

# Restrictive symptomatic tongue tie as a symptom transducer

Symptoms of ankyloglossia in infants, children, adolescents, and adults

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## ABSTRACT

The restrictive symptomatic lingual frenulum can lead to changing symptoms, compensations, and dysfunctions throughout life and is therefore referred to as a symptom transducer. The article explains the embryology, histology, anatomy, and prevalence of symptomatic ankyloglossia (also known as tongue tie). Classification systems and anatomic divisions are discussed, and checklists for recording and documenting symptoms are presented. Symptoms in infants, children, adolescents, and adults with limited tongue mobility are highlighted.

*Keywords:*

*Frenotomy, Breast feeding, Speech therapy, Tongue movement, Ankyloglossia*

**Citation:** Moghtader D (2024) The restrictive symptomatic lingual ligament as a symptom transducer - symptoms of ankyloglossia in infants, children, adolescents and adults. Oral Prophylaxis Paediatric Dentistry - 46: 47-58 - <https://doi.org/10.1007/s44190-024-1011-z>  
Submitted: 29.10.2023 / Accepted: 06.12.2023 / Published online: 07.03.2024 - © German Society of Paediatric Dentistry (DGKiZ) 2024

## LEARNING OBJECTIVES

After reading this article you will ...

- be able to correctly define the lingual ligament as a sublingual fascia anatomically,
- know the embryology, histology, anatomy and prevalence of ankyloglossia,
- have an overview of the nomenclature and classifications,
- know how physiological and compensated breastfeeding works,
- identify the changing symptoms of ankyloglossia.

## INTRODUCTION

When the lingual frenulum is too short, it is referred to as frenulum linguae breve and the condition is called ankyloglossia or ankyloglosson. The ICD code for this condition is ICD10GM2020 Q38.1 [26]. Current knowledge about this condition and its health effects is not covered in detail in dental school and continuing dental education. This article aims to help fill the gaps in knowledge and enable paediatric dentists to identify the connection between symptoms and oral restriction of the tongue.

**Note:** The ICD code for ankyloglossia is ICD10GM2020 Q38.1.

## DEFINITION OF THE SHORT LINGUAL LIGAMENT

The International Affiliation of TongueTie Professionals defines the short lingual ligament as an embryological remnant of tissue in the midline between the underside of the tongue and the floor of the mouth that restricts normal tongue movement [60].

The metric measurement of free tongue length is dependent on age and individual body proportions and can only be a guide. Attempts to specify metric limits for a tongue ligament that is too short have neither been validated nor confirmed in interrater reliability and are regarded as having failed to date. Therefore, the term "too short" should be preferred over "short". The term "too short" clearly indicates that the lingual ligament is too short to allow physiological function range, regardless of the measured length. If the lingual ligament is too short and tongue function is restricted as a result, this restriction is a factor in the development, persistence and treatment resistance of oral dysfunctions.

The term ankyloglossia focuses on the restriction of movement of the tongue as a result of a restrictive symptomatic ligament of the tongue. The term "restrictive symptomatic fascia of the tongue" describes the causality more accurately, as the dysfunction that occurs depends on both the mobility of the tongue at the start of the movement and the target of the movement, the palate and therefore its shape. This means that with the same tongue mobility, no symptoms occur with a closer target, a flat arched Roman palate, but numerous symptoms can occur with a more distant target, a high arched Gothic palate.

**Note:** The restrictive symptomatic tongue tie can cause start and target-dependent symptoms.

## EMBRYOLOGY

The embryology of the frenulum linguae is a complex process that takes place during the early development of the embryo. The development of the tongue begins in the 4th week of pregnancy. It arises from pharyngeal arches 1 to 4. During the 5th to 8th week of gestation, the tongue develops from a paired structure, the lingual bulges, which form on both sides of the developing jaw. As development progresses, the lingual bulges and the impar tubercle overgrow and fuse in the centre to form the primary tongue. Their fusion line is marked by the median sulcus of the tongue. A U-shaped groove develops in front of and on both sides of the oral part of the tongue. This makes the tongue free and very mobile - except in the area of the lingual frenulum, where it initially remains attached [24].

It is assumed that the centre of the tongue is then detached from the floor of the mouth through programmed cell death, or apoptosis. During the development of the frenulum linguae breve, incomplete or faulty apoptosis can lead to a congenital anomaly in which the lingual frenulum is shortened, thickened and/or attached too close to the tip of the tongue. This restricts the mobility of the tongue even in the womb. The exact causes of ankyloglossia have not yet been fully researched and understood [30, 49].

