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Temporalis Muscle Flap in Mid-Facial Reconstruction

Plat mięśnia skroniowego w rekonstrukcji środkowego piętra twarzy

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
D – writing the article; E – critical revision of the article; F – final approval of article

Abstract

Background. Immediate reconstruction after ablative surgery in the mid-facial region seems to be much more comfortable and functional than the conventional obturation methods of post-maxillectomy patient rehabilitation. Among the variety of flap reconstructions, the temporalis muscle flap (TMF) has been utilized for over a century as a relatively simple method of mid-facial restoration.

Objectives. The aim of this study was to present the operative technique and the authors' clinical experience in the TMF reconstruction of mid-face defects.

Material and Methods. The study included 17 consecutive patients who had undergone ablative surgery with immediate TMF transposition: squamous cell carcinoma – 9, basal cell carcinoma – 2, carcinosarcoma – 1, sarcoma – 3, extrapulmonary type small cell carcinoma – 1, and malignant melanoma – 1.

Results. Less advanced tumors were diagnosed in the younger population ($p < 0.01$) and advanced cases had adjuvant radiotherapy significantly more frequent than low T-staged ($p < 0.05$). The local complications were not related to type of the TMF application. One oro-nasal fistula after our procedure, one partial necrosis of the myofascial flap without any functional complaint and two cases of post-operative trismus were observed. The extension of the harvested flap did not increase the number of local complications and no relationship between gender, suction drainage or post-operational CRP level to rate of complications were found.

Conclusions. The clinical evidence reveals the predicted and stable results. In our study, no major complications were observed. In conclusion, the procedure of raising the temporalis muscle flap is a relatively simple, safe, versatile and efficient method of reconstruction. According to the literature review and own experience, it seems to be an excellent alternative for free flaps in mid-facial reconstructions (**Dent. Med. Probl. 2015, 52, 2, 137–143**).

Key words: surgical oncology, maxillectomy, mid-facial reconstruction, temporalis muscle flap.

Słowa kluczowe: chirurgia onkologiczna, resekcja szczęki, rekonstrukcja środkowego piętra twarzy, płat mięśnia skroniowego.

Defects after ablative surgery in the mid-facial region often constitute complex and challenging problems to solve. Conventional obturation methods of post-maxillectomy patient rehabilitation do not seem to be comfortable and functional enough as immediate reconstructions [1]. Among the variety of local flaps, pedicled flaps and even microvascular free grafts, the temporalis muscle flap (TMF) is utilized as a reliable, versatile and relatively simple method of mid-facial restoration [2].

This flap has been employed in maxillofacial surgery for over 100 years. Golovine [3] is known as the first surgeon who used the TMF in 1898 for post-exenteration orbital reconstruction, despite the fact that it was only a forehead skin flap. Without a doubt, the temporalis myofascial method was utilized by Lentz [4] in 1895 for temporomandibular joint ankylosis treatment, by Gillies [5] in 1917 for cheek restoration and by Campbell [6] in 1948 for maxillary defects reconstruction. To improve

TMF mobility, zygomatic arch osteotomy and temporary removal was proposed by Sheehan [7] in 1935. What is more, TMF was also employed at the beginning of the 20th century for eyelid reanimation in the case of a paralyzed facial nerve [8]. For the above-mentioned clinical cases, therefore, the versatility of TMF is still used in mid-facial surgery.

The aim of this study was to present the operative technique and the authors' clinical experience in the TMF reconstruction of mid-face defects.

Material and Methods

Seventeen consecutive patients who had undergone ablative surgery with immediate temporalis muscle flap reconstruction from April 2010 to October 2014 were included in this study. It included 10 males and 7 females with an average age of 57.5 years (ranged from 34 to 75 years). There were unilateral temporalis muscle flaps performed on 4 reconstructions after orbital exenteration (Fig. 1) and 13 TMFs after maxillectomy (Fig. 2). Demographic data, diagnoses (based on histopathological examination), clinical data, laboratory investigation results, clinical outcomes, follow-up and any complications were gathered and analyzed (Tabs. 1, 2). The pathological diagnoses in our study included: SCC (squamous cell carcinoma) – 9, BCC (basal cell carcinoma) – 2, carcinosarcoma – 1, sarcoma – 3, extrapulmonary type small cell carcinoma – 1, and malignant melanoma – 1. The follow-up period ranged from 2 to 54 months (average – 19 months).

