

How I Do It

Reconstruction of Complex Peripheral Facial Nerve Defects by a Combined Approach Using Facial Nerve Interpositional Graft and Hypoglossal-Facial Jump Nerve Suture

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Objectives/Hypothesis: To describe a modified facial nerve reconstruction technique for complex defects of the facial fan after parotid surgery that avoids synkinesis between upper and lower face.

Study Design: Retrospective case series.

Methods: Patients who had undergone radical parotidectomy with a large defect of the facial fan, reconstruction of the upper face by facial nerve interpositional graft, and reconstruction of the lower face by hypoglossal-facial nerve jump nerve suture were included in this series.

Results: Four patients underwent the modified combined approach after tumor resection and prior to postoperative radiotherapy in three of the four cases. Surgery was combined with an upper lid weight implantation. Regeneration of the face was successful in all cases within 12 to 16 months. Most important, the separated reanimation of the upper and lower face circumvented synkinesis of the upper and lower face. This factor was essential for good functional results. Using the hypoglossal jump technique instead of a classical cross-nerve suture technique prevented the sacrifice of ipsilateral tongue function.

Conclusions: The presented method offers satisfactory results for facial reanimation and avoids synkinesis between the upper and lower face. Using the jump technique instead of a classic hypoglossal transfer as it was described originally for the combined approach avoids long-term sequelae for the tongue.

Key Words: Facial nerve, facial palsy, parotid cancer, reconstructive surgery.

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INTRODUCTION

Radical parotidectomy is the method of choice for resectable parotid cancer infiltrating the facial nerve.¹ If possible, facial nerve reanimation should follow directly after tumor resection within the same surgery. Immediate facial nerve reanimation should be completed first, because postoperative radiotherapy seems not to hinder a good functional recovery,² and second, fast repair will give the best results.³ Due to the localization of the tumor, the resection often leads to complex defects of the facial fan leaving proximally the main trunk of the facial nerve and distally several small peripheral branches of the facial nerve. In such a situation a complete reconstruction of all peripheral branches by nerve grafts is

very difficult or impossible. To solve this problem, in 1979 Stennert described a combined approach using the proximal facial nerve stump, together with the complete ipsilateral hypoglossal nerve, to reanimate the upper face with the facial nerve by interpositional grafts and the lower face by a classic hypoglossal cross-nerve suture.⁴ Using this technique had the added advantage that synkinesis between the upper and lower face was avoided as two different nerves were used to supply both regions. Nevertheless, searching the literature of the last 30 years, not much experience is described using such a combined approach.² One reason might be that sacrifice of the complete hypoglossal nerve leads to chronic dysphagia by ipsilateral tongue atrophy. This is a sequela with much impact on the quality of life of the patients.⁵ With the introduction of the hypoglossal-facial nerve jump nerve suture (i.e., a side-to-end nerve suture of the incised hypoglossal nerve to a nerve graft that is then sutured end-to-end to the distal facial nerve), such problems with the tongue can be avoided.⁶ To date, the concept of the hypoglossal jump nerve technique has not been described as part of the combined approach of facial reanimation technique.

Herein, we propose such a modification of the combined approach as a safe and effective alternative that