Several possible contributing factors have been discussed:

- Genetic factors: It is assumed that a frenulum linguae breve can occur in families due to heredity or reverse Darwinism. Studies have identified genes on the X chromosome that may be associated with development [22, 29, 32, 56].
- Disorders of embryonic development: Abnormal processes during embryonic development could lead to incomplete apoptosis and thus to incomplete separation of the tongue from the floor of the mouth [27, 43, 53].

**Note:** It is assumed that incomplete apoptosis leads to ankyloglossia.

## ANATOMY

From an anatomical point of view, the lingual ligament is not a ligament but a fascia that connects the underside of the tongue to the floor of the mouth. It is covered with oral mucosa and contains collagenous connective tissue and musculature [42]. The terms frenulum linguae, lingual frenulum or tongue tie are probably due to the external appearance and are anatomically incorrect. Experts therefore refer to this structure anatomically accurately and correctly as the sublingual fascia.

**Note:** The lingual ligament is a sublingual fascia and not a mucosal ligament.

## HISTOLOGY

All types of lingual ligaments contain a high concentration of highly tensile type I collagen. Therefore, stretching exercises are not helpful to lengthen the lingual ligament, but may cause compensation with further symptoms. Martinelli et al. recommend tongue ligament separation as the only suitable procedure for mobilising the tongue to enable better oral function [61].

**Note:** The sublingual fascia contains a high concentration of highly tensile type 1 collagen.

## PREVALENCE

Screening for ankyloglossia in the initial postnatal examination of newborns is currently only mandatory in Brazil. Therefore, the statistical recording of the incidence of restrictive symptomatic sublingual fasciae in other countries is inaccurate. This should be considered when analysing the average prevalence of 8% calculated by Hill et al. in a meta-analysis. The results of the studies analysed varied between 2 and 15%. A recent study by Maya-Enero et al., in which an examination for ankyloglossia was carried out systematically after birth in a Spanish maternity clinic, analogous to the Brazilian standard, showed a prevalence of 46.3% in 1392 newborns, 70.2% of whom were symptomatic at this time. Clinically significant ankyloglossia was present in 32.5% of newborns born in 2018 [41].

Boys are affected approximately twice as often as girls [1, 25].

**Note:** One third of newborns are affected by symptomatic ankyloglossia. Boys are twice as often.

## CLASSIFICATION

There are numerous attempts to categorise lingual bands according to their anatomical appearance. The classifications according to Coryllos [62] and Kotlow [63, 64] are frequently mentioned.

iii Neither system has been validated to date, and the Coryllos classification gave rise to the division into anterior and posterior lingual ligaments. Coryllos presented the first description of the posterior restrictive tongue tie to the AAP (American Academy of Pediatrics) breastfeeding section in 2004 [62].

Internationally, the terms anterior or posterior are usually used, although the exact distinction remains unclear. There are various definitions of the anatomical correlation to the anterior and posterior lingual ligament. What all these classification systems have in common is that they are anatomically descriptive. They describe the condition without going into the effects on function. They have no relevance for therapy. Therefore, there is no correlation between breastfeeding problems and the Coryllos or Kotlow classification [65, 66].

iii The classifications can be helpful for documentation, statistical analyses and anatomical descriptions.

## DEFINITION OF THE ANTERIOR, MEDIAL AND POSTERIOR LIGAMENT OF THE TONGUE

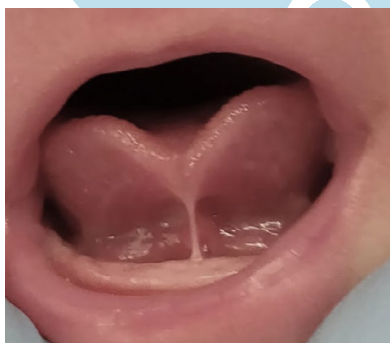
For didactic and functional reasons, it makes sense to add the term "medial" to the classification of anterior and posterior and to define the terms more clearly. The terms anterior, medial and posterior refer to the attachment point of the lingual ligament on the underside of the tongue and the floor of the mouth. To simplify matters, the adjective "attaching" is usually omitted [47].

### ANTERIOR (ATTACHING) TONGUE LIGAMENT

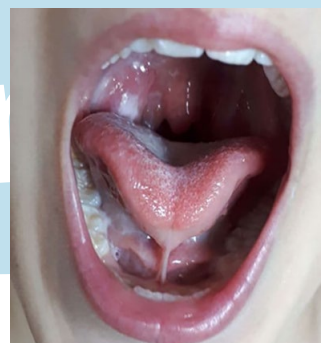
A lingual ligament is described as anterior if it attaches to the anterior third of the underside of the tongue and the floor of the mouth. The anterior (front) lingual ligament always has a medial (middle) and posterior (back) part [47]. If the lingual ligament attaches to the tip of the tongue and in the area of the lower masticatory ridge, the "tongue tie" with a heart shape is seen (Fig. 1, Fig. 2).

