Laser ankyloglossia release: Implications for maxillomandibular growth

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The tongue is normally ankylosed to the floor of the mouth in utero. During fetal development, the ankylosed tongue is released from the floor of the mouth by apoptosis of the cells of the lingual frenum so that by the time of birth, the tongue is freely movable at one end. A critically important developmental anomaly - failed or incomplete apoptosis of the ankylosed tongue adversely affects growth of the face and jaws. This can have a significant impact on the growth and positioning of the infant's oral structures, leading to less than ideal maxillomandibular growth. Laser ankyloglossia release, performed as early as the second day of life, has the potential to prevent oral dysfunction and obviate the need for significant orthodontic therapy. (Semin Orthod 2020; 26:96–101)

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Less than ideal facial formation, jaw growth and development and airway patency, or as a general overall term, oral dysfunction, may have its beginnings before the birth of an infant, occurring as early as the fourth week through the twelfth week of fetal development. During this period the tongue and hard palate begin to form. As the tongue develops and the cells that form the membrane between the floor of the mouth and the underside of the tongue (the lingual frenum) remain connected to the tip of the tongue, normal function and mobility of the tongue can be adversely affected.

Normally, the cells that create this attachment are preprogrammed to undergo apoptosis, which allows the frenum attachment to migrate distally from the tip of the tongue towards the base of the tongue, permitting the tongue to move freely.[1] Placing even a slight limitation on the tongue's functional movements can set up a cascading series of events that can affect the infants' oral structural formation, maxillomandibular growth, and overall body growth and development for a lifetime. Figs. 1–4 illustrate ankyloglossia at various stages of life. Fig. 5 illustrates a significant change in the shape of the tongue immediately after ankyloglossia release. Since the growth and development of oral structures begins in utero, many significant developmental anomalies can have their origins when the tongue continues to be ankylosed during the embryonic development of the face and jaws.

The desired effect in utero of timely apoptosis of the lingual frenum allows the tongue to elevate and aid in spreading the maxillary arch laterally as it grows. This action of the free tongue prevents the formation of a high vault in the maxillary arch. If the frenum is ankylosed, the result will be a patient with constriction of the upper jaw. This creates the potential for significant orthodontic problems and treatments, including requiring palatal expansion. In addition, the maxillary arch not only forms the roof of the mouth but also the floor of the maxillary sinuses. A high-vaulted, V-shaped palate results in significant narrowing of the nasal airway, resulting in decreased volume of air passing through the nose and nasopharynx, as well as decreased volume of the maxillary sinus. Patients with airway problems generally present with a narrow, V-shaped maxillary arch, and a high palatal vault leading to reduced oxygen flow and possible sleep apnea.[2]

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1073-8746/12/1801-$30.00/0

https://doi.org/10.1053/j.sodo.2020.06.004

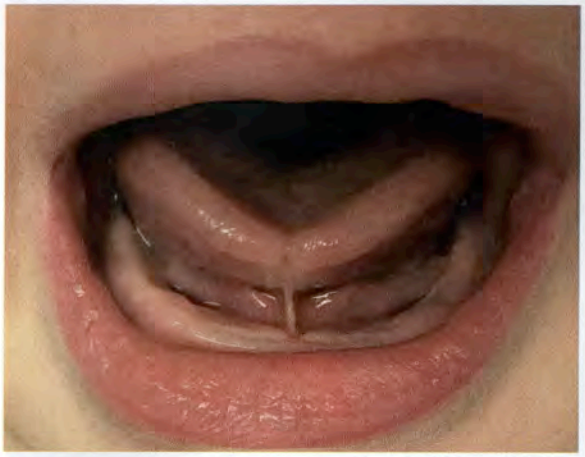

Fig. 1. Newborn infant with ankyloglossia.

Fig. 2. Toddler with ankyloglossia.

Fig. 3. Youth with ankyloglossia.

Fig. 4. Adult with ankyloglossia.

