Lymphatic Malformation of the Lingual Base and Oral Floor

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Background: Lymphatic malformation of the tongue and floor of the mouth is associated with chronic airway problems, recurrent infection, and functional issues related to speech, oral hygiene, and malocclusion. There are no accepted anatomic guidelines or treatment protocols.

Methods: This retrospective review focused on anatomic extent, treatment, complications, and airway management in 31 patients with lymphatic malformation of the lingual base and oral floor.

Results: Involved adjacent structures included the neck (77 percent), mandible (41 percent), face (42 percent), lips (10 percent), pharynx (45 percent), and larynx (26 percent). Fifty-eight percent of patients required tracheostomy during infancy; decannulation was possible in two-thirds of these patients. Management included resection alone (42 percent), resection and sclerotherapy (26 percent), resection and laser coagulation (16 percent), sclerotherapy and laser coagulation (16 percent), and resection and radiofrequency ablation (3 percent). Resection involved the neck (58 percent), floor of the mouth (52 percent), and tongue (42 percent); there were often multiple procedures. Aspiration was tried with little success in 10 percent of patients. Virtually all patients had residual abnormal lymphatic tissue. Complications and postherapeutic problems included infection (81 percent), neural damage (27 percent), difficulty in speech (23 percent), feeding problems (10 percent), and seroma or hematoma (6 percent). Associated dental/orthognathic conditions, particularly prognathism and anterior open bite, were documented in one-third of patients.

Conclusions: The initial step in the protocol is control of the neonatal airway. Staged cervical resection is undertaken in late infancy to early childhood; resection should also include abnormal tissue in the oral floor. Sclerotherapy is primarily for macrocystic disease or secondarily for recurrent cysts following partial extirpation. Vesicles of the mucous membranes and dorsal tongue are treated either by sclerotherapy, laser (carbon dioxide, yttrium-aluminum-garnet, or potassium-titanyl-phosphate), or radiofrequency ablation. Reduction for macroglossia is indicated for persistent protrusion or to allow correction of malocclusion. Embolization controls lingual bleeding. Orthognathic procedures are undertaken at the appropriate age, only after lingual size and position are acceptable. (*Plast. Reconstr. Surg.* 115: 1906, 2006.)

Cervicofacial lymphatic malformation causes both short- and long-term morbidity, including airway obstruction, feeding difficulty, bony and

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soft-tissue overgrowth, recurrent infection, and altered speech and appearance. The high rate of incomplete excision and recurrence has been well documented.[1–12] Several authors have addressed the management of lymphatic malformation in the anterior neck, anterior tongue, lateral face, and airway.[1–3,5,6,13] Extensive lesions of the tongue and oral floor are particularly difficult to resect because of the proximity of important neural, vascular, and muscular structures that can be damaged (Fig. 1). Perhaps for this reason, there are no guidelines for the treatment of lymphatic malformation affecting this functionally vital "central block" composed of the posterior third of tongue and the floor of the mouth.

This is a retrospective study of a subset of patients with cervicofacial lymphatic malformation involving the lingual base and oral floor, undertaken in an effort to define a therapeutic protocol based on 25 years of experience.

PATIENTS AND METHODS

We reviewed the records of all patients with lymphatic malformation of the head and neck registered in the Vascular Anomalies Center at the Children's Hospital. Patients with involvement of the base of the tongue and/or oral floor were selected. Their medical records, radiographic studies, pathological reports, and photographs were analyzed for demographic information, extent of lymphatic malformation, associated problems, airway management, therapeutic efforts, and complications.

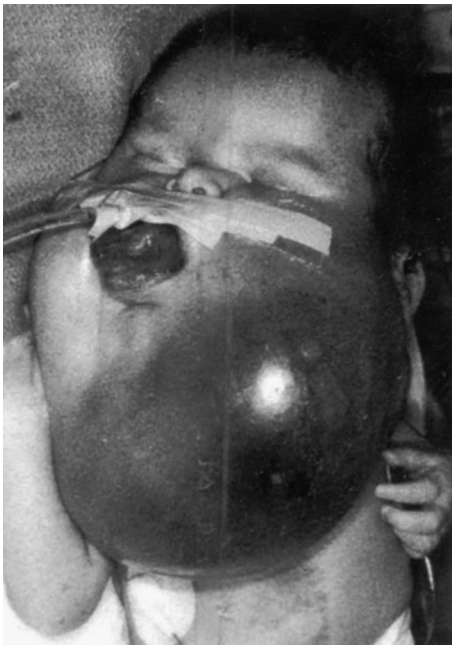

FIG. 1. Newborn with cervicofacial lymphatic malformation involving the tongue and oral floor.