### MEDIAL (ATTACHING) TONGUE LIGAMENT

When a lingual ligament attaches to the middle third of the underside of the tongue and the floor of the mouth, it is referred to as a medially attaching lingual ligament. It has no anterior (front) and always a posterior (back) part (Fig. 3, Fig. 4) [47].



**Figure 1** Infant with anterior tongue tie. (With kind permission © D. Moghtader, all rights reserved)



**Figure 2** Child with anterior tongue tie. (With kind permission © D. Moghtader, all rights reserved)

### POSTERIOR (ATTACHING) LINGUAL LIGAMENT

The posterior lingual ligament attaches to the posterior third of the underside of the tongue and the floor of the mouth and has no middle (medial) or anterior (front) part (Fig. 5, Fig. 6) [47].

**Note:** The lingual ligament is categorised into 3 forms: anterior, medial and posterior - according to its insertion sites on the underside of the tongue and the floor of the mouth.

### EIFFEL TOWER LINGUAL LIGAMENT

If the lingual ligament is too short, the floor of the mouth tissue can be folded up as visible compensation when the tongue is lifted. This raises the carunculae sublinguales and the plicae submandibulares from their anatomically normal and relaxed position on the floor of the mouth.

Due to the tension of the tongue ligament, which is too short, the floor of the mouth is unfolded and put under tension. As a visible sign of compensation, they form a shape similar to the Eiffel Tower together with the restrictive lingual ligament (Fig. 7, Fig. 8) [47].

### EFFECTS OF ANKYLOGLOSSIA ON BREASTFEEDING

Schlatter et al. investigated the effects of ankyloglossia in 116 newborns, 30 of whom were treated with a frenotomy. They came to the conclusion that short lingual ligaments have a significant impact on breastfeeding. The frenotomy proved to be helpful when breastfeeding problems were present. The risk of breastfeeding difficulties in babies with ankyloglossia is 2.6 times higher than in babies without tongue dysfunction [52].



**Figure 3** Infant with medial tongue tie. (With kind permission © D. Moghtader, all rights reserved)



**Figure 4** Child with medial tongue tie. (With kind permission © D. Moghtader, all rights reserved)



**Figure 5** Infant with posterior tongue tie. (With kind permission © D. Moghtader, all rights reserved)



**Figure 6** Child with posterior tongue tie. (With kind permission © D. Moghtader, all rights reserved)

**Note:** Symptomatic ankyloglossia has a significant impact on breastfeeding.

### SYMPTOMS OF THE INFANT WITH SYMPTOMATIC ANKYLOGLOSSIA

Numerous symptoms of the infant and the mother are described in connection with a tongue tie that is too short [3, 14, 15, 33, 36, 43, 52, 56]. They are non-specific and can have multifactorial causes.

Common symptoms are seen in the:

- Sucking and drinking,
- weight,
- behaviour,
- sleeping,
- breathing,
- digestion.

iii Effects of oral tongue restriction on the infant are characterised in the mother by

- pain,
- inflammation,
- increased breastfeeding duration,
- reduced milk quantity.

In 2021, the author organised and summarised these symptoms in a checklist and published a German [45] and English version [46] (Fig. 9). The checklist, which is available as a free download in German and English, enables the symptoms to be documented quickly and easily when taking a medical history. During followup care, changes can be documented and compared with the initial condition.

**Note:** The oral restriction checklist is a tool for documenting the symptoms and progression of symptomatic ankyloglossia.

### PHYSIOLOGY AND PATHOPHYSIOLOGY OF ORAL RESTRICTION OF BREASTFEEDING

#### Physiological tongue function during breastfeeding with a freely movable tongue

The mouth opens, lips and tongue seek and find contact with the breast, the tip of the tongue moves forwards for

breastfeeding. With the mouth wide open and the lips open, the infant pulls the nipple with breast tissue into the mouth.

The anterior part of the tongue surrounds the breast tissue in the shape of a spoon, lies protectively on the chewing ridge and holds the nipple in the oral cavity. The anterior part of the tongue, which is wedged relatively immovably between the lower lip and lower jaw, and the lower lip move with the slight upward and downward movement of the lower jaw, as if in a firmly connected unit, without losing the seal.

