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## How I Do It

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# Feasibility of Endoscopic Submandibular Ganglion Neurectomy for Drooling

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We performed endoscopic transoral neurectomy of the submandibular and sublingual glands to treat drooling. We bilaterally operated two adult cases with treatment-resistant drooling. In these patients, conventional treatment had failed. Repeated botulinum toxin type A (BOTOX®, Abdi Ibrahim Pharmaceutical Company, Istanbul, Turkey) injections had been effective but were becoming less so. The patients benefited from surgery in that their saliva scores decreased. No issue emerged over 6 months of follow-up. Endoscopic transoral neurectomy of the submandibular and sublingual glands reduces saliva production and allows management of drooling in treatment-resistant patients.

**Key Words:** Drooling, sialorrhea, saliva, submandibular glands, sublingual glands.

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## INTRODUCTION

Drooling involves the production of excessive saliva that spills over the lip margin. It is normal in children under 4 years of age, and is a common problem in adults with neuromuscular and cognitive disorders. The etiologies include neuromuscular diseases (Parkinson disease), increased saliva production, macroglossia, dental malocclusion, and reduced saliva clearance.<sup>1</sup>

Various techniques are used to manage drooling, but none are standardized. Conservative methods include postural correction, behavioral modifications, swallowing therapy, and the use of anti-reflux anti-cholinergic drugs. Recently, botulinum toxin injections into the salivary glands have been shown to control sialorrhea effectively in both pediatric and adult patients, with a low risk of side effects.<sup>2</sup> However, Botulinum toxin is expensive and repeat injections are required.<sup>2</sup> Patients who do not benefit from conventional approaches can be treated surgically. The techniques include re-routing of the submandibular gland ducts, submandibular and sublingual gland excision, parotid duct ligation, and tympanic neurectomy.<sup>3</sup> External irradiation also has been used in some cases.

However, no gold-standard surgical treatment exists. In the resting state, 70% of saliva is formed by

the submandibular and sublingual glands.<sup>4</sup> These glands are innervated by parasympathetic fibers of the facial nerve via the lingual nerve and submandibular ganglion.<sup>5</sup> Disruption of innervation would decrease saliva production. We here describe for the first time the use of submandibular and sublingual neurectomy to treat drooling adults, and also summarize the recent literature.

## MATERIALS AND METHODS

Both patients and their families were informed of the advantages and disadvantages of surgery, and written consent was obtained. To evaluate the technique's efficiency, the families and caregivers completed the saliva disorder severity/frequency form, Teacher Drooling Scale, and Drooling Impact Scale before and after the procedure.<sup>6-8</sup> In addition, they completed the Visual Analogue Scale (VAS) for the severity of drooling (0: no drooling, 100: severe drooling).<sup>9</sup>

## Surgical Technique

Both procedures were performed under general anesthesia via nasotracheal intubation. The head was placed in the supine position; an automatic cheek retractor was used to expose the floor of the mouth bilaterally; and the tongue was pulled out to lie on the contralateral side. We used a Karl Storz 0.4-mm-diameter 18-cm-long rigid endoscope (Karl Storz GmbH & Co. KG, Tuttlingen, Germany). A 3-cm-long incision was made commencing just below the opening of Wharton duct and running to the medial side of the angulus mandible (Fig. 1). Dissection was performed with scissors (Fig. 2). First, Wharton duct was identified and preserved; this served as a guide toward the submandibular gland (Fig. 3). Then, the lingual nerve was recognized and skeletonized to identify branches running to the submandibular gland. The main lingual nerve was preserved. Branches running to the submandibular gland were identified at the posterior aspect of the mylohyoid, cauterized with a bipolar device, and then divided with scissors (Fig. 4). Next, the parasympathetic

