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Temporalis Muscle-Galea Pedicled Flap for Reconstruction of Longstanding Facial Paralysis

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Abstract

Reanimation of longstanding facial paralysis is a difficult clinical problem commonly tackled with the method of pedicled muscle flap transfer. The temporalis muscle has been the most popular. In the past, one common problem was that the flap was not long enough to reach parts of the face distant from the affected area. To overcome this disadvantage, we have devised a flap consisting of the pedicled temporalis muscle, temporal fascia and galea together and have achieved good static results in paralyzed faces.

From June, 1996 to May, 2003, we used this procedure with 38 longstanding facial paralysis patients (16 male and 22 female); 23 had right-sided and 15 had left-sided facial paralysis. The patients were followed-up over three years. Our results were recorded as "Excellent", "Good", "Fair" or "Poor". Excellent or good results were obtained in 33 patients (87%). In these patients, the static results are very good. The oral commissure on the affected side maintained a favorable position and almost complete symmetry of expression was attained.

We have acheived dynamic reconstruction by using a temporalis muscle-galea pedicled flap in 38 longstanding facial paralysis patients. Our results show that this is a good option in treating such patients.

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Key words: facial paralysis, reanimation, reconstruction, temporalis muscle, galea

Introduction

Reanimation of longstanding facial paralysis is a difficult clinical problem. Patients show abnormal facial expressions, lower eyelid ectropion and buccinator dysfunction on the affected side of the face. They are also prone to severe psychological problems¹. Of the dynamic rehabilitative methods, free muscle transplantation with microneurovascular

anastomosis, which was first introduced by Harii² in 1976, has produced the most favorable results, especially with one-stage transfer of the latissimus dorsi muscle with cross-face nerve grafting³. But these methods are complicated and require advanced microsurgical skills. In situations where microsurgery is unavailable, pedicled muscle flap transfer, which is also a dynamic method in common use, should be considered. Although masseter and temporalis muscles have been used⁴⁻⁶ for this

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Fig. 1 A diagram of the arterial anatomy and elevation of temporalis muscle-galea pedicled flap in a coronal section of the temporal region. Note the blood supply of galea is continuous with superficial temporal fascia and connected with temporalis muscle. (1) coronoid process of the mandible (2) temporal muscle, (3) temporal bone, (4) parietal bone, (5) zygomatic arch, (6) superficial temporal fascia (7) temporalis muscle was elevated from the surface of temporal bone superficial temporal fascia, (8) superficial temporal artery, (9) galea, (10) cut point of parietal galea. (Quoted and modified: Br J Plast Surg 1995, 48: 446)

purpose, the temporalis muscle has been the most popular⁷⁻¹⁰.

In the past, one common problem with this method was that the flap was not long enough to reach parts of the face distant from the affected area, such as the mouth and, especially, the lips on the normal side. To address this problem, many methods have been attempted¹¹⁻¹⁴: removing the middle portion of the zygomatic arch; combined application of a temporalis muscle transfer to the upper face and masseter muscle transfer to the lower face; and using fascia lata or artifical materials to connect the extremities of the flap. Unfortunately, these methods increase trauma and complicate the operation, and the results tend to be unsatisfactory

because of the use of fascia lata or artifical materials. In comparison, our technique is simple and less harmful. To cover large areas of the face and reanimate eye, nose and mouth deformities with one flap, we have devised a new flap consisting of the pedicled temporalis muscle, temporal fascia and galea together and have achieved good results in paralyzed faces.