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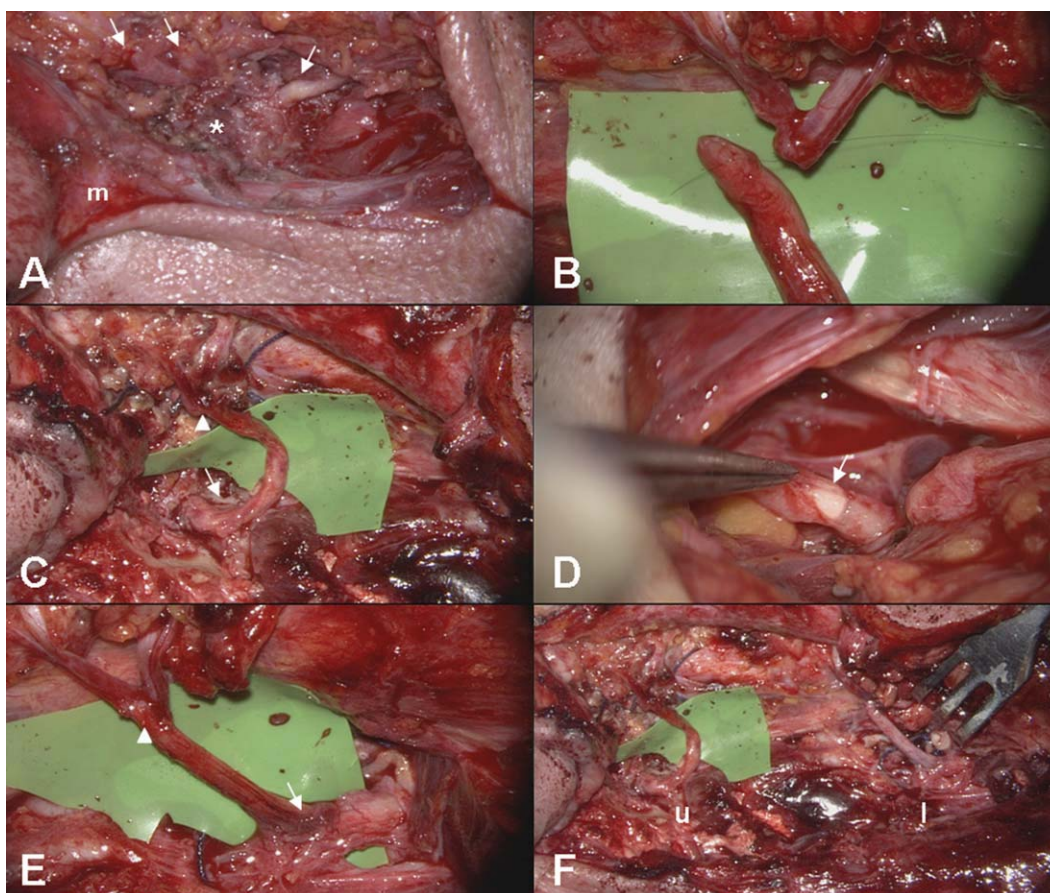


Fig. 1. Parotid cancer infiltrating the facial fan on the right side. (A) Situs at the beginning of surgery; some peripheral branches (arrows) are visible. (B) Pooling of lower peripheral branches and suture to the nerve graft. (C) Upper reconstruction by facial nerve interpositional graft with greater auricular nerve; proximal (arrow) and distal (arrowhead) suture site. (D) One third incision of the hypoglossal nerve (arrow). (E) Lower reconstruction with hypoglossal-facial jump nerve suture; proximal (arrow) and distal (arrowhead) suture site. (F) Final situs of the combined approach with separated upper (u) and lower (l) facial nerve reconstruction. m = mastoid.

leads to satisfactory results when reconstruction of complex facial fan defects is necessary.

METHODS AND TECHNIQUE

Surgery starts with complete parotid cancer resection including resection of infiltrated parts of the facial nerve (Fig. 1A). Then, small biopsies of the proximal facial nerve stump at the level of the main trunk and in the periphery of all distal nerve stumps are taken. These biopsies are used for frozen sections to confirm complete tumor resection. During tumor resection and neck dissection, care is taken to preserve as much from the greater auricular nerve as possible. If the ipsilateral greater auricular nerve is infiltrated by the tumor, the contralateral greater auricular nerve is harvested. If not already done during tumor surgery, the hypoglossal nerve is identified. The peripheral stumps of the frontal and the zygomatic branch or branches of the facial nerve are pooled together (Fig. 1B). The branches are sutured together side-by-side with one or two stitches of 10-0, nonabsorbable, monofilament suture material (D-08254; Catgut GmbH, Markneukirchen, Germany) to reduce the number of peripheral nerve stumps to be reanimated

and at the same time to enlarge the diameter of the peripheral stump for the planned nerve reanimation. In the same manner, the peripheral nerve stumps of the buccal and marginal mandibular branches are pooled and sutured together. The same suture material is used for all following nerve sutures.

