# Facial Nerve Repair: A Retrospective Review

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**ABSTRACT**

The purpose of this article is to review a large series of patients evaluated for disorders of the facial nerve in order to assess the indications for surgery, the timing of surgery, the techniques of nerve repair, and to better define those factors associated with a favorable outcome. **Study design:** A retrospective review of patients undergoing facial nerve repair from 1963–1997. **Methods:** One hundred and three patients underwent surgical intervention designed to repair a disrupted facial nerve. All procedures were performed by one of the senior surgeons (M.M.). Seventy-two patients had a complete data set and at least one year of follow-up. **Results:** Eighty percent of patients attained an outcome considered superb to fair. Twenty percent of patients had a poor outcome. There was a slight worsening of outcome with increased time to repair. Patients with a neoplastic etiology of nerve paralysis tended to have a worse outcome. **Conclusions:** Facial nerve grafting is most successful if intervention is undertaken at or near the time of initial injury. However, prolonged time (up to two years) to repair does not preclude the potential for some recovery. The limitations of the current systems for grading facial recovery after nerve repair are well known, and the adoption of a new grading scale for assessing recovery after reanimation procedure is recommended.

**KEYWORDS:** Facial paralysis, facial nerve repair, neurorrhaphy, nerve graft



The facial nerve is the most commonly injured of all cranial nerves. Loss of facial expression secondary to facial nerve injury can have devastating consequences for a patient and remains one of the most challenging problems faced by the otolaryngologist or facial plastic surgeon. The objectives of surgical repair of the facial nerve include the restitution of facial symmetry and facial expression while minimizing uncontrolled facial movements. The management of facial nerve injury is a complicated algorithm. Many factors are believed to contribute to the survival and success of facial nerve autografts, including location of the lesion, delay between injury and repair, graft length, number of anastomoses, and patient age. Since the time of the first surgical repair of the facial nerve by Sir Charles Ballance in 1894, we have been struggling to resolve many of these controversial issues. This article highlights the results of the 30-year experience (by M. M.) and attempts to provide some insight into mechanisms of improving clinical outcomes.

## MATERIALS AND METHODS

A retrospective chart review was conducted for all patients evaluated for facial nerve disorders at the Shadyside Facial Paralysis Center from 1963 to 1997. All patients who underwent direct surgical repair of the facial nerve that reconstituted the seventh nerve nucleus to the distal facial neuromuscular unit were included in the study. A database designed by one of the senior authors (M. M.) to document the preoperative, intraoperative, and postoperative management of all patients with

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facial nerve disorders facilitated data acquisition. During this 34-year period, 3722 patients were evaluated for facial nerve disorders. From this population of patients, 72 met the criteria for inclusion in the study and had data suitable for analysis. Preoperative evaluation included clinical, radiologic, and electrodiagnostic testing. The techniques of the various anastomotic procedures have been previously described[1] and were performed by the senior authors (M. M., B. S.). During the course of their treatment some patients also underwent a temporalis muscle sling reanimation.

The follow-up assessment after nerve repair consisted of serial clinical examinations. All patients were encouraged to return for outpatient follow-up; however, many lived at great distance and follow-up was provided by the referring physician. In some cases patients provided for evaluation photographs and/or a videotape with the face at rest, closing the eyes gently, closing the eyes tightly, pursing the lips, smiling, and attempting to raise the eyebrows. Posttreatment facial movement was assessed by the senior surgeons (M. M. and B. S.) using the May classification (Table 1) for reporting results of facial nerve repair.[1,2] Recovery of facial nerve function was assessed at periods of 12 months or greater after surgery.

The results were analyzed to determine the relationship between the time to repair (i.e., the duration of pretreatment paralysis), the type of repair, and the recovery of facial movement. The time to repair was calculated as the time interval between the onset of the facial paralysis (complete or incomplete) and the day of surgical intervention. Preoperative facial nerve function was quantified by assigning a percentage of normal function to the forehead, eyes, nose, mouth, and neck. Scores ranged from 100% for normal function, 10% for tone only, and 0% for no facial motor function. Recovery of facial motor function after nerve repair was assessed using the May facial nerve grading scale (FNGS; Table 1).