Anatomy

Soft tissue in the temporal region is composed of skin, a subcutaneous adipose layer, the superficial temporal fascia, deep temporal fascia and temporalis muscle. The temporalis muscle broadly originates from the temporal fossa and terminates at the coronoid process of the mandible. As described by Nakajima¹⁵, the blood supply of the temporal region derives from the superficial temporal, middle temporal, deep temporal and many other arteries. These arteries and their branches form distinct arterial networks in four layers (1. the skin and superficial temporal fascia network; 2. the loose areolar fascia network; 3. the deep temporal fascia network: 4. the temporal muscle network) which anastomose with each other on many levels. In these layers, the superficial temporal fascia includes both the temporoparietal fascia and its aponeurotic extension (galea). The blood supply of temporalis muscle-galea pedicled flap is superical artery and traffic branches with temporalis muscle. The distal part of galea is mainly supplied by the parietal branch of superficial temporal artery (Fig. 1). The main nerves to the temporalis muscle are the anterior and posterior deep temporal nerves, which are branches of the mandibular division of the trigeminal nerve. These nerves pass the undersurface of the muscle beneath the zygomatic arch and provide innervation to the muscle.

Operative Procedure

The operative procedure is begun with a surface rhytidectomy incision that courses from the anterior tragus to the temple and is elongated 12 cm to reach the occipital rear. Then, a frontward slanting incision



Fig. 2 Design and operative procedure

(a) Design of the main incisions (in-line) and the area of the flap (out-line). (b) The scalp and facial skin is elevated, and superficial temporal fascia and galea are exposed. A rectangular pedicle flap is designed on galea and superficial temporal fascia. (c) A temporalis muscle, temporal fascia and galea pedicled flap with the pedicle of the temporal fascia and temporalis muscle is elevated and inverted at 2 cm superior zygomatic. arch. (d) The distal part is split into four compartments. (e) Two sectors are transferred to the oral commissure through subcutaneous tunnel and fixed with the orbicularis oris of the oral commissure. (f) The distal ends of the two sectors are prepared to fix with the orbicularis oris of the contralateral upper and lower lips through subcutaneous tunnels. (g) Drawing of the transfer of temporalis muscle-galea to the oral commissure for transfer to the mouth, nose and eye (1-parietal and temporal born; 2-temporal muscle and temporal fascia; 3-galea). (h) An immediate postoperative view.



Fig. 3 Criteria for reporting results. (a) Method of reporting the results of eye reanimation. (b) Method of reporting the results of mouth reanimation (Quoted and modified: Arch Otolaryngol Head Surg. 1993, 119: 378).

of 8 cm in length is made. These incisions are similar in shape to the letter "Y" (**Fig. 2a**). The scalp and facial skin is elevated from the temple to the anterior auricular incision. On the surface of SMAS, the superficial temporal fascia and galea are sufficiently dissociated, with an area 15 cm in length and 8 cm in width exposed. One transverse and two parallel lengthways incisions are made on the galea, temporal fascia and temporalis muscle to form a rectangular pedicled flap with the pedicle of the temporal fascia and temporalis muscle. The flap is dissociated from the upper side of the galea and goes down to 2 cm superior zygomatic arch (**Fig. 2b, c**). At this time, active bleeding can be seen at the extremity of the flap.

From the temporal and anterior auricular incisions, subcutaneous tunnels are made to the mouth, nasal alar and lower eyelid. The distal end of the flap is split lengthways into four compartments (**Fig. 2d**) and inverted from the subcutaneous tunnels to the mouth, nasal alar and lower eyelid. The compartments are transferred separately to the mouth (upper and lower lips), ipsilateral nasal alar and medial canthus. Several 0.5 cm-long small incisions are made at the oral commissure, nasal alar and medial canthus on the side with palsy. Two further small incisions are made separately in the upper and lower lips on the normal side.

The fascia strips are fixed with the ipsilateral orbicularis muscle of the oral commissure, nasal alar, medial canthus ligament and the contralateral orbicularis muscle of the upper and lower lips (**Fig. 2e, f, g, h**). Suspending force is regulated to put the oral commissure, nasal alar and lower eyelid of the side with palsy in an overcorrected position relative to the normal side. The facial skin is lifted, and any excess skin is excised as in a rhytidectomy. The incisions of the anterior ear, scalp, mouth, nasal alar and medial canthus are sutured by an aesthetic method. Some drains are maintained inside the operative area, and dressings are used.