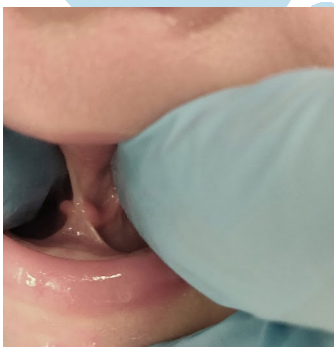
With each sucking movement, the centre of the tongue rises in a pumping motion, presses the breast tissue against the hard palate, then lowers and creates the vacuum. The nipple lies at the transition from the soft to the hard palate. Neither the tip of the tongue nor an undulating movement of the tongue from front to back, but the movement of the center of the tongue towards the palate is essential for milk transfer. The medial elevation of the tongue controls the act of swallowing [67].

As the posterior part of a restrictive lingual ligament also influences the elevation of the centre of the tongue towards the palate, complete separation of the restrictive anterior, medial and posterior parts of the sublingual fascia is important for the long-term success of treatment. Testing the mobility of the tongue by sticking it out and testing the sideways movement are not meaningful as functional tests for breastfeeding alone, as the third direction of movement of the centre of the tongue towards the cranial is decisive for physiological lactation and sucking.

The medial and posterior parts of the tongue control and regulate the flow of milk for a coordinated swallowing action and ensure that the airways are protected. The soft palate and the tongue work together to separate the oesophagus and the airways during sucking, swallowing and breathing and to stop the flow of milk if necessary [3, 43].

### TONGUE DYSFUNCTION IN COMPENSATED BREASTFEEDING WITH ORAL RESTRICTION OF THE TONGUE

The infant with ankyloglossia does not or only partially retract the nipple into the mouth. As the tongue and the floor of the mouth are not functionally dissociated, the elevation of the tongue required for physiological sucking creates a tensile force on the lingual septum via the floor of the mouth.







**Figure 7** Infant with Eiffel Tower tongue tie. (With kind permission © D. Moghtader, all rights reserved)



**Figure 8** Child with Eiffel Tower tongue tie. (With kind permission © D. Moghtader, all rights reserved)

**Symptom checklist oral restrictions**

Name: ..... Birthday: .....

Baby	Mother
 <ul style="list-style-type: none"> <li><input type="checkbox"/> <b>Poor</b> <input type="checkbox"/> <b>Very high weight gain</b></li> <li><input type="checkbox"/> Favorite breast, favorite side</li> <li><input type="checkbox"/> Breast must be held during breastfeeding</li> <li><input type="checkbox"/> Pacifier falls out easily</li> <li><input type="checkbox"/> Falls asleep quickly during breastfeeding</li> <li><input type="checkbox"/> Frustrated <input type="checkbox"/> Cries <input type="checkbox"/> Sweats while feeding</li> <li><input type="checkbox"/> Shallow latch on <input type="checkbox"/> breast <input type="checkbox"/> bottle</li> <li><input type="checkbox"/> Other: .....</li> </ul>	 <ul style="list-style-type: none"> <li><input type="checkbox"/> <b>Pain during breastfeeding</b></li> <li><input type="checkbox"/> Pain after breastfeeding</li> <li><input type="checkbox"/> Reddened <input type="checkbox"/> Sore nipples</li> <li><input type="checkbox"/> Cracked <input type="checkbox"/> Bleeding nipples</li> <li><input type="checkbox"/> Thrush <input type="checkbox"/> Silvershield <input type="checkbox"/> Donuts</li> <li><input type="checkbox"/> Other: .....</li> </ul>
 <ul style="list-style-type: none"> <li><input type="checkbox"/> <b>Unsatisfied baby</b></li> <li><input type="checkbox"/> Fuzzy <input type="checkbox"/> Frustrated</li> <li><input type="checkbox"/> Pops on and off the nipple</li> <li><input type="checkbox"/> Does not like to lie on backside</li> <li><input type="checkbox"/> Sleeps on the stomach <input type="checkbox"/> on the side</li> <li><input type="checkbox"/> Open mouth posture <input type="checkbox"/> mouth breathing</li> <li><input type="checkbox"/> Snoring <input type="checkbox"/> Rattling <input type="checkbox"/> Grunting</li> <li><input type="checkbox"/> Breathing pauses during sleep</li> <li><input type="checkbox"/> Short sleeping .....hours</li> <li><input type="checkbox"/> Other: .....</li> </ul>	 <ul style="list-style-type: none"> <li><input type="checkbox"/> <b>Deformed nipples</b></li> <li><input type="checkbox"/> Nipple lipstick shape</li> <li><input type="checkbox"/> Squeezed <input type="checkbox"/> Flat pressed</li> <li><input type="checkbox"/> High time demand for breastfeeding</li> <li><input type="checkbox"/> Endless continuous breastfeeding</li> <li><input type="checkbox"/> High frequency breastfeeding</li> <li><input type="checkbox"/> Chewing on the nipple</li> <li><input type="checkbox"/> Nipple sensitive to cold</li> <li><input type="checkbox"/> Nipple shield</li> <li><input type="checkbox"/> Other: .....</li> </ul>