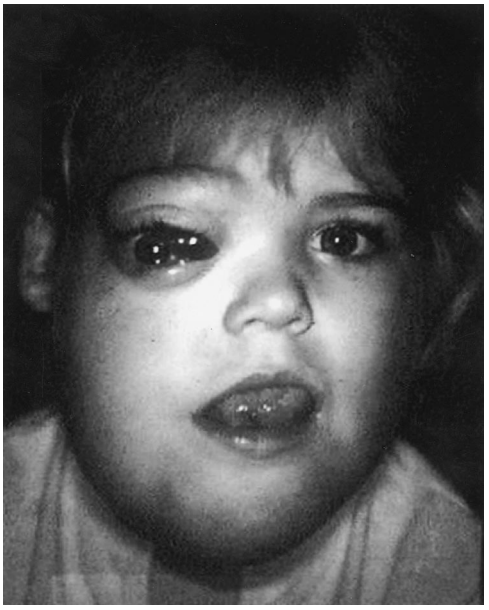

FIG. 2. Eight-year-old girl with lymphatic malformation involving the oral floor, lingual base, suprahyoid region, and right periorbital extension.

RESULTS

Demography

The Vascular Anomalies Center registry listed 141 patients with a diagnosis of cervicofacial lymphatic malformation over a 25-year period. Thirty-one patients had involvement of the lingual base and/or oral floor. The determinate group included 18 female patients (58 percent) and 13 male patients (42 percent); the average follow-up time was 6 years (range, 2 to 18 years).

Extent of Lymphatic Malformation

In addition to the lingual base and oral floor, the lymphatic malformation usually extended to adjacent cervicofacial structures: the anterior neck ($n = 24$), pharynx ($n = 14$), cheek ($n = 13$), mandible ($n = 12$), larynx ($n = 8$) , and lips ($n = 3$). Relative to the hyoid bone, 32 percent ($n = 10$) of lesions were bilateral suprahyoid, 32 percent ($n = 10$) bilateral suprahyoid and infrahyoid, 29 percent ($n = 9$) unilateral suprahyoid and infrahyoid, and 7 percent ($n = 2$) unilateral suprahyoid (Fig. 2). Because of the inclusion criteria (involvement of lingual base or oral floor), none of the patients had an isolated lymphatic anomaly

that was either unilateral infrahyoid or bilateral infrahyoid. Three patients had extracervicofacial extension in the thorax, mediastinum, and axilla.

Management

Several treatment strategies were used during the period of retrospective review (i.e., resection, sclerotherapy, laser coagulation, or radiofrequency ablation, often in combination) (Fig. 3). Twenty-six patients had resection alone or with another therapy; five patients had only sclerotherapy and laser photocoagulation. Multiple resections were done in 21 patients. Sclerotherapy with another type of treatment was used in 13 patients, and laser photocoagulation was used with other modalities in 10 patients. One patient had resection and radiofrequency ablation. None of the patients had laser coagulation or sclerotherapy alone, and 10 patients had radiofrequency ablation as the sole method of treatment. Sclerotherapy and laser photocoagulation were usually done after resection. The location of the resection varied: 18 resections were in the neck (58 percent), 16 were in the floor of mouth (52 percent), and 13 were in the tongue (42 percent). Three patients had attempted aspiration (10 percent).

Problems and Complications

Eighteen patients (58 percent) required tracheostomy; decannulation was possible in 12 (68 percent) of these patients. Postoperative morbidity included infection, neural damage, seroma or hematoma, recurrence, and speech or feeding difficulty (Table I). Dental and orthognathic problems included mandibular prognathism, anterior open bite, crossbite, periodontal disease, and tooth loss (Fig. 4). One neonate had ex utero intrapartum treatment for prenatally diagnosed cervicofacial lymphatic malformation that obstructed the airway.

Discussion

Background

Lymphatic anomalies have been called "cystic hygromas" and "lymphangiomas" since the early nineteenth century. Lymphatic malformation is the more accurate term.[13–15] These slow-flow vascular anomalies are caused by defective embryologic development; however, the precise mechanism is unknown.[16,17] At the molecular level, vascular endothelial growth factor C is the ligand for a preferentially expressed lymphatic endothelial receptor, vascular endothelial growth factor receptor 3. One pathogenic clue is the formation of megalymphatics in transgenic mice with overexpressed vascular endothelial growth factor C.[18,19] In contrast, in mice embryos deficient for vascular endothelial growth factor C, lymphatic endothelium fails to migrate and sprout.[20] Perhaps lymphatic malformations are caused by a somatic mutation that results in abnormal expression of vascular endothelial growth factor C or another anomalous molecular cascade.