Results

From June, 1996 to May, 2003, we used this procedure with 38 longstanding facial paralysis patients (16 male and 22 female); 23 had right-sided and 15 had left-sided facial paralysis. All 38 were cases of complete palsy. Before operation, the eye and mouth functions of their palsy sides were poor. Ten days after operation the local tissue had a littler swelling and the folding-part of the temporalis muscle at the superior border of the zygomatic arch still had bulge, temporal fossa had some hollow. But these signs decreased gradually. The position of the oral commissure on the paralyzed side had been well corrected. In masticatory movement, the oral commissure, nasal alar and lips on this side had superior-rising movement. All patients underwent rehabilitation from one to six months after surgery.

Referring to the criterion of May¹⁰ (static part) (Fig. 3) our results were recorded as "Excellent", "Good", "Fair" or "Poor". "Excellent": complete close of paralyzed eyelids, and almost symmetric appearance in a static position, smile, pursing and full contraction with bite; "Good": complete close of paralized evelids, and symmetric appearance appears in a static position and smile, but slight weaker on the paralyzed oral commissure in pursing and full contraction with bite; "Fair": incomplete close of paralyzed eyelids, asymmetric in a static position and smile, and serious deformity in pursing and full contraction with bite; "Poor": no change after operation. In this list, we added an evaluation of "bite", because our operative method had clealy released the contracture of the orbicularis oris

Table 1

Results	No. (%)
Excellent	13 (34)
Good	20 (53)
Fair	3 (8)
Poor	2 (5)

Results: Dynamic Reconstruction of longstanding Facial Paralysis using Temporalis Muscle-Galea Pedicled Flap muscle, and full contraction with bite was obtained in many cases.

Table 1 shows the final results attained by using the pedicled temporalis muscle, temporal fascia and galea together to reanimate paralyzed faces. Excellent or good results were obtained in 33 patients (87%). In these patients, the static results are very good. The oral commissure on the affected side maintained a favorable position and almost complete symmetry of expression was attained. Three patients were slightly improved (8%). In the 3 "Fair" patients, the oral commissure on the affected side inclined downward, and the manifestations of facial paralysis showed only slight improvement. Just two (5%) showed no change.

Our main conventional methods are a static method using fascia lata or artifical materials to suspend paralyzed mouths and eyelids (56 cases), and a dynamic method using the latissimus dorsi muscle with cross-face facial nerve transplantation (10 cases). **Table 2** shows the results of these conventional methods. Excellent or good results were obtained in 30 to 31% of the patients.

Case Reports

Case 1: A 23-year-old Laborer.

At the age of 18, he suddenly lost normal expression on the left side of his face. He could not close his left eye, and serious dysfunction of the left oral commissure prevented him from pursing his lips and achieving full oral contraction or bite. Neither medication nor acupuncture proved effective in alleviating these signs. Two years after onset, a

Table	2
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Results	Static suspending method * No. (%)	Dynamic method ** No. (%)
Excellent	6 (10)	1 (10)
Good	12 (21)	2 (20)
Fair	27 (48)	5 (50)
Poor	12 (21)	2 (20)

Results: Reconstruction of longstanding Facial Paralysis using conventional methods

Static suspending method *: fascia lata or artifical materials were used Dynamic method **: latissimus dorsi muscle was used and with cross-face nerve transplantation was performed



Fig. 4 A 23-year-old male patient. Preoperative; (a) static view and (b) dynamic view. Three years postoperative; (c) Rest view and (d) slight open mouth view.

temporalis muscle-galea pedicled flap measuring 15 cm in length and 8 cm in width was transferred to the left side of his face. The flap was dissociated from the upper side of the galea and extended down to 2 cm above the zygomatic arch. From the temporal and anterior auricular incisions, subcutaneous tunnels were made to the mouth, nasal alar and lower eyelid. The distal end of the flap was split lengthways into four compartments and inverted from the subcutaneous tunnels to the mouth, nasal alar and lower eyelid.

Six months later, the patient returned to work. His mouth and eyes were nearly perfectly symmetrical at rest three years after the operation (**Fig. 4**).

Case 2: A 21-year-old Woman.

