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RESEARCH ARTICLE

REANIMATION OF THE PARALYZED FACE WITH THE TEMPORALIS MYOFASCIAL FLAP TRANSFER

Vikram Karande[1], Neelam Andrade[2]*, Vaishali Pagare[3], Zameer Pasha[4], Kushagra Sachdeva[5], Umesh Shrivastava[6], Sejal Bhaskar[7],

[1]Professor & HOD, Department of Oral & Maxillofacial Surgery, D.Y. Patil Dental School, Lohegaon, Pune, Maharashtra, India. drvikramkarande@gmail.com

[2]Dean, Professor & HOD, Dept. of Oral & Maxillofacial Surgery, NHDC, Mumbai, Maharashtra, India.drnnandrade@gmail.com

[3]Assistant Professor, Dept. of Oral & Maxillofacial Surgery, D.Y. Patil Dental School, Lohegaon, Pune, Maharashtra, India. dr.vaishali.kk@gmail.com

[4]Assistant Professor, Department of Oral and Maxillofacial Surgery, Alameen Dental College, Navarasapur, Karnataka, India. Drzameer71@gmail.com

[5]Post Graduate Resident, Department of Oral and Maxillofacial Surgery, SDM College of Dental Sciences and Hospital, Dharwad, Karnataka, India. kushagra.omfs@gmail.com

[6]Senior Resident in CIMS, Chhindwara, Chhindwara Institute of Medical Sciences, Madhya Pradesh, India. drumesh1104@gmail.com

[7]Post Graduate Resident, Department of Oral and Maxillofacial Surgery, NHDC, Mumbai, Maharashtra, India.sejalbhaskar8@gmail.com

Corresponding Author*: Neelam Andrade, Dean, Professor & HOD, Dept. of Oral & Maxillofacial Surgery, NHDC, Mumbai e-mail drnnandrade@gmail.com

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ABSTRACT

Purpose: This study presents the "Temporalis myofascial flap transfer technique" in reanimating the paralyzed face in five patients afflicted with long standing and irreversible facial paralysis. It is an attempt to highlight the versatility and effectiveness of this method in Facial reanimation of the patient with long standing and irreversible facial paralysis. A thorough review is presented of the methods and techniques available to the surgeon and the study underscores the success of the "Temporalis-myofascial flap transfer" technique in restoring the facial form, function and esthetics of the patient suffering with this debilitating disorder.

Materials and methods: The study was carried out from June 2002 to Oct 2005. A total of 5 cases were selected for the study. Four patients were male and one was female. The age range varied from 20 to 42 years with an average age of 31 years. All surgeries were planned under general anesthesia and a standard protocol was followed for a thorough assessment and evaluation of each case which included a detailed case history, cinical examination including a general examination and examination of the pathosis i.e., facial paralysis and pre and post-operative facial photographs.

Results: The results using the temporalis muscle to reanimate the face were recorded as "excellent", "good", "fair" and "poor" for the eye and mouth separately. The results in all five cases were considered excellent as concerned mouth reanimation and again excellent as concerned eye reanimation in cases 1, 2, 3 and 5. (Only mouth reanimation was done in case 4 as the eye function and symmetry were normal.)

Conclusion: The results of the temporalis-myofascial / temporalis–myofascial–galeal technique are valid, reproducible, and highly successful in reanimating the mouth and the eye. We believe that the temporalis muscle transfer will continue to play an essential role in reanimating the face, particularly for patients with long-standing facial paralysis. Five cases were successfully treated using the Temporalis muscle fascia/galea transposition technique for eye and mouth reanimation. One patient was treated for only mouth reanimation since the eyelid function and eye esthetics were normal.

Keywords: Facial paralysis, Facial reanimation, Myofascial flap, Temporalis muscle transfer, Temporalis myofascial flap

1.INTRODUCTION

The diagnosis of a permanent facial paralysis can be devastating to the patient. Our society's emphasis on physical beauty contributes to this perception and often leads to the isolation of these patients [1]. These patients are plagued by a cosmetic defect and the functional deficits caused by the loss of facial nerve function [2]. This deformity is related to the muscular inactivity on the affected side and the apparent overactivity on the normal side. Lagopthalmos with resulting ocular exposure, loss of oral competence with drooling, alar collapse with nasal airway obstruction and difficulties with mastication and speech production are all the potential consequences of facial paralysis [3].

