How to Rehabilitate Long-Term Facial Paralysis

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Objective: To project the surgical resuscitation methods that we apply to the lower part of the face and the eyes with the aim of preventing functional and psychological problems that can occur in patients with facial paralysis.

Materials and Methods: Twenty-two patients with facial nerve paralysis due to acoustic neuroma, trauma, cholesteatoma, and parotid carcinoma were included in this study. In the lower facial region, the temporal muscle was suspended to the lower lip. In the upper facial region, eyelid gold implantation was performed. The reanimation results of the upper and lower facial regions were graded as excellent, good, fair, and poor in consideration of the symmetry after rest and smile according to May classification in the third month after the surgery.

Results: The study group comprised 15 men (68.2%) and 5 women (31.8 %) (mean age, 63.82 ± 14.18 years; range, 8–78 years). Of the patients, 18.2% (n = 4) had acoustic neuroma, 40.9% (n = 9) had facial trauma, 27.3% (n = 6) had cholesteatoma, and 13.6% (n = 3) had parotid carcinoma.

Reanimation techniques were applied to 40.9% (n = 9) of the patients during the first 2–4 years, whereas 59.1% (n = 13) of patients underwent surgery after 4 years.

In a total of 17 patients (77.3%) who had lower lip intervention, 4 patients (23.5%) had excellent results, 7 patients (41.2%) had good results, and 6 patients (35.3%) had moderate results.

In the 22 patients who underwent the eyelid procedure, 5 patients (22.7 %) had excellent results, 13 patients (59.1 %) had good results, and 3 patients (18.2 %) had moderate results. Poor results were not observed in any patient.

Conclusion: Facial paralysis is a disease that causes serious functional and psychological problems in patients. Therefore, the choice of treatment method is dependent on the etiology, duration of paralysis, expectations of the patient, and experience of the surgeon. Being less invasive methods, obtaining immediate results, requiring single surgical stage, and having long-lasting results and dynamic muscle transfer and static suspension methods are preferred.

Key Words: Reanimation of facial paralysis, gold implants, temporalis muscle transfer

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Facial paralysis (FP) is a multifaceted disorder that causes social, psychological, and functional problems in patients. The incidence of FP is 15–40/100,000 inhabitants.[1] Facial paralysis can result from a wide variety of etiologies, including infectious, neurologic, congenital, neoplastic, traumatic, systemic, and iatrogenic causes.[1] Thus, interference and outcomes are different. However, long-standing peripheral monolateral FP in the adult has challenged plastic surgeons, maxillofacial surgeons, and otolaryngologists.

As a result of impaired function, decreased lacrimal tears in patients can cause ectropion, keratitis, and blindness after lagophthalmos. Deterioration of oral competence causes swallowing, chewing, and speech difficulties. Nasal valve problems also lead to nasal congestion and facial asymmetry, causing psychological problems.[2,3] It is recommended that surgeons address the aesthetic and functional issues together. Nevertheless, a complete eye protection and full facial symmetry still have not been achieved.

Time is the major determinant for the selection of facial reanimation techniques. In the acute stage (short of 3 weeks), facial nerve decompression and primary repair of the facial nerve are performed. The neurotization process takes approximately 6 months. If it is not successful, hypoglossal, masseteric, or spinal accessory nerve transfer with a cross-face nerve grafting is performed. If a patient has a crossover facial nerve graft, it must be placed at 18 months. A crossover nerve graft cannot be performed at 2 years because the end motor plates will be nonfunctional. At the chronic stage (≥2 years), chronic regional muscle transfer and free muscle transfer, which are dynamic methods, are used.[4] Static methods are used as helper methods at every stage.

In most cases of chronic FP of greater than 2 years' duration, the native facial musculature is in atrophy and requires the use of alternative muscles for facial reanimation. Muscle transfer techniques, including regional and free muscle transfer, are the mainstay of dynamic facial reanimation for chronic FP.[5]

The patients with FP must be treated by considering the duration of paralysis, cause of paralysis, and other conditions of the patients. In this study, we present our facial reanimation outcomes for long-term FP.

