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REHABILITATION OF THE PARALYZED FACE UTILIZING THE MASSETER-TO-FACIAL (V-VII) NERVE TRANSFER

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The masseter-to-facial nerve transfer is an effective method tj rehabilitate the paralyzed face. The positive attributes of the V—VII transfer include: limited donor site morbidity, anatomic consistency, a dense population of myelinated motor nerve fibers capable of producing strong motion, synergy with the facial nerve and potential for effective cerebral adaptation yielding an effortless smile.
Key words: *nerve transfer, face reanimation, descending branch of the masseter nerve.*

Нисходящая ветвь жевательного нерва (из тройничного нерва) является хорошим источником невротизации дистального конца лицевого нерва без необходимости использования аутонервной вставки. Позитивные качества V—VII трансфера: практически отсутствуют осложнения в донорской зоне, анатомическое постоянство, плотность миелиновых двигательных волокон, способных образовывать хорошие связи и проявляющие высокий синергизм к лицевому нерву, что потенцирует эффективность церебральной адаптации и хорошей улыбки.
Ключевые слова: *нервный трансфер, реанимация лица, нисходящая ветвь жевательного нерва.*

УДК 616.742-009.11-089.819.843-031-036.82/.83:611.732.71-032

In cases where the proximal stump of the facial nerve is unavailable for repair or interposition nerve grafting, and there are intact distal facial nerve branches as well as viable mimetic muscles, then nerve transfers offer an effective method to rehabilitate the paralyzed face. A series of donor nerves have been utilized for facial reanimation including the contralateral facial nerve with cross face grafts, hypoglossal nerve, spinal accessory nerve and phrenic nerve, with each donor site possessing a series of benefits and drawbacks [1—7]. During the past decade, the motor nerve to the masseter has emerged as an alternative to more traditional nerve donor sites and has enjoyed a rapid rise in popularity [8—10]. This nerve has a series of inherent properties that make it well suited for transfer to the facial nerve including, proximity, motor fiber density and synergy. The descending branch of the masseter nerve can be mobilized and directly sutured to the main trunk of the facial nerve (or selected zygomatic and buccal branches) without the need for interposition nerve grafts. The nerve also has a high density of motor fibers that corresponds favorably to the axon counts in the native zygomatic and buccal branches of the facial nerve.

Borschel et al found that the proximal segment of the masseter nerve contained approximately 2700 myelinated motor fibers [11]. A similar analysis of the distal portion of the descending branch was performed by Coombs and associates who demonstrated approximately 1500 motor axons at that level [12]. This dense population of motor fibers is responsible for the strong commissure excursion produced by the V—VII transfer (Fig. 1—4).

In addition to providing forceful muscle contraction that yields a near symmetric smile, the masseter nerve demonstrates functional synergy with the facial nerve and the potential for efficient cerebral adaptation. This phenomenon has been well described by Manktelow et al who reviewed their experience with 45 functional free muscle flaps innervated by the motor nerve branch to the masseter. In long-term follow-up, 85 percent of patients could animate without biting and 59 percent smiled without conscious effort [13]. These outcomes correlate well with our initial experience with the V—VII transfer where 75 percent of patients could achieve an effortless smile 24 months after surgery [8]. Schaverien et al examined the state of the masseter muscle during normal smile production [14]. EMG monitoring of the masseter muscle was performed during voluntary and involuntary smiling with 40 percent of the test subjects demonstrating concurrent electrical activity in the masseter muscle. This apparent communication between CN V and CN VII helps explain the effortless, almost spontaneous smile that can develop in a subset of patients. In the future, this type of preoperative EMG evaluation may prove beneficial in candidate selection.

The connectivity between the trigeminal and facial nerve has also been identified in a series of embryologic and anatomic studies. Embryologic evidence is available demonstrating the presence of trigeminal nerve fibers within facial nerve branches [15, 16].

Fig. 1, 2: Right Complete hemifacial paralysis after acoustic neuroma excision (15 months postoperative)