Various methods are available to treat long-standing facial paralysis. They can be static, such as using eyelid weights, and dynamic, like the muscle transfer procedures, which use local or distant muscles to reanimate the face [4]. The distant muscle transfers, however, involve invasive microvascular surgical procedures for reanimation. Hence, local muscle transfers such as the masseter, platysma, and temporalis are preferred for their ease and reliability in rehabilitating the patient with long-standing facial paralysis [5].

This study presents the "Temporalis myofascial flap transfer technique" in reanimating the paralyzed face in five patients afflicted with long-standing and irreversible facial paralysis. It is an attempt to highlight the versatility and effectiveness of this method in the facial reanimation of patients with long-standing and irreversible facial paralysis [6]. A review is presented of the methods and techniques available to the surgeon, and the study underscores the success of the "Temporalis-myofascial flap transfer" technique in restoring the facial form, function, and esthetics of the patient suffering from this debilitating disorder.

MATERIAL AND METHODS

The study was carried out from June 2002 to August 2005. Five cases were selected for the study. Four patients were male, and one was female. The age range varied from 20 to 42, with an average age of 31.

All surgeries were planned under general anesthesia and the following protocol was followed for a thorough assessment and evaluation of each case which included a detailed case history, clinical examination including a general examination and examination of the pathosis i.e., facial paralysis and pre and post-operative facial photographs.

Patients were evaluated for the following parameters:

- Facial symmetry
- Symmetry of the interpalpebral fissures
- Eye closure
- Presence of lagopthalmos
- Mouth symmetry
- Prominence of the naso-labial fold
- Drooping of the corner of the mouth.
- Deviation of the corner of the mouth on speaking and during the execution of facial movements
- Drooling of saliva or foods and liquids from the mouth during eating, speaking and the execution of mouth movements
- Ability to blow the cheeks
- Any speech disturbances

Based on the history and physical examination findings, a diagnosis of Bell's palsy or permanent facial paralysis was made. All investigations for general anesthesia were done and clearance for general anesthesia was obtained. A total head shave was done for all the male patients, whereas the hair was clip-parted for the female patients.

Case Presentation

Surgical procedure for the "Temporalis-myofascial flap transfer"

Nasal intubation was performed to administer general anaesthesia.

Incision lines were marked using a marking pen. 8cc of 1:300000 saline adrenaline was infiltrated along the planned lines of incision at the right/left hemicoronal, temporal, and pre-auricular region. Using the No.15 Bard-Parker blade, a right/left modified hemicoronal incision was taken extending vertically downward in the temporal region and inferiorly into the right/left pre-auricular skin crease as far as the attachment of the tragus (Figure 1).

Skin flaps and the superficial temporoparietal fascia were raised to expose the deep temporal fascia. In two cases, 1.5-2 cm of epicranium was attached to the temporalis muscle to gain additional length (Figure 2). The muscle was traced down inferiorly deep to the zygomatic arch. Bleeding from the superficial temporal and transverse facial arteries was controlled by clamping and ligation with silk sutures. In four cases for both mouth and eyelid paralysis, tunneling of the skin of the upper and lower eyelids was done on the right/left side by blunt dissection using sharp scissors and artery forceps. The forceps were brought out at the medial end of the eyelids through an incision made near the medial canthus. The patency of the submucosal medial canthal incisions near the medial border of the eyelids and the tunnels for the upper and lower eyelids were maintained with the help of two separate ribbon gauze strips. In all five cases, a lip-cheek crease incision of about 1.5 cm in length was taken at the site of the new nasolabial groove (to be reconstructed) in a slightly more medial position than the final result was to be achieved (Figure 1). The location of this incision was identified by placing a finger at the corner of the mouth on the operative side and lifting the lips to create a smile. Soft tissues were undermined from the overlying orbicularis oris muscle to identify the muco-cutaneous junction. The incision was extended through the skin, submucosa and some part of the orbicularis oris muscle. A wider tunnel of two finger breadth was created from the superior preauricular incision starting from the root of the zygoma in the subdermal plane connecting with the lip-cheek crease incision at the nasolabial groove (Figures 3, 4, 5). Another tunnel was created from the nasolabial incision medially across the upper lip to a vertical stab incision just lateral to the ipsilateral philtral column. Patency of these tunnels was maintained with roller ribbon guaze. Temporalis muscle was divided into one/three/four slips pertaining to the individual case (fig. 2, 3). Length of the muscle slips in relation to the area of insertion were checked. Distance between the root of Zygoma and commissure of lip at the right/left side was measured. The slips extended down to the level of the zygomatic arch along the long axis starting from the epicranial attachment. In the case involving only the mouth, the temporalis musle was divided into just a single, broad central slip. Fascial layer was sutured with the individual muscle slips with 3-0 vicryl sutures along the superior edge and few sutures on either side for reinforcement. Muscle slips were elevated by separating the epicranium and periosteum from the underlying bone. Depending on the required measurement for length to reach the corner of the mouth, lengthening of the posterior (3rd slip) was done by sagitally dividing the muscle. Epicranial attachment was sutured to the muscle slips in two cases in which more additional length was needed.