Surgical Technique

In all cases of our study, the hemi-coronal approach with preauricular extension was used (Fig. 3). The area of operational approach was shaved before the surgery for better access and



Fig. 1. Defect after orbital exenteration

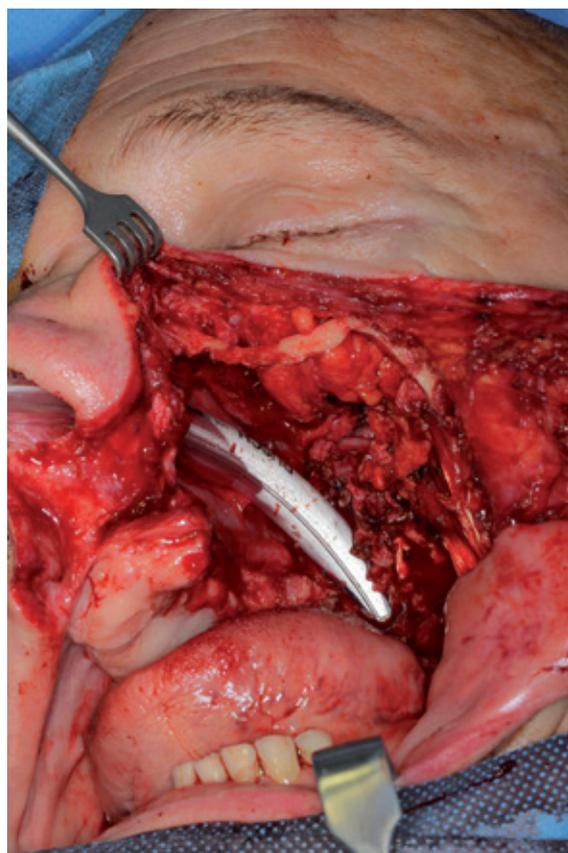


Fig. 2. Defect after maxillectomy

prominence. The incision involved consecutive layers: skin, subcutaneous tissue and superficial temporalis fascia. Haemostatic clips or sutures were utilized due to wound margin bleeding. A following dissection was performed at the layer of deep temporalis fascia to protect the temporal branch of a facial nerve which is located superficially. Subsequently the incision of the deep fascia was made around the muscle margin including the upper rim of the zygomatic arch. Depending on the size of the defect to be reconstructed, the temporalis muscle was often divided coronally into an anterior and posterior part (due to the anatomy of the deep temporal arteries) or rarely taken as a whole. The subperiosteal elevation of the myofascial flap was always performed carefully to prevent the deep temporal vessels from injury (Fig. 4). In all our cases there was no need to execute a zygomatic osteotomy or coronoidectomy to increase the range of the TMF's movement. Then, in case of post-maxillectomy defect, the elevated flap was transposed with silk sutures into the oral cavity through the tunnel which had previously been made with blunt dissection through the infratemporal fossa (Fig. 5). The TMF was sutured to the defect's margins with the fascia facing the oral cavity or dorsal side and left for epithelialization, based on similar out-

Table 1. Summary of demographic data and clinical diagnoses

Patient	Age	Male/ /Female	Diagnosis	T Stage
1	41	F	SSC	3
2	34	M	sarcoma induced by RTX in childhood	4
3	55	F	SSC	4
4	60	F	SSC	4
5	52	F	carcinosarcoma	4
6	50	F	extrapulmonary type small cell carcinoma	4
7	71	M	BCC	4
8	62	M	SSC	3
9	60	M	SSC	4
10	66	M	malignant melanoma	4b
11	53	F	sarcoma	3
12	71	M	pleomorphic sarcoma	3
13	51	M	SSC	4
14	60	M	SSC	4
15	75	F	SSC	4
16	62	M	BCC	3
17	55	M	SSC	4

comes in both rotations [9]. The best fitting of the flap to the reconstructed defect was the main indication for TMF rotation. In the case of an empty orbit filling after exenteration, the TMF was transposed through the opening in a lateral orbital wall (Fig. 6). The temporalis fossa depression was left without filling the volume of the donor site. Finally, the coronal flap was sutured in layers, most often leaving a suction drainage.

