Preliminary observations after facial rehabilitation with the ansa hypoglossi pedicle transfer

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Facial paralysis is a very disabling condition, both functionally and cosmetically. Despite the different methods of facial reanimation that have been described, there is no single method that will restore normal facial tone and motion. Of the methods available, primary neurorrhaphy is probably the most effective. The recovery period, however, is prolonged and, as a result, muscle tone and bulk may be lost. The hypoglossal-facial anastomosis[7-12] is also a very reliable and effective technique but requires necessary interruption of both major cranial nerve trunks. Transfer of a neuromuscular pedicle (based on the ansa hypoglossi) has been offered as a method of facial reanimation that involves neither prolonged recovery nor interruption of the major cranial nerve functions. The application of this technique for reinnervation of a paralyzed larynx was first described by Tucker in 1970, and the technique was applied to facial muscle (in animal models) in 1977. The effectiveness of this technique—and its application in the management of facial paralysis in the human patient—remains controversial. We report our experience with a series of six patients who underwent neuromuscular pedicle transfer in conjunction with other more conventional methods of facial reanimation. The function of the pedicle and its contribution to the overall facial rehabilitation were assessed clinically and electromyographically. Factors influencing the success of the procedure and clinical and experimental evidence to support its application are discussed. While our experience with this technique is limited, it would appear that the neuromuscular pedicle transfer may play a useful adjunctive role in reanimation of the face in selective cases of facial paralysis. (OTOLARYNGOL HEAD NECK SURG **94**:302, 1986.)

Facial paralysis is devastating, both cosmetically and functionally. It interferes with eye protection, competency of the oral commissure, and communication. It follows that facial rehabilitation is subject of clinical interest and research. As a result, numerous reanimation techniques have been popularized. The cause of the facial paralysis, the type of injury and its location, and the anticipated duration of paralysis all contribute to the selection of the appropriate reanimation method. However, as with so many of the available techniques for facial rehabilitation, the results of reinnervation efforts are variable and generally difficult to assess.

Ideally, facial reanimation should restore and maintain muscle tone and symmetry and preserve voluntary and mimetic movement without the sacrifice of other head and neck functions. A single-stage procedure and rapid return of function are also desirable. As yet, no single reinnervation procedure has met these goals satisfactorily. Primary neurorrhaphy may give the most optimal results but often may not be possible because of nerve length loss or the site of injury.[1] There is also a prolonged recovery period following neurorrhaphy in which muscle bulk and tone may be lost. Interposition nerve grafts and nerve crossovers have also been effective, but they share similar problems.[2,3] The hypoglossal facial anastomosis is both effective and reliable, particularly when primary neurorrhaphy is not appropriate.[4,5] Even this method has major disadvantages, including sacrifice of both the seventh and twelfth cranial nerves, loss of segmental function, and delayed recovery. Phrenic-facial and accessory facial anastomoses have also been used, but they share similar drawbacks and are not widely accepted.[2,3]

Transfer of the neuromuscular pedicle (NMP), based on a branch of the ansa hypoglossi to reinnervate the paralyzed larynx, was first described by Tucker, who

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applied the technique to facial musculature in rabbits.[6] Tucker applied this technique in five patients with bilateral vocal cord paralysis. In all cases, clinical and electromyographic evidence of reinnervation was evident 6 to 8 weeks postoperatively.[7] Although Tucker has reported encouraging results with the use of the pedicle (both experimentally and clinically),[8] other investigators have had difficulty duplicating his results.[9-11] The neuromuscular pedicle transfer, however, remains an attractive reinnervation technique, since segmental function may be restored early—within 4 to 6 weeks—without sacrifice of other major cranial nerve function.

Our interest in this procedure was kindled by a recent animal study in which the neuromuscular pedicle was transferred to denervated strap muscles in rabbits.[12] Successful reinnervation within 6 weeks was achieved, as determined by visual, electromyographic, and contractile parameters. The results were substantiated histologically by horseradish peroxidase tracer techniques. Given these data, we were optimistic that similar results could be achieved in the clinical setting. Our enthusiasm was moderated by the experimental nature of the procedure and the possibility that muscular reinnervation by this means might preclude reinnervation by another more conventional method.[2]

Six patients with facial paralysis accepted the neuromuscular pedicle transfer, which was generally performed in conjunction with another reanimation procedure or facial nerve repair. The candidates were selected randomly (without matching) from a small patient population. We accept the limitations imposed on this investigation by the poorly controlled protocols. Keeping these limitations in mind, however, the goal of the investigation was to determine whether facial reinnervation could be achieved by this means and to comment on its possible application.

