Temporalis Muscle for Facial Reanimation

A 13-Year Experience With 224 Procedures

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• **A procedure for temporalis muscle transposition was used to reanimate the paralyzed face in 219 patients. In most cases, facial paralysis had followed an operation to remove an acoustic tumor. Analysis of the results showed this procedure to be highly successful and the method of choice, alone in cases of long-standing facial paralysis or to augment the effects of facial nerve grafting or hypoglossal–facial nerve anastomosis, in reanimating the mouth. It was successful in restoring a smile to 80% of the 219 patients and provided overall improvement in mouth function in 96%. Complications occurred in 21% of patients, with the most common being infection (12% of patients). Since one of us began to use the procedure to reanimate the eye and mouth, results of temporalis muscle transposition have been improved by the following: (1) using the procedure to reanimate the mouth only; (2) performing revision surgery, most often tightening the corner of the mouth (25% of patients), as indicated; (3) transposing only the midsection of the muscle; (4) implanting a prefabricated Silastic prosthesis to fill the muscle defect; (5) when indicated, lengthening the muscle with polytef (Gore-Tex+); and (6) placing the muscle in a tunnel lateral to the superficial musculoaponeurotic system to avoid injuring the underlying facial nerve should some spontaneous recovery of facial nerve function be possible.**

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Transposing the temporalis muscle and suturing it to submucosa or periorbicularis oris muscle in the region of the angle of the mouth can restore a voluntary smile and facial symmetry to patients with long-standing facial paralysis. The procedure also can augment the results of facial nerve grafting or hypoglossal-facial nerve anastomosis. The details of this technique, indications for its use, and results have been reported previously[1]; this article reports on modifications that have been introduced to improve the outcome of this procedure and the results of its use in 224 cases (219 patients).

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Table 1.—Causes of Paralysis

Causes	No.
Trauma	129
External	11
Surgical	118
Tumors	43
Benign	19
Malignant	24
Birth	20
Infection	12
Bell's palsy	10
Vascular	5

PATIENTS AND METHODS

During the years 1977 through 1990, 219 patients underwent 224 temporalis muscle transposition procedures to reanimate the face. This includes five patients in whom bilateral procedures were performed. In most cases, the patients underwent the procedure to manage longstanding facial paralysis that resulted from surgery to remove an acoustic neuroma (Table 1). The group comprised 136 male and 83 female patients aged between 6 and 80 years. Facial paralysis was complete in 145 and incomplete in 79 cases. All patients gave consent before the procedure was done.

Operative Procedure

The patient undergoing a temporalis muscle transposition procedure is positioned and draped in the usual fashion for surgery on the side of the face and head. The patient's hair on the operative side is parted over the temporalis muscle along the proposed incision line, and a narrow swath of hair is clipped with a scissors on each side of the part, as close to the scalp as possible (Fig 1, A). This incision line and the proposed area of incision in the mouth region (lip-cheek crease for patients who have one or vermilion border for the few, usually pediatric, patients who do not) are infiltrated with 1% lidocaine hydrochloride and 1:100 000 epinephrine (Adrenalin) for hemostasis.

Five minutes are allowed for these agents to act, then the incision in the scalp is made down to the superficial temporalis fascia (continuous with superficial musculoaponeurotic system [SMAS] in the facial region). This layer is divided with a scissors to expose the fascia overlying the temporalis muscle, approximately 4 cm in the midportion, which is elevated from the fascia-periosteal attachment superiorly to the level of the zygomatic arch inferiorly (Fig 1, B). A cutting cautery is used to outline the flap,

