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FACIAL REANIMATION THROUGH NERVE REPAIR: A REVIEW LITERATURE

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ABSTRACT

AIM- To discuss the various available methods for facial nerve repair for facial reanimation

BODY- Our face acts like a window to the world. It helps us to communicate. It helps us to express our emotions. Disorders of the face, involving the ones that disrupt facial movements, cause severe negative psychosocial impact on an individual. It is thus of utmost importance that this facial movement be restored, irrespective of the age or gender of the individual. Many different techniques have thus been devised in order to reanimate the face, which involve nerve repair and functional muscle grafts or transfers. In this review literature we shall delve into the various ways the facial nerve can be repaired.

CONCLUSION- All these techniques, however effective may they be, create certain morbid conditions. Thus, it is imperative to do more research in order to devise such a technique which produces great results in reanimation of the face without inducing morbidity.

KEY WORDS

FACIAL NERVE REPAIR, FACIAL PARALYSIS TREATMENT, FACIAL REANIMATION

1. INTRODUCTION

We, Homo Sapiens are a very unique species of social animals. We have become what is to be considered the pinnacle of the evolutionary process going on over millions of years. Incidentally one of those unique, specialized, distinguishable features that defines a human being is that of the ability to convey emotions through facial expression. Whether we cry when sad, or we smile when we are happy or frown when we are angry, etc., this spontaneous change in facial composure in real time in sync with the emotional state is brought about by the muscles of facial expression (*Occipitofrontalis, Orbicularis oculi, Corrugator supercilii, nasalis, procerus, depressor septi nasi, orbicularis oris, buccinators, depressor anguli oris, levator anguli oris, risorius, zygomaticus major and minor, levator labii superioris, levator labii superioris alaeque nasi, depressor labii inferioris, mentalis and platysma*) and the seventh Cranial Nerve, i.e., The FACIAL NERVE. Thus, disorders of the face such as facial nerve disorders and facial muscle disorders have an immense derogatory impact in an individual's life in the form of negative psychosocial impact, low self-esteem, and functional deficits such as drooling, difficulty in speech, difficulty in eating, semi or complete eye closure. Thus, facial reanimation is of utmost importance in patients with such manifestations. The 1st known historic evidence of human beings acknowledging such a condition is that of The Babylonians

of early human civilization. They distinguished facial weakness of stroke from flaccid paralysis and had separate prescriptions for the treatment of either conditions. The earliest known surgical repair of the facial nerve was done by, Drobnick, in 1879. He had had performed a connection between the proximal SPINAL ACCESSORY NERVE and the distal FACIAL NERVE. Sawicki determined that this procedure had in fact made the facial features more symmetrical. It is widely accepted that, restoration of the facial neve and muscle function and its rehabilitation is even more so important in case of children. The cause of facial nerve and muscle disfunction ranges from Syringobulbia, Mobius syndrome, Goldenhar-Gorlin syndrome, Hemifacial microsomia to Infection and neoplasm. Facial reanimation can be brought about by either nerve repair/grafting/transfer or by muscle repair/grafting or a combination of both according to the specific etiology of that specific case. So, let us delve into the finer details of the various ways to bring about facial reanimation through nerve repair.

2. DISCUSSION

before the commencement of the surgical procedure, preoperative evaluation is of the utmost importance. The formulation of a proper diagnosis, treatment plan and prognosis are meted out through a very thorough and careful history taking and physical examination. Detailed documentation of the circumstances regarding the loss of function has to be done to get an accurate diagnosis. A complete and thorough neurological assessment of all the cranial nerves of either sides has to be done, which will help in determining the mode of treatment. Diagnostic procedures such as *NEEDLE ELECTROMYOGRAPHY* (EMG) and nerve conduction studies has to be undertaken on a daily basis during the preoperative evaluation to rule out multi-cranial nerve involvement. After pre-evaluation and before commencement of the surgery, the most import and first point of concern is that of eye protection. The methods employed for corneal protection are:

- Copious lubrication with saline eye drops
- Moisture chamber
- Eyelid weighting with platinum chain6
- Tarsal strip procedures

There are three main ways of nerve repair: end-to-end repair, nerve grafting and nerve transfer.

3. END-TO-END REPAIR

End-to-end repair the simplest form of nerve repair. It is done by reapproximating and then suturing together the severed ends of the nerve. It is highly effective if it is done in a way that the re-approximation procedure results in a tensionless repair. If there is tension in the repaired segment, it will hinder vascularization and thus cause scarring and failure. It is also of great importance that this procedure is done within 72hrs of the nerve being severed or damaged. Wallarian degeneration starts by 24hrs and is completed by around 72hrs. There is degeneration of the myelin sheath, and the degeneration products are cleared by macrophages. The rate of growth of axons is about 1mm pre day and hence the procedure is so successful if done within the correct window of time. This technique is the 1st method that a surgeon should consider if the conditions are right. The attachment can also be done using tissue adhesives such as fibrin adhesive which shows similar results as suturing. If the reattachment cannot be done in a tensionless manner, by mobilization of the nerve.

4. NERVE GRAFTING

When there is excessive tension when trying to do a direct anastomosis, which cannot be mitigated whatso ever, then interpositional grafting has to be considered. Both sensory and motor nerves can be used as a donor nerve for the grafting procedure. Commonly used sensory nerve grafts include the sural nerve, great auricular nerve, and the ante brachial cutaneous nerve. The sural nerve is used often because of its length, with grafts harvested as long as 40 cm. There are some literatures which report that motor nerves serve as better donor nerves as they produce better and faster reanimation. But it is also associated with donor nerve site morbidity. Vastus Lateralis is a very commonly used motor donor nerve as it is easily harvested and is a redundant motor nerve suitable for interposition grafting. Other commonly used nerves for grafting are the great auricular nerve, or branches of the cervical plexus. The principle behind this procedure is to provide a safe environment for the nerve axon to grow back and reattach to the severed end. So in certain times, instead of grafting an actual nerve, a different type of conduit may also be used like veins or artificial conduits made

of polyglycolic acid or collagen, as they serve the same purpose and produce similar results to an actual nerve graft. When there is severing of multiple branches of the facial nerve, then multiple nerve grafts have to be placed. One slight problem with this technique is performing two simultaneous anastomoses contributes to its delayed results, as the regenerating axons have to traverse the entire graft before reaching the distal stump, thus delaying the rehabilitation.