PATIENTS AND METHODS

Twenty-two patients with facial nerve paralysis due to acoustic neuroma, trauma, cholesteatoma, and parotid carcinoma were included in this study between January 1998 and November 2008. The duration of paralysis varied between 2 and 12 years.

A thorough medical history, a detailed clinical examination, electrophysiological testing, including needle electromyography and nerve conduction studies, and documentation of facial movements were recorded for each patient. Bilateral high-resolution computed tomography or magnetic resonance imaging of the VII canals were performed as needed.

The follow-up period of the patients, surgical methods, and results were reported. The reanimation results of the upper and lower facial regions were graded as excellent, good, fair, and poor in consideration of the symmetry after rest and smile according to the May classification in the third month after the surgery (Figs. 1–2).[6,7] All of the patients were documented with photographs during the preoperative

Grade	Definition
• Excellent	• Eye completely closed and no asymmetry
• Good	• Slight asymmetry while eye closed
• Fair	• No difference between two eyes while eye open
• Poor	• Asymmetry or lagophthalmus while eye open

FIGURE 1. Grading of paralysis in the upper facial region according to the May classification.

and postoperative follow-up periods. Informed consent had been taken for all patients.

SURGICAL TECHNIQUE

The upper and lower facial regions of the patients were subjected to surgery separately. In the lower facial region, the temporal muscle was suspended to the lower lip. In the upper facial region, eyelid gold implantation was performed.

In the method of temporal muscle transposition, the incision was made in the front of the helix in the temporal region to the superior and parietal areas located slight posteriorly (Figs. 3, 4). An incision was made lateral to the vermilion without extending to the lateral 1/3 portion, the lateral commissure. The lip edge was reached by the tunnel created using the subcutaneous dissection technique to the nasolabial fold in the superficial layer of the temporal fascia. One third of the temporal muscle was separated from the periosteum by elevating the temporal region to be used for suspension (Figs. 3, 4). Thereafter, the temporal muscle flap was held with a clamp in a longitudinal pedicle form and passed through the subcutaneous tunnel. Thus, the pedicles were reached to the edges of the lip and were sutured to the lip corner. Unless provided a sufficient length, it was lengthened with fascia lata or Gore-Tex.

The gold implant procedure, which is carried out as a static method, was performed under local anesthesia. The appropriate weight of the gold implants was determined preoperatively by taping the prepared gold implant on the central portion of the upper eyelid. The gold weights ranged from 1.0 to 1.4 g. A pocket was formed on tarsal layer with a 1.5-cm incision in the middle of medial and lateral canthus horizontally over supratarsal fold, and then gold implant was fixed with sutures (Figs. 5, 6). Some of these patients were supported with canthoplasty.

STATISTICAL ANALYSIS

For statistical analysis, Number Cruncher Statistical System 2007 and Power Analysis and Sample Size 2008 Statistical Software (Utah, USA) were used to assess the findings of the study. Descriptive statistical methods (mean and standard deviation) and Pearson χ^2 for the comparison of quantitative data were used for the difference. The significance level were set as $P < 0.05$ and 95% confidence interval.

RESULTS

The study group comprised 15 men (68.2%) and 5 women (31.8%) (mean age, 63.82 ± 14.18 years; range, 8–78 years). Of the patients, 18.2% (n = 4) had acoustic neuroma, 40.9% (n = 9) had facial trauma, 27.3% (n = 6) had cholesteatoma, and 13.6% (n = 3) had parotid carcinoma (Table 1). When the type of diseases was compared with sex, no difference was observed in the sex ratio (Table 2).

Reanimation techniques were applied to 40.9% (n = 9) of the patients during the first 2–4 years, whereas 59.1% (n = 13) of the patients underwent surgery after 4 years (Table 3). All of the selected cases were unable to undergo the primary facial nerve reconstruction technique.

Grade	Definition
• Excellent	• No significant difference while laughing
• Good	• Slight asymmetry in paralytic side while laughing
• Fair	• No difference at rest
• Poor	• Asymmetry in paralytic side at rest

FIGURE 2. Grading of paralysis in the lower facial region according to the May classification.

