Ankyloglossia (tongue tie) is a congenital oral anomaly characterized by an abnormally short lingual frenulum. Partial fusion or in rare cases total fusion of the tongue to the floor of the mouth due to an abnormality of the lingual frenulum (Kummer, A. 2005, Dec 27). Believed to limit the range of motion of the tongue, impairing the ability to fulfill its function.
Ankyloglossia

Short Frenulum

- By definition, a frenulum is a narrow fold of mucous membrane connecting a moveable part to a fixed part.
- As such, it can help to stabilize the base of the tongue but does not interfere with tongue tip movement.
- With Ankyloglossia, however, the lingual frenulum has an anterior attachment near the tip of the tongue and may also be unusually short.
- This causes virtual adhesion of the tongue tip to the floor of the mouth and can result in restricted tongue tip movement.

Clinical assessment of Frenulum

- Attachment of the frenum to the tongue should normally be approximately 1 cm posterior to the tip
- The frenulum’s attachment to the inferior alveolar ridge should be proximal to or into the genioglossus muscle on the floor of the mouth
Why would Limited tongue mobility matter?

Tongue is an important oral structure that is essential in:

- Position of teeth
- Periodontal tissue health
- Swallowing and nursing
- Mastication and Deglutition
- Forming words during speaking
- Squeezing food into the pharynx
- Taste

Development of the Tongue

- Begins at GA 4 weeks
- Localized proliferation of the mesenchyme results in formation of several swellings in the floor of the oral cavity

- Oral part (anterior two-thirds) develops from the fusion of two distal tongue buds or **lateral lingual swellings** and a **median tongue bud** (tuberculum impar)

- Pharyngeal part or root of the tongue (posterior one-third) develops from the **copula** and the **hypobranchial eminence** (forms from the 2nd, 3rd, and 4th branchial arches)

- Fusion of the two (adult = terminal sulcus)

- Muscles of the tongue arise from **occipital somites** which migrate into the tongue area
Embryology
• During tongue’s development it is fused to the floor of the mouth
• The frenulum is left as the only remnant of the initial attachment
• Ankyloglossia is the result of a short fibrous lingual frenulum or a highly attached genioglossus muscle

Anatomy
• Tongue highly mobile organ made up of longitudinal, horizontal, vertical and transverse intrinsic muscle bundles
  Intrinsic muscles fan-like genioglossus inserted into the medial part of the tongue
  Extrinsic Muscles Styloglossus & hyoglossus inserted into the lateral portions
• Sublingual and Submandibular ducts travel in the anterior floor of the mouth and terminal junction is at the base of the frenulum
Ankyloglossia

- Incidence Varies widely based on study
- Ranges between 0.02% to 5%  (Kupitetzy, botzer, Pediatric dentistry, 27:1, 2005)
- 1.7%-4.8% (Deshmukh V. Pediatric On Call 2007)
- 4.8% Messner et al. Arch Otolaryngl Head Neck surgery/ Vol 126, Jan 2000
- Male to female ratio is 3:1 with no racial predilection
- Associated with Opitz syndrome, orofacialdigital syndrome, beckwith-Wiedemann syndrome

Features of Newborns affected by Ankyloglossia

Features of 36 Newborns affected (Messner et al.)

Sex M/F 24/12 (50%)
First born 8 (42%)
Race: Hispanic 18/Caucasian 8/Pacific Islander 5/Asian 4
Ankyloglossia Mild 23 (64%) Moderate 13 (36%)
Frenulum Thin 32 (89%) Thick 4 (11%)
Notched Tongue 8 (22%)
Differential Diagnosis

- Bifid tongue
- Oral Ranula
- Congenital furrowing
- Macroglossia
- Lymphatic Malformations
- Lingual thyroid

An infant with Ankyloglossia will look different on exam than an older child with the same condition