Insertion of the muscle slips (Figure 6, 7, 8): The anterior (first) slip was rotated medially and inferiorly in such a manner that the fascial layer faced the dermal layer of the tunnel and was inserted into the tunnel created at the upper eyelid and was brought out medially through the stab incision and was secured with the dermal layer and orbicularis oculi muscle at the medial canthal region using 3-0 prolene sutures. In a similar fashion the middle (second) slip was inserted through the lower eyelid tunnel upto two thirds the length and was secured with the dermal layer using 3-0 prolene sutures. Another tunnel was created along the medial border of the eye connecting the previous two stab incisions at the medial end of the upper and lower eyelids. Excess length of tissue after securing the anterior slip at the medial end of the upper eyelid was inserted through the tunnel created and was brought down and secured with the middle slip at the lower eyelid using 3-0 Prolene sutures. Posterior (third slip) was divided through and through along the long axis involving the fascial layer at its free end for about a length of 2.5cm creating a bifurcation at its anterior end. Entire posterior slip along with it’s bifurcated ends was rotated medially over the zygomatic arch and inserted into the pre auricular tunnel and was brought out through the lip crease incision. The upper bifurcated The end was secured with the orbicularis muscle using 2-0 Prolene. After securing the excess length, it was inserted into the tunnel created at the upper lip region, brought out at the opposite philtrum, and secured using 2-0 Prolene with the dermal layer.In the cases involving only paralysis of the mouth, a single

central slip of the temporalis muscle and fascia was used and passed through the tunnel above the zygomatic arch (Figure 8).

The lower bifurcated slip was secured with 2-0 prolene sutures just 2 cm above the commissure and was slinged around a layer of orbicularis oris muscle, brought above and backward and was sutured with the dermal layer of the tunnel involving a part of superficial skin using 2-0 prolene thereby overcorrecting the defect and creating a perpetual smile or dimple in the over corrected position. The lip crease incision was closed by subcuticular sutures using 3-0 vicryl. Remaining incisions (at philtrum and medial canthal region).We were closed by interrupted sutures using 4-0 Vicryl. No.10 mini vac drain was placed at the defect created after elevation ofthe temporalis muscle and was secured extraorally with silk sutures in the pre-auricular region. Hemicoronal incision with its pre-auricular extension was sutured in two layers using Vicryl and black silk sutures. Post-operative recovery of the patients was well-monitored and was uneventful.