Lymphatic malformations most commonly occur in the head, neck, and axillary regions.[21]

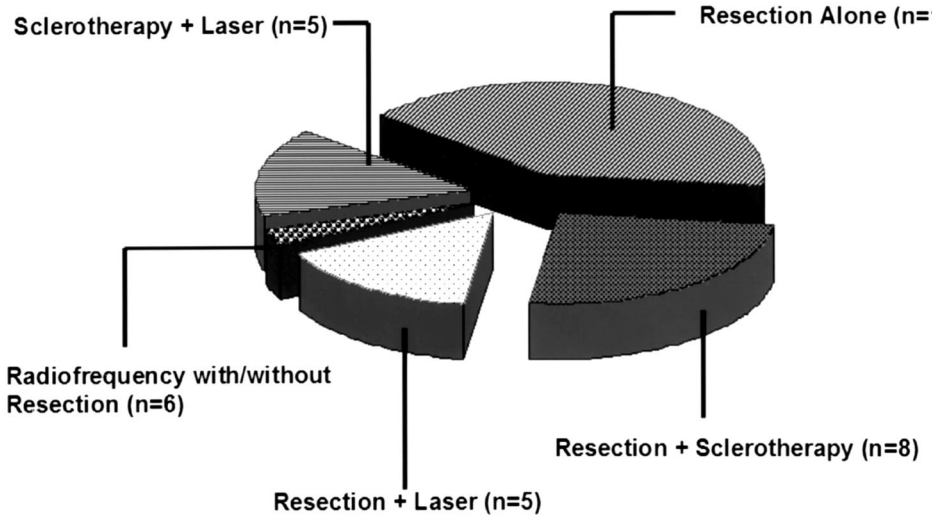

Fig. 3. Management of lymphatic malformation of the oral floor/lingual base in 31 patients (often more than one type of treatment per patient).

TABLE I
Postoperative Morbidity in Patients with Lymphatic Malformation of the Lingual Base and Oral Floor

	No. of Patients	%
Infection	25	81
Residual/recurrent disease	12	39
Dental/orthognathic problems	9	29
Nerve damage	8	27
Speech problems	7	23
Feeding problems	3	10
Seroma or hematoma	2	6

Cervicofacial lymphatic malformations commonly are supraglottic, with variable involvement of the anterior neck, face, pharynx, airway, lips, tongue, and floor of the mouth. Often there is extension into the upper mediastinum. Lingual lymphatic malformation is the most common cause of macroglossia.[22]

Clinical reports of patients with cervicofacial lymphatic malformation range from isolated cases to larger series, but none has focused on disease in the oral floor and lingual base.[8, 21, 23–27] The high rate of complications associated with cervicofacial lymphatic malformation is well known, particularly with extensive and bilateral involvement.[28] Indeed, most of the patients in our study had either a problem or complication. Infection and intralesional hemorrhage are the recognized causes of rapid expansion of these lesions. Over 80 percent of our patients had infections. Cervicofacial resection has been the

