Outcomes and complications of direct end-to-side facial-hypoglossal nerve anastomosis according to the modified May technique

Clinical article

FREDERIC VENAIL, M.D.,1,3 PASCAL SABATIER, M.D., PH.D.,2 MICHEL MONDAIN, M.D., PH.D.,1,3 FRANÇOIS SEGNARIEUX, M.D., PH.D.,2 CHRISTOPHE LEIPP, M.D.,1 AND ALAIN UZIEL, M.D., PH.D.1,3

1Ear, Nose, and Throat, and 2Neurosurgery Departments, University Hospital Gui de Chauliac; and 3INSERM U583, Institute for Neurosciences in Montpellier, France

Object. The aim of this study was to address the efficiency and safety of direct end-to-side facial-hypoglossal nerve anastomosis for facial palsy rehabilitation.

Methods. The authors conducted a retrospective study of 12 consecutive procedures performed between December 2000 and February 2006. Facial palsies were caused by the surgical removal of tumors in the brainstem, cerebellopontine angle, or mastoid process. Direct end-to-side facial-hypoglossal anastomosis was performed in each case. Facial function (evaluated using the overall percentage of facial function and House-Brackmann scale grades), as well as tongue trophicity and mobility, were assessed at 6, 12, and 24 months after surgery. Postoperative early and late complications were systematically reviewed.

Results. The mean delay between tumoral and reparative surgery was 15.9 ± 4 months (median 11 months). Preoperatively, the mean percentage facial function score was 11.6 ± 1.7% (45% of patients with House-Brackmann Grade 5 facial palsy and 55% of patients with House-Brackmann Grade 6). Mean facial function scores increased to 19.3, 32.2, and 43.8% at 6, 12, and 24 months after surgery, respectively. Twenty-four months after surgery, 50% of cases had House-Brackmann Grade 3 facial palsy and 50% had Grade 4. A significantly better recovery at 24 months was observed postoperatively for neural lesions occurring in the mastoid or the brainstem compared with those in the cerebellopontine angle. Tongue hemiparesis was observed in 5 patients (41.7%), 2 of whom had tongue hypotrophy (16.7%). No patient complained of swallowing or speech disturbance. Facial synkinesis was noted in 1 patient (8.3%).

Conclusions. Facial recovery after direct end-to-side facial-hypoglossal nerve anastomosis is similar to results observed with end-to-end or end-to-side facial-hypoglossal nerve anastomosis with an interpositional graft. Tongue hypotrophy and palsy were observed in a small number of cases. This procedure allows one to minimize, although not fully prevent, facial synkinesis. The site of the neural lesion appears to be an important factor in the prognosis of recovery. (DOI: 10.3171/2008.9.JNS08769)

Key Words • anastomosis • end-to-side suture • facial palsy • hypoglossal nerve • tongue hemiparesis

Despite recent advances in intraoperative facial nerve monitoring, facial palsy is a complication feared by all surgeons during CPA surgery and other otological procedures. In cases of poor recovery from facial palsy caused by direct trauma to the nerve or neurological lesions, rehabilitative procedures such as facial-hypoglossal nerve anastomosis have been proposed since the early 20th century. Refinement of earlier techniques has permitted the replacement of the classic end-to-end anastomosis by end-to-side anastomosis, with the aim of reducing tongue atrophy and dysfunction. Such techniques require the use of a neural graft to fill the anatomical gap between these cranial nerves (the May technique). This technique has recently been improved, allowing the complete release of the facial nerve from the geniculate ganglion to the stylomastoid foramen, for a direct suture to the hypoglossal nerve (the modified May technique). The combination of end-to-side anastomosis with a direct suture appears to improve facial nerve recovery and reduce tongue atrophy. In the present study, we describe the long-term results and the complications of direct facial-hypoglossal end-to-side nerve anastomosis in 12 patients.

Methods

This retrospective study was performed after submission and approval of the study design by the local Ethics
Facial Palsy Recovery

Preoperatively, the mean facial function score was 11.6 ± 1.7% (in 11 patients; median score 10%; range 6–20%; Table 1). These scores corresponded to 45% of patients with House-Brackmann Grade 5 facial palsy and 55% of patients with Grade 6. Six months after surgery, the mean facial palsy score was 19.3 ± 2% (in 12 patients) showing a significant improvement of the palsy in 11 patients over preoperative scores (p < 0.001, Student t-test for paired data). One patient (Table 1) who underwent end-to-side facial-hypoglossal nerve anastomosis immediately after tumor removal was not included in the 6-month analysis. Twelve months after surgery, the mean facial palsy score was 32.2 ± 3.3% (in 12 patients), indicating a significant improvement of the palsy between the 6th and the 12th months following surgery (p < 0.001, Student t-test for paired data). Twenty-four months after surgery, the mean facial palsy grade was 43.8 ± 3.6% (in 12 patients), showing a significant improvement of the palsy between the 12th and the 24th months following surgery (p < 0.001, Student t-test for paired data). After a 2-year follow-up, 6 patients (50%) had House-Brackmann Grade 3 facial palsy and 6 (50%) Grade 4. During the follow-up, 4 patients with Grade 3 facial palsy received botulinum toxin in the contralateral side of the face to improve facial symmetry.