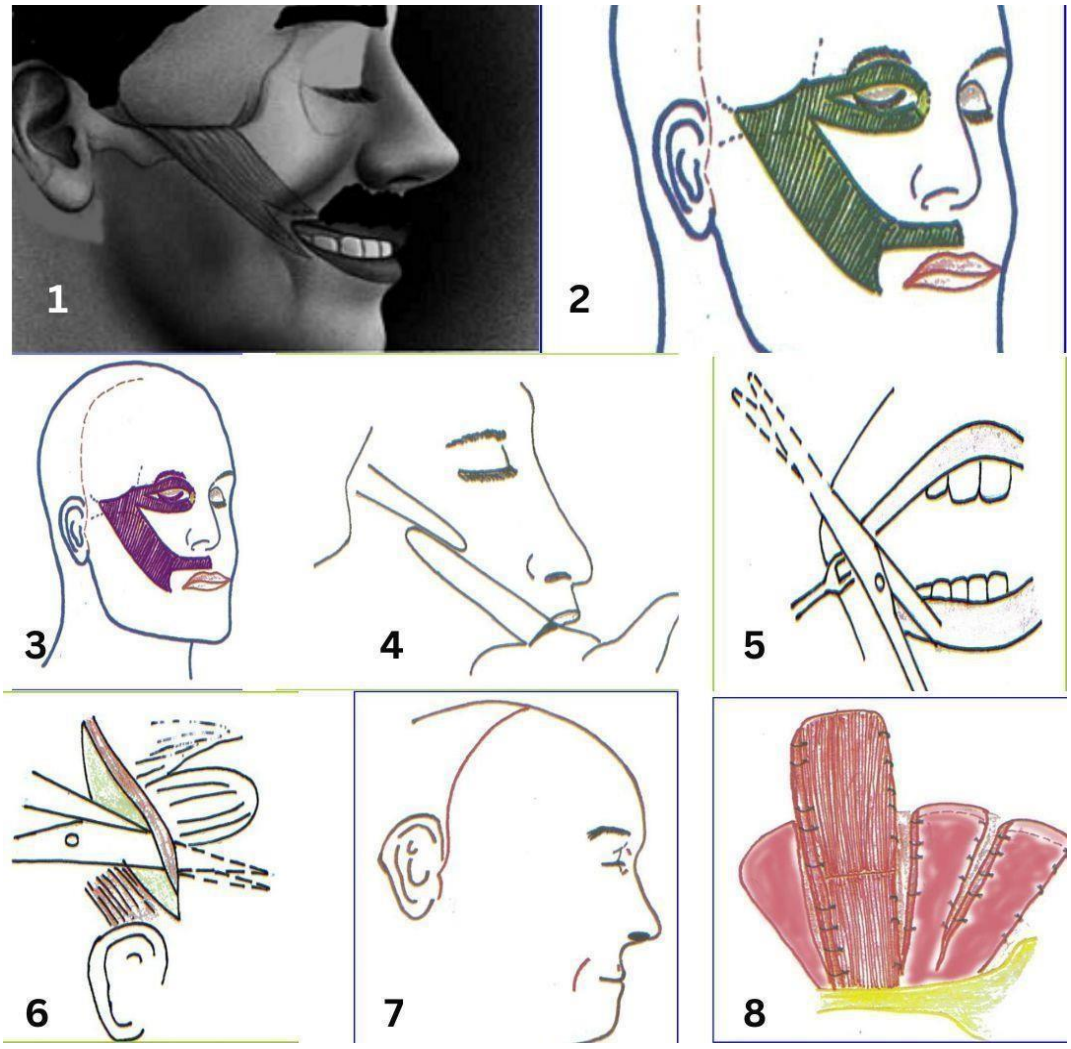

Figure 1-8. Illustration showing stepwise facial dissection techniques including incision planning, muscle exposure, flap elevation, intraoral access, and layered closure for surgical access to facial musculature.

RESULTS

The results of using the temporalis muscle to reanimate the face were recorded as “excellent,” “good,” “fair,” and “poor” for the eye and mouth separately.

The results for **Eye Reanimation** were considered:

Excellent: when the patient could achieve complete approximation of the paralyzed eyelids with attempts to close the eye.

Good: If a slightly incomplete approximation of the eyelids was achieved with just a 1-2mm gap remaining.

Fair: If a poor approximation of the eyelids was achieved, but symmetry of the eyelids was present in the resting open position

Poor: If the interpalpebral fissure was wider on the paralyzed side than on the normal side.

Mouth Reanimation

Criteria for judging the success of this procedure include the achievement of mouth symmetry and a voluntary smile. The results of transposing the temporalis muscle to reanimate the mouth were evident by 3 to 6 weeks after the procedure, although improvement continued for as long as a year postoperatively. Because the patient’s learning can enhance the results of muscle transposition to activate the transposed muscle by voluntary efforts, the procedure results were best in patients motivated to learn the necessary motor-sensory co-ordination techniques.

