Controversies in Contemporary Facial Reanimation

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KEYWORDS

• Facial reanimation • Facial paralysis • Facial palsy • Dynamic reanimation • Nerve transfers
• Free gracilis muscle transfer

KEY POINTS

- Determining the cause, pattern, and duration of facial palsy is critical. Timely intervention is perhaps the most important factor that influences outcome after facial reanimation.
- Smile reanimation options include regional muscle transfer, neurotization, and free muscle transfer. The selection of a donor nerve for the last two is highly individualized.
- Dual innervation by the masseteric nerve and cross-facial nerve graft may optimize both strength and spontaneity of movement when free muscle transfer is used.
- Analysis of clinical outcomes in facial nerve reconstruction remains limited because of the lack of universal evaluation methods and standardized outcome measures.

Video content accompanies this article at http://www.facialplastic.theclinics.com

INTRODUCTION

Facial palsy (FP) is a devastating condition with profound functional, aesthetic, and psychosocial implications. Injury to the facial nerve disrupts the complex association between facial expression and emotion, thereby compromising social interactions and adversely affecting quality of life.[1,2] FP can result in a myriad of aesthetic and functional sequelae, including facial asymmetry, paralytic lagophthalmos and subsequent exposure keratopathy, eyelid retraction and ectropion, nasal obstruction secondary to nasal valve collapse, impaired oral competence, and articulation deficits. Ultimate outcomes following facial nerve insult are widely heterogeneous, ranging from full return of normal function to complete flaccid facial paralysis, with varying degrees of static and kinetic hypoactivity, hyperactivity, and synkinesis in between. There are numerous causes of FP. The most common cause is Bell palsy, followed by benign or malignant tumors, iatrogenic injury, Varicella-zoster virus–associated FP, trauma, and congenital palsy.[3] The treatment of FP is equally as diverse and requires a thoughtful, highly individualized approach based on the cause, pattern, and time course of FP.

OVERVIEW OF FACIAL REANIMATION

Although the complexity of facial expression and intricate synergy of facial mimetic muscles are difficult to fully restore, the ultimate goal of FP treatment is to reestablish facial symmetry and movement. Static techniques and nonsurgical procedures lack true reanimation, although they are a useful adjunct in many patients to improve facial resting appearance. In order to identify the appropriate techniques for dynamic reanimation, it is essential to have a thorough understanding of

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the mechanism and extent of facial nerve injury, the duration of palsy, and viability of facial musculature. Equally as important are patient factors, such as age, overall health, motivation, and goals for rehabilitation. A holistic approach with attention to both the paralyzed and nonparalyzed sides of the face tends to yield more effective results.[4]

Classification of Facial Palsy

Outcomes following facial nerve insult are widely heterogeneous, ranging from full return of normal function to complete flaccid facial paralysis, with varying degrees of static and kinetic hypoactivity, hyperactivity, and synkinesis in between. *Complete flaccid FP* results in loss of symmetry at rest, paralytic lagophthalmos, nasal obstruction, oral incompetence, and loss of dynamic facial movement. In *nonflaccid FP*, symptoms are dictated by the specific pattern of dysfunction with varying degrees of mass movement and synkinesis occurring on the affected side and compensatory hyperactivity on the healthy side. Lack of a meaningful smile can also occur in severe nonflaccid palsy.[5] It is important to identify the type of facial paralysis as it intimately affects management.

Reversible Versus Irreversible Facial Palsy

One of the most critical assessments in FP management is determining whether the FP is reversible or irreversible. Although *reanimation* (via regional or free muscle transfer) is possible even in cases of irreversible paralysis, *reinnervation* is not. Thus, the clock starts ticking from the day of onset of facial paralysis. Facial nerve biopsies from patients with long-term FP show that the size and number of nerve axons decline even during the first 3 months.[6] Facial muscles with *reversible* palsy have viable muscle fibers with intact motor units that will respond to ingrowing axons. When the time from injury to reinnervation exceeds more than 18 to 24 months, facial paralysis becomes *irreversible;* denervated muscles develop nonfunctional motor end plates and irreversible atrophy, eliminating any chance of successful reinnervation.[7]

Key Principles in Dynamic Facial Reanimation

The facial nucleus and nerve provide tone, volitional movement, and emotional animation that cannot be adequately replaced. Where feasible, *primary facial nerve repair* provides the best outcomes. When tension-free primary repair is not possible but the proximal facial nerve remains intact and available, a *nerve interposition graft* (most commonly with the greater auricular or sural nerve) is the next best choice.[8] However, when the proximal facial nerve stump is not available because of damage of its intracranial and/or intratemporal segments, *neurotization or nerve transfer* using a new motor nerve is an option. Neurotization procedures seek to repurpose an alternative neural source to restore existing facial mimetic muscles and are indicated when the native muscles remain amenable to reinnervation. The most commonly used nerve substitutes are the contralateral facial nerve, motor nerve to the masseter muscle, and the hypoglossal nerve.

Methods that reinnervate native facial muscles in a timely matter are preferred if possible, as no other skeletal muscle can adequately simulate the complex morphology and organization of facial mimetic muscles. However, when native muscles are congenitally absent or are irreversibly paralyzed because of prolonged denervation, *regional muscle transfer* (ie, temporalis tendon transfer) or *free muscle transfer* (ie, microvascular gracilis muscle transfer) can be used to replace muscle function in dynamic reanimation. Static suspension techniques, nonsurgical procedures such as chemodenervation, and physical therapy are useful adjuvant and, sometimes, primary treatment options for some patients.

The duration of facial muscle denervation and timeliness of intervention are perhaps the most important factors that determine the ultimate success of any reinnervation procedure.[7,9] Patient age has also been shown to be an important factor influencing outcomes, with elderly age associated with poorer results.[8–10] The age-related decline in neural regeneration is well established and thought to be multifactorial, secondary to myelin sheath deterioration, axonal atrophy, decline in nerve conduction, and slower rate of axonal regeneration.[11]

CONTROVERSIES IN CONTEMPORARY FACIAL REANIMATION

The management of FP is challenging because of the wide variability in cause and presentation and the diversity of available treatment options. Contemporary facial reanimation is particularly charged with debate in the following areas (summary in **Table 1**):

Patient evaluation

- How should FP be graded and outcomes assessed?

Timing of intervention

- At what point in the time course of FP is reanimation surgery appropriate, particularly in