



# Dynamic Reconstruction for Facial Nerve Paralysis

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Dynamic and static reconstruction procedures are employed for facial reanimation in patients suffering from facial nerve paralysis. Denervation and paralysis of the facial nerves causes considerable psychological and functional damage. Facial paralysis can affect facial expressiveness, communication, smile symmetry, eye protection, and speech competence. Due to their presumed poor prognosis, patients requiring facial nerve repair in a head and neck cancer practice are historically the least likely to receive a nerve graft. Dynamic reconstruction, on the other hand, is the gold standard in neurotology since patients are unlikely to die from their

underlying condition. Even with malignant pathology, extended preoperative palsy, proximal nerve injury location, radiation, or long graft length, the current series supports the use of dynamic reconstruction. Dynamic facial reconstruction should be preformed in most cases unless there's health risk of the method.

*Keywords: Reconstruction; nerve; face; facial nerve; paralysis.*

## 1. INTRODUCTION

Dynamic and static reconstruction operations are working for facial reconstruction in patients with facial nerve paralysis. Though, dynamic approaches lean towards being more effective and successful and would be obtainable to patients considering reconstruction, unless there are health risk contraindications [1,2]. The most communal methods for reconstruction are direct facial nerve repair with or without grafting, cross-facial nerve grafting, nerve transfer, and muscle transfer [3- 6].

Denervation and paralysis of the facial nerves causes considerable psychological and functional damage. Facial paralysis can affect facial expressiveness, communication, eye protection, smile symmetry, and speech ability. For each patient, a variety of modalities and strategies are available; the physician must carefully evaluate and examine the patient to establish the cause, length, and severity of the paralysis. The budding for recovery and the most suitable reconstructive structure are strongminded by considerate of face nerve architecture combined with a careful evaluation of the paralysis and health condition [1,7,8].

It is possible to use a standardized approach: Patients with chronic facial palsy must first have the etiology of the palsy accurately diagnosed. A step-by-step clinical examination, which may include MRI imaging and electromyography, allows for the classification of the palsy's etiology as well as the identification of the palsy's severity and functional limitations [9].

Because it poses a range of functional, cosmetic, and emotional issues, facial nerve paralysis can be difficult to treat. Facial symmetry at repose, corneal protection, oral competence, restoration of voluntary and spontaneous facial movements, and minimal synkinesis are all goals of treatment. To attain these objectives, a variety of static and dynamic approaches have been applied. The best end results are connected with facial nerve reapproximating or interpositional grafting. Dynamic processes produce superior results than static procedures in most cases [10].

## 2. MATERIALS AND METHODS

PubMed, Web of science, Google scholar and EBSCO Information Services was chosen as the search databases for the publications used within the study, as they are high-quality sources. PubMed being one of the largest digital libraries on the internet developed by the National Center for Biotechnology Information (NCBI) which is a part of the United States National Library of Medicine. Topics concerning dynamic reconstruction of facial nerve paralysis, and other articles was used in the making of the article. Restriction to the last 20 years and English language due to unavailable resources for translation was used. The founded articles were screened by titles, and reviewing the abstracts. Inclusion criteria: the articles were selected based on the relevance to the project which should include one of the following topics; 'nerve, paralysis, face, reconstruction, facial. Exclusion criteria: all other articles which did not have one of these topics as their primary end, or repeated studies, and reviews studies was excluded.

### 2.1 Statistical Analysis

No software was utilized to analyze the data. Data was reviewed by the group members to determine the initial findings, and the modalities of screening. Double revision of each member's outcomes was applied to ensure the validity and minimize the mistakes.

### 2.2 Epidemiology

Facial nerve paralysis is a disabling illness that affects roughly 20 to 30 people per 100,000 each year. 1 The facial nerve is in charge of the innervation and control of face expression muscles, also known as facial mimetic muscles. The brow, eyelid, cheek, and corner of the mouth all droop and relax pathologically when this function is lost. 2 Speech, oral competence, eyesight, and emotional expression may be impaired, affecting the overall quality of life of those who are afflicted. Because facial expressions are so important in interpersonal communication, the psychological and social

repercussions of this disease cannot be overstated. Facial paralysis can impair this vital function, leading to feelings of social isolation and depression in those who are affected [11].