The results of mouth reanimation were considered:

Excellent: The patient could voluntarily create a smile that exposed the teeth.

Good: If the patient could smile without showing the teeth.

Fair: If the corners of the mouth were symmetrical with the lips in repose.

Poor: If the corner on the paralyzed side drooped.

Given the above gradings, the results in all five cases were considered excellent as concerned for mouth reanimation and again excellent as concerned for eye reanimation in cases 1, 2, 3 and 5. (Only mouth reanimation was done in case 4 as the eye function and symmetry were normal.)

The overcorrection that resulted in an upward and lateral displacement of the lateral oral commissure persisted for about three weeks and then decreased so that the position of the oral commissure was only slightly overcorrected by the sixth week . At this time, the muscle spasms began to subside, and the patients began to show dramatic improvement in movements of the mouth and eye .

The patients began to demonstrate eyelid closure, and symmetry of the interpalpebral fissures was obtained (fig.9, 11, 12, 14, 15, 20, 21). Mouth symmetry was restored (Fig. 9, 12, 16, 18, 20). The patients were able to produce a broad smile which showed the teeth by tensing the temporalis muscle (fig.10, 13, 17, 19, 22). The ability to blow the mouth was restored in all cases. Mouth movement and eyelid closure improved for a year in all cases.

Figure 9-12. Preoperative and postoperative images showing patients with facial asymmetry and muscle weakness undergoing surgical correction and rehabilitation, demonstrating improved facial symmetry, oral competence, and muscle tone over time.

Figure 13-16. Sequential postoperative recovery of a patient with facial nerve paralysis, illustrating progressive improvement in facial symmetry, eye closure, oral competence, and muscular function through surgical intervention and rehabilitation.

Figure 17-22. Sequential postoperative recovery of a patient with facial nerve paralysis

DISCUSSION

A patient with facial palsy presents one of the most difficult challenges the reconstructive surgeon encounters. Understanding facial expressions and the physiology of nerve injury and its repair is critical for evaluating and treating this problem. Only after careful discussion with the patient and developing an individualized treatment plan can a satisfactory result be obtained.

Bell's palsy, viral in origin, is by far the most common cause of facial paralysis, representing 75% of the patients in one large series[6].

Documentation of the clinical findings is essential for the work-up, both for diagnostic and prognostic purposes. Photographs are a useful adjunct if taken in a standardized fashion.

The established facial palsy patient has aesthetic and functional goals that must be addressed in the reconstructive plan. In our study **"Reanimation of the paralyzed face with the Temporalis-myofascial flap transfer technique",** out of the five patients with facial paralysis; three patients suffered from long

standing Bell's palsy while one patient suffered with irreversible, post-trauma facial paralysis of more than 1 year duration and one patient sustained with irreversible facial paralysis following cerebello-pontine angle surgery one year back. Two patients suffered from right-sided facial paralysis, and two patients from left-sided facial paralysis involving both the eye and the mouth. One patient had only left-sided mouth palsy. Four patients – three males and one female had paralysis of both the eye and the mouth while all five showed some or all of the following features:

- Facial asymmetry.
- Lagopthalmos with incomplete closure of the eye on the affected side.
- Widening of the interpalpebral fissure on the affected side.
- Drooping of the corner of the mouth on the affected side.
- Drooling of food and liquids from the affected side of the mouth.
- Difficulty in speaking.
- Loss of controlled balance and difficulty in making facial movements.
- An inability to express certain emotions.
- Deviation of the corner of the mouth to the opposite side when an attempt was made to smile or speak.
- Inability to blow the cheeks.

The patient with only mouth palsy had symmetry of the eyes with equal width of the interpalpebral fissure on both sides. Also, eye closure was adequate in this case and there was no evidence of lagophthalmos.