FIGURE 3. A, One third of the temporal muscle was separated from the periosteum by elevating the temporal region to be used for suspension. B, Three months after the surgery. C, One year after the surgery. The smile of the patient was completely symmetrical. The surgical outcome was graded as ''excellent'' according to the May classification.

FIGURE 4. Preoperative and postoperative pictures of the patient who underwent temporal muscle suspension. There was a slight asymmetry in paralytic side while laughing. The surgical outcome was graded as ''good'' according to the May classification.

FIGURE 5. Preoperative and postoperative pictures of the patient who underwent gold implantation. Eye was completely closed and there was no asymmetry. The surgical outcome was graded as ''excellent'' according to the May classification.

Temporal muscle suspension was applied to 77.3% (n = 17) of the patients. Of these, 18.18% (n = 4) had FP due to acoustic neuroma, 27.27% (n = 6) had FP due to trauma, 18.18% (n = 4) had FP due to cholesteatoma, and 13.64% (n = 3) had FP to parotid carcinoma. Overall, the lower facial region showed no interference in 22.7% (n = 5) of the patients (Table 4).

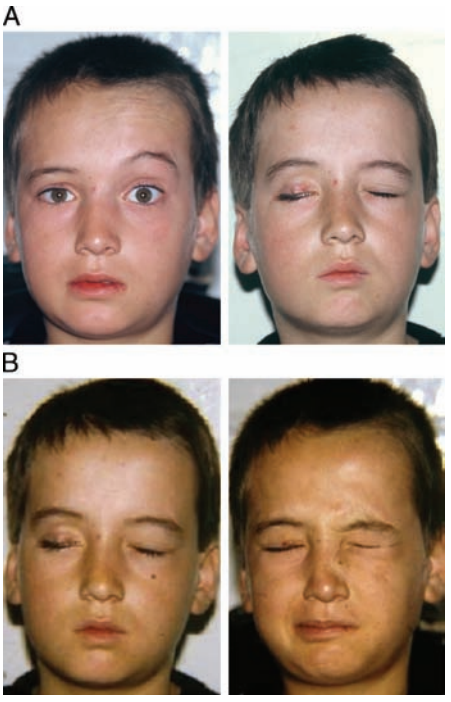

FIGURE 6. A, Three months after the surgery. B, One year after the surgery. There was no difference while eyes were opened. Eye closure was better after 1 year. The surgical outcome was graded as ''good'' according to the May classification.

TABLE 1. Diseases of Patients Who Underwent Facial Reconstruction

Disease	n	%
Acoustic neuroma	4	18.2
Trauma	9	40.9
Cholesteatoma	6	27.3
Parotid carcinoma	3	13.6
Total	22	100.0

In a total of 17 (77.3%) patients who had lower lip intervention, 4 patients (23.5%) had excellent results, 7 patients (41.2%) had good results, and 6 patients (35.3%) had moderate results according to the May classification (Table 5; Figs. 3, 4).

A total of 22 patients (100%) with FP underwent gold implantation in the upper facial region. Of these, 18.18% (n = 4) had FP due to acoustic neuroma, 40.91% (n = 6) of them had FP due to trauma, 18.18% (n = 4) had FP due to cholesteatoma, and 13.64% (n = 3) had FP due to parotid carcinoma (Table 4).

In the 22 patients who underwent the eyelid procedure, 5 patients (22.7 %) had excellent results, 13 patients (59.1 %) had good results, and 3 patients (18.2 %) had moderate results according to the May classification (Table 5; Figs. 5, 6).

Local inflammation developed after gold implant surgery in one of the patients, and it was improved with antibiotic treatment. Although gold implantation was carried out due to the formation of corneal epithelial problems, 2 patients required gold weight upsizing. One patient underwent temporal muscle suspension revision.

There was remarkable improvement in all the patients regarding overall esthetic and functional outcomes. Good and excellent overall esthetic and functional outcomes were observed.

