

The Role of the CranioSacral Therapist in the Treatment of Ankyloglossia (Tongue-Tie)

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Abstract

Ankyloglossia has the potential to create strain patterns that originate with the extrinsic muscles of the tongue. These strain patterns may impact craniofacial development, anatomical structure as well as musculature and cranial nerve function. When there is difficulty eating and breathing, the stress felt by the system may result in activation of the autonomic nervous system putting the reticular activating/alarm system (RAS) into overdrive. A surgical release of the frenulum is only the first step in aiding the healing of the total body system. CranioSacral therapy is a modality that facilitates bringing the body into normal physiological motion and functionality.

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Introduction

Ankyloglossia comes from the Greek words, *agkilos* (Αγκυλος) which means “hooked” and *glossa* (γλώσσα) which means tongue. The more familiar term is “tongue-tie.” Tongue development starts at approximately 4-5 weeks gestation [1]. The cells of the frenulum undergo apoptosis and tend to migrate distally around the 12th week of gestation [2]. When this does not occur, or is incomplete, we have the condition known as ankyloglossia [3].

Ankyloglossia has been associated with feeding difficulties: breast, bottle and solids [4,5], malocclusion [3], difficulty swallowing [6,7], speech difficulties [6,5,7], delayed speech as well as difficulty with pronunciation and enunciation [5-7]. An inability to perform dental hygiene [5,6,8]. Mouth breathing that may lead to the Bohr effect-whereby the mouth breathing by passes the filtration warming and humidification system of the nose. The mouth is able to deliver five (5) times as much air to the lungs. The air, however, is unconditioned and dry. The bronchiolar reflex responds by shrinking the airway passage in order to reduce the quantity of irritating air. Breathing becomes rapid and shallow. The lung tissue produces mucus to protect itself. CO₂ levels become lower (hypocapnia), blood ph increases and respiratory alkalosis ensues.

Obstructive sleep apnea, obstructive sleep apnea syndrome, sleep disordered breathing [9,10,11,13] and sudden infant death (or what is now termed a brief resolved unexplained event) have been correlated with ankyloglossia as has craniofacial [6] and stomatognathic developmental disorders or disturbances [12,14,15]. Michael C. Oldfield in 1959 shared releasing the tongue-tie of a 22-year-old who had struggled with “embarrassment at school and in his work” [16] due to his speech difficulties. This and other issues of self-esteem and psychological issues are discussed in the literature [5,8]. This paper establishes that ankyloglossia likely also causes activation of the sympathetic nervous and reticular activating systems.

During his time at Michigan State University John E Upledger DO, OMM developed the treatment modality and coined the term “Craniosacral Therapy” [17]. While there, he researched and found support for the previously questioned theories of cranial and primary motion. Dr. Upledger explains Craniosacral therapy as “a gentle, hands-on method of evaluating and enhancing the functioning of the

physiological body system called the craniosacral system comprised of the membranes and the cerebrospinal fluid that supports and protects the brain and the spinal cord. Using a soft touch generally no greater than 5 grams, or about the weight of a nickel, practitioners release of restrictions in the craniosacral system which has been shown to improve the functioning of the central nervous system, as well as many other systems of the body, such as digestive, musculoskeletal, respiratory, circulatory, and more” [18].

In order to understand the role of the Craniosacral therapist we need to start by looking into the strain patterns that ankyloglossia may precipitate in a person. These strain patterns have the potential to effect bone, musculature, and fascia. As the bones shift they may exert pressure on the cranial nerve sleeves resulting in an alternation of neurological functioning.

The tongue contains two types of muscles - intrinsic and extrinsic. The intrinsic muscles mainly have both their origin and insertion within the tongue. Therefore, for the purposes of this paper we will be focusing on the extrinsic muscle. Intrinsic muscles function to alter the shape of the tongue. Optimal functioning will be inhibited if the tongue is tethered. The vertical intrinsic muscle has part of its origin in the genioglossus.

The vertical intrinsic muscle provides the connection from the intrinsic to extrinsic muscles. The extrinsic originate in bone and insert into the tongue. These are the muscles that we will focus on. When the tongue is tethered, it would follow that there is a strain on the attached muscles. These muscles pull on the bones that they are connected to. When muscle pulls on bone, muscle prevails. The extrinsic muscles are the genioglossus, the hyoglossus, the styloglossus and the palatoglossus (Figure 1, Table 1).

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The genioglossus originates on the mental spine of the mandible and inserts along the length of the tongue. It is made up of three sets of fibers - the inferior attach to the hyoid, the intermediary extends to the posterior aspect of the tongue and the superior fibers travers the entire ventral surface of the tongue. These protrude, depress and draw the tongue tip back and down. When the tongue is tethered the pull along these muscles gives rise to a greater degree of mandibular retraction which we often see in babies with ankyloglossia. This retraction can also impede effective milk transfer in the breastfeeding baby [19] (Table 1).

The hyoglossus originates on the greater cornua of the hyoid and inserts along the lateral surface of the tongue. Its function is to depress and retract the tongue (Figure 2).