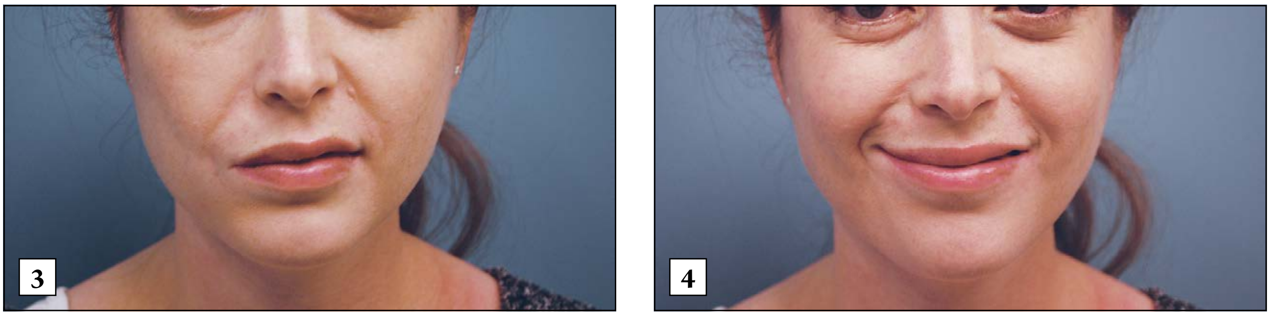

Fig. 3, 4. Face at rest and smiling 3,5 years after masseter-to-facial nerve transfer (V—VII)

Developmental models have also identified facial nerve fibers coursing within the motor pathway of the trigeminal nerve that ultimately reunite with the facial nerve branches by means of masseter-to-facial nerve communicating rami [17]. The details of the anatomical relationship between the masseter nerve and the facial nerve require additional clarification; however they are likely important factors for the effectiveness of the V—VII transfer.

The masseter nerve also differs from other potential donor nerve sources in its lack of donor site morbidity. During the V—VII transfer the descending branch of the masseter nerve is transected and sutured to the facial nerve, leaving the proximal masseter nerve branch intact. Preservation of the proximal nerve branch prevents atrophy of the masseter muscle that could produce a cosmetic deformity at the mandibular angle. In a 12 year review of patients treated with the V—VII transfer at our facial paralysis center, no difficulties with mastication or TMJ dysfunction were encountered. This is accounted for by the functional overlap between the masseter, temporalis and ptyergoid muscles along with the incomplete denervation of the masseter muscle.

SURGICAL TECHNIQUE

The facial nerve is explored via a preauricular incision extended below the sideburn proximally and behind the lobule of the ear inferiorly. A SMAS flap is then elevated above the parotid gland and the dissection is propagated medially until the branches of the facial nerve are identified as they radiate from the leading edge of the parotid (Fig. 5, 6). In cases of complete paralysis, the facial nerve is now identified at the stylomastoid foramen and its course is then traced through the parotid gland, in a fashion similar to a superficial parotidectomy. The main nerve trunk can now be divided and the facial nerve reflected forward, providing unobstructed access to the masseter muscle. In cases of incomplete paralysis, the desired zygomatic branches are dissected in a retrograde fashion. The dissection originates at the anterior border of the parotid gland and is carried toward the facial nerve bifurcation. The dissection is terminated when there appears to be adequate nerve length to reach the zygomatic arch region.

Attention is now focused on identifying the masseter nerve. A vertical line is drawn 3 cm in front of the tragus, and a horizontal line is drawn 1 cm below

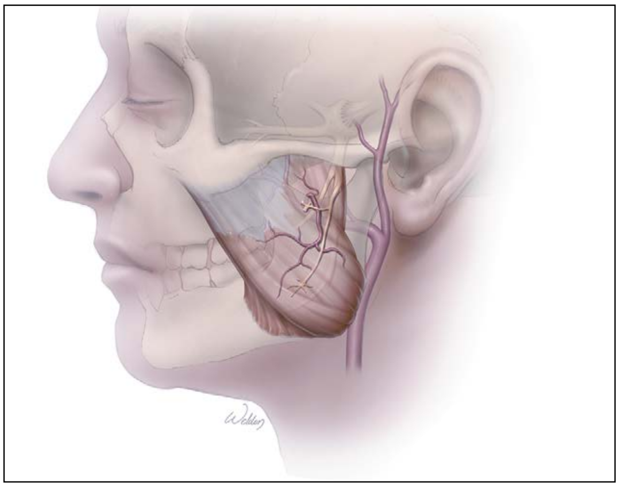

Fig. 5. Branching pattern and oblique deep muscular course of the masseter nerve

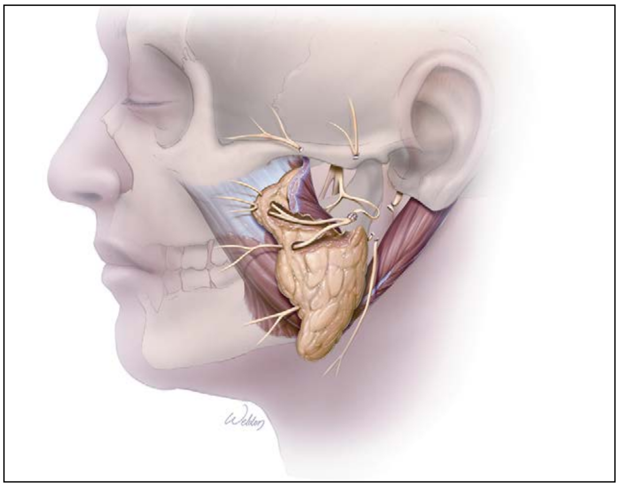

Fig. 6. Drawing depicting surgical anatomy. Microsurgical anastomosis of the descending branch of the masseter nerve to selected branches of the facial nerve is shown