Criteria to Diagnose Ankyloglossia

<table>
<thead>
<tr>
<th>STUDY</th>
<th>YEAR</th>
<th>N</th>
<th>COUNTRY</th>
<th>TYPE OF STUDY</th>
<th>DIAGNOSTIC METHOD</th>
<th>DAYS POSTNATUM</th>
<th>PREVALENCE 95% C.I. (CONFIDENCE INTERVAL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measner et al.²³</td>
<td>2000</td>
<td>1041</td>
<td>United States</td>
<td>Prospective trial</td>
<td>None; subjective impression with clinical correlate</td>
<td>Not applicable</td>
<td>50 (40) (36-63)</td>
</tr>
<tr>
<td>Ballard et al.²⁴</td>
<td>2002</td>
<td>8036</td>
<td>United States</td>
<td>Uncontrolled case series</td>
<td>Hazeltine's assessment tool²⁵ for lingual frenulum function</td>
<td>2-3</td>
<td>122 (4.5) (3.3-4.8)</td>
</tr>
<tr>
<td>Griffith²⁶</td>
<td>2004</td>
<td>521</td>
<td>United Kingdom</td>
<td>Prospective uncontrolled cohort study</td>
<td>None; subjective impression with clinical correlate</td>
<td>18</td>
<td>All patients in study had ankyloglossia</td>
</tr>
<tr>
<td>Hogan et al.²⁷</td>
<td>2006</td>
<td>1866</td>
<td>United Kingdom</td>
<td>Randomized controlled trial</td>
<td>None; subjective impression with clinical correlate</td>
<td>3-70 (median 10)</td>
<td>148 (4.24) (1.3-7.42)</td>
</tr>
<tr>
<td>Richè et al.²⁸</td>
<td>2005</td>
<td>3480</td>
<td>United States</td>
<td>Case-control study</td>
<td>Hazeltine's assessment tool²⁵ for lingual frenulum function</td>
<td>Both 1 and 30 days</td>
<td>148 (4.24) (1.3-7.42)</td>
</tr>
</tbody>
</table>
Evaluation of the Frenulum

Lalakea recommended measuring lingual mobility in children and tongue elevation to document and define the degree of restriction and AG.

Mobility is evaluated by measuring in mm the tip of the tongue extended past the lower dentition.

Elevation is measured by recording interincisal distance with the tongue tip maxillary elevated and in contact the upper teeth.

- Typically children with AG have protrusion and elevation values of 15 mm or less; 20-25 mm is normal range.

Classification of Ankyloglossia

**Free tongue**: length from the inside of the lingual frenulum at the base of the tongue to the tip of the tongue.

Clinically acceptable normal range of the free tongue is minimum of **16 mm**.

Kotlow Assessment (American specialist pediatric dentistry)

A group of 322 children ranging from 16 months to 14 years were examined for the length of free tongue and evaluated for clinical evidence of speech and oral problems; Assessment of these measurements resulted in the development of the above descriptions/categories of Ankyloglossia.
Ankyloglossia Classification

Kotlow Assessment

Class I: Mild 12-16 mm
Class II: moderate 8-11 mm
Class III: severe 3-7 mm
Class IV: complete <=3 mm

Structural Guidelines

The tongue should not place excessive forces on the mandibular anterior teeth
the lingual frenum should allow a normal swallowing pattern

The lingual frenum should not create a distemia between the mandibular central incisors

In infants the underside of the tongue should not exhibit abrasion

The frenulum should not inhibit latching on during feeding

Children should not exhibit speech difficulties associated with limitations of the movement of the tongue

Tongue Tie Assessment Protocol (TAP) Tongue-tie “From Confusion to Clarity”
Hazelbaker
The Assessment tool for Lingual Frenulum Function

- Most commonly used by lactation consultants
- Difficult to implement in busy clinic
- Score based on:
  - Functional Items: lateralization/Lift of Tongue/Extension of Tongue
  - Appearance Items: Appearance when lifted/Elasticity/Length of lingual frenulum when lifted

Diagnostic Characteristics
Inability to protrude the tongue past the edge of the lower gingiva or mandibular incisors.

With protrusion attempts, the tongue tip becomes notched in midline, resulting in a heart-shaped edge.