**Figure 9** Example of checklist for oral restrictions in babies 2021. The complete checklists (in English) is available via QR code. (With kind permission © D. Moghtader, all rights reserved)



This tensile stress is transferred via the septum linguae to the hyoid bone (Os hyoideum) via the suprahyoid muscles and changes its position, affecting the muscle groups connected to the hyoid bone. As a result of the altered hyoid bone position, the infant reduces the mouth opening to compensate for the resulting tension. This leads to shallow latching, with little breast tissue in the mouth. As the nipple is far forward and the entire tongue or the middle or rear part of the tongue is fixed to the floor of the mouth, the physiological sucking process cannot take place. A sufficiently effective vacuum is not produced. Even if latching is initially good with a lot of breast tissue, the baby loses its grip and slips down onto the nipple. He then presses the nipple together with his lips drawn in and the chewing ridges together in order to pump milk. This compensated sucking action with intensive movements of the chewing muscles, the lower jaw and also the head, neck, throat and torso muscles is more like chewing than sucking and quickly tires the baby. The strong pressure can deform and injure the nipple. This results in deformed and injured nipples with pain during breastfeeding, sucking blisters and two-coloured profile lips in the infant. The squeezing of the nipples stops the flow of milk, which can lead to the baby unlatching. The consequences of this can be a latch-on-off behaviour and a mechanically triggered vasospasm in the mother. The pain during breastfeeding can be reduced after a few weeks of compensated sucking, as the lower masticatory ridge flattens out like a plateau due to the pressure and the forces acting on the nipple are distributed over a larger area [43].

As the vacuum seal on the breast is occasionally lost through the lips and tongue with the typical noises such as clicking, smacking and snapping when drinking, the baby swallows air. Colic, flatulence and air-induced reflux can be the result. The necessary sealing of the airways in the interaction between the tongue and the soft palate is not guaranteed, so that milk enters the airways.

Symptoms include choking, coughing when sucking and a permanently blocked nose. Ineffective breastfeeding means that the breast is not emptied sufficiently to stimulate and maintain milk production. As a result, milk production can decline, milk ducts can become blocked and can lead to mastitis. The infant only drinks the foremilk and cannot stimulate the nutritious hindmilk. This has an effect on the baby's weight and increases the frequency and duration of breastfeeding. On the other hand, a strong milk let-down reflex and a lot of milk can lead to the baby gaining too much weight as it is unable to regulate or stop the milk flow. A lot of milk in the mother can lead to a masking of the symptoms of ankyloglossia, as the milk letdown reflex is easily triggered and maintained and the milk flows into the baby's mouth without any further action on the part of the baby. For this reason, an examination for oral restrictions is indicated even if the baby's weight is normal.

**Note:** Elevation of the center of the tongue is essential for physiological breastfeeding and sucking.

#### GASTROESOPHAGEAL REFLUX DISEASE IN INFANTS WITH SYMPTOMATIC ANKYLOGLOSSIA

In studies often both the tongue tie and the lip tie are released, making it impossible to differentiate the effect of the lip tie and tongue tie on the outcome.

■■■ In Siegel's study, 52% of 1000 infants showed an improvement or complete regression of reflux symptoms by the time reflux medication was discontinued after release of the lip and tongue ligaments [68].

■■■ Ghaheri showed a significant improvement in GERD (gastro-oesophageal reflux disease) symptoms 1 week and 1 month after sublabial and sublingual release [18, 19].

Hand et al. confirm the need for functional assessment of tongue and lip movement in breastfeeding problems. Laser surgical removal of the lingual, labial and buccal frenulum

resulted in a significant improvement in breastfeeding outcomes with a reduction in nipple pain and reflux in both the classic anterior lingual frenulum and the posterior submucosal lingual frenulum [23].

Brooks et al. presented a 21-month-old patient with significant dysphagia in the pharyngeal phase, characterised mainly by impaired movement of the base of the tongue, poor pressure generation and diffuse residue leading to aspiration [6]. He was eventually diagnosed with a posterior restrictive tongue tie and a release was performed. The results of the subsequent examination showed a significant improvement in tongue base movement, pharyngeal pressure generation and pharyngeal constriction. This led to an efficient movement of the bolus through the pharynx into the oesophagus. Nasopharyngeal regurgitation or aspiration no longer occurred and pharyngeal dysphagia was largely resolved. Patients with impaired tongue base movement and impaired pressure generation leading to pharyngeal residue on normal neurological examination could possibly have a posterior tongue tie, which should be investigated and included in the differential diagnosis [5].

