are all factors to be considered. Free tissue flap transplantation with anastomosis of blood vessels is the mainstream method for repair and reconstruction of large defects in the oral and maxillofacial region, but the technical requirements are high and the operation time is long, which limits the application to patients who cannot tolerate prolonged surger. Selection of free flaps requires better basic surgical skills as well as microsurgical technical support to ensure the success rate of surgery.

With the advantages of simple operation, reliable operation in the same area and reliable blood supply, local pedicled flaps still play an important role in the reconstruction of maxillofacial defects, among which nasolabial groove flaps are commonly used for the repair of oral and maxillofacial defects. The local skin flap has the following advantages: the color, softness and thickness of the skin flap are almost the same as that of normal facial skin; The local tension of the flap was small, the wound was flat, the surrounding tissue was not easy to deform, and the postoperative healing was good. The flap transplantation is convenient and flexible, and can directly rotate and advance the flap around the lesion, which is conducive to the survival of the flap, high surgical safety, and fast wound healing[37].

To sum up, different flaps have their own advantages, and different flaps should be selected for repair according to different facial soft tissue defects. Adopting the principle of proximity can improve the survival rate of skin flap and ensure good recovery of facial function and appearance after operation. For different facial soft tissue defects, different flaps should be used to repair them according to the facial defect site, surrounding skin condition and anatomical structure.

References

[1] Gong Zhongzhong, He Duomin, Ling Bin, et al. Clinical application of submental island flap in repairing postoperative defects of oral cancer [J]. China Cosmetic Medicine, 2012, 21 (11): 1501-1504.
[2] Wang Tao, Zhao Guoqiang, Wan Linzhong. Clinical study of nasolabial groove axial flap pedicled at the lower end of facial artery for repairing soft tissue defects after oral cancer surgery [J].Journal of Nanjing Medical University (Natural Science Edition), 2015,35 (10): 1454-1456,1473.
[3] Xiao Yanhong, Qiu Shuxian, Xu Li.Comparative study of free forearm flap and submental island flap in the repair of postoperative defects of oral cancer [J].Chinese Cosmetic Medicine, 2022, 31(2):13-17.
[4] Minton T J, Williams E F. Lipotransfer in the upper third of the face [J]. Facial Plastic Surgery, 2010, 26(05): 362-368.
[5] Tian Hao, Yu Jianjun, Li Zan, et al. Application of common tissue flaps in the repair of head and neck surgical defects [J].Chinese Journal of Otolaryngology and Skull Base Surgery, 2015(6):489-492.
[6] Lo Nigro C, Denaro N, Merlotti A, et al. Head and neck cancer: improving outcomes with a multidisciplinary approach[J]. Cancer management and research, 2017: 363-371.
[7] Marur S, Forastiere A A. Head and neck squamous cell carcinoma: update on epidemiology, diagnosis, and treatment[C]//Mayo Clinic Proceedings. Elsevier, 2016, 91(3): 386-396.
[8] Shi Haibo, Xiang Danwei, Ye Jiapeng, et al. Application of submental island flap in the repair of oral and maxillofacial malignant tumor after resection [J]. Journal of Oral and Maxillofacial Surgery, 2021, 31(4):221-225.
[9] Mao Chi, Peng Xin, Zhang Lei, et al. Simplified head and neck microsurgery and its clinical application[J].Otorhinolaryngology Head and Neck Surgery of China, 2016(3):127-130.
[10] Patel U A, Hartig G K, Hanasono M M, et al. Locoregional flaps for oral cavity reconstruction: a review of modern options[J]. Otolaryngology–Head and Neck Surgery, 2017, 157(2): 201-209.
[11] Martin D, Pascal J F, Baudet J, et al. The submental island flap: a new donor site. Anatomy and clinical applications as a free or pedicled flap[J]. Plastic and reconstructive surgery, 1993, 92(5): 867-873.
[12] Xu H, Xu J, Wang X, et al. Quantum dot-based, quantitative, and multiplexed assay for tissue staining[J]. ACS Applied Materials & Interfaces, 2013, 5(8): 2901-2907.
[13] Li J, Nie L, Wang L, et al. Submental Island Flap Combined With Reconstruction Titanium Plate: A New Way to Treat Mandibular Osteoradionecrosis [J]. Surgical Innovation, 220, 27(6): 580-586.
[14] Jorgensen MG, Tabatabaeifar S, Toyserkani NM, et al. Submental island flap versus free flap reconstruction for complex head and neck defects [J]. Otolaryngol—Head Neck Surg, 2019, 161(6): 946-953.