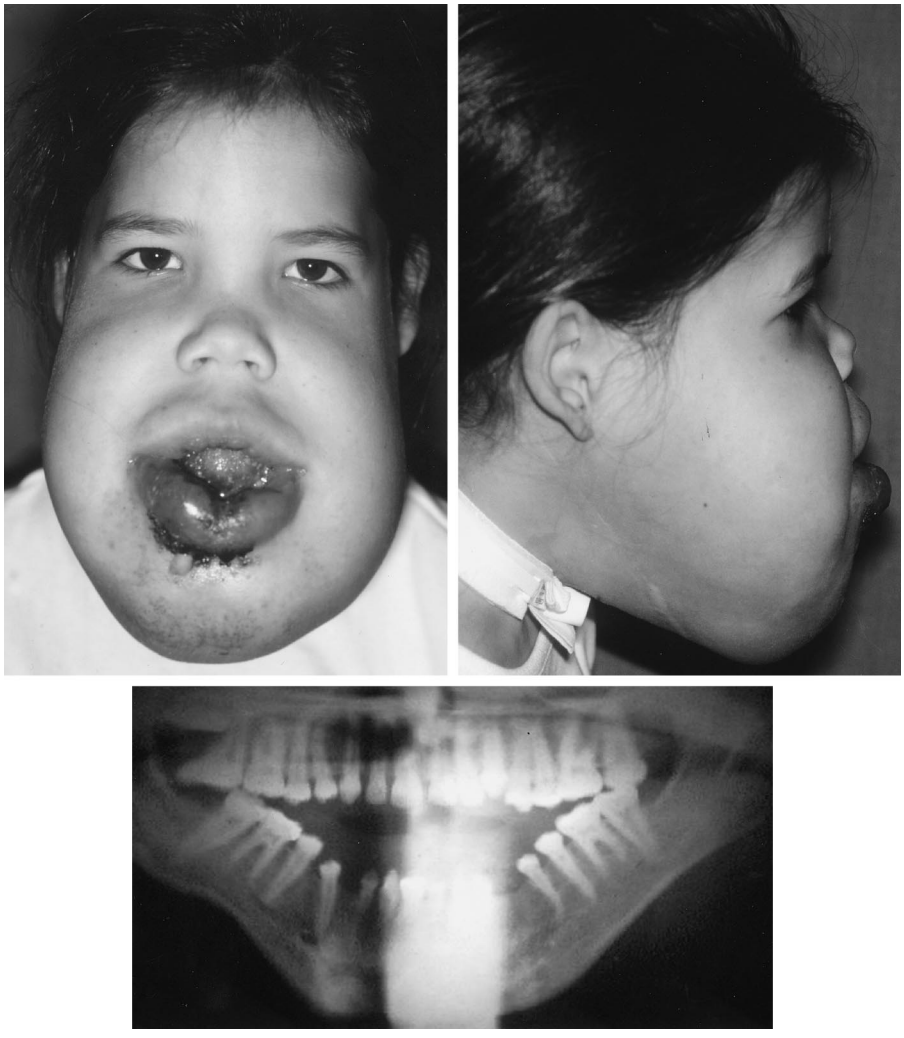

FIG. 4. Poor oral hygiene, gingival infection, and dental loss are common with lymphatic malformation of lingual base and oral floor. (*Above, left*) Seven-year-old girl with cervicofacial lesion and vesicles of the tongue, anterior sulcus, and lower lip. (*Above, right*) Lateral view demonstrates mandibular overgrowth. Note tracheostomy and cervical resection scar. (*Below, center*) Panoramic radiograph shows apertognathia, missing teeth, and mandibular overgrowth.

mainstay of management, but insufficient effort has been directed to removal of the abnormal tissue in the lingual base and floor of the mouth. Furthermore, following subtotal resection, lymphatic channels regenerate (lymphangiogenesis). Recurrence has also been ascribed to postoperative dilatation of persistent anomalous channels secondary to scarring and obstruction.[29]

Diagnosis and Evaluation

Cervicofacial lymphatic malformation is increasingly diagnosed by prenatal ultrasonography.[30–33] If the airway appears compromised, an ex utero intrapartum treatment should be considered for early assessment and management, as was necessary in one of our patients.[34–36] Most cervicofacial lymphatic malformations are obvious at birth or discovered in early infancy. A complete examination of the airway is required, including fiberoptic nasopharyngoscopy and laryngoscopy, to identify possible involvement of the hypopharynx, supraglottis, and glottis. Radiologic evaluation is essential to determine the extent of the lymphatic anomaly and proximity to vital structures. Ultrasonography typically demonstrates the multilocular cystic tissue without flow except in the septal areas. Computed tomography scan reveals a low-attenuated lesion with enhancement of the channel walls after injection of contrast.[37] Magnetic resonance imaging is the best radiologic technique for characterizing lymphatic malformation and typically shows cystic spaces and rim enhancement on T_1-weighted images after injection of gadolinium.[38–40] Lymphatic malformations can be categorized as macrocystic, microcystic, or combined macrocystic/microcystic lesions. Macrocystic lesions (defined as more than 5 mm diameter) are amenable to sclerotherapy, as well as resection.

Management: Immediate Considerations

Airway issues. The airway is the primary concern in an infant with lymphatic malformation involving the oral floor and lingual base. Signs and symptoms usually correlate with the extent of the lesion. There can be either extrinsic compression by the lymphatic anomaly or intrinsic involvement of the supraglottic region. Narrowing of the airway demands prompt recognition and treatment because a marginal airway can rapidly obstruct due to viral infection or intralesional bleeding. Tracheostomy is indicated for a compromised airway and performed by an ex utero intrapartum treatment procedure or in the first days of life.[41–43] Tracheostomy should be done without hesitation; this was necessary in more than one half of the children in this series.