DISCUSSION

Facial paralysis continues to represent a challenging clinical problem without a single surgical procedure. Lack of objective, quantitative measures of facial weakness, and reliable prognostic indicators for spontaneous recovery make facial nerve dysfunction difficult to manage.[8]

Each region has its own problems, and there are various interventions in their own. Ocular protection and oral competence are the most important issues that should be provided in surgery. Optimal rehabilitation of FP depends on thorough site-specific assessments.

The purpose of treatment for FP was to protect facial symmetry and prevent ocular complications. The most important factor in the selection of a reanimation technique for facial nerve paralysis is timing. Early intervention and primary nerve reconstruction are required in patients with full-thickness facial nerve laceration. In

TABLE 2. Sex Distribution of Patients Who Underwent Facial Reanimation

	Male	Female	Total
Acoustic neuroma	2	2	4 (18.2%)
Trauma	6	3	9 (40.9%)
Cholesteatoma	4	2	6 (27.3%)
Parotid carcinoma	3	0	3 (13.6%)
Total	15	7	22 (100.0%)

Pearson χ^2, $P = 0.567$.

TABLE 3. Intervention Time of Patients Who Underwent Facial Reanimation

Intervention Time (Year)	n	%
2–4	9	40.9
4–6	8	36.4
6>	5	22.7
Total	22	100.0

facial nerve paralysis, the main options were neural reconstructions, including accessory to facial nerve transfer and hypoglossal to facial nerve crossover. However, the dynamic muscle transfer method also provides good results due to the long recovery time of the facial nerve reconstruction.

Many surgeons prefer to perform muscle transfer due to the atrophy of motor end plates 2 years after paralysis.[9,10] Thus, after 2 years, reinnervation is not helpful. If possible, dynamic reanimation and static suspension methods should be preferred. Dynamic muscle transfer indicates regional muscle and tissue transposition in patients without facial reinnervation.[11] Additionally, the cosmetic outcome of the dynamic method is better than that of the static method.

First, Gillies et al[12] folded the temporal muscle over the zygoma to reach the lip subcutaneously, resulting in significant muscle bulging over the zygoma and a residual hollow in the temporal fossa. Later, McLaughlin et al[13] described a method that used the entire muscle after sectioning the coronoid process through an intraoral approach, using a strip of the fascia lata as well. Labbe and Huault proposed transfer technique, namely, lengthening temporalis myoplasty, with the definite advantages of being one-step, technically easier, and relatively fast.[14] Another method, which can be applied to the lower facial region defined by McLaughlin and developed by Labbe and Huault, is reconstruction method by transferring coronoid process with temporal tendon to lip edge.[15,16]

Temporal muscle transfer in the lower facial region was popularized by Rubin, Baker and Conley in the early 1970s.[1,2] Many authors have considered that the conventional method was problematic owing to the depression in the temporal region and swelling in the zygomatic arch.[3–6] We obtained good aesthetic and functional results using the temporal muscle suspension method by using the middle-third part of the temporal muscle, preventing temporal region depression and zygomatic region swelling (Figs. 3, 4). None of the patients had swelling in the temporal region.

Long-standing facial nerve reanimation results are still not well known. In our study, 40.9% (n = 9) of the patients underwent reanimation in the first 2–4 years, 59.1% (n = 13) of the patients underwent reanimation after 4 years, and we reported our late facial nerve reanimation results.

Many clinics offer their own methods. The most important reason is the lack of a quantitative parameter for the comparison

TABLE 4. Diagnosis of Patients Who Underwent Temporal Muscle Suspension and Gold Implant

Etiology	Temporal Muscle Suspension Performed	Temporal Muscle Suspension not Performed	Gold Implant	Total
Acoustic neuroma	4 (18.18%)	0 (0%)	4 (18.18%)	4 (18.18%)
Trauma	6 (27.27%)	3 (13.64%)	9 (40.91%)	9 (40.91%)
Cholesteatoma	4 (18.18%)	2 (9.1%)	6 (27.28%)	6 (27.28%)
Parotid carcinoma	3 (13.64%)	0 (0.0%)	3 (13.64%)	3 (13.64%)
Total	17 (77.3%)	5 (22.7%)	22 (100%)	22 (100%)