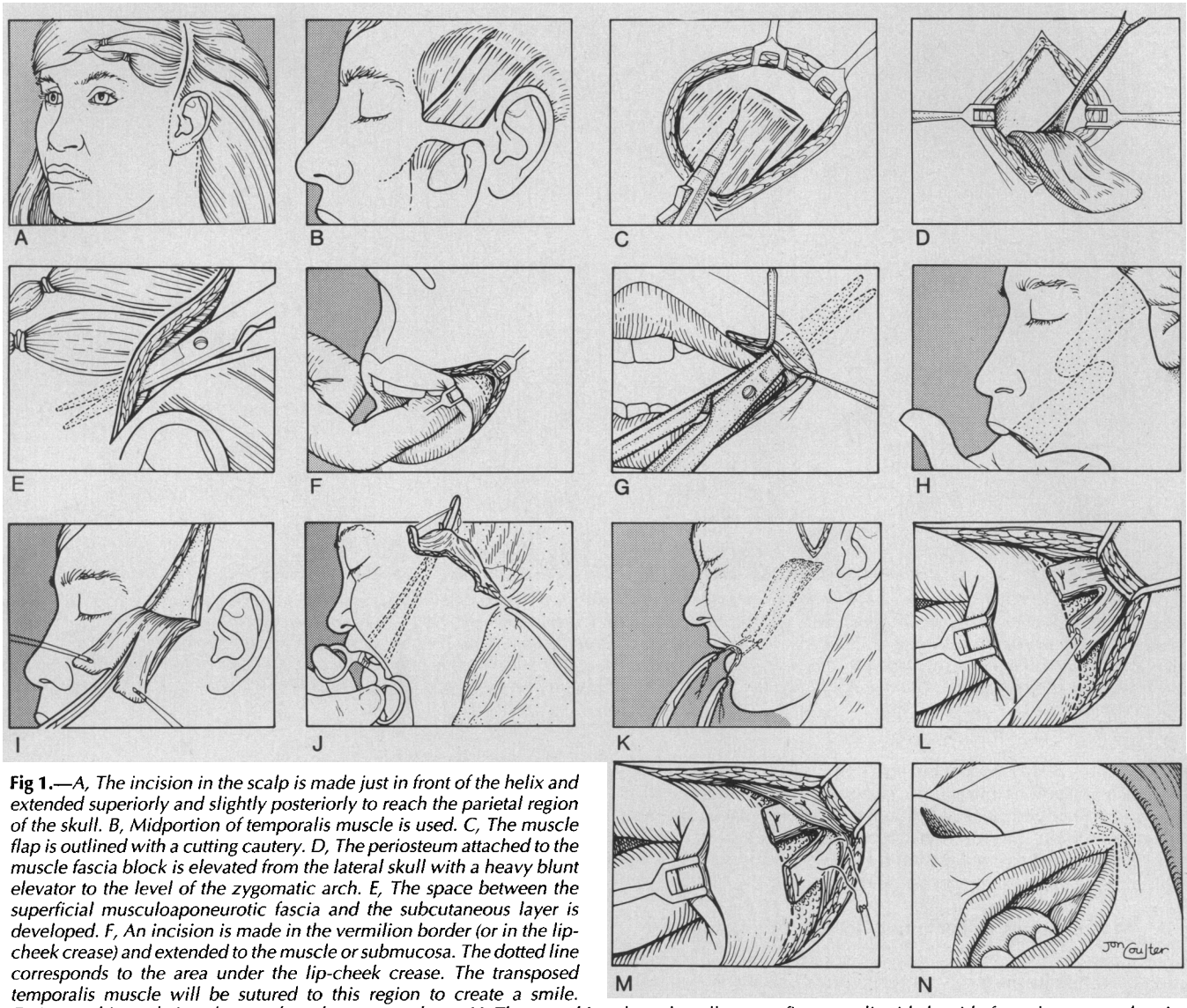

Fig 1.—*A, The incision in the scalp is made just in front of the helix and extended superiorly and slightly posteriorly to reach the parietal region of the skull. B, Midportion of temporalis muscle is used. C, The muscle flap is outlined with a cutting cautery. D, The periosteum attached to the muscle fascia block is elevated from the lateral skull with a heavy blunt elevator to the level of the zygomatic arch. E, The space between the superficial musculoaponeurotic fascia and the subcutaneous layer is developed. F, An incision is made in the vermilion border (or in the lip-cheek crease) and extended to the muscle or submucosa. The dotted line corresponds to the area under the lip-cheek crease. The transposed temporalis muscle will be sutured to this region to create a smile. G, A tunnel is made just deep to the subcutaneous layer. H, The tunnel is enlarged to allow two fingers to lie side by side from the temporal region to the mouth. I, The temporalis muscle is bisected. J, 2-0 polypropylene (Prolene) is used to pull the muscle through the tunnel. K, The muscle is pulled through the tunnel to the lip incision. L, The muscle is sutured to the submucosa or perioral muscle. M, The muscle is sutured to the subcutaneous layer. N, The corner of the mouth is fixed in an overcorrected position.*