Timing of resection. In the past, an infant with lymphatic malformation in the oral floor and lingual base often underwent resection in the first months of life. Most of these patients went on to have multiple procedures. In our series, one-fourth of these early cervical resections were associated with damage to a cranial nerve, particularly the hypoglossal and/or facial. Ideally, cervical resection should be performed electively and without time constraint. An experienced surgical team should be assembled early in the morning because these procedures require lengthy and tedious dissection.

The timing of resection is based on functional concerns as well as emotional issues. In the absence of supraglottic obstruction, staged cervical resection is indicated to relieve compression of the upper airway, in an effort to avoid tracheostomy. The dissection is easier if the infant is older (i.e., 6 to 12 months of age); waiting also minimizes anesthetic risk.[44,45] Resection should be scheduled before age 3 years, which is before development of facial image and memory. Secondary procedures may be necessary before school age for psychosocial problems. Typically, these patients need several interventions throughout childhood (Fig. 5). Two-thirds of patients in our series had repeated resections beyond the neonatal period. Orthognathic correction for anterior open bite secondary to overgrowth of the mandibular body and macroglossia usually is not undertaken until completion of skeletal growth.[46]

In planning cervical resection, a reasonable sequence is to dissect the more extensively involved side of the neck first, followed 6 to 12 months later by dissection of the opposite side. The sternocleidomastoid muscle should be preserved on a superiorly based pedicle, unless it is extensively infiltrated by the lymphatic anomaly. If magnetic resonance imaging studies show involvement of the oral floor, the cervical dissection should be extended medially to remove abnormal lymphatic tissue below the tongue. Transoral resection of the oral floor or lingual base should be avoided because of the high likelihood of postoperative functional problems. As in resection of any lymphatic malformation, the main postopera-

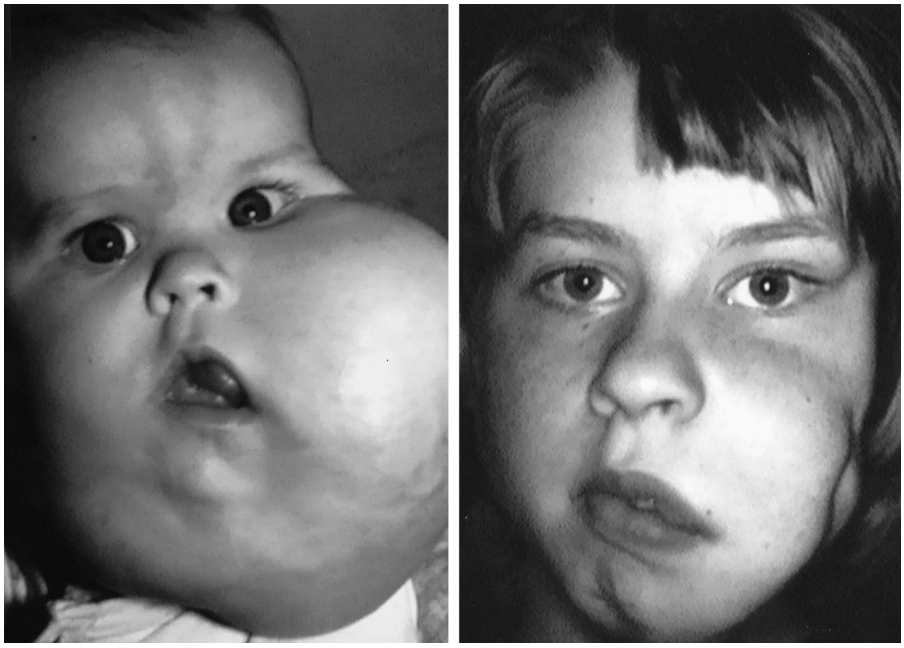

FIG. 5. (*Left*) Infant with large cervicofacial lymphatic malformation involving the lingual base and oral floor. (*Right*) Age 15 years following four soft-tissue and bony resections and free tissue transfer for lateral facial contour.

tive complications are infection, bleeding, and recurrence/re-expansion.