Ankyloglossia can also result in reduced maxillary and mandibular intercanine widths and reduced maxillary intermolar width. According to Moss's functional matrix concept,[8] nasal breathing allows proper growth and development of the craniofacial complex. Thus, continuous airflow through a properly formed nasal passage unimpeded by a V-shaped palatal vault induces a constant stimulus for the lateral growth of the maxilla and for lowering of the palatal vault.[4] When the tongue is free to rest in the palatal vault area, it aids in preventing the maxillary arch from constricting inward.

The position of the mandible and the patency or degree of constriction of the child's airway is of extreme importance and needs to be considered in diagnosing these malocclusions.

In newborn infants, studies have shown that an infant's brain is growing at a rate of one percent per day in the first 90 days. Scientists at the University of California scanned the brains of 87 healthy babies from birth to three months. The most rapid changes in brain growth occurred immediately after birth - newborn brains grew at an average rate of 1% a day. This slowed to 0.4% per day at the end of the 90-day period.[5]

This is a critical time for growth for the brain, and if oxygen flow to the brain is reduced due to an obstruction such as the ankylosed tongue resting in the airway, and/or a V-shaped palate

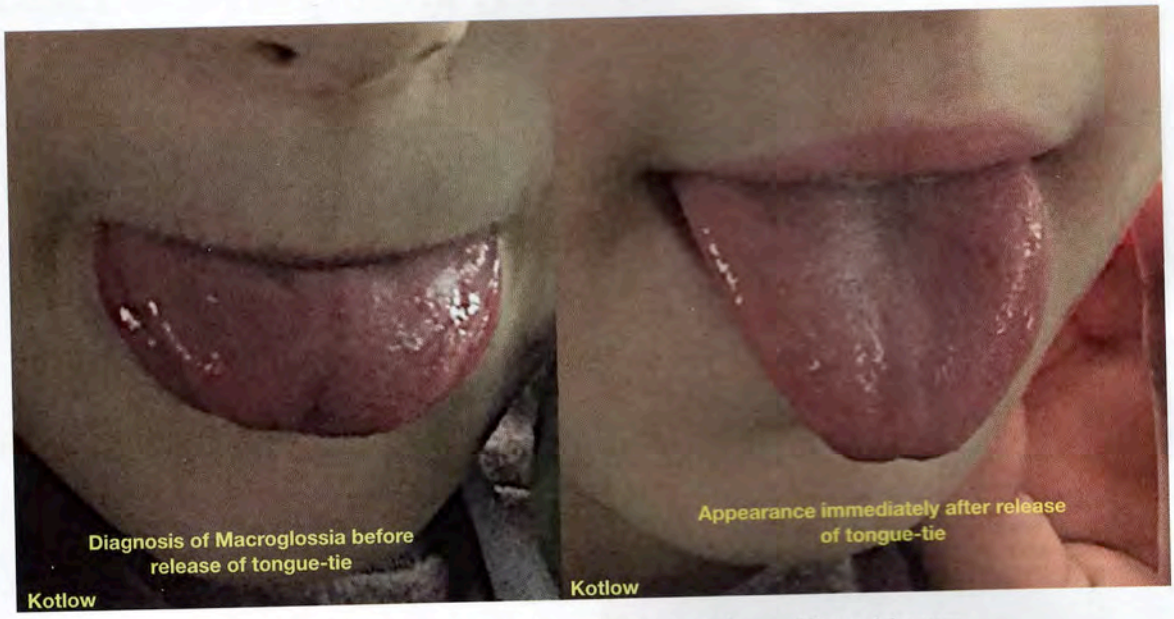

Fig. 5. Appearance of tongue before and after release of lingual frenum.