In addition, the patient is unable to touch the roof of the mouth with the tongue tip when the mouth is open.
Evaluation of Patient with Ankyloglossia

**Maternal Factors**
- Pain/nipple injury, blocked ducts/mastitis during breastfeeding

**Infant Factors**
- Poor weight gain, vomiting, gagging, gas, burping

**Child Factors**
- Lack of lingual mobility which affects speed and accuracy of tongue movements
- Eating difficulty caused by poor coordination of oral musculature
- Dental problems which are severe and wide ranging

Preschool/School age Patient

- AG does not prevent or delay the onset of speech, but may interfere with Articulation
- Simple speech articulation test: If the tip of the tongue is restricted, the articulation of l or tongue sounds such as t “d” “th and s” may not be accurate
- If a child can correctly articulate the above sounds but has other speech challenges, a speech pathology evaluation vs. frenulectomy is suggested
To Clip or Not to Clip: That is the Question?

Controversy

Messner and Lalakea (2000) found that 60% of ENTs, 50% of SLPs, and 23% of pediatricians believed that Ankyloglossia is likely to cause speech problems.

No consensus among practitioners regarding the significance of a short frenulum and its management.
Possible issues from a Short Frenulum

- **Feeding problems**: 25% of newborns with a short frenulum
- **Dentition**: pulling effect on the gingiva away from the teeth and even a cause for mandibular distemia; Usually occurs after age 8-10
- As the child gets older the may have difficulty moving a bolus in the oral cavity and clearing food from the sulci and molars. This can lead to chronic halitosis and dental decay
- **Cosmetic**: looks abnormal and tongue has a forked or serpentine look
- **Speech**: usually /L/ sounds and interdentally sounds like /th/ are affected because of the restricted movement of the lip

Functional Effects of Ankyloglossia

The functional effects

- **Feeding problems**. The literature on Ankyloglossia primarily deals with potential difficulty with breast feeding (Nicholson, 1991; Jain, 1995; Fitz-Desorgher, 2003; Ricke et al., 2003). Range 15-25% of newborns with Ankyloglossia will have trouble with nursing
Ankyloglossia and Lactation

- Prospective study: Majority are able to breastfeeding, 25% will experience
- Feeding difficulties
- Latching issues
- Prolonged maternal pain
- Do not have problems with the bottle—Ankyloglossia should not deter parents from breastfeeding
- Tongue movement evaluations using U/S has demonstrated that in breastfeeding vs. bottle feeding infant tongue is projected further forward

Lactation and Ankyloglossia

- Messner et al. Arch of Otolaryngology-Head and Neck Surgery:
  - 50 Newborns with Ankyloglossia
  - 83% successful lactation with no intervention vs. 92% of parents with infants with no Ankyloglossia
  - Breastfeeding difficulties in 9 (25%) of the Ankyloglossia parents vs. 1 (3%) of the control Mothers during a minimal 2 month follow up
  - Thus early weaning not substantiated by these results; subgroup (25%) with difficulties had no correlation b/n grade of Ankyloglossia and incidence of BF difficulties
Functional Effects of Ankyloglossia

Dentition. If the lingual frenulum is attached high on the gingival ridge behind the lower mandibular incisors, it can pull the gingiva away from the teeth and even cause a mandibular diastema. However, this is usually not a problem until age 8-10.

Functional Issues with Ankyloglossia

- Cosmetics and personal interactions. There is no doubt that Ankyloglossia may look abnormal and has even been described as a forked or “serpent” tongue.
- There can also be difficulty in social interactions.
Through the centuries assumed that if the tongue tip cannot move well due to Ankyloglossia it must effect speech

In fact, this is even mentioned in the Bible. In Mark 7:35, it says “… and the bond that tied his tongue was loosed, and he talked plainly.” Despite the common belief of this effect, there is no empirical evidence in the literature that Ankyloglossia typically causes speech defects.

On the contrary, several authors, even from decades ago, have disputed the belief that there is a strong causal relationship (Wallace, 1963; Block, 1968; Catlin & De Haan, 1971; Wright, 1995; Agarwal & Raina, 2003).