## RESULTS

The subject population consisted of 38 females with a mean age of 37.3 years (range 6 to 80 years) and 34 males with a mean age of 34.6 years (range 1 to 69 years). An equal number of patients had involvement of the right ($n$ = 37) and left ($n$ = 35) side of the face. The diagnoses at the time of surgery are summarized in Table 2. Seventeen patients had iatrogenic injuries, 16 had traumatic injuries, and 38 had facial nerve injury associated with tumor excision. Patients with iatrogenic and traumatic facial nerve injury (mean $\pm$ 1 S.D. [standard deviation] FNGS of 2.2 $\pm$ 1.1 and 2.1 $\pm$ 0.8, respectively) and patients with benign tumors (FNGS = 2.4 $\pm$ 1.3) had a more favorable outcome than those patients with malignant tumors (FNGS = 2.9 $\pm$ 1.5).

**Table 1 May's FNGS for Reporting Results of Complete Lesions of the Facial Nerve**

| Grade | Description | Characteristics |
|---|---|---|
| I | Superb | Gross: Some mimetic movement (spontaneous emotion)<br>Rest: Good tone and symmetry<br>Motion: Well controlled, visible, individual facial muscle movements with some evidence of spontaneous mimetic motion |
| II | Excellent | Gross: Mimetic movement absent<br>Rest: Good tone and symmetry<br>Motion: same as Grade I without mimetic motion |
| III | Good | Gross: Mass movement<br>Rest: Good symmetry in repose<br>Motion: Some movement with effort |
| IV | Poor | Gross: Tone and symmetry only<br>Rest: Tone and symmetry<br>Motion: None |
| V | Failure | Gross: No movement.<br>Rest: asymmetry, minimal or absent tone<br>Motion: None |

Adapted from Refs. 1 and 2.

The most common method of nerve repair was interposition grafting (79%; Table 3). The best results were obtained with primary repair of the nerve wherein the outcome resulted in a facial nerve grading score of 1.5 $\pm$ 1.0. Table 3 lists the number of patients undergoing each procedure and the mean FNGS. Eighty-one percent of patients regained facial movement to some degree (Table 4) and the majority of the patients had a grade I to III result.

The time between the onset of paralysis and surgical intervention varied between 0 days and 17 years, with the average interval being 1.1 years. Examination

**Table 2 Etiology of Facial Nerve Paralysis and Results of Facial Nerve Repair in 72 Patients Evaluated Between 1963 and 1997**

| Etiology | Number of Patients | % | Mean FNGS | S.D. FNGS |
|---|---|---|---|---|
| Iatrogenic | 17 | 27.3 | 2.2 | 1.1 |
| Trauma | 16 | 22.1 | 2.1 | 0.86 |
| Tumor, Benign | 21 | 27.3 | 2.4 | 1.3 |
| Tumor, Malignant | 17 | 22.1 | 2.9 | 1.5 |
| Other | 1 | 1.3 | | |
| Total | 72 | 100 | | |

**Table 3 Number of Patients Undergoing Each Type of Nerve Repair Procedure and the Mean ± 1SD Facial Nerve Grading Score**

| Procedure | *N* | Mean FNGS | S.D. FNGS |
|---|---|---|---|
| Primary | 4 | 1.5 | 1.0 |
| Interposition | 61 | 2.5 | 1.3 |
| Segmental | 7 | 1.4 | 0.5 |
| Total | 72 | | |

of the relationship between the time to repair and outcome reveals that time between injury and repair is the single most important influence on outcome. Immediate nerve repair resulted in the best outcome, with a mean FNGS of 1.57 ± 0.97 (mean ± 1 S.D.). Between 0 and 1 year most patients can achieve a grade II to III outcome, and if the nerve is repaired within 2 years at least a grade 4.

The results were analyzed independently for patients who also had a temporalis muscle transposition to ensure that the improvement in facial motor activity was exclusively from the nerve graft procedure. There was little difference in outcome between the entire patient population and those patients who did not undergo a temporalis muscle reanimation procedure.