The styloglossus originates on the anterior and lateral surface of the styloid process near its apex and inserts along the lateral surface of the

tongue. Its function is to retract and elevate the tongue. The styloid process is a projection of the temporal bone. When the tongue is tethered the styloglossus will be pulled anteriorly and inferiorly. This will put tension on the cranial bones starting at the temporal bones.

The tension of the styloid process may affect the parietal, sphenoid, and occipital bones. This tension may be the cause of the chronic headaches that tongue-tied adults share experiencing. These headaches often resolve after the release of the ties. However, infants, if they are having headaches are unable to communicate this (Figure 3).

There is some speculation that there is a connection between infant colic and migraines [20-22]. To date, no one has looked at ankyloglossia in these infants [23].

The palatoglossus originates from the palatine aponeurosis and inserts broadly across the tongue. Its function is to elevate the posterior

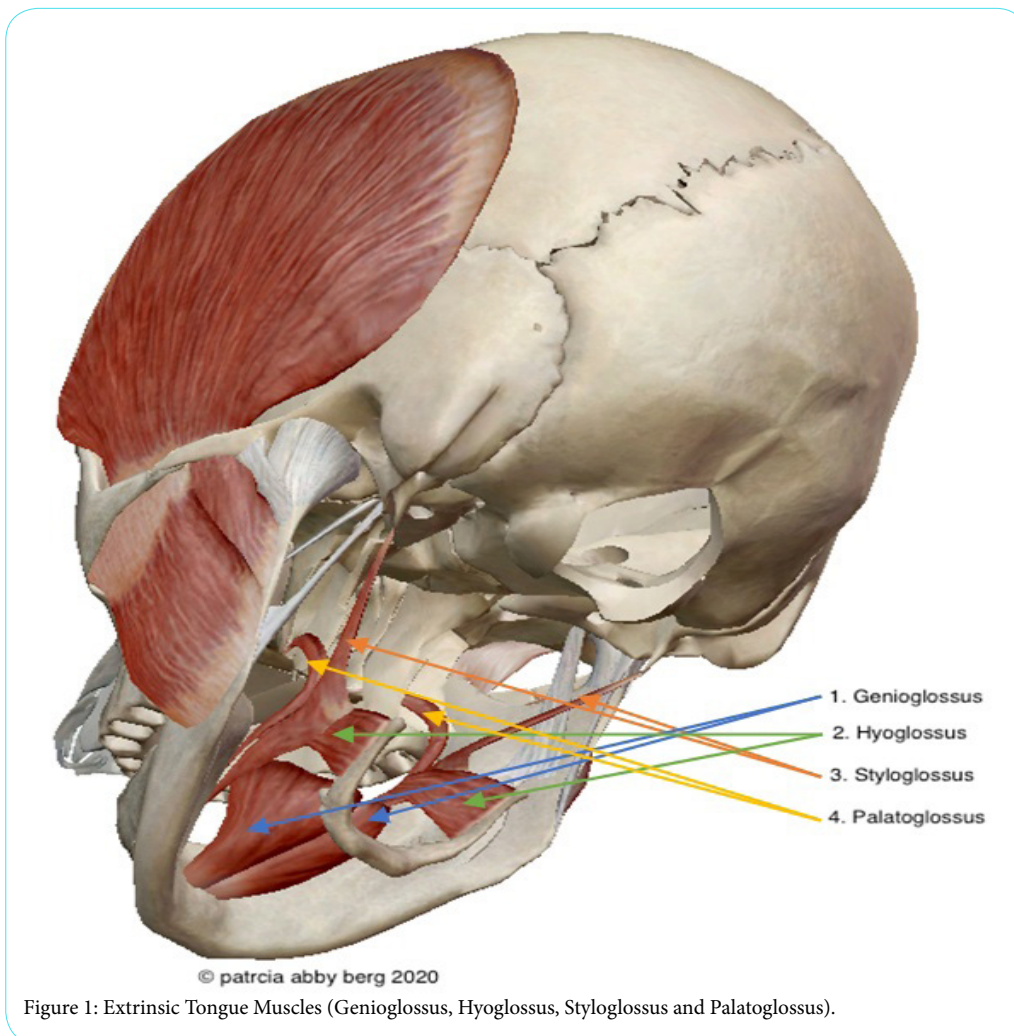


Figure 1: Extrinsic Tongue Muscles (Genioglossus, Hyoglossus, Styloglossus and Palatoglossus).

Muscle	Origin	Insertion	Function	Nerve	Figure
Genioglossus	Metal spine of the mandible	Length of the tongue	Protrude, depress, draw tip back & down	XII	1
Hyoglossus	Greater horn of the hyoid	Lateral surface of the tongue	Depresses and retracts	XII	2
Styloglossus	Styloid Process	Lateral surface of the tongue	Retracts and elevates	XII	3
Palatoglossus	Palatine	Posterolateral tongue	Elevates posterior aspect of the tongue	X	4

Table 1: Extrinsic Tongue Muscles.

aspect of the tongue. When the tongue is tethered, there will be tension in the palatoglossus. This inferior tension by the palatoglossus on the palate maybe a factor in the elevated palates that are often seen in infants, children and adults with ankyloglossia. Defabianis published a case report in which, following the release, there was spontaneous expansion of the upper arch. The patient was followed clinically and radiologically for 7 years [24] (Figure 4).