Although peripheral facial palsy is the most prevalent cranial nerve disorder, with an annual incidence of 20 to 30 cases per 100,000 persons, only a small percentage of patients require surgical therapy. During the acute period of the palsy, the rationale for surgery is based on the individual's possibility of spontaneous and good functional recovery, rather than the aetiology. In the chronic phase, surgery may be indicated in individuals who have failed to recover or who have made a poor recovery, as well as those who have poor healing. Viral infections, such as reactivation of latent herpesvirus infection, trauma, iatrogenic injury, inflammatory affections of the middle ear, metabolic illnesses, and tumours of the facial nerve are among the listed causes [9].

In 7 to 10% of temporal bone fractures, the facial nerve is damaged. Falls, motor vehicle accidents, and assault, as well as penetrating trauma, such as gunshot wounds, are common causes of these injuries. Depending on their direction relative to the petrous ridge, temporal bone fractures are generally classed as longitudinal, transverse, or mixed. Temporal bone fractures are now classified as violating or sparing the otic capsule in new classification schemes that may be better predictive of clinical outcomes [12-19].

About 70 to 80 percent of fractures are longitudinal, caused by a temporoparietal impact; 10 to 30 percent are transverse, caused by a frontal or occipital injury; and 0 to 20% are mixed. Facial nerve involvement occurs in 10 to 25% of longitudinal fractures, but it is more common in transverse fractures, where it occurs in 38 to 50% of cases [17,20-23].

Idiopathic paralysis, often known as Bell's palsy, is the most common cause of facial palsy, accounting for 60 to 75 percent of cases. 70% to 90% of patients with Bell's palsy recover completely, depending on how early they begin steroid treatment. In Ramsay-Hunt-Syndrome, which is caused by reactivation of herpes zoster, the chance of complete recovery is only 50%. Both the patient and the treating physician should be aware that many patients will require conservative and/or surgical treatment for poor healing in the future [9]

### 2.3 Different Approaches to Facial Nerve reconstruction

A personalized surgical concept is applicable using three primary approaches, taking into account the patient's desire, age, and life expectancy: a) Early extratemporal reconstruction; b) Early reconstruction of proximal lesions if extratemporal reconstruction is not possible; c) Late reconstruction or congenital palsy. A standardised review of the treatment results 12 to 24 months following the last stage of surgical reconstruction is indicated to determine the need for adjuvant surgical procedures or other adjuvant therapies, such as botulinum toxin administration [9].

The restoration of face symmetry, oral competence, eye closure, voluntary facial movement, and spontaneous facial expression in the absence of synkinesis are all goals of facial reanimation. There are two types of surgical methods that have been developed to fulfil these goals: dynamic and static.

- Dynamic procedures are those that allow the face to move again. They are, on average, more successful than static techniques at achieving reconstruction goals.
- Static techniques help to support and stabilize the face's soft-tissue structures. They do not, however, provide animation. [10].

The patient's medical history is crucial in distinguishing paralysis that would recover on its own, such as Bell palsy or a brief iatrogenic damage, from paralysis caused by a persistent injury or an undiagnosed malignancy. The appropriate course of action is determined by the source of the paralysis. Treatment must, however, be tailored to the patient's life expectancy, age, preferences, and cosmetic or functional deficiencies.

The most essential aspect in selecting the timing and type of reconstructive approach is the aetiology, therefore intervention should wait until the reason of paralysis has been identified. Idiopathic, traumatic, viral, neoplastic, neurologic, or systemic/metabolic causes of facial nerve palsy exist. [10]

### 2.4 Definition and Classification

The term "facial palsy" refers to both partial (paresis) and complete (paralysis) loss of facial

nerve function. The distinction is crucial because the need for surgical reconstruction in patients with partial facial palsy must be demonstrated with greater rigour. Reconstruction in the case of a complete functional deficiency, on the other hand, is more difficult. Permanent facial palsy and non-transient functional impairments are the most common reasons for facial nerve repair surgery [9].

This is a classification of facial palsy and surgical reanimation guidelines:

#### A. Congenital

- syndromal
- non-syndromal: Nerve plasty is usually not viable, and cortical limitations make subsequent mimic and physical training difficult.