The subgroup of patients who presented with a slowly progressive (i.e., incomplete) facial paralysis was also analyzed separately. Independent of the duration between the onset of the paralysis and the time of repair, patients with a slowly progressive facial paralysis had a worse outcome. The outcome ranged from a FNGS of 2 to a maximum of 3.3.

## DISCUSSION

### Outcome After Facial Nerve Repair

It is clear that some method of facial reanimation is appropriate for patients undergoing intentional sacrifice of the facial nerve or after traumatic injury to the main facial nerve trunk or one of its branches. The method(s) selected depend on the location of the injury, the cause and duration of the paralysis, coexistent functional and cosmetic defects, patient comorbidities, disease prognosis, and patient needs. The most commonly implemented procedures are (1) direct nerve repair, (2) cranial nerve substitution techniques, (3) regional reanimation, (4) static suspension, and (5) free muscle transfer. Studies of facial nerve repair comparing primary repair to autograft repair suggest that primary repair yields a better clinical outcome.[3]

**Table 4 Frequency of Outcome for Patients Evaluated in Study**

| FNGS | FNGS | Number of Patients | % Total |
|---|---|---|---|
| I | Superb | 21 | 29.2 |
| II | Excellent | 23 | 31.9 |
| III | Good | 15 | 20.8 |
| IV | Fair | 7 | 9.7 |
| V | Poor | 6 | 8.3 |

There is no agreement in the literature as to when reinnervation procedures should be executed to obtain the optimal result. It is a commonly held belief that the earliest possible repair, optimally within 30 days after the onset of the paralysis, will result in the best functional outcome.[1,4–6] In cases of incomplete paralysis, the best result achievable is the preoperative grade.[7] Barrs,[8] in a porcine model of facial nerve trauma, concluded that although histologic and technical factors were suggestive of a better outcome with early repair, functionally acceptable results were achieved with nerve repairs performed 90 days post-trauma. Barrs[8] was able to detect a significant decrease in distal axon counts in grafts performed 60 days or 90 days after the initial injury compared with early repair (≤ 21 days). This suggests a worsening trend for axon regrowth relative to time after the onset of complete facial nerve paralysis. Green,[9] in an evaluation of 22 patients undergoing facial nerve repair after iatrogenic nerve injury, concluded that there was not a substantial difference in outcome between patients undergoing repair within the first 7 days from those having delayed repair. However, they had a mean time to repair of 27 days and their longest patient was repaired at 110 days, which is within a 4-month time frame. Our review of 77 patients supports the position that early repair is associated with a more favorable outcome. Our data indicate that facial nerve repair within 1 month after the onset of paralysis is associated with the best outcome, with a marked decline in outcome with repairs even as early as 3 months after the onset of paralysis.

Secondary reanimation techniques are performed most often within 12 months of the initial nerve injury. Even long-term facial paresis may respond to mimetic muscle reinervation if the muscle biopsy fails to yield a significant degree of fibrosis or atrophy.

The duration of an incomplete neural deficit was another uncontrolled variable in our study. Patients with a neoplastic etiology of their facial nerve injury are likely to have had prolonged periods of intermittent nerve injury and recovery. Patients with a slowly progressive paralysis most likely have ongoing axonal degeneration and regeneration. Only at that time when a critical degree of nerve injury has occurred (i.e., degeneration exceeds regeneration) does facial weakness become manifest. Benign tumors likely affect the nerve slowly and by compression of the nerve; in these instances the nerve is almost never completely disrupted.

Malignant processes often involve infiltration and replacement of functional neurons by tumor. In these cases patients may have normal nerve function despite histologic evidence of nerve invasion. It is possible that the tumor, via effects of cellular toxins or affects on the vaso nervorum, may affect nerve function in an unpredictable fashion.