Five years ago, she underwent an acoustic neurinoma resection. Following this operation, she developed complete facial paralysis on the left side, a condition that remained unchanged for three years. At this point, a temporalis muscle-galea pedicled flap was transferred to the left side of her face. The distal end of the flap was split lengthways into four compartments. The fascia strips were fixed with the ipsilateral orbicular muscle of the oral commissure, the nasal alar, medical canthus ligment and the contralateral orbicular muscles of the upper and lower lips. The static results are very good, and two years after surgery, there is no noticeable asymmetry at rest (**Fig. 5**).



Fig. 5 A 21-year-old female patient. Smiling view (a) preoperative view; (b) postoperative view, two years after operation.

Discussion

A temporalis muscle flap for use in the reconstruction of facial paralysis cases was originally described by Lexer¹⁶ and Gillies¹⁷. This flap was not long enough to reach the mouth and needed to be connected with a piece of fascia lata. Sheehan¹⁸ suggested removal of the zygomatic arch to add length. McLanghlin¹⁹ used the coronoid end for transposition. Rosenthal suggested a combination of a temporalis muscle transfer to the upper face and masseter muscle transfer to the lower face. All of these methods increase trauma and complicate the operation. Furthermore, the resulting flap is still not long enough to reach parts of the face distant from the affected area, especially the lips on the normal side. A recent paper²⁰ shows that free fascia lata also need to be used for temporalis transfer in facial reanimation.

Our method uses the pedicled temporalis muscle, temporal fascia and galea together to reanimate paralyzed faces, and our results show that it is a simple and effective way of dealing with longstanding facial paralysis. The method has various advantages. The use of a pedicled compound tissue flap ensures that it has a good blood supply, which comes from a parietal branch of the superficial temporal artery and traffic branches of temporal muscle. It does not require the use of free fascia lata tissue or artifical materials, which have no blood supply and are prone to fibrosis, infection and necrosis, thereby producing unfavorable results. The folding part of our flap at the superior border of the zygomatic arch has no effect on the blood supply, as evidenced by bleeding at the distal galea.

The operative procedure is simpler and less invasive than other techniques. It can be performed under local anesthesia, and the addition of epinephrine to the local anesthetic restricts bleeding during the operation. Thanks to the fact that the flap uses the temporalis muscle as its pedicle, this method produces a dynamic reconstruction of paralyzed faces. The method also allows early training of the temporalis muscle, which leads to better results. Regular training in mastication and facial expression can begin three weeks after the operation, and follow-up has shown that this training leads to good movement on the affected side and that facial expressions become more and more symmetrical.

In conjunction with a facelift operation, even better results can be achieved, because the facelift both tightens the facial skin and fixes the orbicularis oculi and orbicularis oris. Moreover, after the fascia strips are fixed in the subcutaneous tunnels, more exact results are obtained. However, our method also has one disadvantage: a bulge caused by the folding part of the temporalis muscle at the superior border of the zygomatic arch remains on the paralyzed side (**Fig. 5b**). This can be partly hidden by hair, especially in female patients. Five of our patients treated by this method have been rated "Fair" (three patients) or "Poor" (two) in terms of the results achieved. The main reason was that the fascia strips were too long to overcorrect. In fact, the results were good in the early stages after operation, but after the swelling reduced and the fascia strips relaxed, the final result was not satisfactory. This problem appears to occur in early cases and can be overcome in later cases.

Some authors have described the use of two separate strips of tissue on the lower and upper eyelids. In our experience, just one strip from a flap transferred to the lower eyelid can close a paralyzed eye completely. To achive this, it is necessary to fix the extremity of the flap at a high position in the medial canthus ligament . According static suspension technique, we sutured the extremity of the flap with the orbicularis oris of the normal side through each lip tunnel (Fig. 4 below, right). We find that it is important. If the extremity of the flap is just fixed with the oral commissure or the lateral upper and lower lips, the final dynamic appearance of mouth will not be ideal. Also, we hope the pedicle of temporalis muscle can get some dynamic reanimation, but the results are not satisfactory.

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