the zygomatic arch. The intersection reproducibly marks the location of the main trunk of the masseter nerve [11, 18]. A window is created in the local fascia, exposing the masseter muscle. The bipolar cautery is then utilized to create a window in the superficial and middle lobes of the masseter muscle. The dissection now proceeds carefully, with the assistance of a hand held nerve stimulator to identify the masseter nerve, which courses between the middle and deep lobes of the muscle. Once identified, the nerve is encircled with a vessel loop and a lighted nasal retractor is used to further mobilize the descending branch. The descending branch of the masseter nerve is now transected and transposed into a more superficial plane for later microsurgical anastomosis. In cases of complete facial paralysis, the previously divided main trunk of the facial nerve is sutured, end-to-end, to the descending branch of the masseter nerve with interrupted 10-0 nylon epineurial sutures, in a tension free fashion. The frontal branch of the facial nerve and the zygomatic branches, coursing directly to the orbicularis oculi, are selectively transected. In many patients, cross face nerve grafts are placed at this time in an effort to restore blink and eye closure that is independent of mid-face motion [19]. Additional cross face nerve grafts can also be employed to enhance resting tone in the mid-face and to maximize spontaneity. Distal end-to-end and distal end-to-side nerve repairs can be utilized (Fig. 7).

In cases of incomplete paralysis, the masseter nerve can be explored via an interval between zygomatic branches coursing to the orbicularis oculi. The mobilized descending branch is then repaired to the selected zygomatic or buccal branch in an end-to-end, epineurial fashion without transection of normally functioning facial nerve branches. The position of the transferred nerves is then secured with fibrin glue and the skin-SMAS flap is sutured back in its native location. Use of fibrin glue is felt to help avoid accidental separation of the nerve repairs during closure while reducing the risk of sialocele formation. The patients are maintained on a soft diet for four weeks. The restoration of mid-face muscular tone is usually identified during the fourth postoperative month, and positive feedback exercises in front of a mirror are then initiated. Active commissure excursion with clenching of the teeth is usually witnessed during the sixth postoperative month. The strength

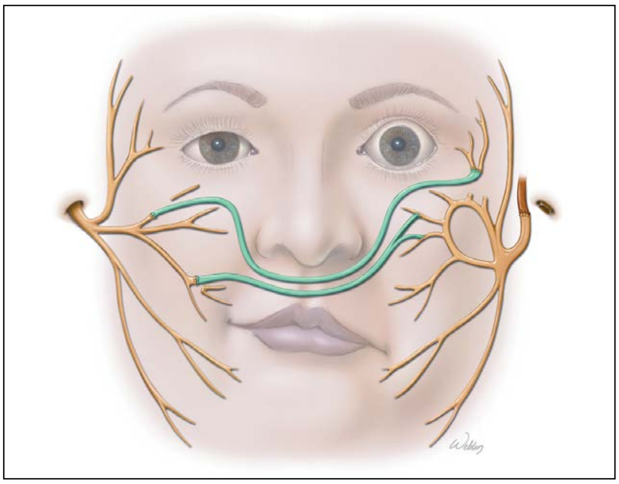

Fig. 7. Masseter-to-Facial nerve transfer with cross face nerve grafts

and coordination of the smile tend to improve over the next two to three years, with approximately 75 percent of patients developing an effortless (no biting) smile after twenty four months [8].

Complications are rare, but include otitis external and sialocele formation that normally respond favorably to medical management.

A subset of patients have demonstrated inadequate resting tone despite powerful, active commissure excursion. In these cases, secondary, fascia lata static sling suspensions have been successfully utilized to improve resting contour.

CONCLUSION

In conclusion, the masseter-to-facial nerve transfer has rapidly increased in popularity over the past decade as a method to rehabilitate the paralyzed face. The positive attributes of the V—VII transfer include: limited donor site morbidity, anatomic consistency, a dense population of myelinated motor nerve fibers capable of producing strong motion, synergy with the facial nerve and potential for effective cerebral adaptation yielding an effortless smile.

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Поступила в редакцию 14.07.2013
Утверждена к печати 29.11.2013

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