Results

In our study, less advanced tumors were diagnosed in the younger population ($p < 0.01$). In 13 cases of TMF reconstruction, the donor extension ranged the anterior part, in 1 case the posterior one and in 3 cases the whole temporalis muscle was used. Suction drainage was always utilized after transposing the whole muscle. Hemoglobin concentration significantly decreased post-operatively (t-test for paired samples $t = 10.34$, $p < 0.0001$). There was pre-operative radiotherapy administered in 1 case (in one case, radiotherapy-induced sarcoma was suspected due to pharynx radiotherapy in adolescence) and post-operative in 13 cases. Advanced cases had adjuvant radio-

Table 2. Summary of post-operative clinical data

Patient	Neck dissection	Radiotherapy	Use of TMF	Side of TMF	Donor extension	Vaccum drainage	Complications	Follow-up (months)
1	none	RTX	MR	right	2/3 anterior	none		54
2	none	none	MR	left	2/3 anterior	RD		53
3	SOH L	RTX	OR	left	2/3 anterior	none		37
4	SOH R	RTX	MR	right	2/3 anterior	none	trismus	26
5	none	RTX	MR	right	2/3 anterior	RD		20
6	SOH R	RTX	MR	right	2/3 anterior	RD		19
7	none	none	OR	right	2/3 anterior	RD		19
8	none	RTX	MR	left	2/3 anterior	RD		17
9	SOH R + L	RTX	MR	left	2/3 anterior	RD	antro-oral fistula, trismus	14
10	none	RTX	OR	right	2/3 anterior	none		13
11	SOH R+L	RTX pre	MR	left	whole	RD		11
12	RAD L + SOH R	RTX	MR	left	2/3 anterior	RD		11
13	none	RTX	MR	right	whole	RD		10
14	SOH R	RTX	MR	right	whole	RD		10
15	SOH L	RTX	MR	left	2/3 posterior	RD	partial necrosis of flap	5
16	none	none	OR	left	2/3 anterior	none		3
17	SOH L	RTX	MR	left	2/3 anterior	RD		2

SOH R/L – supra-omohyoid right/left.
 RAD R/L – radical right/left.
 MR – maxilla reconstruction.

OR – orbital reconstruction.
 RD – Redon drainage 1.