CASE REPORTS

Case 1. A 26-year-old white man with chronic otitis media and progressive facial paralysis underwent a radical mastoidectomy in February 1983. At that time, a cholesteatoma was found engulfing the labyrinthine segment of the facial nerve, which was necessarily sacrificed. The patient subsequently underwent an anastomosis of the twelfth nerve to the seventh nerve, in conjunction with a neuromuscular pedicle transfer to the musculature of the oral commissure. Electromyography, performed 1 month postoperatively, showed signs of reinnervation in the implanted muscle. One week later, the neuromuscular pedicle was infiltrated (where it was palpable at the mandibular margin) with 1% lidocaine. Following this procedure, electromyographic activity in the area of the commissure was temporarily ablated. Seven months postoperatively, there was clinical evidence of recovery in all divisions.

Case 2. A 55-year-old white woman experienced loss of function of both seventh and eighth nerves following temporal bone fracture. Facial nerve exploration revealed a complete severance of the seventh nerve at the geniculate ganglion and the internal auditory canal. Primary neurorrhaphy was accomplished at the time of exploration. The patient subsequently underwent a neuromuscular pedicle transfer and, 2 months later, electromyography demonstrated reinnervation potential in the region of the oral commissure. The patient was able to increase the electric activity in the implanted facial muscles (with practice) by tensing her strap muscles. Six weeks later, there was continued evidence of reinnervation in the lower third of the face. One year later, there was evidence of recovery in all facial nerve branches except the forehead.

Case 3. A 45-year-old white man suffered facial-nerve paralysis following a temporal bone fracture. Exploration of the facial nerve revealed an avulsion of the nerve at the geniculate ganglion, which was primarily repaired. Two weeks later, the patient underwent an ansa hypoglossi neuromuscular pedicle transfer to the muscles of the oral commissure. One month postoperatively, electromyographic evidence of reinnervation was present in the depressor musculature. After 6 months, there was evidence of clinical recovery in all branches. Recovery was almost complete when the patient was lost to follow-up.

Case 4. A 42-year-old native American man suffered a seventh-nerve paralysis after temporal bone fracture. The facial nerve was explored, and a contusion at the geniculate ganglion was found. Because of the electromyographic evidence of denervation, a neuromuscular pedicle transfer was performed. Five weeks later, the patient was noted to have slight movement of the oral commissure musculature. However, he did not return for electromyography or any subsequent follow-up.

Case 5. A 46-year-old white man exhibited a seventh-nerve paralysis of unknown duration secondary to chronic otitis media. On exploration, a large cholesteatoma involving the mastoid and petrous portion of the temporal bone was found. Complete removal of the cholesteatoma necessitated sacrifice of a segment of the seventh nerve. Seven days later, a hypoglossal to facial anastomosis and a neuromuscular pedicle transfer were performed. Electromyography (20 months post-reanimation) showed evidence of reinnervation. The patient was lost to follow-up until 1½ years later, when improved facial symmetry at rest was apparent on examination. No voluntary motor function was clinically apparent.

Case 6. An 80-year-old white woman experienced a complete facial-nerve paralysis following radical mastoidectomy in 1979. Three years later, a dynamic temporalis myofacial sling was placed in conjunction with an ansa neuromuscular pedicle transfer. The patient subsequently showed no evidence of reinnervation, clinically or electromyographically.

DISCUSSION

Three of six patients (cases 1 to 3) demonstrated function of the neuromuscular pedicle, which was confirmed electromyographically. Patients 4, 5, and 6 showed no electromyographic evidence of reinnervation within the anticipated recovery interval and are considered failures. Patient 4 was lost to follow-up early and cannot be referred to further. Preoperative electromyography was performed on one patient to confirm denervation of the facial musculature after injury. In the remainder of the patients, the clinical completeness of the paralysis led us to assume that electromyography would confirm this. In patients 1, 2, 3, and 5 complete transection was confirmed during surgical exploration. The neuromuscular pedicle was implanted within 2 weeks of exploration. It is unlikely that there was electromyographic activity prior to the neuromuscular pedicle transfer, in view of the proof of nerve transection and the fact that fibrillation potentials were consistently present postoperatively (except in those areas influenced by the pedicle). We conjecture that the lack of reinnervation in both patients 5 and 6 was related to the duration of the paralysis (resulting in fibrosis) and the atrophy of the facial musculature, which had occurred prior to surgery. This was significant in the case of patient 6, where age was probably a factor in the significant loss of facial tone that was apparent preoperatively.