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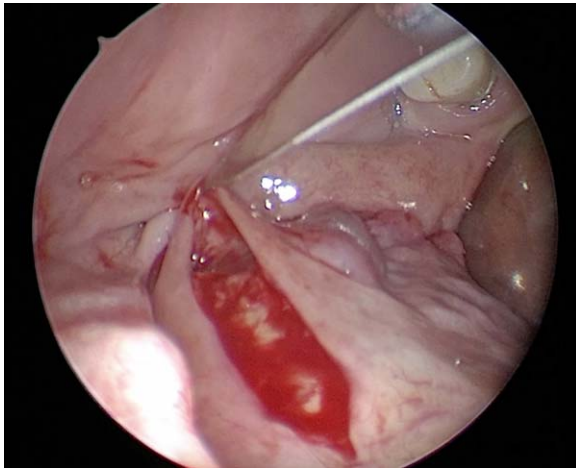


Fig. 1. Mucosal incision along the lateral aspect of the floor of the mouth. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

postganglionic fibers were followed anteriorly to the sublingual glands, cauterized, and cut with scissors (Fig. 5). Bleeding was controlled, and a hemostatic agent (oxidized regenerated cellulose) was placed to prevent re-innervation (Fig. 6). The incision was closed with interrupted sutures. This procedure was repeated on the other side; no perioperative or postoperative complications were noted. The procedural time was about 15 minutes for each side.

## RESULTS

### Case 1

One of the patients was a 26-year-old male with cerebral palsy and mental retardation who was referred to our hospital with a complaint of excessive saliva flow of many years in duration. Rash was evident around the mouth, which was not closed. Flexible laryngoscopy showed that saliva pooled in the vallecula and to a lesser extent in the pyriform sinus. No swallowing disorder

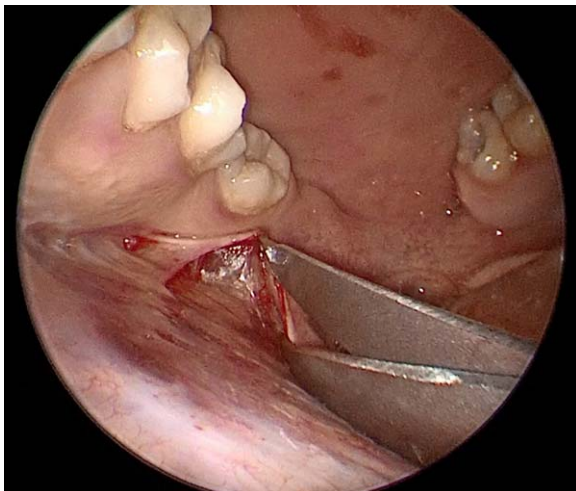


Fig. 2. The dissection performed from the incision. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

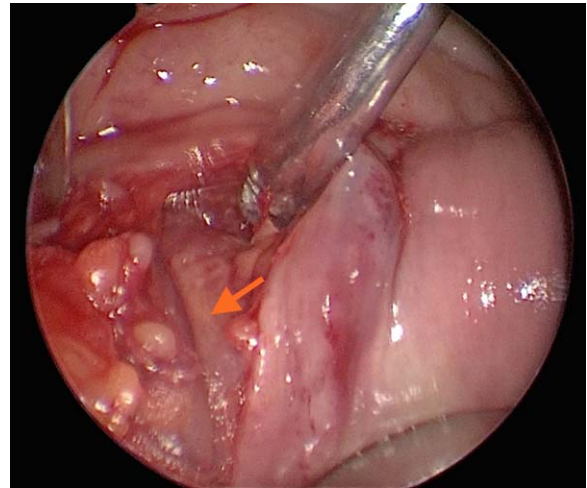


Fig. 3. The arrow shows the Wharton duct. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

was evident, but aspiration was apparent upon modified barium esophagography. The patient's compliance was inadequate to permit functional endoscopic evaluation of swallowing, but the gag reflex was positive; deglutition was delayed; and minimal penetration of the vallecula and pyriform sinus was apparent. The patient had undergone repeated conventional therapies but had not benefited therefrom. Over the past 2 years, the patient had received two Botox injections into the submandibular and parotid glands. These had been partially effective, but only for 4 to 5 months.