Fig. 3. Hemi-coronal approach with preauricular extension

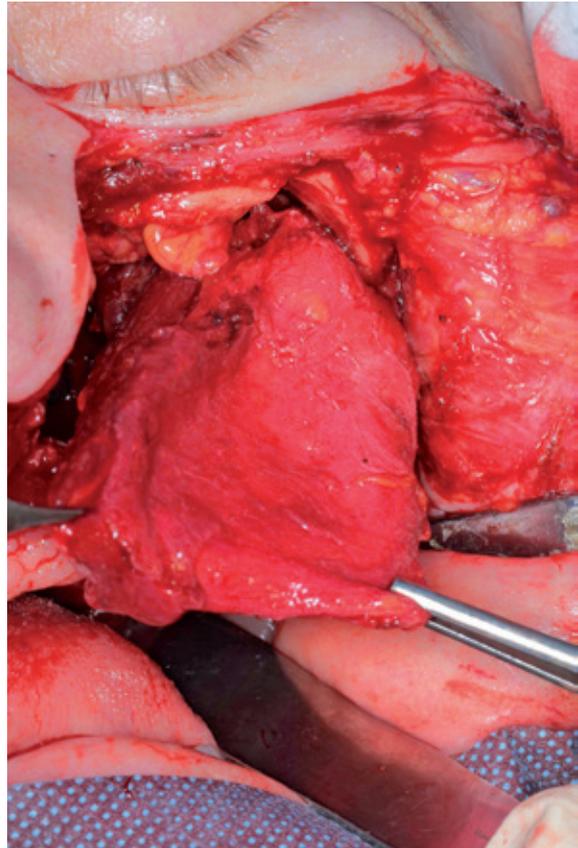


Fig. 5. Flap transposition into oral cavity

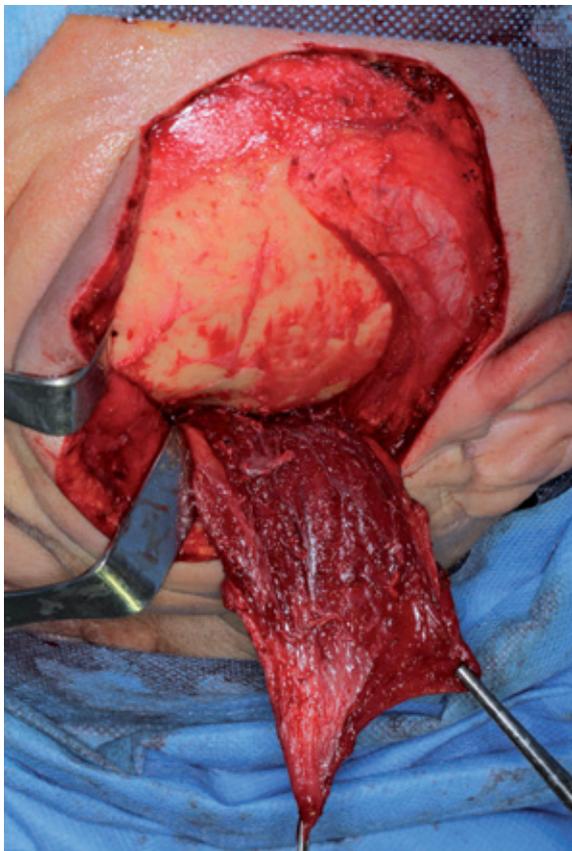


Fig. 4. Elevation of the myofascial flap

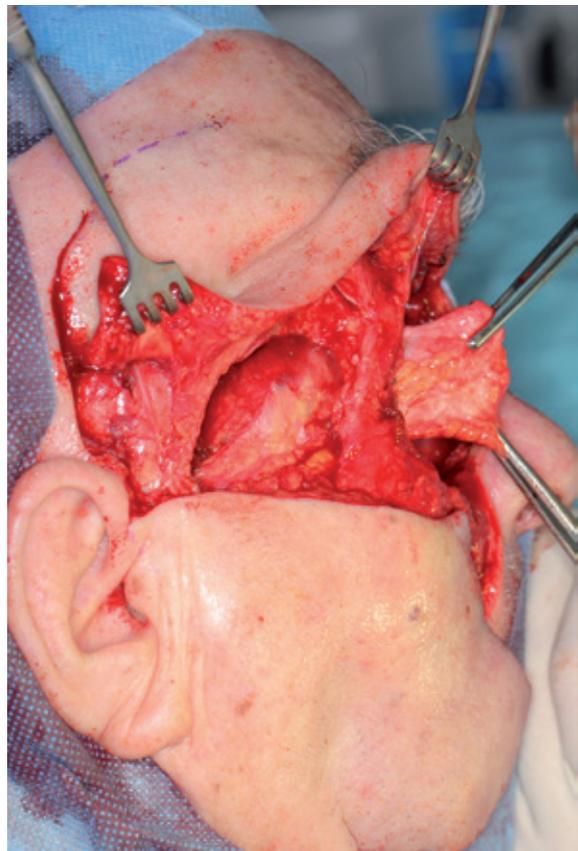


Fig. 6. Flap transposition through the window in a lateral orbital wall



Fig. 7. Three-month post-operative view of TMF reconstruction after maxillectomy

therapy significantly more frequently than low T-staged ($p < 0.05$).

The process of muscle surface epithelialization in the oral cavity ranged from 4 to 8 weeks (Fig. 7).

The local complications were not related to the type of the TMF application ($p = 0.76$). Although as orbital socket filling was performed, there were not any complications observed at all. Only one oro-nasal fistula after our procedure (6%), one partial necrosis of the myofascial flap without any functional complaint (6%) and two cases of post-operative trismus (12%) were observed. On the other hand, no post-operative bleeding and facial nerve palsy were observed in that series. The extension of the harvested flap did not increase the number of local complications ($p = 0.07$). There was also no statistically significant relationship between gender, suction drainage, post-operational CRP level and complications. In all cases except for one, depression in the temporalis fossa was visible.