and an elevator is used to lift the muscle and periosteum from the underlying bone (Fig 1, C and D).

The boundary of the superficial temporalis fascia (STF) with subcutaneous tissue is identified, and a pocket to receive the temporalis muscle flap is started between the STF and subcutaneous tissue with a scissors (Fig 1, E). Saline solution is injected into the pocket lateral to the STF in the temporal area and into the subcutaneous tissue in the facial area to elevate subcutaneous tissue from the SMAS. Preserving the integrity of the SMAS in this way should preserve any residual function of facial nerve fibers that lie in or deep to the SMAS.

Next, the incision in the lip-cheek crease is made. The location for this incision is identified by the surgeon placing a finger in the corner of the mouth on the operative side and lifting the lips to create a smile. The "smile fold" or lip-cheek crease that then appears is marked with methylene blue dye, and this is the lip-cheek crease incision line (in patients, usually youngsters, who do not have a smile fold, the lower incision is made in the vermilion border). The incision in this area extends through the skin to the periorbicularis oris muscle, if present, and if no muscle is present it extends to the submucosa (Fig 1, F).

Moving back to the scalp incision, the pocket begun at the inferior end of this incision is enlarged and a tunnel is formed with a scissors (Fig 1, G). The tunnel is extended to the lip-cheek incision and enlarged to accommodate two fingers, wide enough for the transposed temporalis muscle to lie flat in the tunnel (Fig 1, H).

Next, the elevated temporalis is bisected for a distance of 2 cm from its tip (Fig 1, I), and a 2-0 polypropylene (Prolene) suture is placed in figure-of-eight fashion through the end of each pedicle thus created (Fig 1, J). These sutures are brought down through the tunnel with Kelly clamps (Fig 1, J), followed by the temporalis muscle (Fig 1, K), which is then sutured to the submucosa (Fig 1, L) or to the periorbicularis oris muscle. The temporalis muscle is sutured to the subcutaneous layer (Fig 1, M) if it is desirable to deepen the lip-cheek crease to match that on the normal side. This process results in the temporalis muscle being sandwiched between the submucosa and the subcutaneous layer of tissue.

Polytef (Gore-Tex+) strips are used to lengthen a muscle that is too short to reach the mouth tissues without creating tension at the suture line. The corner of the mouth is overcorrected at the time of surgery (Fig 1, N); the overcorrection will resolve over 3

Fig 2.—*Patient with slowly progressive right-sided facial palsy over 2.5 years. Left, Note corner right side mouth sags. Center, Eight weeks following resection of facial nerve arteriovenous malformation involving vertical-horizontal segment. Note the pleasing voluntary smile achieved with temporalis muscle transposition. A nerve graft repair was performed as well but the time is too short for any useful function from the graft. Right, Two years following the surgery a spontaneous smile is noted and is augmented by the temporalis muscle procedure. Note that the temporalis muscle transposition does not interfere with nerve regeneration and provides almost immediate rehabilitation at least a year before the results of the nerve graft become effective.*

to 6 weeks to create a pleasing result (Fig 2). The defect left by rotating the temporalis muscle out of its natural position is filled with a prefabricated Silastic implant. A drain is placed through the scalp incision into the cheek before wound closure, and the drain is connected to wall suction for 2 days postoperatively. Patients receive clindamycin perioperatively.