#### B. Acquired

- **Traumatic:** Extracranial, or intracranial: It is necessary to pinpoint the exact location of the lesion. Only in cases of total palsy is acute nerve repair superior than conservative treatment.
- **Tumourous** whether it's benign Tumor or malignant, The quoad vitam prognosis must be considered: choose a quick recovery approach, for malignant Intracranial: The reconstruction method that does not include co-adaptation of the proximal facial nerve stump is frequently the best option..
- **Infectious:** Causal therapy first, then reconstruction surgery after complete healing and an examination of any lingering deficiencies.
- **Neuromuscular:** Endplate region, ganglionic or axonal. [9]

### 2.5 Patient Evaluation

History and physical examination are the basic corners in evaluation of these cases. The onset and duration of paralysis, general medical history and overall medical status, and any past surgical treatments are all important parts of the history. The patient's overall health and life expectancy must be considered; for example, a procedure that takes two years to provide results is clearly inappropriate for a patient with a terminal condition. Realistic expectations must be formed early in the patient's education, and the patient must be encouraged to invest the time and financial resources required for a good outcome [10].

To give effective patient counselling on prognosis and therapy, precise characterization of facial nerve paralysis is required. The most widely used standardised measure for determining the degree of face weakness is the House–Brackmann 6-point scale of facial nerve function. However, this scale falls short when it comes to describing facial paralysis that is limited to a single facial distribution. The Terzis-Noah, Burres-Fisch, Nottingham, and Sunnybrook scales are among the others. [17,24-28].

A thorough evaluation guides the surgeon to the best treatment option. Based on the findings of a rigorous medical assessment of the patient, a thorough study of the disease process, and sound judgement, the surgeon must choose the most appropriate form of reconstruction. The location, extent, and degree of paralysis should be determined, as well as the aetiology of the nerve injury, the length of paralysis, and the time between injury and presentation. The patient's medical history is crucial in distinguishing paralysis that would recover on its own, such as Bell palsy or a brief iatrogenic damage, from paralysis caused by a persistent injury or an undiagnosed malignancy. The appropriate course of action is determined by the source of the paralysis. Treatment must, however, be tailored to the patient's life expectancy, age, preferences, and cosmetic or functional deficiencies [29].

Moreover, the physical examination should determine if the paralysis is total or partial, unilateral or bilateral, symmetric or asymmetric. Brow ptosis, dermatochalasis, skin laxity, oral commissure incompetence, and ocular exposure should all be considered when assessing facial asymmetry [30,31]. Other important considerations include the degree of synkinesis, the presence of other cranial nerve deficits, and the eye's health. With the rest of the face at rest, isolated region-specific facial motion such as brow elevation, eye closure, smile, pucker, and frown should be observed and documented. [10].

### 2.6 Surgical Techniques of Facial Paralysis

Here is the classification of most methods that are used for facial paralysis correction, based on duration [32].

In acute facial paralysis or less than three weeks, surgical management should be either facial nerve decompression which is divided into

different approaches, Transmastoid approach, Middle fossa approach, and Translabrynthine approach. Or facial nerve repair which can be divide into: Primary nerve repair, and Cable grafting.

In intermediated facial paralysis during 3 weeks to two years, surgical management should be nerve transfers and cross-facial nerve grafting.

In chronic facial paralysis that lasts for more than 2 years, regional muscle transfer or free muscle transfer should be conducted.

## 2.7 Nerve Grafting Techniques for Dynamic Facial Reconstruction

- **Direct hypoglossal-to-facial graft:** Voluntary movement develops and improves over a period of two to three years. This method is unlikely to result in spontaneous, symmetrical movement. To develop voluntary movement control, reduce synkinesis, and limit facial grimacing that can arise with mastication, patients necessity experience biofeedback and motor sensory reinstruction. Rather than using the usual House-Brackmann scale, the team uses the degrees of tone, symmetry, movement, and synkinesis to assess facial nerve function following hypoglossal-facial anastomosis.
- **Partial hypoglossal-to-facial jump graft:** Using a jump graft, a part hypoglossal-to-facial nerve transfer can reactivate the facial muscles while avoiding the problems of complete hypoglossal sacrifice. Using microsurgical principles, a cable graft is anastomosed in a notch in the hypoglossal nerve and linked to the intact facial nerve stump.
- **Cross-facial nerve graft:** Symmetry and involuntary mimetic function are possible with this technology. The contralateral facial nerve is deteriorated, and the control to innervate the ipsilateral musculature is deficient. If the proximal ipsilateral facial nerve is unobtainable but the distal stumps are, cross-face nerve grafting is suggested. Cross-nerve grafting's success is determined by timing and technique, and if performed on the proper patient, it can produce the greatest face reanimation scheme. The sural nerve serves as a cable graft, and the physician duty select suitable segmental branches of the contralateral facial nerve as donors. A single segmental-