Management: Long-Term Considerations

Airway issues. The long-term management of the tracheostomy-dependent patient is a major concern. One-third of our patients were tracheostomy-dependent. They need a dedicated otorhinolaryngologist for frequent evaluation by direct laryngoscopy and bronchoscopy, combined with aggressive treatment of obstruction and attempts at downsizing and decannulation. Attention to development of speech and communication is essential. Decannulation has been shown to have a tremendous positive effect on quality of life.[47,48]

Competing goals. The concept of competing goals applies to the long-term planning of surgical procedures in the adolescent with central cervicofacial lymphatic malformation. Macroglossia is associated with mandibular hypertrophy and the development of anterior open bite and other malocclusions.[2,46] However, mandibular setback to correct prognathism/anterior open bite is likely to compromise the airway because of lingual retropositioning.[49,50] Thus, the outcome of mandibular setback to improve occlusion and facial appearance must be weighed against the potential for adverse effect on the airway. Similarly, debulking an enlarged and protruding tongue to return it to the oral cavity can have a negative effect on speech and feeding secondary to insufficient functional lingual mass. Overresection of the neck is another long-term problem.[46]

Infections. Over 80 percent of patients in this study had one or more bouts of infection, typically heralded by rapid increase in size of the tongue. This high infection rate is similar in other studies of patients with cervicofacial lymphatic malformation.[28,46] Broad spectrum antibiotic treatment should be given promptly whenever an infection is suspected and should be continued for weeks rather than for days. Blood cultures are rarely positive. Intravenous antibiotic administration is necessary if oral treatment fails or if there are signs of respiratory compromise. Regularly scheduled dental prophylaxis (every 4 months) is mandatory to minimize gingival inflammation caused by lymphatic malformation. Antibiotic prophylaxis is controversial; parents often find it to be useful, although most infectious disease specialists frown on the practice.

Management of the Tongue: Swelling, Bleeding, and Vesicles

Lingual resection should be avoided and undertaken only in certain circumstances. A solitary lesion located in the anterior tongue, without involvement of the lingual base/floor of the mouth, usually can be excised. In rare in-

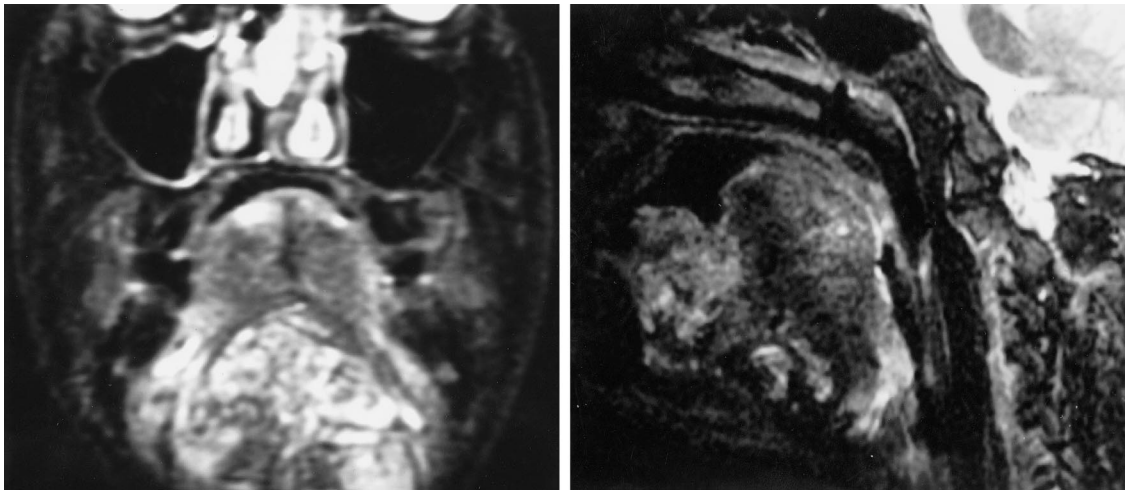

FIG. 6. (*Left*) Magnetic resonance image, coronal T2, of patient with lymphatic malformation of oral floor before sclerotherapy. (*Right*) Pretreatment sagittal magnetic resonance image.

stances, a large segment of the anterior (mobile) tongue must be removed to permit oral closure and minimize excoriation and traumatic irritation.[12] However, resection of the lingual base should be avoided because of the high likelihood of subsequent functional sequelae.

Sclerotherapy. There is an increasing role for sclerotherapy for macrocystic disease in the oral floor, especially as an alternative to resection (Figs. 6 through 8). However, if resection is necessary, we recommend this as the first stage followed by sclerotherapy for the residual/recurrent disease. Several sclerosant agents were used during the period of this review.[15,51,52] OK-432 can shrink macrocystic head and neck lymphatic malformation.[53–57] Absolute ethanol is also used for macrocysts and mucosal vesicles but must be injected with care near the hypoglossal and lingual nerves. Doxycycline is another effective sclerosing agent; it does not cause neural toxicity or stain the teeth.