Slagter describes lip and tongue tie frenotomy as a safe procedure with no postoperative complications, leading to a significant improvement in breastfeeding, nipple pain and gastro-oesophageal reflux problems [54].

iii Oral restrictions result in a compensated sucking or drinking technique. This leads to a loss of vacuum and increased air swallowing. This mechanism is known as aerophagia. The air accumulated in the gastrointestinal tract can cause reflux, belching, paralyses and abdominal pain. To date, there is a lack of controlled studies investigating the relationship between oral restrictions and aerophagia [17, 50].

**Note:** Aerophagia can cause GERD symptoms in patients with oral restrictions.

### ANKYLOGLOSSIA AND SLEEP-RELATED BREATHING DISORDERS

The link between ankyloglossia and sleep-related breathing disorders (SRBs) was described by Baxter and Zaghi in their studies [4, 48].

Restrictive sublingual fascia is a risk factor for sleep disordered breathing. An early multidisciplinary approach and screening for SRBs are indicated when restrictive tongue mobility is recognised [55]. Conversely, this means that an examination for a tongue tie that is too short is also indicated if SBAS is detected.

Brożek-Mądry et al. found a correlation between a restrictive tongue tie and the risk of obstructive sleep apnoea in children. In addition, obstructive sleep apnoea was associated with a greater forward head posture. They concluded that the detection and treatment of ankyloglossia in children is necessary before it leads to orofacial changes, malocclusion and consequently sleep apnoea [7].

Enlarged palatine tonsils, higher values in the Mallampati classification, the presence of a crossbite, a tongue tie

that is too short and a high arched palate can indicate abnormal breathing during sleep in children [9]. The Mallampati classification was originally used to assess the degree of difficulty of endotracheal intubation prior to anaesthesia [38]. For the examination, the awake patient sits or stands and stretches the tongue out of the mouth as far as possible in a neutral head position without phonation and without moving the head. Mallampati classification can be a rapid, non-invasive screening tool to improve identification and timely intervention in children at risk of SRBs [2, 34, 37, 59]. The hypothesis that Class III malocclusion is related to a too short sublingual frenulum is supported by Calvo-Henríquez [11].

The studies included in the review by Bussi et al. support the link between ankyloglossia and obstructive sleep apnoea [10].

The connection can be explained as follows. The tongue is held in a caudal-posterior position due to the restrictive lingual ligament being too short. Therefore, the tongue cannot passively stabilise itself in a cranial-anterior position in the tongue resting position on the palate through the saliva. During sleep, the muscles relax and the tongue is pulled dorsally by gravity in the supine position. The airway can become constricted, resulting in a reduced supply of oxygen.

Complete sublingual fascioplasty ideally leads to the tongue resting on the palate. Lip closure is therefore possible at rest and nasal breathing can be established [40].

**Note:** Ankyloglossia is an important factor in the development of sleep-related breathing disorders.





### ANKYLOGLOSSIA, BREASTFEEDING AND EARLY CHILDHOOD CARIES

Kuminek et al. investigated the relationship between breastfeeding and caries. The shortcomings of earlier studies were to be avoided. Therefore, the caries and oral hygiene status were recorded directly in the children's mouths, exclusive and partial breastfeeding were recorded and analysed separately. Confounding factors such as socioeconomic status, age, body mass index and oral hygiene as an indicator of carbohydrate-rich diet and oral hygiene were recorded. Over a period of 3 years, 597 children aged 1 to 5 years for whom analysable data was available were examined. This resulted in a cohort of 597 children. The authors concluded that, among the study parameters analysed, poor oral hygiene and low socioeconomic status were risk factors for caries in the primary dentition. The duration of exclusive and partial breastfeeding had no influence on the development of caries [35].

iii A possible connection between early childhood caries (ECC) and a restrictive lingual fascia during long-term breastfeeding or bottle drinking can be established as follows: If the nipple or teat is located at the transition from the hard to the soft palate during functional sucking, the teeth are hardly washed around and the retention time in the mouth is short. If the mother has a lot of milk, compensated breastfeeding over a

**Symptom checklist oral restrictions children / adolescents / adults**

Name: ..... Date of birth: .....