Modifications in Technique to Improve Results

Since one of our reports on use of temporalis muscle transposition to reanimate the face,[1] many modifications have been instituted that have improved the success and decreased the morbidity of this procedure. (1) Temporalis muscle transposition is used exclusively to reanimate the mouth of a patient with facial paralysis. Eye reanimation is achieved by another technique. (2) Passing the temporalis muscle from the temporal area to the lip-cheek crease through a tunnel superficial to the SMAS protects from injury any still-functioning facial nerve fibers in or deep to the SMAS. This permits the temporalis transposition procedure to be used to augment residual facial nerve function in patients with paresis or the effects of other reanimation procedures. (3) Injecting saline solution into tissue lateral to the SMAS to create a pocket helps to elevate tissue to create the tunnel and also protects the facial nerve. (4) Making the tunnel for the temporalis muscle at least two fingers wide allows the muscle to lie flat in the tunnel, thus avoiding a bulge in the cheek from the transposed muscle. (5) Possible bulging of the temporalis muscle in the tunnel and the size of the defect under the scalp are reduced by using only the middle third of the temporalis muscle for facial reanimation. (6) The defect under the scalp left by transposition of the temporalis muscle is filled at the time of surgery with a prefabricated Silastic implant. (7) Using the technique of Baker and Conley[2] of raising periosteum attached to the temporalis muscle fascia, rather than repositioning and sewing the temporalis fascia to the muscles as proposed by Rubin,[3] has reduced operating time. (8) Placing the incision in the mouth region in the lip-cheek crease in patients who have such a crease or in the vermilion border in those who have no natural crease reduces the visibility of the scar. (9) Extending parallel incisions 4 cm apart from the temporalis line at the temporoparietal junction to the level of the zygomatic arch usually provides a temporalis muscle flap long enough to reach the lip-cheek crease, but when it does not, reinforcing or extending the muscle flap with polytef improves results. (10) Placing multiple sutures in the muscle-submucosal layer at the level of the corner of the mouth to overcorrect the smile is essential to achieving consistently good results. (11) Using suction drainage postoperatively has significantly reduced the incidence of pooling of serum or blood in the operative area which, in combination with clindamycin administered perioperatively to decrease the possibility of infection, has led to improved results.

RESULTS

The results of using the temporalis muscle to reanimate the face were recorded as "excellent," "good," "fair" or "poor," for the eye (Fig 3) and mouth (Fig 4) separately.

Eye Reanimation

The temporalis muscle procedure was considered to give excellent results in reanimating the eye when the patient could achieve complete approximation of the paralyzed eyelids with attempts to close the eye. Incomplete approximation of the eyelids was considered a good result of the procedure, and poor approximation of the eyelids but symmetry of the eyelids in the resting open position were considered to be fair results of surgery. The procedure was considered to give poor results if the interpalpebral fissure was wider on the paralyzed side than on the normal side.

The affected eye was reanimated with the temporalis muscle using the procedure described previously[1] in 29 patients. The procedure was considered a success in that results were either excellent or good, in seven (26%) of these 29 patients. Results were fair or poor in 20 patients, and two patients were unavailable for follow-up. Results