Sclerotherapy can be used to shrink lymphatic malformation in the tongue and oral floor. Injection of contrast (before sclerosant) typically shows dilated, interconnecting lymphatic spaces or channels throughout the involved tissue. Therefor, the sclerosing solution will permeate throughout the lesion. In contrast, macrocystic lesions in the neck do not interconnect, so each cyst must be cannulated and injected separately (using ultrasonic guidance).

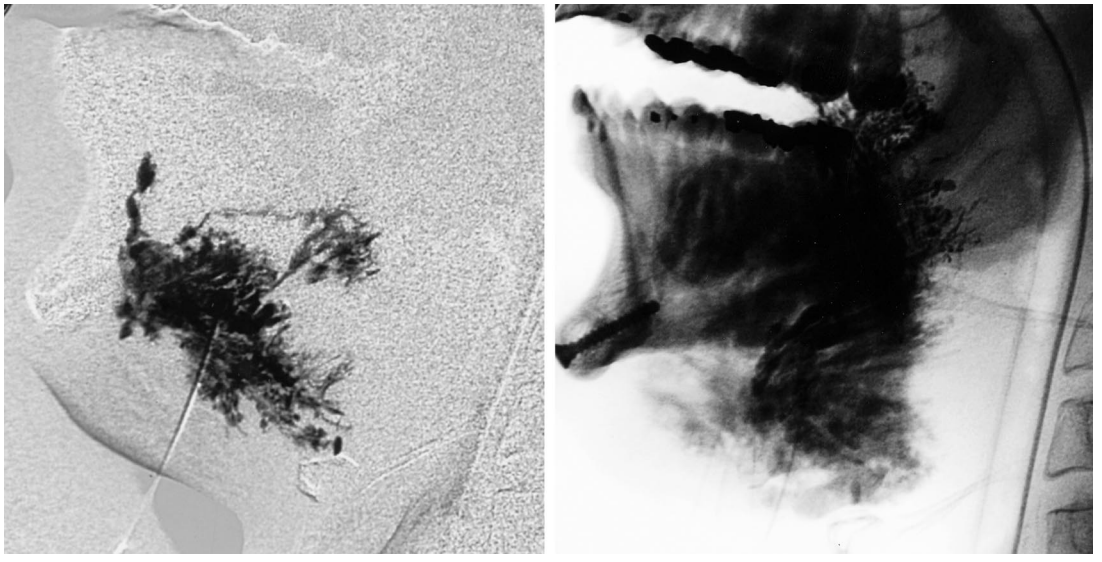

FIG. 7. (*Left*) Contrast injection of lymphatic malformation. (*Right*) Lateral radiograph after injection of opacified ethanol (same patient as shown in Fig. 6).

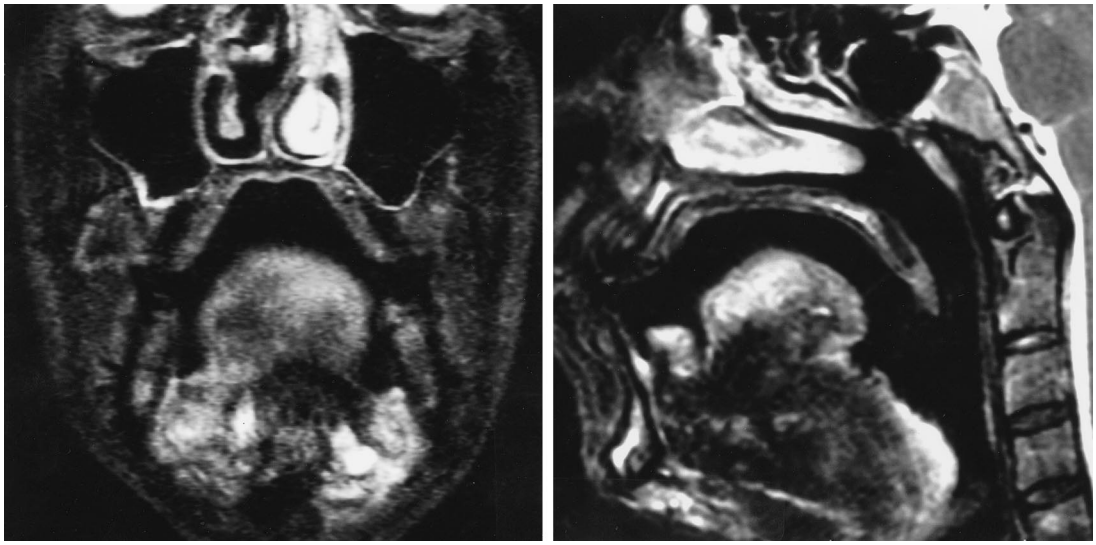

FIG. 8. (*Left*) Coronal magnetic resonance image shows diminished size of lingual base 2 months after sclerotherapy. (*Right*) Sagittal magnetic resonance image shows shrinkage and inferior position of tongue with expansion of the oropharynx. See Figure 6.