The reconstruction is started with the reconstruction of the upper face. As described elsewhere in more detail,⁷ a standard facial nerve interpositional graft in between the proximal facial nerve stump and the pooled peripheral upper peripheral branches is used to reanimate the upper face (Fig. 1C). The length of all nerve grafts is exactly measured in advance using a surgical ruler to strictly avoid any tension on the suture sites. For the readaptation, the interpositional graft is sutured end-to-end with several 10-0 sutures to both the proximal and distal upper nerve stump. The lower face is reanimated using a hypoglossal-facial jump nerve suture.^{8,9} Briefly, the hypoglossal nerve is incised proximal to the ansa cervicalis at about 30% of its diameter (Fig. 1D). The occurring cleft is used for a side-to-end suture to a second greater auricular nerve graft. The graft itself is then sutured end-to-end to the pooled lower peripheral facial nerve branches (Fig. 1E, F;

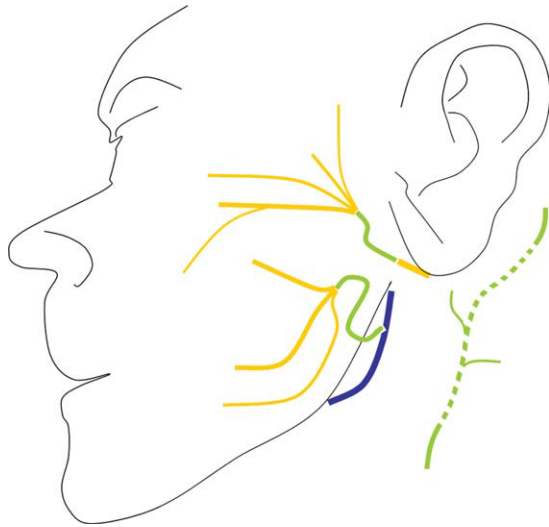


Fig. 2. Schematic drawing of the modified combined approach on the left side. Reconstruction of the upper face with the facial nerve (yellow) and the lower face with the hypoglossal nerve (blue). The peripheral facial nerve branches are pooled together to allow the separated reconstruction of the upper and lower face. As a graft for both reconstructions the greater auricular nerve (green) was used. The sites for the graft harvest of the greater auricular nerve are illustrated by the green broken line.

Fig. 2). Due to the large defect of the facial fan, a direct side-to-end nerve suture to the lower peripheral branches of the facial nerve is normally not possible. Finally, the wound is closed. To bridge the time until full nerve regeneration is reached, the procedure can be combined with an upper lid weight.

RESULTS

Three patients with stage IV parotid cancer and one patient with a large facial nerve neurinoma (see the video clip in the online supplementary material) underwent the procedure within the last 2 years. The postoperative course was uneventful in all four cases. Postoperative radiotherapy was applied in the three cancer cases. Nerve regeneration was monitored by regular clinical and electrophysiological follow-up examinations every 3 months.^{2,10} The first polyphasic reinnervation potentials were seen between 4 and 6 months after surgery. Final results were reached about 12 to 16 months after surgery (Fig. 3). In all four cases, the upper lid weight was left in place. Most important, neither the clinical nor the electromyographical examinations revealed synkinesis between the upper and lower face, as would be the case when using either a facial nerve graft or a jump nerve suture for reanimation of the whole facial fan. The patients with the present combined