ISSN 2706-6819 Vol.5, Issue 12: 76-82, DOI: 10.25236/IJFM.2023.051211

[15] Brodell L A, Gru A A, Haughey B, et al. Autologous fat transfer–induced facial nodule[J]. Journal of the American Academy of Dermatology, 2013, 69(2): e107-e108.
[16] Chang B A, Asarkar A A, Nathan C A O. What is the oncologic safety of using the submental flap to reconstruct oral cavity cancer defects [J]. The Laryngoscope, 2019, 129(11): 2443-2444.
[17] Wang JB, Tan YR, Shen Y, et al. Oncological safety of submental island flap for reconstruction of pathologically node-negative and node-positive T1-2 oral squamous cell carcinoma-related defects: A retrospective study and comparison of outcomes[J]. Oral Oncol, 2020, 102: 104507.
[18] Howard B E, Nagel T H, Barrs D M, et al. Reconstruction of lateral skull base defects: a comparison of the submental flap to free and regional flaps[J]. Otolaryngology–Head and Neck Surgery, 2016, 154(6): 1014-1018.
[19] Zhao Yang, Xiang Jingzhou, Liu Fayu.Postoperative quality of life assessment of patients with tongue cancer repaired by forearm flap, anterolateral thigh perforator flap and submental island flap [J]Shanghai Stomatology, 2017,26(1):111
[20] Gabrysz-Forget F, Tabet P, Rahal A, et al. Free versus pedicled flaps for reconstruction of head and neck cancer defects: a systematic review [J]. Journal of Otolaryngology-Head & Neck Surgery, 2019, 48(1): 1-31.
[21] Cariati P, Serrano A C, Fernandez A B M, et al. Is submental flap safe for the oncological reconstruction of the oral cavity [J]. Journal of stomatology, oral and maxillofacial surgery, 2018, 119(4): 284-287
[22] Geng Zhongli, Ma Binlin, Ren Guanghui.Application of pedicled pectoralis major myocutaneous flap in head and neck soft tissue defects [J] Journal of Xinjiang Medical University, 2009,32(3):333-335
[23] Teo K G W, Rozen W M, Acosta R. The pectoralis major myocutaneous flap [J]. Journal of reconstructive microsurgery, 2013, 29(07): 449-456.
[24] Liu M, Liu W, Yang X, et al. Pectoralis major myocutaneous flap for head and neck defects in the era of free flaps: harvesting technique and indications[J]. Scientific reports, 2017, 7(1): 1-9.
[25] Nguyen S, Thuot F. Functional outcomes of fasciocutaneous free flap and pectoralis major flap for salvage total laryngectomy[J]. Head & Neck, 2017, 39(9): 1797-1805.
[26] Li W, Zhang P, Li R, et al. Radial free forearm flap versus pectoralis major pedicled flap for reconstruction in patients with tongue cancer: assessment of quality of life [J]. Medicina oral, patologia oral y cirugia bucal, 2016, 21(6): e737.
[27] Anehosur V, Dikhit P S, Nagraj N, et al. PMMC flap revisited and its clinical outcome in 150 patients[J]. Journal of Maxillofacial and Oral Surgery, 2020, 19(1): 26-31.
[28] Chen W, Zhang D, Huang Z, et al. Comparison of outcomes with extensive segmental pectoralis major myocutaneous flap via the anterior axillary line and the conventional technique in oral and oropharyngeal cancer[J]. Head & Neck, 2018, 40(2): 349-354.
[29] Poh E H K, Xu L Q, Yin X L, et al. Extending the arc of rotation of the pectoralis major myocutaneous flap for orofacial reconstruction via a modified subclavicular route through the clavipectoral fascia[J]. Journal of Oral and Maxillofacial Surgery, 2017, 75(1): 222. e1-222. e6.
[30] Tian Hao, Yu Jianjun, Li Zan, Zhou Xiao. Clinical application of modified pedicled pectoralis major myocutaneous flap in repairing complex defects after surgery for advanced head and neck malignant tumors [J]. Chinese Journal of Cancer, 2016, 26(02):151-154.
[31] Mehta S, Agrawal J, Pradhan T, et al. Preservation of aesthetics of breast in pectoralis major myocutaneous flap donor site in females[J]. Journal of maxillofacial and oral surgery, 2016, 15(2): 268-271.
[32] Zhang C, Zhu M, Chen M, et al. Free flap combined with pectoralis major flap for reconstruction after total laryngopharyngectomy in patients with advanced hypopharyngeal carcinoma[J]. Acta Oto-Laryngologica, 2016, 136(8): 841-846.
[33] Wu Xubin, Keremu Abbas, Abu Duklimujiang Maimaiti, et al.Clinical application of pectoralis major myocutaneous flap in the repair of postoperative defects of malignant tumors in the middle of the face [J].Journal of Xinjiang Medical University, 2022,45(4) : 415-418.
[34] Bozikov K, Arnez Z M. Factors predicting free flap complications in head and neck reconstruction [J]. Journal of Plastic, Reconstructive & Aesthetic Surgery, 2006, 59(7): 737-742.
[35] Yu Jianjun, Zhou Xiao, Chen Jie, et al. Application of various free tissue flaps in the repair of cheek perforation defect [J]. Chinese Journal of Otorhinolaryngology and Skull Base Surgery, 2008,14(2):107-110.
[36] Guimarães A V, Aires F T, Dedivitis R A, et al. Efficacy of pectoralis major muscle flap for pharyngocutaneous fistula prevention in salvage total laryngectomy: a systematic review[J]. Head & neck, 2016, 38(S1): E2317-E2321.
[37] Wu Suzhou, Hua Dong, Fang Xiaokui, et al.Application of skin flap in the repair of soft tissue defects after resection of facial lesions [J].Journal of Tissue Engineering and Reconstruction Surgery, 2020,