 <p><b>Speech and voice</b></p> <input type="checkbox"/> Frustration with communication <input type="checkbox"/> Inhibitions to speak <input type="checkbox"/> Taciturn <input type="checkbox"/> Difficulty to be understood <input type="checkbox"/> Difficulty speaking clearly <input type="checkbox"/> Difficulty speaking rapidly <input type="checkbox"/> Hard to understand language in long sentences <input type="checkbox"/> Stuttering <input type="checkbox"/> Searches for words <input type="checkbox"/> Difficulty with sounds, which? ..... <input type="checkbox"/> Language development delayed, when? ..... <input type="checkbox"/> Speech therapy, since/until? ..... <input type="checkbox"/> Coughing <input type="checkbox"/> Clearing throat when speaking <input type="checkbox"/> Speaking quietly <input type="checkbox"/> Mumbling <input type="checkbox"/> Cluttering <input type="checkbox"/> Voice little resilient <input type="checkbox"/> Others: .....	 <p><b>Food and drink</b></p> <input type="checkbox"/> Food frustration <input type="checkbox"/> Difficulty with solid food <input type="checkbox"/> Slow eater <input type="checkbox"/> Smacks <input type="checkbox"/> Does not finish meal <input type="checkbox"/> Eats throughout the day <input type="checkbox"/> Packs food in the cheeks <input type="checkbox"/> Gets food out with finger in mouth <input type="checkbox"/> Picky about consistency <input type="checkbox"/> Does not chew <input type="checkbox"/> Does not swallow <input type="checkbox"/> Eats with mouth open <input type="checkbox"/> Chokes <input type="checkbox"/> Gags <input type="checkbox"/> Reflux <input type="checkbox"/> medicated <input type="checkbox"/> Spits out food <input type="checkbox"/> Breastfeeding problems as an infant
 <p><b>Sleep</b></p> <input type="checkbox"/> Difficulty falling asleep <input type="checkbox"/> Sleeps on <input type="checkbox"/> Belly <input type="checkbox"/> Side <input type="checkbox"/> Overextends <input type="checkbox"/> Wriggles <input type="checkbox"/> Restless sleep <input type="checkbox"/> Turns <input type="checkbox"/> Sleep in strange positions, which? ..... <input type="checkbox"/> Plunges <input type="checkbox"/> Drools <input type="checkbox"/> Sweats <input type="checkbox"/> Moves a lot at night <input type="checkbox"/> Bedding messed <input type="checkbox"/> Wets <input type="checkbox"/> Sleeps too short <input type="checkbox"/> Easily wakes up often	 <p><b>Musculature and skeleton</b> <input type="checkbox"/> Neck  <input type="checkbox"/> Shoulder <input type="checkbox"/> In therapy  <input type="checkbox"/> Tension <input type="checkbox"/> Pain  <input type="checkbox"/> Blocks where? .....  <input type="checkbox"/> Headache <input type="checkbox"/> Migräne</p> <p><b>Mouth</b></p> <input type="checkbox"/> Temporomandibular joint pain <input type="checkbox"/> Crackle <input type="checkbox"/> Grating <input type="checkbox"/> Abrasion <input type="checkbox"/> Lip <input type="checkbox"/> Tongue-tie <input type="checkbox"/> Gag reflex

**Figure 10** Example of checklist for oral restrictions in children, adolescents, and adults 2021. The complete checklists (in German) is available via QR code. (With kind permission © D. Moghtader, all rights reserved)



long period of time is also possible with a too short tongue-tie. The nipple is close to the front teeth when sucking. This leads to intensive rinsing of the teeth and a long retention time. This can increase the risk of tooth decay.

**Note: Functional** long-term breastfeeding beyond 12 months does not lead to an increased risk of tooth decay with a healthy diet and daily dental care.

**Note:** Disfunctional sucking due to oral restrictions or sucking can lead to an increased risk of caries due to the anterior nipple position on the front teeth.

### ANKYLOGLOSSIA AND BEHAVIOUR

Oxygen deprivation at birth is suspected of contributing to ADHD (Attention Deficit Hyperactivity Disorder) and ADD (Attention Deficit Disorder). Sleep-related breathing disorders lead to oxygen deficiency. The connection between SBAS and ankyloglossia has already been explained. It is conceivable that chronic hypoxia in infants, babies, toddlers and children can cause, exacerbate or trigger ADHD and ADD symptoms.

### PERSISTENT ANKYLOGLOSSIA

If proper treatment is not provided in infancy, the symptoms change. The function of sucking is no longer required and is replaced by chewing. The body develops different strategies to compensate for the restriction of the tongue's mobility by compensating for eating, speaking, drinking and breathing. These compensations can result in specific symptoms. The lack of flat development of the palate due to an dysfunctional low tongue resting position and an open mouth resting position can lead to an anatomically deviating skeletal development of

the midface with functional impairments, mouth breathing, snoring and other limitations.