Complications of the Procedure

We observed no early postoperative complications in any patients. Tongue hemiparesis was observed in 5 cases (41.7%) including 2 patients with tongue hypotrophy (16.7%). One of these 2 patients also complained of hyperesthesia and hypogeusia. No atrophy or palsy was observed. No patient complained of swallowing or speech disturbance. Facial synkinesis was noted in 1 patient only (8.3%), occurring 2 years after surgery. Interestingly, this patient also had hemiparesis and hypotrophy of the tongue.

Factors Determining Recovery

We observed no statistically significant difference in facial palsy recovery at 12 or 24 months postoperatively.
F. Venail et al.

788

J. Neurosurg. / Volume 110 / April 2009

Results of Facial Recovery

In 1904, Körte was the first to describe the technique of using end-to-end facial-hypoglossal nerve anastomosis, using a neural graft to suture the facial to the hypoglossal nerve. This type of anastomosis was more widely developed by the works of Balance and Duel in 1932. However, this technique is associated with palsy and hypotrophy of the ipsilateral tongue, leading to impaired swallowing and speech in 45% of patients. To reduce these functional defects, May and colleagues proposed performing an end-to-side nerve anastomosis with an interposition graft to suture the facial nerve at the level of the stylomastoid foramen. To achieve this, however, a sectioning of half of the neural fascicles of the hypoglossal nerve was necessary. In 1997, Darrouzet and associates followed by Atlas and Lowinger modified the May technique to improve axonal resprouting by avoiding the repeated anastomosis between the cranial nerves and the neural graft. After releasing the facial nerve in the facial canal from the geniculate ganglion to the stylomastoid foramen and rerouting in the neck, a direct end-to-side epineural suture was performed without tension to the hypoglossal nerve. Two or 3 neural fascicles of the hypoglossal nerve were now sufficient to anastomose this nerve to the facial nerve (Fig. 1).
Outcomes of direct end-to-side facial-hypoglossal anastomosis

In the present work, 50% of the patients had a House-Brackmann Grade 3 facial palsy and 50% had a Grade 4 facial palsy 2 years after direct end-to-side nerve anastomosis. These results are similar to those reported in previous case series of end-to-side facial-hypoglossal nerve anastomosis (Table 2) of Atlas and Lowinger (3 cases) and Rebol et al. (5 cases). However, our results appear slightly less encouraging than those described in the updated series of Franco-Vidal and colleagues (15 cases), in which the percentage of patients with House-Brackmann Grade 3 facial palsy was 73%. One explanation for this difference could be the presence in our study of 1 patient with an otherwise good facial recovery, who developed facial synkinesis; the facial palsy of this patient was rated Grade 4 because of this synkinesis. Without this complication, the rate of Grade 3 facial palsy would have increased to 58%, which is more consistent with previous data. This discrepancy could also be attributed to the differences between the 2 studies in terms of the suture technique used. Darrouzet et al. and Franco-Vidal et al. placed perineural sutures instead of the epineural sutures used in our study.

The overall results of facial recovery using a modified May technique are similar to those of older techniques using end-to-end anastomosis or end-to-side anastomosis in addition to an interposition graft (Table 2). In cases of good recovery of facial function (for patients with House-Brackmann Grade 3 facial palsy), botulinum toxin was injected in the contralateral side of the face to improve facial symmetry and enhance cosmetic results, as described elsewhere.

Factors Affecting Facial Recovery

Most authors agree that to improve recovery, the delay between the facial palsy and neurotization should not exceed 12 months. We found no difference in recovery between those patients operated on before and after 11 months (median facial palsy duration) in our series, an observation in contrast with the results of Franco-Vidal et al. However, we believe that this difference could be explained by the small number of patients in our series, which could be insufficient to show any difference. Therefore, we continue to propose this type of anastomosis between 9 and 12 months after the onset of facial palsy to limit facial muscle atrophy. Nevertheless, although the success rate of this procedure is lower when the anastomosis is performed later, we have read an interesting case of recovery (House-Brackmann Grade 3) in a patient who underwent the operation 2 years after the facial palsy. In this report, no relationship was found between the severity of the preoperative facial palsy and the outcome of surgery. The size of our study sample could explain this finding, although interestingly the same conclusion was drawn by Yetiser and Karapinar who performed a meta-analytic study with a larger case series.