TABLE 5. Surgical Outcomes of Lower and Upper Facial Region Surgical Intervention According to the May Classification

	Excellent	Good	Moderate	Not Interfered	Total
Lip results					
Performed	4 (23.5%)	7 (41.2%)	6 (35.3%)	0 (0%)	17 (100.0%)
Not performed	0 (0%)	0 (0%)	0 (0.0%)	5 (100.0%)	5 (100.0%)
Total	4 (18.2%)	7 (31.8%)	6 (27.3%)	5 (22.7%)	22 (100.0%)
Ophthalmic results	Excellent	Good	Moderate	Poor	Total
Gold implant	5 (22.7%)	13 (59.1%)	4 (18.2%)	0 (0%)	22 (100.0%)

of facial nerve paralysis measurements. In this study, we compare our results according to the May classification.[7,17,18]

In the total of 17 (77.3%) patients who had lower lip intervention, 4 patients (23.5%) had excellent results, 7 patients (41.2%) had good results, and 6 patients (35.3%) had moderate results according to the May classification (Table 5; Figs. 3, 4). This procedure can be applied in the late period owing to the lack of poor results and a low degree of swelling.

Although the best results are obtained using free tissue transfer, which often requires multiple surgeries and the need for a long postoperative period to observe an improvement, the results are of increasing interest compared with less invasive methods. Temporal muscle suspension, which we applied to our patients, is a less invasive method, and it may be a preferable method owing to the achievement of immediate results: the method is a one-stage surgery and carries a long-lasting effect.

In facial nerve palsy, the most important functional loss is upper eyelid function. Artificial eyedrops, tarsorrhaphy, lateral-medial canthopexy, canthoplasty, performing gold or platinum implants and pedicle or free muscle transpositions to upper eyelid are the methods applied to protect the eye.[19]

Upper eyelid gold implants were applied to patients with short- and long-term FP to protect the eye. In some patients with long-term FP, canthoplasty, which is an irreversible method, was applied to the lower eyelid to provide eyelid closure and to protect the eye. We applied gold implants to our 22 patients. In the 22 patients who underwent the eyelid procedure, 5 patients (22.7%) had excellent results, 13 patients (59.1%) had good results, and 3 patients (18.2%) had moderate results according to the May classification (Table 5; Figs. 5, 6). Complications occurred in 3 patients who had difficulty in closing their eyelids, and gold implants were applied to two of these: one patient was treated with canthoplasty addition, and the other improved with antibiotic treatment after upper eyelid inflammation. Some authors have used platinum instead of gold implants owing to gold inflammation and the high risk of extrusion.[19] Such a complication risk was not considered because only one of our patients had inflammation.

Gold implant provides the best cosmetic result because it preserves normal function of the eye and does not block vision. The most important disadvantage is inadequate closure of the eye in the supine position. Good results were obtained in our study because of the relatively lower frequency of complications.

Although dynamic methods are preferred, static methods are still applied for immediate response. In addition, static methods are used in patients with FP whose muscle function is especially deteriorated and cannot be rehabilitated. In addition, static methods can be performed alone in elderly and sick individuals who cannot tolerate dynamic procedures, in patients where dynamic procedures do not work, and in patients who do not want to wait a long time for the results.

Patient's compliance and motivation are vital in facial reanimation.[20] In particular, the role of physical therapy after surgery is very

crucial. For our patients, physical exercise started on the 20th postoperative day, once per week. The patients were asked to pursue the exercises 4 times a day at home. Booklets were given to all patients. In our experience, patients underwent treatment consisting of exercise and infrared and massage therapy before and after surgical intervention. After the surgery, patients were educated for browlift (musculus frontalis), frowning (musculus corrugator), eye closure (musculus orbicularis superior/inferior), moving the nose wings (musculus dilatator naris), smile (musculus risorius), showing teeth (musculus zigomaticus major/minor), the crimping jaws (musculus mentalis), whistling (musculus orbicularisoris superior/inferior) exercises, and self-massaging. If the patient cannot move eyebrows actively, these movements were performed passively. Infrared therapy was applied to the patients after closure of the eyes, and then electrical stimulation (galvanic current) was applied to the facial nerve innervated muscles. Stimulating the denervated muscle has been shown to preserve the contraction ability of the muscle. The demonstration of the beneficial effect of exercise on denervated muscles has an important bearing on the problem of the cause of denervation atrophy. The treated muscles were found to be in a better state after the exercise had been discontinued.