Several studies have been presented on eyelid and mouth reanimation muscle transfer. Regarding muscle transfers, facial reanimation with Temporalis muscle transfer has withstood the test of time and is still a reference technique. Good results can be obtained in a few weeks with a single and relatively simple surgical procedure. There is no current consensus for objectively evaluating postoperative smiling outcomes. Several objective measurement systems have been proposed [7], but no single system has been adopted due to their complexity, cumbersome nature, or cost. With such variation in reporting results, it isn't easy to make comparisons and conclusions about the outcome of different surgical techniques.

Temporalis muscle transpositions are highly successful in long-standing and irreversible facial paralysis. Analysis of the results of some studies has shown the Temporalis muscle transposition technique to be highly successful and the method of choice alone in long-standing and irreversible facial paralysis or to augment the effects of facial nerve grafting or hypoglossal-facial nerve anastomosis in reanimating the mouth. For patients with facial palsy, lagophthalmos is often a more serious problem than the inability to smile. Dynamic reconstruction of eye closure by muscle transposition or free functional muscle transplantation offers a good solution for regaining near-normal eye protection without needing implants. Transposing the Temporalis muscle and suturing it to the 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. It has also been found that it is usually not necessary to transpose the masseter muscle since excellent results have been achieved with the Temporalis muscle alone. For facial reanimation, the Temporalis muscle has enjoyed more popularity than the masseter because of its position, its facility for greater excursion of movement, and its adaptability to the orbicularis oris.

Advantages of the temporalis muscle flap procedure are multifold:

- The temporalis muscle can be lengthened in continuity of it's natural galea attachment.
- The reconstructive procedure avoids additional injury to the facial nerve.
- As with other temporalis muscle transfer techniques the direction of the muscle pull is proper. The temporalis muscle with galea will pull up laterally on the mouth to evoke a smile and across the eyelids to close the palpebral fissure.
- Theoretically, a patient can learn to operate one muscle independently of the other i.e., the eye can be closed without the appearance of a smile and a smile can be achieved without the eyes being closed.
- Tissue bulk to the cheek when facial tissues are missing or when they have

- atrophied from a prolonged standing facial paralysis is provided.
- Direct muscular insertion in the structures to be moved is achieved.

Disadvantages of the temporalis muscle flap procedure:

- Motion has to be triggered by a muscle of mastication rather than by one of facial expression.
- The motion has to be learned and much time spent in education to achieve effective mobility.
- Emotion and feelings have to be recognized by the patient and then voluntarily transferred to a facial expression.
- The patient has to learn to reduce facial movements during chewing and clenching of teeth.
- The described procedure does not make use of myoneurotization. Muscle interdigitation is not possible and it is unlikely that the nerve to the temporalismuscle will cross the galea to reach the denervated facial muscle. The procedure however does not preclude normal crossover or cross nerve grafts with muscle implantation from the normal side.

- In developing Galea flaps the surgeon has to be careful not to damage the hair follicles of the scalp. Scalp dissection is difficult and hair loss is a possibility.
- Patient's appearance can also be affected by the bulging of muscle over the zygomatic arch and by the post operative hollow in the temporal region if it is not replaced by a suitable substitute.

The other muscles that are commonly used for facial reanimation include the masseter transfer first delineated by Lexer [8], pectoralis minor vascularized muscle graft, extensor digitorum brevis, Gracilis, latissimus dorsi, rectus abdominis, Palmaris Longus tendon, and platysma. Facial reanimation using CFNG results in spontaneity and synchronicity with the healthy side. Additional simultaneous masseteric coaptation allows for fast and powerful reinnervation. This dual innervation technique combines the benefits, resulting in powerful and coordinated facial movements [9]. Temporalis tendon transfer is a relatively straightforward procedure with distinct advantages compared to other forms of facial reanimation, and it provides outstanding results.

Other methods of dynamic facial reanimation include direct nerve repair and grafting, cross-face nerve grafting, and nerve crossovers. They play a role in treating facial paralysis of short-term duration and, as such, are not of much relevance to the cases included in our study. The masseter-to-facial nerve transfer is also an effective method for reanimation of the midface and perioral region in a select group of facial paralysis patients. The technique is advocated for its limited donor-site morbidity, avoidance of interposition nerve grafts, and potential for cerebral adaptation, producing a strong, potentially effortless smile [10]. Using a minimally invasive approach, the temporalis tendon can also be transposed for immediate dynamic reanimation of the paralyzed lower face. This procedure involves a single small incision and minimal dissection, with no foremost osteotomies. Also new software such as FACE [11] has been introduced for the analysis and evaluation of facial function but is not very popular as of now. insertion, and suturing fascia lata to it.

