Mandibular subluxation as an adjunct to exposure of the distal internal carotid artery in endarterectomy surgery

Technical note

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The location of the carotid artery bifurcation and the distance atherosclerotic disease extends distally in the internal carotid artery (ICA) are two factors that contribute to the technical difficulty of carotid endarterectomy. When the bifurcation is high (above C-3) or the disease extends distally, standard approaches may not provide adequate exposure for dissection of plaque or for arteriotomy repair. A simple method of mandibular subluxation is described for added exposure of the distal carotid artery. The criteria for use of this method include: a carotid bifurcation at or above C-2; disease extending to within 2 cm of the skull base; and a small-caliber distal ICA lumen with the expectation of a patch graft extending close to the skull base. In dentulous patients, the mandible is subluxed by attaching an intradental wire from the ipsilateral mandibular bicuspid to a wire around the contralateral maxillary bicuspid. In edentulous patients, a wire is placed around the ipsilateral mandible and secured to a wire placed through the anterior nasal spine. The entire preoperative subluxation requires 10 to 15 minutes under anesthesia and an additional 1 to 2 minutes postoperatively to remove the wires. A single skin suture and an absorbable intraoral suture were placed in some edentulous patients.

This technique has been evaluated over a 15-month reference period during which 115 carotid endarterectomies were performed. The criteria stated above were met in seven cases (six patients, 6%) and jaw subluxation was performed preoperatively. An additional 1 to 2 cm of distal exposure was obtained by using this technique and endarterectomy proceeded without complication. A slight “shift” of the standard anatomical landmarks occurred due to the movement of the mandible, which was easily recognized. There were no significant postoperative complaints related to the subluxation; specifically, no temporomandibular joint pain, no other postoperative pain, and no tooth damage were encountered. It is concluded that this relatively simple approach to mandibular subluxation provided significant added exposure to the distal ICA without notably increasing operative time. In addition, there was no morbidity and little additional care was needed when compared with other more radical approaches to high carotid artery exposure.

KEY WORDS • mandibular subluxation • carotid artery • endarterectomy • operative technique

The anatomical location of the bifurcation of the carotid artery in the neck and the extent of distal atherosclerotic disease in the internal carotid artery (ICA) are two factors that contribute to the technical difficulty of carotid endarterectomy. When the bifurcation is high or the disease extends far distally, standard approaches may not provide adequate exposure for dissection of plaque or for arteriotomy repair due to proximity to the jaw. Several alternative approaches which more fully expose the distal ICA under the mandible have been described, including angle mandibulotomies, mandibular osteotomy and retraction, and medial jaw subluxation. Medial jaw subluxation has become the least invasive methodology for improving distal ICA exposure. Mandibular subluxation was initially described with the use of maxilloman-

Operative Technique

Anesthesia was induced in the usual fashion for carotid endarterectomy and patients were intubated by standard oral–tracheal techniques using appropriate endotracheal intubation equipment. Patient position was identical to
Jaw subluxation in carotid endarterectomy

that of standard carotid endarterectomy patients. For patients with healthy teeth, intradental No. 26 wires were placed as Ivy loops around the mandibular bicuspid tooth on the arch ipsilateral to the ICA lesion. Similar intradental wires were placed around the contralateral maxillary bicuspid teeth. If the bicuspid teeth could not be utilized (because they were missing, loose, or involved with periodontal disease), adjacent teeth were used. Once Ivy loops were placed, the mandible was subluxed by pulling anteriorly and contralaterally. The subluxation was completed and stabilized by twisting the maxillary and mandibular wires together (Fig. 1A).

For patients who were edentulous or who had significant periodontal disease, a circummandibular No. 26 wire was passed in the midbody of the mandible ipsilateral to the ICA lesion. This was done with a mandibular awl after a small incision was made in the skin approximately 1 cm below the inferior border of the mandible. The wire was then twisted down onto the mandibular ridge (Fig. 1B). In the maxilla, a 1-cm incision was made through the buccolabial mucoperiosteum above the attached gingival margin in the midline overlying the anterior nasal spine. A periosteal elevator was used to lift a tiny mucoperiosteal flap superiorly to expose the anterior nasal spine. A hole oriented horizontally was then made through the anterior nasal spine using a Hall drill and a 1.5 mm hole-drilling burr. The wire was then passed through the hole and twisted down onto the anterior nasal spine. The mandible was subluxed as with the dentulous patient (Fig. 1C).