The aim of a study by Cordray et al. was to investigate the spectrum of paediatric sequelae associated with ankyloglossia that can occur in children who do not undergo a frenotomy in infancy. Symptoms such as speech/articulation difficulties, eating disorders, dysphagia, symptoms of sleep-disordered breathing, malocclusion and oral hygiene problems have been identified as being partially or wholly attributable to persistent sub-lingual restriction. Several comparative studies have found a link between ankyloglossia and risk factors for obstructive sleep apnoea; one randomised controlled trial found that tongue tie release can reduce the severity of apnoea. Ankyloglossia can also be a contributing factor for crowding of the teeth [13].

Various authors describe the symptoms in children, adolescents and adults [3, 4, 5, 7, 8, 9, 10, 11, 12, 16, 20, 21, 28, 31, 51, 55]. The symptoms are not specific for a restrictive sublingual fascia. Therefore, a differential diagnosis is necessary before intervention.

In children, adolescents and adults, symptoms of a restrictive tongue ligament that is too short are mentioned in the literature in the following areas:

- Articulation,
- voice,
- sleep,
- eating,
- drinking,
- musculature,
- skeleton,
- behaviour,
- mouth, throat, nose and ears.



The symptoms associated with persistent ankyloglossia were organised by the author in a checklist, summarised and published in a German [45] and English [44] version (Fig. 10).

### ANKYLOGLOSSIA AND ARTICULATION

In a prospective cohort study, Baxter et al. showed that after sublingual fascioplasty with the CO2 laser, speech improved in 89%, solid food intake in 83% and sleep in 83% of patients. Fifty per cent (8/16) of the speech-delayed children spoke new words after the procedure, 76% (16/21) of the slow eaters ate faster, and 72% (23/32) of the restless sleepers slept less restlessly. After releasing the tongue tie in combination with orofacial exercises, most children showed functional improvements in speaking, eating and sleeping [4].

Wang et al. investigated the correlation using published randomised control trials (RCTs), cohort studies, case-control studies and case series with more than 5 cases. Of the 16 included studies, all but one were cross-sectional studies with small sample sizes. The quality of the evidence was generally low. The literature analysis showed no clear link between ankyloglossia and speech disorders. Generally accepted, standardised grading systems and well-designed clinical trials are needed to better assess the impact of ankyloglossia [57].

In daily practice, after complete sublingual fascioplasty, we regularly receive consistently positive feedback on the success of the subsequent necessary speech therapy, particularly in the area of consonant pronunciation disorders, like sigmatism and low basal tongue rest. In our opinion, the reasons for the inconsistent study results can be explained by partially incomplete releases, unsuitable surgical procedures, reattachment, lack of preparation, aftercare and follow-up therapy as well as selection of the wrong time for therapy.

### ANKYLOGLOSSIA, JAW GROWTH AND TOOTH ALIGNMENT

Ankyloglossia is associated with craniofacial growth disorders, malocclusion, orthodontic recurrence and bruxism [48, 58]. Although there is biological plausibility for this hypothesis, the available evidence is still scarce. It is assumed that overdevelopment of the mandible and underdevelopment of the maxilla are favoured due to the restriction and the resulting dysfunctional low basal tongue rest position. The study by Calvo-Henríquez et al. supports the hypothesis that Class III malocclusion is associated with a short lingual frenulum, as it was statistically significantly twice as common in the Ankyloglossia group [11].

### CONCLUSION FOR THE PRACTICE

- In the course of life, changing symptoms accompany ankyloglossia due to changing functional

requirements such as chewing instead of sucking and the developing compensation mechanisms. This is why symptomatic restrictive sublingual fascia is referred to as a symptom transducer.

- After further training, paediatric dentists can become the competent specialists who identify the restrictive sublingual fascia during the dental examination, assign symptoms to the area of oral ankyloglossia syndrome and treat them in an interdisciplinary network with specialised professionals.

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### Conflict of interest

D. Moghtader declares that there is no conflict of interest.

### Compliance with ethical guidelines

No studies on humans or animals were conducted by the author for this article. The ethical guidelines apply to the studies listed. Written consent has been obtained from patients and/or their legal representatives for images or other information within the manuscript that identifies patients.

### Thanks for proofreading to

Petra Krätsch-Sievert (Denmark/Germany) speech pathologist and developer of therapy method M.U.N.D.T and  
Monika Ivanovic (Croatia) speech pathologist specialized in children with oral restrictions, tongue ties, oralmotor- and feeding disorders and  
Antonia McCurdy (Australia) speech pathologist language and dyslexia therapy.

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