Facial Nerve Monitoring in Resection of Vascular Malformations: Description and outcomes of a new methodology.
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**Objective**
To describe and evaluate outcomes in a new intra-operative facial nerve monitoring technique used in over 300 patients with complex vascular malformations of the head and neck.

**Abstract**

**Study Design:** Retrospective chart review.

**Methods:** Charts of 323 consecutive resections of complex head and neck vascular malformations performed by a single senior surgeon using a new intra-operative continuous compound muscle action potential (CMAP) facial nerve monitoring technology were reviewed. Patient, pathology, surgical, and facial nerve outcome data was reviewed along with prospectively gathered data on CMAP potential changes at the end of each procedure.

**Results:** Between 2005 and 2011, 296 head and neck vascular malformation and benign tumor resections were performed using this monitoring technique and met inclusion criteria. Pathology included venous malformation (36%), hemangioma (23%), lymphatic malformation (23%), arteriovenous malformation (12%), and other (6%). The median age of patients was 7.6 years. Facial CMAP values were noted at the end of the case in 91 cases (31%). A 50% or greater degradation in CMAP values was seen in 52 cases (17%), but new clinically apparent facial nerve deficit in at least one diagnosis was seen in only 13 cases (4.4%), all of which had a greater than 70% degradation in CMAPs.

**Conclusions:** The continuous evoked intra-operative CMAP method of facial nerve monitoring is a new active evoked monitoring technique that imparts less electrical power than standard nerve stimulators, gives real-time feedback for potential or impending facial nerve injury, gives an objective measurement of nerve activity, and may predict post-operative clinical nerve function. It is therefore useful in surgical excisions with a high risk of facial nerve injury.

**Results**

**Patient Characteristics**

<table>
<thead>
<tr>
<th>Cases</th>
<th>n=296</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>168 (64%)</td>
</tr>
<tr>
<td>Female</td>
<td>128 (42%)</td>
</tr>
<tr>
<td>Mean</td>
<td>12.5 years</td>
</tr>
<tr>
<td>Median</td>
<td>7.6 years</td>
</tr>
<tr>
<td>Min</td>
<td>1 month</td>
</tr>
<tr>
<td>Max</td>
<td>72 years</td>
</tr>
</tbody>
</table>

**Surgical Characteristics**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>External</th>
<th>Modified Blair</th>
<th>Cervical</th>
<th>Parasal</th>
<th>Elliptical</th>
<th>Intraoral</th>
<th>Combined</th>
<th>Adjunct</th>
<th>Parotidectomy</th>
<th>CN VII Mobilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>229</td>
<td>109</td>
<td>64</td>
<td>19</td>
<td>47</td>
<td>71</td>
<td>4</td>
<td>50</td>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td>Percentage</td>
<td>77%</td>
<td>37%</td>
<td>22%</td>
<td>6%</td>
<td>16%</td>
<td>24%</td>
<td>1%</td>
<td>17%</td>
<td>68%</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Pathology**

- Lymphatic Malformation: 23%
- Arteriovenous Malformation: 12%
- Venous Malformation: 39%

**CMAP Changes and FN Outcome**

| Change in CMAPs | 91 (31%) |
| No Change in CMAPs | 202 (69%) |

**Discussion**
This study describes how we use continuous evoked monitoring of the facial nerve with individual muscle CMAPs in resection of complex vascular malformations in the head and neck. This is a primarily pediatric population, and we report on our outcomes, and suggest an association between changes in CMAP values and post-operative facial nerve function.

Key to this approach is the constant communication between the neurophysiologist and the surgeon in regards to changes in CMAPs and applying saline to cool a nerve which may have received heat damage. The surgeon then waits for CMAPs to improve, and proceeds with caution in that area. In addition, when faced with the possibility of sacrificing a peripheral branch, by knowing the contribution to the overall CMAP for a specific muscle, the surgeons have the information to weigh risks and benefits in real-time.

The results of this study demonstrate the possibility of this method to prognosticate post-operative facial nerve outcome. All patients with post-operative facial nerve dysfunction had a more than 70% decrease in CMAPs in the affected branch or branches. However, in the affected branch or branches, and outcomes in individual branches will be necessary to better assess the ability of this methodology to actually predict outcomes. Nevertheless, we see this technology as contributing greatly to our ability to safely resect complex vascular malformations and benign tumors in the head and neck with excellent outcomes.

**References**