In addition, there are very few other articles in the literature that even address the effects of tongue-tie on speech.

Certainly, children with Ankyloglossia are often found to have no speech problems. So how is this possible?

Lingual-alveolar sounds (t, d, n) are produced with the top of the tongue tip and therefore, they can be produced with very little tongue elevation or mobility. The /s/ and /z/ sounds require the tongue tip to be elevated only slightly, but can be produced with little distortion if the tip is down.

The most the tongue tip needs to elevate is to the alveolar ridge for production of an /l/, /th/.
Speech and Ankyloglossia

- In their study, 9 out of 15 patients showed "improvement" in speech after frenulectomy. However, many months went by between the pre- and post-operative assessments.

- No information on the types of disarticulations noted preoperatively.

- Finally, the authors admitted that they used a relatively small and disparate study group.

- In addition, they noted that they did not use a standard speech sample, and that multiple SLPs performed the assessments, which were not blinded. Therefore, the results of this study should be considered with caution.

Speech & Ankyloglossia

- In evaluating the effect of Ankyloglossia on speech, therefore, it is important to focus on lingual-alveolar sounds (particularly /l/) and interdental sounds (voiced and voiceless /th/).

- Tongue-tie could be considered a contributing factor if the child cannot produce these sounds, even with the alternate placement noted above, and all other speech sounds are produced normally.

- Tongue tie may also be a bigger problem if there is oral-motor dysfunction as well.
Articulation

- Retrospective Review (Haber et al. Can tongue tie cause dysarticulation? Nov 2008)
- 11 children with articulation problems who underwent frenuloplasty, 9 improved significantly
  What is not clear is whether these articulation problems can be overcome without intervention?

No clinical scale available sensitive enough to relate length of the frenulum and articulation difficulties

No tool in predicting which kids will develop speech/mechanical problems

Most Children with articulation problems speech therapy is indicated and often all that is required.

When is Ankyloglossia a problem that needs treatment?

Feeding - A new baby with a too tight frenulum can have trouble sucking and may have poor weight gain. Such feeding problems should be discussed with your child’s pediatrician who may refer you to an otolaryngologist—head and neck surgeon (ear, nose, and throat specialist) for additional treatment.

NOTE: Nursing mothers who experience significant pain while nursing or whose baby has trouble latching on should have their child evaluated for tongue tie. Although it is often overlooked, tongue tie can be an underlying cause of feeding problems that not only affect a child’s weight gain, but lead many mothers to abandon breast feeding altogether.

Around the age of three, speech problems, especially articulation of the sounds l, r, t, d, n, th, sh, and z may be noticeable. Evaluation may be needed if more than half of a three-year-old child’s speech is not understood outside of the family circle. Although, there is no obvious way to tell in infancy which children with Ankyloglossia will have speech difficulties later, the following associated characteristics are common:

- V-shaped notch at the tip of the tongue
- Inability to stick out the tongue past the upper gums
- Inability to touch the roof of the mouth
- Difficulty moving the tongue from side to side

As a simple test, caregivers or parents might ask themselves if the child can lick an ice cream cone or lollipop without much difficulty. For older children with tongue-tie, appearance can be affected by persistent dental problems such as a gap between the bottom two front teeth.
Treatment of Ankyloglossia

If the child demonstrates any of the problems noted above, a frenulectomy (surgical release of the tongue) can be done. In past times, midwives used a sharpened fingernail to slit the frenulum immediately after birth.

Infant Frenulectomy

- Frenulectomy can be done in the office with no anesthetics. In older children, the operation requires general anesthesia to ensure adequate cooperation from the patient to gain access to the floor of the mouth to perform the procedure.

- The frenulum is divided with scissors or with electrocautery. The band is thin, and generally requires no sutures.

- The procedure takes only a few minutes to perform. Tongue mobility is generally adequate to prevent adhesions from forming that may again limit tongue mobility.
Treatment

- Frenotomy technique: Defined as cutting/division of the frenulum may be accomplished with topical anesthetic and minimal discomfort to the infant.