There was slight distortion of the anatomy of the carotid artery dissection after jaw subluxation. The posterior belly of the digastric muscle was moved anteriorly and superiorly, as was the hypoglossal nerve. The carotid bifurcation itself, as well as the ICA and the external carotid artery and its branches were rotated medially. These distortions provided additional exposure of the distal ICA; however, recognizing the different positioning of the hypoglossal nerve and the changed orientation of the vessels was essential.

The entire preoperative subluxation required 10 to 15 minutes of additional anesthesia time and an additional 1 to 2 minutes postoperatively to remove the wires. A single skin suture and an absorbable intraoral suture were placed in some edentulous patients.

Summary of Cases

We evaluated this technique over a 15-month reference period during which 115 carotid endarterectomies were performed by the neurosurgical service at our institution. The inclusion criteria for mandibular subluxation were as follows: a carotid bifurcation at or above C-2; atherosclerotic disease extending to within 2 cm of the skull base; and a small-caliber distal ICA lumen with the expectation of a patch graft extending close (2 cm) to the skull base. These criteria were met in seven cases (six patients, 6%) and jaw subluxation was performed preoperatively. The specific indications for each patient are listed in Table 1.

Patients were examined by the oral surgical team after anesthesia was induced, a decision was made as to the appropriate subluxation technique, and the jaw was subluxed without difficulty. In each case, endarterectomy was performed without complication. There were no significant postoperative complaints related to the subluxation; in particular, no temporomandibular joint pain, no other postoperative facial or jaw pain, and no tooth damage were encountered. One patient complained of discomfort due to the intraoral stitch, which required trimming.

Discussion

Surgical treatment of occlusive vascular disease that extends near the skull base, particularly in patients whose
ICA bifurcation is located high in the neck, can be challenging. The methodologies described in the vascular surgical literature for approaching the distal carotid artery through a standard endarterectomy incision include resecting or creating a mandibular window. Resecting the angle of the jaw with bone-biting instruments does provide limited additional exposure; however, it risks permanent facial disfigurement. Osteotomy of the mandible at the angle or more anteriorly near the mental foramen will provide excellent exposure of the ICA as it courses under the jaw toward the skull base without anatomical distortion. However, these techniques require postoperative maxillomandibular arch bar fixation and internal fixation of the reduced mandible.

Temporary mandibular subluxation does not disfigure the face or jaw and will provide nearly the same exposure as a mandibular window. The first report of mandibular subluxation for management of traumatic lesions of the distal ICA described the use of maxillomandibular fixation with arch bars for bilateral subluxation. This procedure required nearly 90 minutes for completion. The simpler technique of unilateral mandibular subluxation was subsequently described using circummandibular/transnasal wiring in a prospective group of 12 patients presenting with a variety of distal carotid artery pathologies. Diagonal wiring as we have described in dentulous patients, as well as diagonal wiring using Steinmann pin fixation in edentulous patients, have been described in approaches to high cervical carotid artery stenosis, trauma, and aneurysmal disease.

All of these techniques for unilateral mandibular subluxation provide an additional 1 to 2 cm of distal ICA exposure. We have noted and have become accustomed to the slight “shift” of the standard anatomical landmarks that occurs with subluxation of the mandible. This medial translocation of soft-tissue structures overlying the distal ICA can be easily recognized and dealt with. Theoretical pitfalls in this procedure include overly aggressive subluxation that can dislocate the mandible. This may cause ipsilateral injury to temporomandibular joint structures or compression of contralateral carotid artery sheath structures. None of the patients who have undergone preoperative mandibular subluxation at our institution has experienced any of these complications. In fact, none of our patients complained of any postoperative symptoms referable to the subluxation maneuver itself, although several recognized the placement of the intraoral stitch.

We conclude that this relatively simple approach to mandibular subluxation provides significant added exposure to the distal ICA without notably increasing operative time. The procedure is well tolerated with no morbidity and virtually no additional required care when compared with other more radical approaches to high carotid artery exposure.

References


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### TABLE 1

**Summary of patient data**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Level of Bifurcation</th>
<th>Level of Disease</th>
<th>Operative Technique</th>
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<td>C-3</td>
<td>C-1</td>
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* Arterial shunt used during endarterectomy.
† Arteriotomy closed with patch graft.