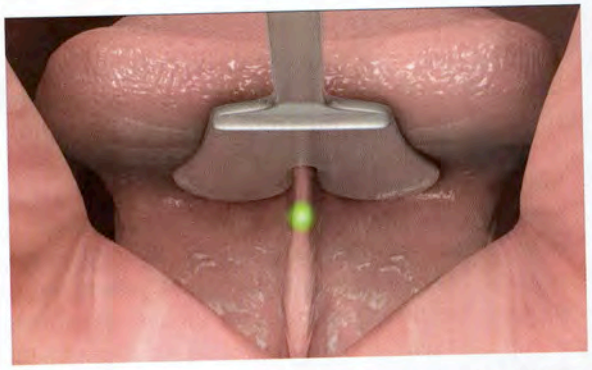

Fig. 6. Placement of laser beam in center of frenum.

Fig. 7. Laser incision.

reducing airway volume, oxygenation of the growing brain may be interfered with. Children diagnosed with ADHD or ADD, may in fact have a problem that has as one of its etiological factors reduced air flow from an ankylosed tongue, along with other structures compromising the airway, such as enlarged tonsils and adenoids. In the mid 1900s, children routinely had their tonsils and adenoids removed. Towards the end of the 20th century, the pendulum swung the other way and the number of tonsillectomies and adenoidectomies decreased, with a concomitant increase in the number of children diagnosed with ADD and ADHD. It may be reasonable to consider ADHD as secondary to a medical condition such as OSA before a diagnosis of primary ADHD is considered[6]

Children who breath through their mouths due to airway blockage may be more prone to crowded dentitions, and malocclusions due to less than ideal maxillary and mandibular jaw development. The ankylosed tongue should be considered an important component and contributing cause of these problems. The unrestricted tongue fills a significant portion of the oral cavity. When the tongue is tethered and cannot spread laterally, it may appear to be overly large, bunch up and thus position itself into the child's airway, as well as contribute to the reduced maxillary intercanine width. This may incorrectly be diagnosed as macroglossia

and could be identified as the cause for speech disorders, obstructive sleeping apnea as well as food texture issues, including choking and gagging on solid foods.[7] Releasing the tethered tongue will allow the tongue to elongate naturally, resolve the bunching of the tongue, and allow proper resting position behind the maxillary incisor teeth. This will permit the tongue to move food around the oral cavity allowing correct mastication and swallowing of food. The previously observed large tongue volume resting in the oral cavity will often seem to disappear and the tongue will now appear normal once the release of the frenum is completed. This reduction in apparent size can be of considerable assistance for treatment for Class III skeletal malocclusion, severe open bite and bimaxillary dentoalveolar protrusion.[8,9] During growth and development of the upper and lower jaws, lack of proper tongue positioning, lack of proper nasal breathing, accompanied by poor or no lip seal can be significant factors in creating abnormal imbalances of the midface and jaw development. When the tongue is not able to rest behind the upper front teeth, the jaws cannot develop properly.

During oral examination of children who present with a variety of malocclusions, many similar traits may be observed. These children often present with the long elongated face symptomatic of a mouth breather, a narrow high arched palatal vault, circles under their eyes due to lack of restful sleep, flattened facial profile, and occasional history of headaches and other symptoms.

Orthodontic care should include as part of the diagnostic evaluation and treatment planning of the developing dentition the optimization of the airway for every patient. This is the concept behind Airway Centric®[10] This philosophy involves understanding how lack of forward growth of the entire lower face can reduce the airway size, with the result of impacting one's ability to breathe easily both night and day.

Treatment approaches that move the mandible forward are more appropriate than those that would restrict the development of the maxilla and/or retract the maxilla. Thus, one of the many issues the orthodontist needs to include in the examination and health history is how the tongue may be part of a larger problem and make sure the ankylosed tongue is released. During airway-centric treatment of these children changes in their facial appearance appeared to be significantly more pleasantly esthetic.[10,11,12,13] Understanding this concept of the face developing forward, thus dragging the maxilla and mandible forward along with the soft palate and tongue, achieving forward movement of the hard tissues of the face not only improves the malocclusions but also equally importantly opens the airway.