Static methods were used because elderly patients have more ptosis in the face; thus, suspension methods are preferred over dynamic methods. Nerve regeneration is more difficult in this group of patients. Static methods may be applied alone because long-lasting surgery and a prolonged healing process cannot be tolerated.

Facial paralysis is a disease that causes serious functional and psychological problems in patients. Therefore, the choice of treatment method is dependent on the etiology, duration of paralysis, expectations of the patient, and experience of the surgeon. For chronic FP, treatment typically requires regional or free muscle transfer. Static techniques of facial reanimation can be used for acute, intermediate, or chronic FP as adjuncts to the overall management strategy.

REFERENCES

1. Melvin TA, Limb CJ. Overview of facial paralysis: current concepts. *Facial Plast Surg* 2008;24:155–163
2. Coulson SE, O'Dwyer NJ, Adams RD, et al. Expression of emotion and quality of life after facial nerve paralysis. *Otol Neurotol* 2004;25:1014e9
3. Bradbury ET, Simons W, Sanders R. Psychological and social factors in reconstructive surgery for hemi-facial palsy. *J Plast Reconstr Aesthet Surg* 2006;59:272e8
4. Mehta RP. Surgical treatment of facial paralysis. *Clin Exp Otorhinolaryngol* 2009;2:1–5
5. Erni D, Lieger O, Banic A. Comparative objective and subjective analysis of temporalis tendon and microneurovascular transfer for facial reanimation. *Br J Plast Surg* 1999;52:167e72
6. May M, Drucker C. Temporalis muscle for facial reanimation. A 13-year experience with 224 procedures. *Arch Otolaryngol Head Neck Surg* 1993;119:378e82
7. May M (Ed). *The Facial Nerve*. 2nd ed. New York, NY: Theime, 2000
8. Lee LN, Susarla SM, H Hohman M, et al. A comparison of facial nerve grading systems. *Ann Plast Surg* 2013;70:313e6
9. Terzis JK, Olivares FS. Long-term outcomes of free-muscle transfer for smile restoration in adults. *Plast Reconstr Surg* 2009;123:877e88
10. Verdú E, Ceballos D, Vilches JJ, et al. Influence of aging on peripheral nerve function and regeneration. *J Peripher Nerv Syst* 2000;5:191e208
11. Boahene KD. Dynamic muscle transfer in facial reanimation. *Facial Plast Surg* 2008;24:204–210
12. Gillies H. Experience with fascia latae grafts in the operative treatment of facial paralysis. *Proc R Soc Med* 1934;27:1372
13. McLaughlin CR. Permanent facial paralysis; the role of surgical support. *Lancet* 1952;2:647e51
14. Labbe D, Huault M. Lengthening temporalis myoplasty and lip reanimation. *Plast Reconstr Surg* 2000;105:1289–1297
15. Byrne PJ, Kim M, Boahene K, et al. Temporalis tendon transfer as part of a comprehensive approach to facial reanimation. *Arch Facial Plast Surg* 2007;9:234–241
16. Boahene KD, Farrag T, Ishii L, et al. Minimally invasive temporalis tendon transposition. *Arch Facial Plast Surg* 2011;13:8–13
17. Rubin LR. The anatomy of a smile: its importance in the treatment of facial paralysis. *Plast Reconstr Surg* 1974;53:384–387
18. Harrison DH. Pectoralis minor for facial palsy. *Plast Reconstr Surg* 1985;76:656e7
19. Terzis JK, Kyere SA. Experience with the gold weight and palpebral spring in the management of paralytic lagophthalmos. *Plast Reconstr Surg* 2008;121:806e15
20. Prakash V, Hariohm K, Vijayakumar P, et al. Functional training in the management of chronic facial paralysis. *Phys Ther* 2012;92:605–613