Frenulectomy with closure

- Older Children
- Thick/vascular Frenulum may require sutures/z-plasty
- This “Z-plasty” minimizes the risk of scar formation. Risks of frenulectomy are very low, but may include pain, minor bleeding, or infection.
Frenectomy

- Defined as the excision or removal of the frenum; Preferred procedure for patients with a thick and vascular frenulum where bleeding may be a possibility and or concern for scar tissue; wound is sutured closed; Done With GMA

Effectiveness of frenotomy for Infants

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>n</th>
<th>Type of Study</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopkins et al.</td>
<td>2005</td>
<td>1881-301 with ankyloglossia, 6 had frenotomy</td>
<td>Randomized controlled trial</td>
<td>54/55 had improved breast feeding mechanics and reduced nipple pain with frenotomy; 79% improved immediately and an additional 14% improved within 48 h.</td>
</tr>
<tr>
<td>Griffiths</td>
<td>2004</td>
<td>519 had frenotomy (375 were &lt;3 mo)</td>
<td>Prospective uncontrolled cohort study</td>
<td>129/215 (59.9%) had improved by day 1; 179/215 (83.3%) had improved by 3 days; 130/215 (60%) were still breastfed at 3 weeks.</td>
</tr>
<tr>
<td>Ballard et al.</td>
<td>2003</td>
<td>3030: 125 with ankyloglossia; 26 had frenotomy</td>
<td>Uncontrolled case series</td>
<td>Decreased mean maternal pain score from 6.8 (± 3.3) to 1.2 (± 1.3); increased comfort by 3/7/4 breastfeeding mechanics</td>
</tr>
<tr>
<td>Muxitis and Kemple</td>
<td>1996</td>
<td>3450: 76 had frenotomy</td>
<td>Case report</td>
<td>33/35 (94%) were breastfeeding 1 wk after procedure; 32/35 (94%) had normal tongue mobility; 24/35 (69%) had appropriate growth at 3 mo; 34/35 (99%) reported normal elimination; 1/35 (30%) continued breastfeeding; 35/35 (100%) were weaned early due to breastfeeding problems</td>
</tr>
<tr>
<td>Norey et al.</td>
<td>1990</td>
<td>12: 7 had frenotomy</td>
<td>Case report</td>
<td>57% had improved latch and decreased nipple pain and had restored mean weight gain and milk supply difficulties; 10% had improved suck dynamics and 17% showed no improvement</td>
</tr>
<tr>
<td>Ribe et al.</td>
<td>1990</td>
<td>3: 2 had frenotomy</td>
<td>Case report</td>
<td>1 showed improved sucking, and weight gain normalized; 1 developed a lip</td>
</tr>
<tr>
<td>Norey et al.</td>
<td>1990</td>
<td>2: 2 had frenotomy</td>
<td>Case report</td>
<td>1 mother had increased nipple comfort and less nipple tissue; 1 had increased comfort, and nipple distortion was resolved</td>
</tr>
</tbody>
</table>
Frenotomy Results Reviewed

- 7 Studies: poor methodological quality; Only one: randomized controlled trial
- All showed significant improvement in recorded outcomes after frenotomy
- None described serious complications
- In prospective nonrandomized cohort study, 80% had improved feeding 1 day after frenotomy

Conclusion:

- Ankyloglossia is an uncommon oral anomaly that can cause difficulty with breastfeeding, speech articulation, and mechanical tasks. For many years, the subject of Ankyloglossia has been controversial, with practitioners of many specialties having widely different views regarding its significance.
- In many children, Ankyloglossia is asymptomatic; the condition may resolve spontaneously, or affected children may learn to compensate adequately for their decreased lingual mobility. Some children, however, benefit from surgical intervention (frenotomy or frenuloplasty) for their tongue-tie.
- Parents should be educated about the possible long-term effects of tongue-tie while their child is young (< 1 year of age), so that they may make an informed choice regarding possible therapy.
- Early intervention is ideal since it avoids habit formation and negative effects of failure, whether it is due to messy/slow eating/funny looking teeth/self-esteem/speech problems.