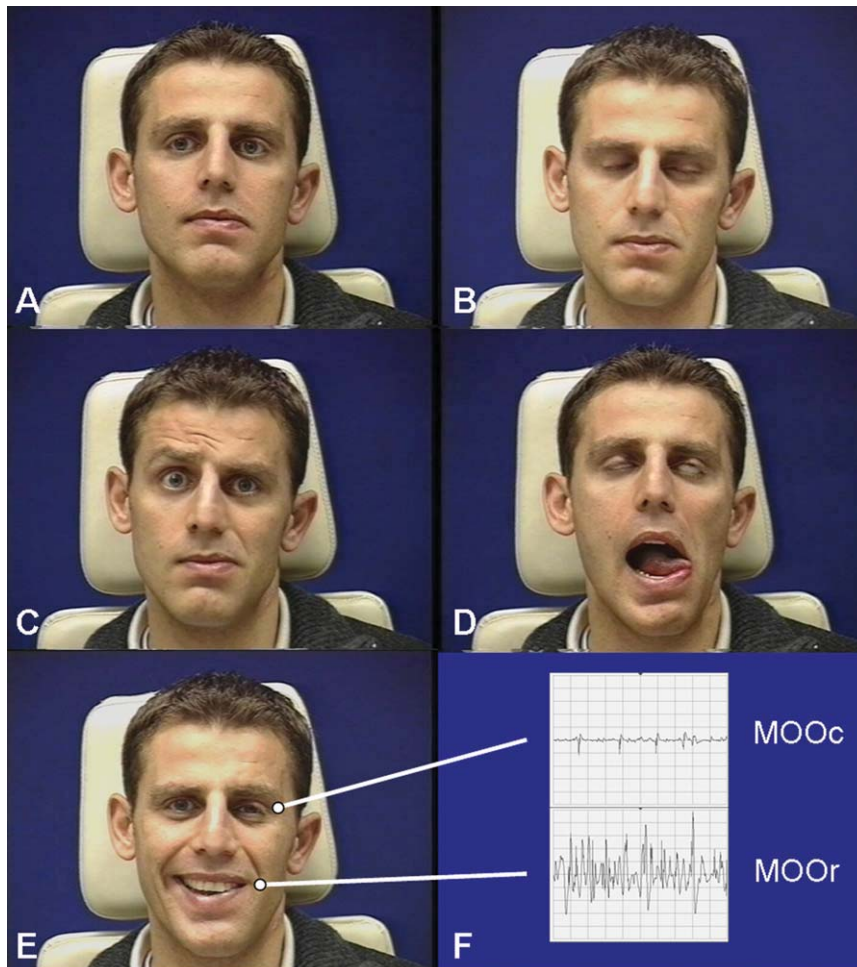


Fig. 3. A patient 16 months after combined approach on the left side. (A) Resting tone. (B) Complete eye closure. (C) No recovery of frowning due to autoperalytic syndrome. (D) Normal tongue movement. (E) Smiling without synkinesis in the eye region. (F) Corresponding two-channel electromyography examination to (E), confirming absence of synkinesis between upper and lower face. MOOc = orbicular oculi muscle; MOOr = orbicular oris muscle.

approach are, for instance, able to smile or show the teeth without synchronous unintended and disturbing closure of the eye. Synchronous electromyography of the orbicularis oculi muscle and of the orbicularis oris muscle during smiling confirmed intended voluntary activity of the orbicularis oris muscle without activity of the orbicularis oculi muscle (Fig. 3E, F). Vice versa, eye closure occurred without synchronous unintended mouth and lower face movement (Fig. 3B). Of course, within both compartments, synkinesis with lost frowning due to antagonistic eye closure function by autoperalytic syndrome (Fig. 3C), was visible and measurable by electromyography in all cases. The orbicularis oculi muscle and the frontal muscle are antagonistic muscles. Humans are not able to frown while closing the eye. After facial nerve reanimation, any intention to frown will also activate involuntarily the orbicularis oculi muscle due to the synkinetic activity. Electromyography shows activity during frowning without clinical movement. This special case of synkinesis is therefore identified as autoperalytic syndrome and was observed in all for cases.

DISCUSSION

A large defect of the facial fan after radical parotidectomy is often estimated as not suitable for nerve reanimation surgery. If the proximal facial nerve stump is still available at the stylomastoid foramen, or if the stump can be tracked back into the mastoid by mastoidectomy and decompression of the nerve, and if at minimum 2- to 3-cm peripheral branches are left, a combined approach is appropriate. Due to the discrepancy of only two proximal nerve stumps (facial and hypoglossal nerve) and four to eight peripheral branches, pooling of the peripheral branches is necessary as described. Modifying the combined approach by using a hypoglossal-facial nerve jump nerve suture instead of a classic hypoglossal-facial nerve suture avoids hemiatrophy of the tongue and its consecutive long-term sequelae. Any kind of motor nerve suture leads to synkinesis as result of aberrant nerve sprouting.^{11,12}

Most disturbing for the patients are synkinesis of the upper and lower face. If the complete peripheral facial nerve is reconstructed by facial nerve interpositional graft or hypoglossal-facial jump nerve suture alone, the

patients often complain of unintended eye closure while eating, speaking, or laughing.⁵ This problem can only partly be diminished by botulinum toxin injection in the orbicularis oculi muscle.¹³ The combined approach is an optimal solution that avoids this problem.

CONCLUSION

The combined approach is a neglected technique to reanimate the face. The combined approach, using both the facial and hypoglossal nerve, allows the reconstruction of very large defects of the facial fan. Furthermore, synkinesis between the upper and lower face is avoided. Using this modified technique with a hypoglossal-facial jump nerve suture in combination with facial nerve interpositional grafts results in the same morbidity as if only interpositional grafts would have been used. Therefore, we recommend use of the combined approach more generously when faced with complex facial nerve reconstruction.

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