The saliva disorder severity was grade 5, and the frequency of production was grade 4. Teacher Drooling Scale score was 5. The Drooling Impact Scale score was 74 prior to surgery. Within 1 day of surgery, the situation improved markedly. At 6-month follow-up, saliva disorder severity was grade 2; Drooling Severity and

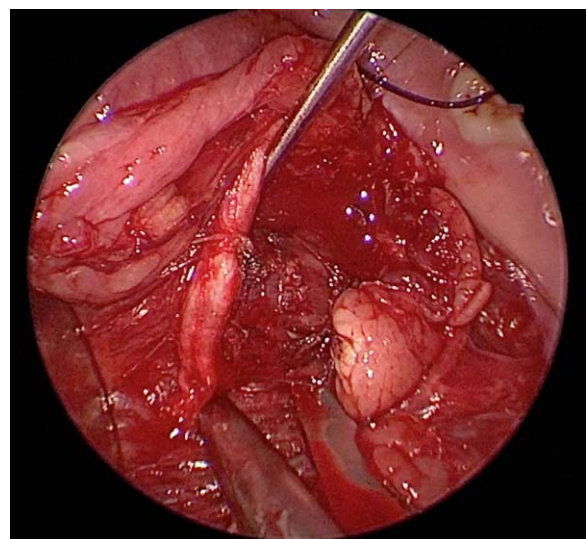


Fig. 4. The lingual nerve is separated from the branches running to the submandibular gland. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

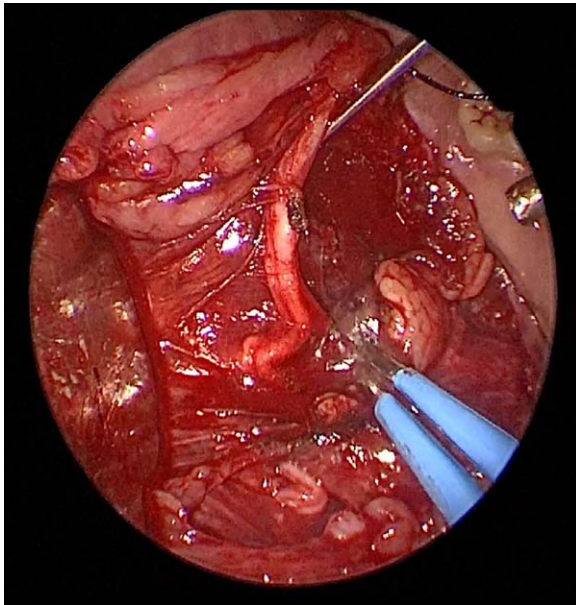


Fig. 5. Postganglionic fibers are separated from the sublingual gland. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

Frequency Scale scores were each grade 2; Teacher Drooling Scale score was 2; and Drooling Impact Scale score was 23. The patient's relatives reported a 90% improvement on a VAS.

### Case II

The second patient was a 70-year-old male who was admitted to our hospital with a complaint of drooling 2 years in duration. The patient had right-side hemiplegia caused by a cerebrovascular attack suffered 4 years previously. Upon flexible endoscopic laryngoscopy, the

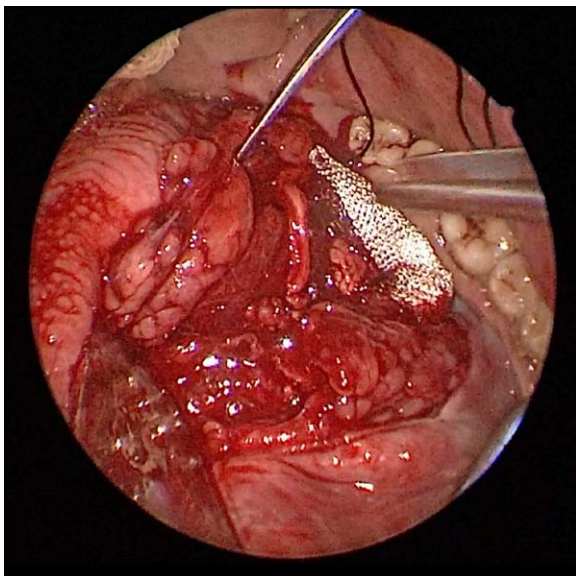


Fig. 6. Multiple hemostatic agents were placed for preventing re-innervation. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