Discussion

The temporalis muscle flap is commonly known as an efficient and excellent alternative in mid-facial reconstructions. The TMF versatility can be used in various clinical cases: post-maxillectomy defects, palatal defects, post-exenteration orbital reconstructions, temporomandibular joint ankylosis and reanimation of unilateral facial nerve paralysis [1, 10–12]. Cleft patients can be treated with this reconstruction technique in secondary repairs in the case of local mucosal flap failure [10]. Moreover, TMF is suggested to be the best alternative for free microvascular flaps, especially in elderly patients, patients requiring aggressive post-operative radiotherapy and those with cardiovascular risk factors. Some authors pro-

pose TMF in these patients as the first choice reconstruction method [1, 2, 12]. According to literature, another advantage of TMF reconstruction is avoiding the prosthetic obturation of the palatal defect [1, 13, 14]. However, sometimes the defect is left opened by surgeons due to inspection for recurrence [12].

A detailed anatomical study of the mid-facial region can explain TMF utility and vitality. Firstly, this flap can provide five different tissues (muscle, fascia, bone, periosteum and skin) due to diverse clinical cases [1, 15]. Secondly, its fan-shape and three length-diversified parts are useful for closing defects ranging from small unilateral to extensive bilateral cases. This is particularly important for defects located in the direct neighborhood of this muscle – the maxilla, which is described as a critical structure on account of chewing, swallowing, phonation and eye-positioning functions [2]. The temporalis muscle spreads from the lateral orbital rim and anterior temporal crest to the occiput. The middle and posterior parts are known to be similar in length and significantly longer than the anterior one [9]. What is more, deep temporal arteries (anterior and posterior) mainly supplying the flap are the key tool for the predicted reconstruction result. That is why the subperiosteal elevation of the flap should be always performed with extra care to prevent the vascular pedicle from injury [9, 11].

The surgical technique of the temporalis muscle flap is quite easy to use and its hemi-coronal approach is worth performing for an esthetic reason [2, 11, 15]. There are two techniques for flap transposition and two different arcs of rotation: traditional with leaving temporalis fascia facing the oral cavity [1, 12] and inverted with fascia at the dorsal side [9]. The inverted one is suggested to result in fewer complications. The same authors claim that there is no evidence of a fascia protective role for the vascular pedicle. Based on Wong et al. results, in our series both rotation techniques were used. The only choosing criterion was the best fitting of the flap to the reconstructed defect. On the other hand, they pay attention to the extraction of any occluding teeth avoiding artery injury and suggest performing hypotension during the procedure – mean blood pressure 60–65 mm Hg. The hypotension should be helpful while transposing the constricted muscle. Some surgeons prefer to execute a zygomatic osteotomy [2, 11, 12] or coronoidectomy [1, 10] for better range of the TMF's movement. However, this method is not compulsory [16], as in our series there was no need to perform that.

TMF versatility is not only connected to the simple surgical procedure but also the few compli-

cations that occur. In our study, 3 cases of 17 demonstrated minor complications. There were two cases of post-operative reduced mouth opening (12%), one oro-nasal fistula (6%) and one partial necrosis of the myofascial flap (6%) in our series. These values of complications are similar to such problems observed in a review of 182 cases (trismus – 9.3%; total necrosis – 1.6%; partial intraoral dehiscences – 13.7%). Moreover, the orbital reconstructions in both studies were performed with satisfactory results [10], probably due to less angle of flap rotation. Other authors also emphasize the correlation between the size of the defect, adjuvant radiotherapy and complications observed [1, 2]. Furthermore, an estimation of C-reactive protein, one of the acute phase proteins, is commonly used for post-operative wound healing process evaluation [17]. In the main part of our clinical cases, healing was uneventful despite a high CRP level and post-operative hemoglobin loss.

Nevertheless, it is claimed that TMF reconstruction has some disadvantages (for instance fibrous metaplastic retraction) [10] and contraindi-

cations (in particular, previous damage of the donor site and reduction in blood supply) [15].

There are some ways to reconstruct the donor site after TMF transposition. Filling the defect with hydroxyapatite bone cement is one of them [10–12]. It is possible to correct any residual defects with a second-made lipotransfer [11] or lyophilized bovine cartilage [10]. Porous high-density polyethylene and silicone implants are also used successfully [10, 15, 18, 19]. In our clinical study, there were no temporalis fossa reconstructions performed. In one case of our series, that esthetic problem was resolved by transposition of the posterior part of the muscle to protect face symmetry below hair line.

In conclusion, the procedure of rising the temporalis muscle flap is a relatively simple, safe, versatile and efficient method of reconstruction. According to the literature review and our own experiences, it seems to be an excellent alternative for free flaps in mid-facial reconstruction. The clinical evidence reveals the predicted and stable results.

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