5. NERVE TRANSFER

When there is extensive damage or a developmental anomaly causing the proximal nerve stump of the facial nerve to not be available for anastomosis with the distal stump, then other motor neurons from nearby areas can be used to anastomose with the distal end. The facial nerve is repaired in this method commonly using the *HYPOGLOSSAL NERVE, THE MASSETERIC NERVE* and *THE CONTRALATERAL FACIAL NERVE*. Sacrificing an intact, functioning uninvolved nerve to restore the facial muscle functioning causes severe morbidity in the form of difficulty in eating, atrophy of tongue, difficulty in speech, in case of a hypoglossal nerve transfer. Thus, hypoglossal nerve transfers have largely been abandoned nowadays.
Masseteric nerve transfer is a much more preferred mode of treatment as there is no donor site morbidity, no difficulty in mastication and the onset of reanimation is much sooner, at about 6 months post-operatively. This advantage of absence of donor site morbidity is due to the overlap of function of the masticatory muscles. The descending branch is divided in order to leave at least some of the proximal branches intact to prevent muscular atrophy. There has been no evidence of bite deformities or temporomandibular joint dysfunction in long term studies.

Using the contralateral facial nerve is also a viable option for nerve transfer surgeries for facial reanimation. The technique involves harvesting of the sural nerve, anastomosing one end to the functioning contralateral facial nerve, traversing it across the face and anastomosis the other end to the damaged distal stump of the damaged facial nerve. The advantages are limited donor site morbidity and the simultaneous mimicking action from the contralateral side. The disadvantage is the greater period of time required for the axon to traverse the length of the graft to bring about the onset of the reanimation and that sometimes its outcomes are very unpredictable.

Contralateral Seventh Cranial Nerve Transfer via cross facial nerve grafting (CFNG) - This technique uses the synchronous transmission of neural impulses from the main peripheral branches of the contralateral, intact, uninvolved seventh cranial nerve to distal branches of the affected seventh cranial nerve, thus reinnervating corresponding muscle groups. This procedure allows synchronous, coordinated movements as well as the possibility of self-expression gradually. One important factor here is that the surgery has to be done within 6 months of the injury to the facial nerve. If more that 6 months have passed, a motor neuron of the ipsilateral hypoglossal nerve has to be used due to stronger impulse generation. The number of cross facial nerve grafts required is determined by the severity of the damage to the facial nerve. If the sural nerve isn't adequate or has been used as a graft elsewhere, then saphenous nerve can be harvested for use.

The Babysitter Procedure – This technique involves a partial hypoglossal nerve or a min-hypoglossal nerve anastomosis to the ipsilateral affected facial nerve stump, supplemented by a CFNG. This technique is done by splitting the hypoglossal nerve longitudinally using a diamond knife under a microscope. This is possible as the hypoglossal nerve is oligofascicular in nature and thus this technique only uses 40% of the donor hypoglossal nerve, thus mitigating donor site total dysfunction. This method was developed because a classical hypoglossal nerve transfer causes immense donor site morbidity. Other advantage is that it causes rapid salvaging of the facial muscles of the affected site until the fibers from the CFNG arrive on the site. This technique is so effective that it can be used to successfully reanimate the muscles even up to 12 months of nerve damage. After 12 months the procedure has to the augmented with pedicle or free muscle transfer methods.

Nerve Transfers from Branches of the Fifth Cranial Nerve – When the contralateral intact facial nerve is not available for a nerve transfer, then, the trigeminal nerve, mostly the masseteric branch is used. The

masseteric nerve is connected directly to the affected facial nerve distal stump thus there is no need for a graft. *Faria et al* states in a study that surgical access to the masseteric nerve may cause lesion of the facial nerve branches with preserved function, generally of the zygomatic and frontal branches. Although the motor donors of the trigeminal nerve do not restore emotional movements, but with time the patients are able to certain coordinated movements such as smiling and mastication.

Transfer of the Eleventh Cranial Nerve – This technique is used only in cases where there is multi-cranial nerve involvement and facial paralysis, such as Möbius patients. This technique is generally avoided as it causes lesser reanimation of the affected muscles, much greater donor site morbidity and rarely is there any independent movement. Mostly the facial movements are by conscious control.

Transfer of the Motor Branch of the Cervical Plexus - The motor branches from the cervical plexus have been used for brachial plexus reconstruction but with less favorable outcomes due to the smaller number of motor fibers. This is generally carried out through the transfer of the C4 dorsal motor root. This technique should exclusively be used in the case of Möbius patients.

6. CONCLUSION

There is no singular greatest technique in order to achieve facial nerve reanimation. The technique to be followed varies from case to case and from surgeon to surgeon due to personal preferences. Sometimes a combination of the techniques may be employed so as to get the greatest benefits. Yet all of these techniques generate some form of morbidity how ever small it may be. Thus, more research and studies need to be undertaken in order to find better and more feasible techniques with lesser complexity. With the recent advancement in tissue engineering, that possibility is not so far away, where we may be able to grow actual complete nerves in the lab, commercially available and ready to transplant to the host site.

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