ISSN 2706-6819 Vol.5, Issue 12: 76-82, DOI: 10.25236/IJFM.2023.051211

16(1): 46-47, 53.
[38] Zhuang Shubo, Xu Mengmeng, Liu Yi. Clinical observation of nasolabial flap in repairing nasal skin and soft tissue defects [J]China Cosmetic Medicine, 2019,28(1):36-38.
[39] Zhang Rong, Wang Rongyao, Gao Zhan. Application of nasolabial flap in the repair of maxillofacial soft tissue defects [J]Chinese Cosmetic Medicine, 2019,28(5):113-114, 142
[40] Rahpeyma A, Khajehahmadi S. The place of nasolabial flap in orofacial reconstruction: A review[J]. Annals of Medicine and Surgery, 2016, 12: 79-87.
[41] Chen Jie, Jiang Canhua, Chen Lichun, et al. Modified nasolabial fold flap for anterior buccal mucosal defect [J]. Chinese Journal of Repair and Reconstruction Surgery, 2015, 29(5):582-585.
[42] LI Jiancheng, SONG Peijun, YANG Dongkun, et al. Repair of facial penetrating defects after oral and maxillofacial malignant tumor surgery with posterior lateral peroneal artery perforator free flap [J]. Chinese Journal of Microsurgery, 2019,42(1):26-31.
[43] Sagheb K, Blatt S, Rahimi-Nedjat R K, et al. Cervical metastases behavior of T1–2 squamous cell cancer of the oral mucosa [J]. Clin Oral Investig, 2017:931-935.
[44] Huang Long, Guo Feng, Jian Xinchun, etc. Clinical application of submental artery perforator flap in repairing postoperative defects of oral cancer [J].Chinese Journal of Stomatology, 2018, 53(1):3-7.
[45] Shao Xia, Ye Pengcheng, Fang Yiming, et al.Analysis of 47 cases of oral and maxillofacial defects after tumor resection treated with free forearm flap transplantation [J].Chinese General Medicine, 2017,15(2):206-209.
[46] Zhang Lixia.Nursing experience of 16 cases of forearm free flap transplantation for repairing postoperative defects of oral and maxillofacial tumors [J].China Health Nutrition, 2021,31(14):173.
[47] Ma Teng, Tan Yu, Meng Qingwei. Evaluation of the effect of free flap transplantation in the repair of tissue defects after resection of oral and maxillofacial malignant tumors [J].General Stomatology Electronic Journal, 2017,4(06):2.
[48] Zhang Rui.Effect of free anterolateral thigh flap on oral sensation in patients with oral and maxillofacial tumors [J].Modern diagnosis and treatment, 2020, 31(15):2465-2467.