Previous studies involving the neuromuscular pedicle have been subject to criticism when electromyographic data consistent with reinnervation have been lacking. In patients 1 and 2, electric potentials were recorded in those muscles served by the pedicle 4 to 6 weeks after surgery. This is consistent with the time course for reinnervation by a neuromuscular pedicle and cannot be accounted for by intramastoid neurorrhaphy or anastomosis of the seventh and twelfth cranial nerves. In patient 2, the apparent recruitment of facial muscle fibers, generated upon activation of the cervical strap muscles, appears to support our contention that reinnervation occurred via the pedicle. This is further substantiated by patient 1 in whom evidence of reinnervation was temporarily ablated by anesthetic blocking of the pedicle. A question is thus raised as to whether the anesthetic blocked activity in the neuromuscular pedicle or some other neural source. In this case, initial electromyographic evidence of reinnervation (at 4 to 6 weeks) was found only in the oral commissure. The pedicle was palpated at the inferior mandibular border, and a small amount of lidocaine was injected. The electromyographic activity was temporarily abolished. It would be very unlikely that reinnervation *only* at the oral commissure would begin after 4 to 6 weeks via hypoglossal-facial anastomosis. This time course is most consistent with reneurotization via the neuromuscular pedicle. Therefore, we probably blocked this neural source. In patient 3, reinnervation might have been documented earlier had the patient been available for testing.

In the three patients with functional pedicles, more complete motor function was eventually restored to the affected side by primary neurorrhaphy or anastomosis of the seventh to twelfth cranial nerves. These patients achieved facial symmetry at rest, motion greater than 75% of the normal side, competent oral sphincter, and eye closure. The neuromuscular pedicle did not appear to interfere with subsequent reinnervation of the lower third of the face.

Technically, reinnervation by the neuromuscular pedicle must be limited to the lower third of the face, because of the length of the pedicle. Clearly, this is one of its disadvantages. As stated earlier, the duration of paralysis and muscle fibrosis may adversely affect pedicle function. This issue becomes less germane if the procedure is performed early, following the onset of paralysis.

In conclusion, our experience with three of six patients who underwent a neuromuscular pedicle transfer suggests that facial reinnervation by this means does occur and can be substantiated electromyographically. It should be clear that there are a number of inherent weaknesses in this study which preclude objective data collection involving the pedicle. For purposes of investigation, it would have been desirable to perform the pedicle transfer independently. We did not recommend (in a clinical setting) that the pedicle be used as a sole source of facial rehabilitation. Having performed the pedicle procedure in conjunction with other procedures, we believe it is significant that the neuromuscular pedicle did not interfere with reinnervation by other methods. The number of patients in this series is too small to warrant comment regarding clinical application of the neuromuscular pedicle. Early reinnervation, preservation of facial tone, and compatibility with other reinnervation procedures appear to be desirable features of this technique.

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Facial reanimation with the VII-XII anastomosis: Analysis of the functional and psychologic results

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The VII-XII anastomosis has been employed for more than a decade by The Otology Group, P.C., in the facial reanimation of patients undergoing extirpation of tumors involving the cerebellopontine angle and the skull base. A retrospective review based upon a detailed questionnaire and submitted photographic documentation from 61 patients forms the basis for this review. Details and analysis of the functional results include (1) onset of function, (2) synkinetic activity, (3) corneal irritation and associated ophthalmologic problems, (4) facial tone and symmetry, and (5) volitional mimetic function. From a psychosocial perspective, evaluation was made regarding (1) workplace and home acceptance, (2) self consciousness, (3) adaption, and (4) overall satisfaction. Because of the nature of its technical performance and reliability, the VII-XII anastomosis is an important technique for the otolaryngologist to be familiar with. Cognizance of the functional and psychologic results with this procedure will ensure optimal (yet realistic) rehabilitation for this patient population. (OTOLARYNGOL HEAD NECK SURG **94**:305, 1986.)

In an attempt to mollify the functional and psychologic disability associated with a peripheral facial paralysis, surgeons have employed a variety of operative modalities to reanimate the face.[1,3,4,8,13,17] Dynamic techniques employed include primary anastomosis, cable grafts, and crossed-nerve anastomosis. In addition, static procedures afford improvement alone or may be adapted (subsequent to a dynamic procedure) to enhance the functional or cosmetic result.

We have employed the facial hypoglossal anastomosis (VII-XII) for more than a decade in the management of patients who have sustained permanent damage to the facial nerve as a result of the extirpation of tumors at the skull base and cerebellopontine angle[11]. An analysis of the data obtained from a retrospective review of 61 cases, based upon information gleaned from patient questionnaires with photographic documentation, forms the basis of this report.

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