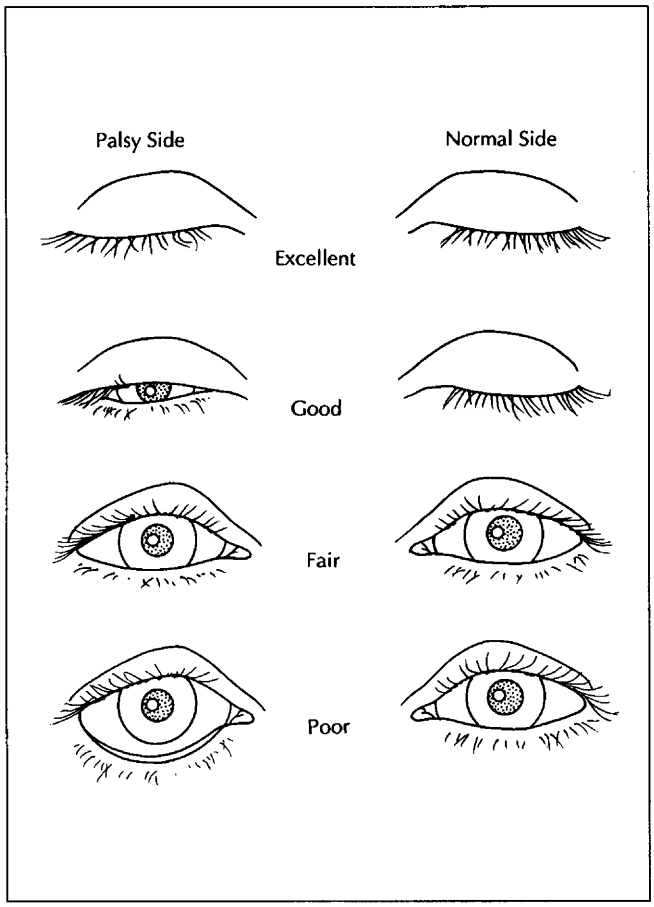

Fig 3.—*Method of reporting results of eye reanimation.*

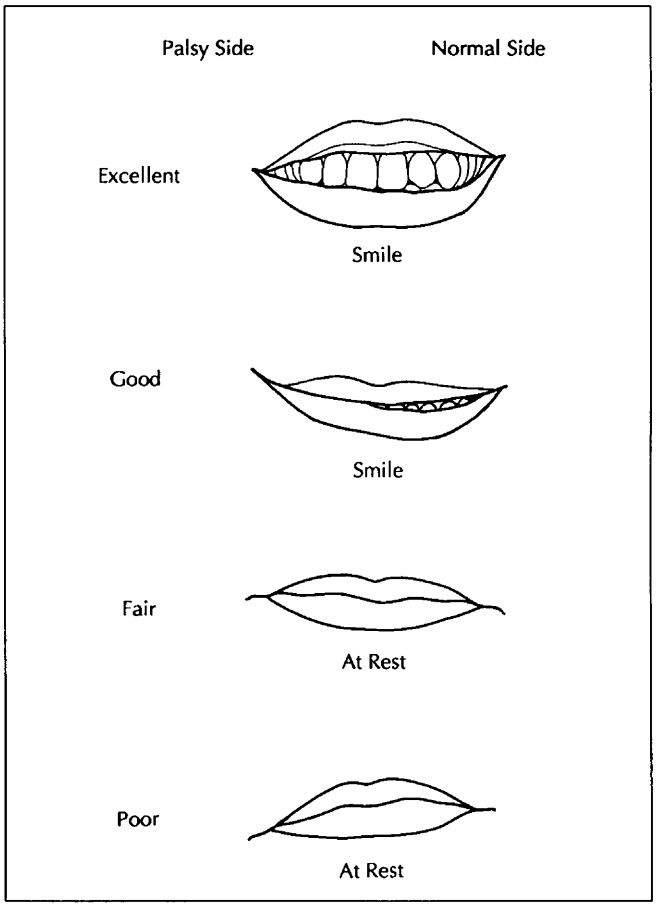

Fig 4.—*Method of reporting results of mouth reanimation.*

were most often judged to be fair or poor (unsuccessful) because of incomplete closure of the eyelids (20 patients); ectropion occurred in four patients.

Mouth Reanimation

The results of transposing the temporalis muscle to reanimate the mouth are evident by 3 to 6 weeks after the procedure, although improvement may continue for as long as a year postoperatively. Criteria for judging the success of this procedure include the achievement of mouth symmetry and a voluntary smile. Because the results of muscle transposition can be enhanced by the patient's learning to activate the transposed muscle by voluntary effort, the results of the procedure are best in patients who are motivated to learn the necessary motor-sensory coordination techniques.[4]

The results of temporalis muscle transposition to reanimate the mouth were considered excellent when the patient could voluntarily create a smile that exposed the teeth. Results were good if the patient could smile without showing the teeth, and fair if the corners of the mouth were symmetrical with the face in repose. Results of the procedure were considered poor if the corner of the mouth on the paralyzed side drooped.