During the Middle Ages, a midwife using a sharp fingernail completed the release of the ankylosed tongue. As our understanding of infection control increased, and medicine evolved into a profession, this practice was superseded by physicians using blades/scissors/scalpels

Today, there are three ways to release a frenum:

a) Steel blade (scissors/scalpel)

b) Electrosurgery/radiosurgery

c) Laser

A blade cuts tissue with no ability for hemostasis, and requires the incised area to heal via the body's inflammatory response to the surgical insult. Electrosurgery/radiosurgery is an electric burn. In the hands of a skilled practitioner, either can result in a satisfactory outcome; however, with today's technology, the use of lasers should be the standard of care for this procedure.

The keys to successful laser surgery require the practitioner to be knowledgeable in laser physics, lasers safety, laser-tissue interaction, as well as a complete understanding that not all lasers work in the same manner, with widely varying results in speed, precision, and healing.[14] In the author's opinion, the optimal laser for release of the attachments is an all tissue or soft tissue only carbon dioxide laser. Other options, with some limitations, include members of the diode or erbium family of all tissue or soft tissue lasers.[15,16]

The technique the author recommends for release of the lingual attachment involves beginning the incision in the middle of the frenum as the tongue is elevated using a grooved tongue director or similar instrument. Fig. 6 illustrates the correct placement of the laser beam at the start of the incision and Fig. 7 illustrates the beginning of the laser ankyloglossia release. The incision is actually a dissection of the mucosal membrane and should not usually require incising the genioglossus

muscle during the release. It is recommended both prior to and after revisions the patient receive instruction in myofunctional therapy to help prevent the tongue from healing back to its original attachment and help it adjust to its new freedom of movement. Healing will normally take approximately 10–14 days. In addition to the use of a surgical laser, the author also recommends pretreating the area with topical anesthetic and a photobiomodulation laser (also know as a soft laser, cold laser, low level laser, or therapeutic laser) to aid in obtaining some analgesia at the site. In many cases this may eliminate the need for using a local anesthetic[17]. The advantages of lasers were well documented by Wigdor[18] . They include:

a) Dry and bloodless surgery
b) Instant sterilization of the surgical site
c) Reduced bacteremia
d) Reduced mechanical trauma

Fig. 8. Ankyloglossia.

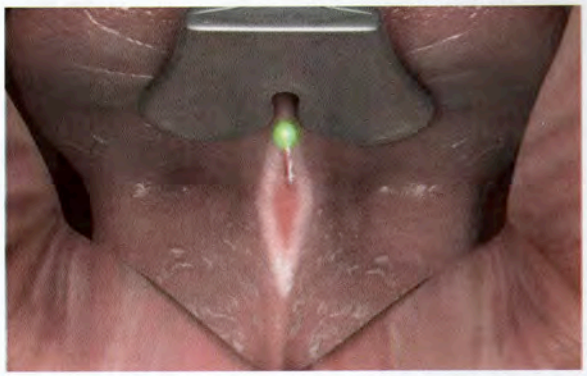

Fig. 9. Laser placed for incision.

Fig. 10. Completed release.

Fig. 11. One week post surgery.

e) Minimal postoperative swelling and scarring
f) Minimal postoperative pain

Figs. 8–11 Surgical release of lingual frenum using the 9300 nm Carbon Dioxide laser.

Conclusion

Chronic mouth breathing, obstructive sleep apnea or sleep disordered breathing due to the ankylosed tongue are significant problems, which may affect growth and development of the maxillary and mandibular arches, hard palatal growth and

Fig. 12. Two years post surgery.

development, maxillary sinus obstruction, and/or a primary disorder of muscular or connective tissue dysfunction.[19–21] Continuation of mouth breathing after adenotonsillectomy and palatal expansion may lead to recurrence of sleep disordered breathing in adolescence and adulthood. The ankylosed tongue needs to be considered as a significant factor in many orthodontic malocclusions due to the effect it may exert on tongue position in the child's airway and mouth. Laser ankyloglossia release, performed as early as the second day of life may prevent many of these problems.

Declaration of Competing Interest

None.

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