We noticed that a distal facial nerve lesion (in the mastoid process) was more favorable for reinnervation than a facial lesion occurring in the CPA. In addition, the rehabilitation of incomplete lesions of the brainstem nuclei gave better results than anastomosis after CPA lesions. In both cases, lesions of facial neurons are often incomplete, contrary to nerve trauma occurring in the CPA, in which the facial nerve is frequently cut. It could therefore be presumed that a better trophicity of the tissues innervated by neurons of the remaining facial nerve helps the sprouting axonal fibers find their target by the secretion of neurotrophic factors. The good prognosis of incomplete nuclear lesions could also be explained by the capacity to restore connections and central compensa-

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Type of Anastomosis</th>
<th>No. of Patients</th>
<th>H-B Grade ≤ 3 (%)</th>
<th>H-B Grade ≥ 4 (%)</th>
<th>Tongue Hypotrophy (%)</th>
<th>Speech or Swallowing Problems (%)</th>
<th>Synkinesis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pensak et al., 1986</td>
<td>FHA</td>
<td>61</td>
<td>42</td>
<td>58</td>
<td>74</td>
<td>21</td>
<td>67</td>
</tr>
<tr>
<td>Luxford and Brackmann, 1985</td>
<td>FHA</td>
<td>66</td>
<td>60</td>
<td>40</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Magliulo et al., 2001</td>
<td>FHA</td>
<td>10</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>70</td>
<td>NR</td>
</tr>
<tr>
<td>Hammerschlag, 1999</td>
<td>FHA</td>
<td>22</td>
<td>55</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>27</td>
</tr>
<tr>
<td>May et al., 1991</td>
<td>IFHA</td>
<td>20</td>
<td>80</td>
<td>20</td>
<td>10</td>
<td>0</td>
<td>NR</td>
</tr>
<tr>
<td>Manni et al., 2001</td>
<td>IFHA</td>
<td>29</td>
<td>44</td>
<td>56</td>
<td>4</td>
<td>0</td>
<td>NR</td>
</tr>
<tr>
<td>Hammerschlag, 1999</td>
<td>IFHA</td>
<td>18</td>
<td>83</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>44%</td>
</tr>
<tr>
<td>Atlas and Lowinger, 1997</td>
<td>ESFHA</td>
<td>3</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rebol et al., 2006</td>
<td>ESFHA</td>
<td>5</td>
<td>40</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Franco-Vidal et al., 2006</td>
<td>ESFHA</td>
<td>15</td>
<td>73</td>
<td>27</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>present study</td>
<td>ESFHA</td>
<td>12</td>
<td>50</td>
<td>50</td>
<td>16</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

* ESFHA = direct end-to-side facial-hypoglossal nerve anastomosis; FHA = end-to-end facial-hypoglossal anastomosis; H-B = House-Brackmann; IFHA = end-to-side facial-hypoglossal anastomosis with an interposition graft (May technique); NR = not reported.
tion with the hypoglossal and trigeminal nuclei. However, we agree with the idea that complete lesions of brainstem nuclei (for example, after a stroke) are less suitable for this kind of facial reanimation, as discussed elsewhere.

Complications of the Procedure

In our series, tongue hypotrophy was observed in 2 cases (16.7%). In previous studies of Franco-Vidal et al. and Rebol et al., rates of tongue hypotrophy were 7 and 0%, respectively (Table 2). Moreover, hemiparesis without speech or swallowing disturbance was observed in 5 cases, including the 2 cases just noted. Data about hemiparesis were not available from other studies, although this slight complication appears to be rare elsewhere. However, these complications occur significantly less frequently after end-to-side anastomosis in comparison with end-to-end anastomosis (Table 2).

In this paper we described the first case of facial synkinesis after direct end-to-end facial-hypoglossal nerve anastomosis. Interestingly, this complication occurred 2 years after surgery. This patient also complained of tongue hypotrophy, hyperesthesia, and hypoguesia. In this case, the synkinesis revealed an aberrant reinnervation by the hypoglossal nerve. In our experience, this type of complication cannot be completely avoided in all cases after end-to-side anastomosis. Moreover, it emphasizes the important role of physiotherapy with passive (massage) and active reeducation, and the dissociation of facial and tongue mobility.

Conclusions

Previous studies in small series of patients demonstrated the efficacy and safety of end-to-side facial-hypoglossal nerve anastomosis to restore facial function. These results have been confirmed in this larger patient series. However, facial recovery appears to be similar to the results obtained with other techniques, and not better as suggested elsewhere. In our experience, the site of the nerve injury and the grade of preoperative facial palsies are the most relevant points for facial recovery. Fewer complications such as tongue hypotrophy, tongue hemiparesis, and facial synkinesis were observed using direct end-to-side facial-hypoglossal nerve anastomosis compared with previous techniques, although they are not completely avoided. The optimal timing for the anastomosis and the type of suture used (epineural vs perineural) appear to be key factors affecting facial nerve recovery, although their exact role remains to be elucidated in further studies.

Disclaimer

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References

Outcomes of direct end-to-side facial-hypoglossal anastomosis


Manuscript submitted June 21, 2008.
Accepted September 19, 2008.
Please include this information when citing this paper: published online January 2, 2009; DOI: 10.3171/2008.9.JNS08769.
Address correspondence to: Frederic Venail, M.D., Service ORL B, CHU Gui de Chauliac, 80 Avenue Augustin Fliche, Montpellier, France 34295. email: f-venail@chu-montpellier.fr.