## REPORTING OF RECOVERY

Grading of facial nerve function is necessary for evaluating and communicating the results of medical and surgical therapy of facial paralysis. An ideal grading system should be simple, reproducible, applicable to both complete and incomplete Cranial nerve VII paralysis, and sensitive enough to discriminate between small variations in facial nerve function (see the article by Nedzelski et al. in this issue for further discussion). The postoperative evaluation of our patients with autologous facial nerve grafts was performed using the FNGS.[1,2] This classification system reports the results of complete facial nerve lesions after neurrorhaphy. The House–Brackmann scale has been most widely accepted as a reliable and consistent tool for evaluating facial nerve function,[11] but this scale was not designed to evaluate nerve graft results. We did not employ the House–Brackmann scale because, by definition, a "superb" result would at best be a House–Brackmann grade III (Table 5); a House–Brackmann grade I is an unobtainable result after neurorrhaphy.

There are a number of difficulties with both the May and the House–Brackmann grading systems. Both systems are relatively subjective. Neither system grades patients on a continuous scale, nor do they take into account regional differences in resting symmetry, volitional motion, and synkinesis. This is particularly important in those cases where the nerve is injured distal to the pes anserinus or only a single branch (such as the marginal) is injured. Furthermore, it would be of benefit to employ a scale that could be used in both complete and incomplete lesions and after facial reanimation procedures. This would provide a better longitudinal assessment of recovery. Croxson et al.[12] advocate using both the House–Brackmann and the Burres–Fisch Linear Measurment Index (LMI) for reporting functional recovery. Their premise was that the House–Brackmann

**Table 5 House–Brackmann Grading System for Facial Paralysis**

| Grade | Description | Characteristics |
|---|---|---|
| I | Normal | Normal facial function |
| II | Mild dysfunction | Gross: slight weakness; may have slight synkinesis<br>Rest: Normal symmetry and tone<br>Motor:<br>Forehead: moderate to good function<br>Eye: complete closure with minimal effort<br>Mouth: slight asymmetry |
| III | Moderate dysfunction | Gross: obvious difference between two sides; noticeable synkinesis, contracture and/or hemifacial spasm<br>Rest: Normal symmetry and tone<br>Motor:<br>Forehead: slight to moderate movement<br>Eye: complete closure with effort<br>Mouth: slight weak with maximum effort |
| IV | Moderately severe dysfunction | Gross: obvious weakness and/or disfiguring asymmetry<br>Rest: Normal symmetry and tone<br>Motor:<br>Forehead: none<br>Eye: incomplete closure<br>Mouth: asymmetric with maximal effort |
| V | Severe dysfunction | Gross: only barely perceptible motion<br>Rest: Asymmetry<br>Motor:<br>Forehead: none<br>Eye: incomplete closure<br>Mouth: slight movement |
| VI | Total paralysis | No movement |

From Ref. 11.

system provides an overall impression of facial function whereas the Burres–Fisch LMI, being a more objective, continuous, and quantitative system, allows better longitudinal follow-up and interindividual comparison. Unfortunately, the Burres–Fisch system is time consuming and may be operator dependent. We believe that the facial grading system as outlined by Ross, Fradet, and Nedzelski[13] is a viable adjunct to the House–Brackmann or May facial grading scales and that this system merits further clinical evaluation. The House–Brackmann system remains valuable when the nerve is injured but intact, as with Bell's palsy; however, when the nerve is divided or repaired the Ross, Fradet, Nedzelski system allows for more analysis and understanding of the changes that occur over time.

## CONCLUSIONS

The rehabilitation of mimetic and functional motion of a paralyzed face with an autologous nerve graft is a well-established and successful procedure. We have summarized our experience over the past three decades of 72 patients undergoing primary facial nerve repair. In spite of advancements in surgical technique and in spite of early nerve repair, a perfect result remains elusive; however, it seems clear that early intervention with direct nerve repair gives the patient the best possible result.

At this time, the method of repair will most likely be based on surgeon preference rather than on scientific support for one technique over another. It is clear that many, if not all, of these issues need to be addressed in a prospective and systematic fashion so that we can one day optimize the likelihood of a favorable outcome. One step in this direction is to develop and universally implement a more objective system for grading the results of facial nerve injury and repair. (See Chee and Nedzelski, this issue.) The results with various techniques of facial reanimation can only be evaluated adequately if a uniform, nonobjective scheme for grading facial function is adopted.

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