pooling of saliva in the pyriform sinus was noted. No aspiration was apparent on the modified barium esophagram or upon endoscopic evaluation of functional swallowing. The gag reflex was positive, and penetration was evident especially into the left-side vallecula and pyriform sinus. The patient had received both swallowing and drooling therapy (including medical therapy) at another clinic. Because saliva production remained excessive, the patient had developed psychosocial problems and was withdrawn. Botox had been injected three times into both submandibular and parotid glands after other therapies had failed. The injections had been effective for only 4 to 5 months.

Saliva disorder severity was grade 4; Drooling Severity and Frequency Scale scores were each grade 4; Teacher Drooling Scale score was 5; and Drooling Impact Scale score was 70. The symptoms improved immediately after surgery. At 6-month follow-up, saliva disorder severity was grade 2; Drooling Severity and Frequency Scale scores were each grade 4; Teacher Drooling Scale score was 2; and Drooling Impact Scale score was 12. The patient's relatives reported a 90% improvement on a VAS.

### DISCUSSION

Drooling is a significant psychosocial stressor and may cause social isolation, embarrassment, and discomfort, and reduce quality of life.<sup>5</sup> In addition, drooling may cause aspiration, halitosis, infections, skin rashes, and speech difficulties.<sup>5</sup> Although surgical interventions to prevent drooling have high success rates, the disadvantages include damage to the facial and lingual nerves, scar formation, and permanent xerostomia. Duct ligation may cause facial pain, swelling, and infection.<sup>10</sup> In addition, the procedures are irreversible and the total loss of saliva flow can cause dry mouth. Furthermore, the thick mucoid saliva emanating from the minor and sublingual glands may cause swallowing problems, halitosis, and infection.

Our technique affords many advantages over other surgical interventions. We used an intraoral approach toward submandibular and sublingual parasympathetic neurectomy because this avoids the need for a skin incision. With the help of magnification of the endoscope, the Wharton duct, lingual nerve, and submandibular–sublingual junctions were readily identified. The procedure can also be performed effectively with microscopes and loupes. The technique is simple, quick, and reliable. It does not reduce IgA and other protein contents of saliva because protein production depends on sympathetic innervation.<sup>11</sup>

It has been shown that denervation of the submandibular glands reduces gland size and saliva production in animals.<sup>12</sup> In vivo studies have shown that denervation is associated with less risk of ductal stenosis, gland swelling, or cyst formation compared with ductal ligation and gland excision.<sup>13</sup> Clinically, transcanal, transtympanic chorda tympani neurectomy has been used to treat sialorrhoea.<sup>14</sup> As might be expected, this causes sense and taste problems, and the technique remains unpopular. Selective parasympathetic denervation of the facial nerve would theoretically decrease saliva production

without loss of taste or sensation. The potential complications of this technique are damage of Wharton duct, damage of the main truncus of lingual nerve, and related sense and taste problems.

Spock et al. sought to manage sialorrhea via transoral submandibular neurectomy; the authors studied the feasibility of the technique employing cadavers.<sup>15</sup> The procedure was attractive in that it was minimally invasive, highly selective, and feasible. The risk of damage to the residual branches of the lingual nerve was minimal; taste sensation should be preserved.

## CONCLUSION

We present the first report of transoral, endoscopic submandibular/sublingual gland neurectomy used to prevent drooling in patients resistant to conventional treatments. Our success may pave the way for effective management of drooling. However, further clinical studies are required.

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