Table 2 shows the final results of using temporalis muscle transposition to reanimate the mouth in 219 patients. About 25% of patients underwent a total of 73 revision procedures, including 56 procedures to tighten the muscle, three to loosen the muscle, 13 to revise the implant, and one to revise the scar. Mouth function was improved at the completion of these surgical interventions in 96% of patients, and in 80% the final results of surgical intervention were considered excellent or good.

Table 2.—Results: Temporalis Muscle Mouth Reanimation

Result	No. (%)
Excellent	71 (37)
Good	83 (43)
Fair	31 (16)
Poor	7 (4)

Complications

Complications of temporalis muscle transposition occurred in 44 (21%) of the 219 patients. The complication that occurred most often was infection (25 patients [12%]), followed by hematoma (seven patients), extrusion of the Silastic implant (seven patients), extrusion of a suture (three patients), formation of a seroma (one patient), and wound dehiscence (one patient).

COMMENT

The fact that temporalis muscle transposition provided good or excellent results in 80% of cases and improved function in 96% of cases reported in this article shows that this procedure is an effective means to reanimate the mouth in patients with long-standing facial paralysis and

in selected patients undergoing facial nerve grafting or hypoglossal-facial nerve anastomosis.

Because better reanimation of the eye has been achieved by implantation of gold weights,[5] eyelid springs,[6] or cartilage[7] than by how the temporalis muscle transposition procedure was used initially, the modified temporalis muscle transposition procedure described in this article to reanimate the mouth only is recommended. Thus, the overall results of using temporalis muscle transposition to reanimate the mouth are most satisfactory when it is viewed as one component in a comprehensive program to improve facial function that may include an eye reanimation procedure, revision temporalis muscle procedures to refine surgical results, facial nerve grafting or hypoglossal-facial anastomosis when indicated, and patient education to achieve maximal control of voluntary muscle activity.

Other techniques for facial reanimation, such as free muscle-nerve–blood vessel anastomosis, continue to be refined. Since the results of the temporalis muscle transposition procedure are useful, reproducible, and highly successful in reanimating the mouth, we believe it will continue to play an important role in reanimating the face, particularly for patients with long-standing facial paralysis.

Since preparation of this article, the Silastic implant used in this study (Mentor Corporation, Santa Barbara, Calif) is no longer available. The defect created in the temple area by transposing the temporalis muscle is covered with a pericranial flap consisting of the superficial temporal fascia vascularized by the temporal artery and vein. This was demonstrated by Mack Cheney (Department of Otolaryngology Head and Neck Surgery, Massachusetts Eye and Ear Infirmary, Boston) at the Ohio State Head and Neck Reconstruction Symposium in June 1992. The polytef (Gore-Tex+) used in this study is no longer used by us for facial reanimation because of a delayed 30% extrusion rate. Fascia lata is used instead.

Figure 1 was reproduced from *The Facial Nerve* (New York, NY: Thieme-Stratton Inc; 1986:714-717).

References

1. May M. Muscle transposition for facial reanimation: indications and results. *Arch Otolaryngol.* 1984;110:184-189.
2. Baker DC, Conley J. Regional muscle transposition for rehabilitation of the paralyzed face. *Clin Plast Surg.* 1979;6:317-331.
3. Rubin L. *Reanimation of the Paralyzed Face.* St Louis, Mo: CV Mosby Co; 1977.
4. May M, Croxson GR, Klein SR. Bell's palsy: management of sequelae using EMG rehabilitation, botulinum toxin, and surgery. *Am J Otol.* 1989; 10:220-229.
5. May M. Gold weight and wire spring implants as alternatives to tarsorrhaphy. *Arch Otolaryngol Head Neck Surg.* 1987;13:656-660.
6. May M. Paralyzed eyelids reanimated with a closed-eyelid spring. *Laryngoscope.* 1988;98:382-385.
7. May M, Hoffmann D, Buerger GF, Soll DB. Management of the paralyzed lower eyelid by implanting auricular cartilage. *Arch Otolaryngol Head Neck Surg.* 1990;116:786-788.