Embolization. Fluoroscopically guided embolization (coils or glue) is used to control recurrent lingual bleeding that can be traced to specific vessels in the oral floor. Usually the bleeding is a slow oozing from vesicular eruptions of the lingual surface, usually related to trauma or infection, and thus relegating a limited role for embolization. However, lingual arterial embolization can shrink a tongue with lymphatic malformation that has a capillary-lymphatic component.

Laser. Energy from laser light can be used to coagulate, vaporize, or cut malformed lymphatic tissue.[58–61] A "serpiginous" method of carbon dioxide laser application for lingual surface vesicles has been described.[62] Neodymium: yttrium-aluminum-garnet laser has also been used for lymphatic malformation in the oral mucosa.[63–65] The pulsed dye laser has been used to shrink lymphatic lesions that contain blood (venous component) but probably has little use for a pure lingual lymphatic anomalies.[66]

Intralesional bare fiber laser has been used for deep vascular lesions, either potassium-titanyl-phosphate, argon, or an Neodymium: yttrium-aluminum-garnet laser attached to a fiberoptic wand.[67] This approach may be helpful in conjunction with conventional surface laser therapy for deep and superficial lingual lymphatic lesions. It is difficult to draw conclusions concerning the long-term effectiveness of various laser techniques because many of the patients have had other treatments, usually lingual resection. Neodymium: yttrium-aluminum-garnet and carbon dioxide laser seems most appropriate for the bothersome vesicular oozing or for surface

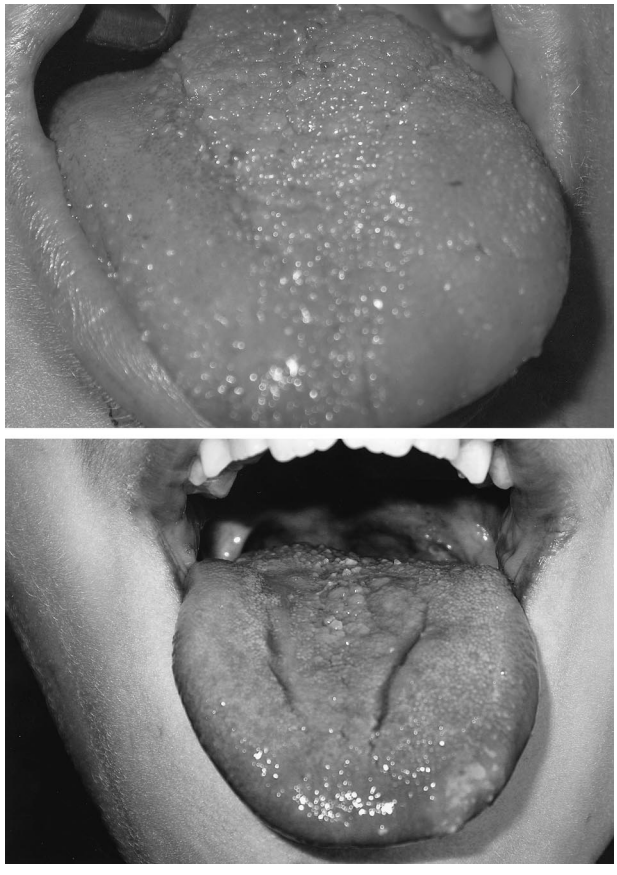

FIG. 9. (*Above*) Intraoperative photograph of patient with microcystic lymphatic malformation of tongue. (*Below*) Eight months after radiofrequency ablation.

bleeding that accompanies infection or minor trauma.

Radiofrequency ablation. This modality is similar to laser photocoagulation for treatment of mucosal vesicles. It has been shown to safely reduce lingual volume in a porcine model.[68] Radiofrequency ablation also is useful to control bleeding of lingual lymphatic malformation, secondary to infection or trauma. Our experience with 10 patients treated with radiofrequency has been promising. We also have used this same unit for resection of lymphatic malformation in the tongue and lip and for the treatment of mucosal vesicles (Fig. 9). Postoperative pain, swelling, and infection seem to occur less frequently in these patients; however, the follow-up period is too short to assess recurrence.

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