In our study in order to achieve extra length, we used the temporalis fascia in one case by lifting it off the muscle and reinforcing it by suturing it at the end and it's margins for lengthening the temporalis sling. Galea was also used in two cases in an attempt to gain additional length for the temporalis sling to reach the corner of the mouth. However in four of our cases, the muscle was sagitally split wherever required in it's upper third portion to gain the extra length required to reach the paralyzed corner of the mouth. By this innovative method, we were able to obtain a total length of almost 14-15 cms in all three cases and thus, we could very passively secure the temporalis muscle to the orbicularis muscle fibres as well as the dermis both at the oral commissure and at the philtrum. Also, the blood supply to the temporalis was preserved as the muscle was split mid-sagitally. This technique further precluded the use of fascia lata or other modalities to increase the length and was found to be more superior than the use of galea or deep fascia as the muscle itself was

provided to the corner of the mouth thereby enhancing the function of smiling.

In our study, case1, the patient a female, had long hair growth and good volume; the post-op hollow in the temporal region was thus camouflaged. In cases 2,3,4 and 5, the temporalis was found to be thin in volume and the post operative hollow was too miniscule to pose a cosmetic problem. For the same reason the bulk over the zygomatic arch was also not evident.

The years of one sided facial paralysis make for abnormal facial movements with the normal side overwhelming the weakened muscles. A prolonged careful relearning on how to smile is needed. Instructions are given to the patient on how to limit the full excursion on the normal side and how to strengthen the weakened muscles on the paralysed side with the help of the temporalis muscle and how to clench and smile or speak. With frequent sessions in front of the mirror the patient learns how to smile.

All said and done, the temporalis muscle flap remains a versatile and essential tool in plastic reconstructive surgery. Dynamic Facial Reanimation with orthodromic Temporalis tendon has also been tried successfully in children. Temporalis muscle transposition and lengthening myoplasty are also good options for patients who are not good candidates for neurotization by the facial nerve[13]. Chenney et al.[14] has also advocated a modified temporal tendon approach. For restoring a truly spontaneous smile and facial muscle movement, Temporalis muscle transposition can also be used to immediately treat complete facial paralysis due to injuries, leaving the facial nerve anatomically intact but requiring a prolonged recovery time (more than 1 year). Because temporalis muscle transposition does not interfere with neuronal regeneration, it may also be employed early in managing complete facial paralysis when recovery is predicted to be extended and incomplete.

Five cases were successfully treated using the temporalis muscle-fascia / galea transposition technique for eye and mouth reanimation. One patient was treated for only mouth reanimation since the eyelid function and eye esthetics were normal. More than satisfactory results were obtained in all five cases.

CONCLUSION

Facial paralysis is a grave deformity and a setback for the patient in terms of both emotion and function . Of the muscle transfer techniques, the temporalis muscle has shown time-proven results and is quite popular. The results of the temporalis-myofascial / temporalis-myofascial-galeal technique are useful, reproducible and highly successful in reanimating the mouth and the eye. We believe that the temporalis muscle transfer will continue to play an important role in reanimating the face, particularly for patients with long standing facial paralysis. Five cases were successfully treated using the temporalis muscle-fascia / galea transposition technique for eye and mouth reanimation. One patient was treated for only mouth reanimation since the eyelid function and eye esthetics were normal. With our modification of sagittal splitting of the muscle, we gained more than the extra muscle length to reanimate the mouth. This technique described in our study is innovative, most reliable and a safe procedure to gain the extra length as required.

DECLARATIONS

Conflict of interest: No conflict of interest is declared by all the authors.

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Ethics approval

Ethical Committee Clearance Number: Not Required

Consent to participate: Informed consent was obtained from all the patients and their legal guardians by informing and clearly explaining the details of the study.

Consent for publication: Informed consent was obtained from all the patients and their legal guardians by informing and clearly explaining the details of the study.

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