to-main trunk anastomosis and multiple anastomoses from segmental branches to segmental branches are among the strategies reported. The orbicularis oculi graft is tunnelled above the supraorbital ridge, the zygomatic and buccal branches are tunnelled above the upper lip, and the marginal mandibular branch is tunnelled below the lower lip [1].

## 2.8 Comparison between Dynamic and Static Facial Reconstruction

**A study that looked at Patients who received static and dynamic facial nerve repair in head and neck cancer,** patients received static reconstruction were 10.3 years older on average. Overall survival for tumor cases was 61.9 months on average, with parotid squamous cell carcinoma having a worse prognosis. The average period of follow-up was 16.1 months (range, 4-96.1 months). At a median of 6.2 months postoperatively (range, 4-9 months), the majority (63.6%) of patients who had a nerve transplant had some return of function, and the majority (63.6%) had satisfactory function. Patients who had a static reconstruction (29.2%) were more likely than those who had a nerve graft to have symptomatic facial palsy (15.2 percent) [19].

**In a study on 655 patients received Dynamic Reanimation of Spontaneous Facial Expression:** The authors performed 505 two-stage gracilis, one rectus abdominis, and 14 single-stage latissimus dorsi microvascular muscle transfers, in addition to 28 cross-facial facial nerve neurotization procedures. These procedures were based on neurotization of the paralyzed region by the contralateral healthy facial nerve. Procedures involving motor nerves or muscle beyond the territory of the facial nerve included 73 temporalis muscle transpositions, four lengthening temporalis myoplasty procedures, 26 neurotizations by the hypoglossal nerve, and four neurotizations by the spinal accessory nerve. Patients who were treated using approaches that relied on the motor function of nerves other than the facial nerve did not regain their ability to smile spontaneously. However, facial nerve neurotization resulted in the recovery of a spontaneous grin in all cases that were satisfactory or better [33].

May evaluated the outcomes and problems of cranial nerve XII-VII direct-transfer and XII-VII

jump-graft procedures, finding that only 8% of jump-graft patients had a permanent tongue impairment, compared to 100% of nerve transfer patients. In 41% of jump graft patients, good facial mobility and expression were noticed, and the patients had less synkinesis than nerve transfer patients [34].

After looking into the different data published that compare between static and dynamic facial reconstruction, we can say that dynamic facial reconstruction have the advantage of less complication after surgery, dynamic reconstruction is being used by more young patients because it provide the advantage of being able to animate the face muscles again. Furthermore when it come to different methods Patients who were treated using approaches that relied on the motor function of nerves other than the facial nerve did not regain their ability to smile spontaneously. However, facial nerve neurotization resulted in the recovery of a spontaneous grin in all cases that were satisfactory or better.

For patients who are not suitable candidates for facial nerve neurotization, temporalis muscle transposition and lengthening myoplasty are appropriate alternatives. Free microvascular muscle transfer neurotized by the contralateral healthy facial nerve has become first-choice surgical approach for the restoration of both completely spontaneous grin and facial muscle movement.

### 3. CONCLUSION

Techniques are now being developed to provide appropriate dynamic face reanimation of the paralysed facial nerve, the results are improving. Management is dependent on a thorough clinical examination, a thorough grasp of the anatomic course, and suitable diagnostic testing. When it comes to dynamic facial nerve reanimation, the possibilities vary from nerve grafting, nerve anastomosis, crossover methods, and muscle transfer to microvascular muscle flaps and recently-potentially novel concepts utilising microelectromechanical systems (MEMS) technology. Finally, the method is determined by the surgeon's experience.

### CONSENT

It is not applicable.

### ETHICAL APPROVAL

It is not applicable.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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