It is well known that the tongue's resting positioning on the palate contributes to how the palate is shaped [6,25]. Proper breastfeeding is another contributor to palatal shaping.

When there is ankyloglossia, proper breastfeeding does not occur. If, along with the tongue not being able to touch the palate, there is inferior strain from the palatoglossus the palate maybe arched and narrowed also narrowing the nasal and oropharyngeal spaces [25,26]. When the mouth is not wide the palate rides upward. This upward movement shrinks the nasal cavity. The reduced nasal space inhibits airflow.

The hyoid, while not articulating with any other bone, is connected to bone through muscular, ligamentous and membranous attachments. The hyoid provides stability to the adjacent structures via the attached muscles, ligaments and membranes. "Hyoid movement is an essential component for swallowing, mastication, intraoral transport and respiration" [27]. Pearson concluded that "the geniohyoid has the most potential to displace the hyoid in an anterior direction and the mylohyoid has the most potential to displace the hyoid in the superior direction" [28]. Both of these muscles can be restricted by ankyloglossia. The hyoid articulates with the tongue and the larynx during swallowing. There are eight (8) muscles, two (2) membranes and a ligament attached to the hyoid (Table 2). The muscles that insert into the upper surface of the hyoid are the suprahyoid. These muscles are located between the mandible and the hyoid and form the floor of the mouth. They are the digastric, geniohyoid, mylohyoid and stylohyoid.

The muscles that attach to the lower surface of the hyoid are the infrahyoid. These muscles attach the hyoid to the sternum, larynx

	Origin	Insertion			nerve
Digastric anterior posterior	Digastric fossa of mandible Digastric groove of the mastoid process	Greater cornua and body	Depress and retract the chin and facilitate mouth opening	suprahyoid	V3
Geniohyoid	Mental spine of the mandible	Anterior surface of the hyoid	Protracts and elevates hyoid during swallowing		XII
Mylohyoid	Mylohyoid line of the mandible	Body of the hyoid	Elevate floor of the mouth and raises hyoid		V3
Stylohyoid	Styloid process of temporal	Body of the hyoid	Retract and elevate hyoid		VII
Omohyoid	Inferolateral surface of the hyoid	Transverse and superior scapula	Depress hyoid	infrahyoid	
Sternohyoid	Manubrium sterni& medial end of clavicle	Inferior surface of hyoid	Depress hyoid		
sternothyroid	Dorsal surface of the manubrium	Body of the hyoid	Depress the larynx		
thyrohyoid	Superior thyroid lamina	Superior aspect of the greater cornua	Extrinsic of the larynx Depress hyoid		XII
hyoepiglottic	Anterior and later epiglottis	greater cornua	Extrinsic of the larynx	ligament	
stylohyoid	Apex of the styloid process	lesser cornua	Point of attachment for the middle pharyngeal constrictors		
thyrohyoid	Superior thyroid lamina	Superior aspect of the greater cornua		membrane	XII
Middle pharyngeal constrictor	Stylohyoid ligament	Greater and lesser cornua	Constricts pharynx		XI

Table 2: Attachments to the Hyoid.

Nerve	#	Motor/Sensory	Innervates		Pathway
Olfactory	I	S	Nasal mucosa		Cribiform plate of the ethmoid
Trigeminal	V	S m/s	V2- maxillary V3 -mandibular	Ant 2/3	Foramen rotundum Foramen Ovale
Facial	VII	S M	Anterior 2/3 Salivary Glands	Taste	Stylomastoid Foramen
Glossopharyngeal	IX	S M	Posterior 1/3 Swallowing, gag	Touch, taste	Jugular Foramen
Vagus	X	M/S	Palatoglossus m- larynx		Jugular Foramen
Spinal Accessory	XI	M	Trapezius & SCM		Jugular Foramen
Hypoglossal	XII	M	Extrinsic& intrinsic tongue muscles		Segments of the occipital bone Hypoglossal canal

Table 3: Cranial Nerves.

and scapula. They play an active role in swallowing. They are the omohyoid, the sternohyoid and the hyoepiglottic. They play a role in supporting the hyoids' location in the neck.

The thyrohyoid is a membrane whose primary function is anchoring the laryngeal skeleton to the hyoid.

While German et al. in their article in dysphagia contend that there is a general lack of information for the hyoid musculature as a whole and a serious deficiency of information in the case of man, osteopathic medicine teaches that when structure is compromised, function will be as well.

The hyoid bone connects the floor of the oral cavity to the pharynx and larynx. Neck and sternum tension seen in tongue-tied babies, infants, children and adults follow the restrictions as you move down the body from the tongue to the hyoid to the sternum.

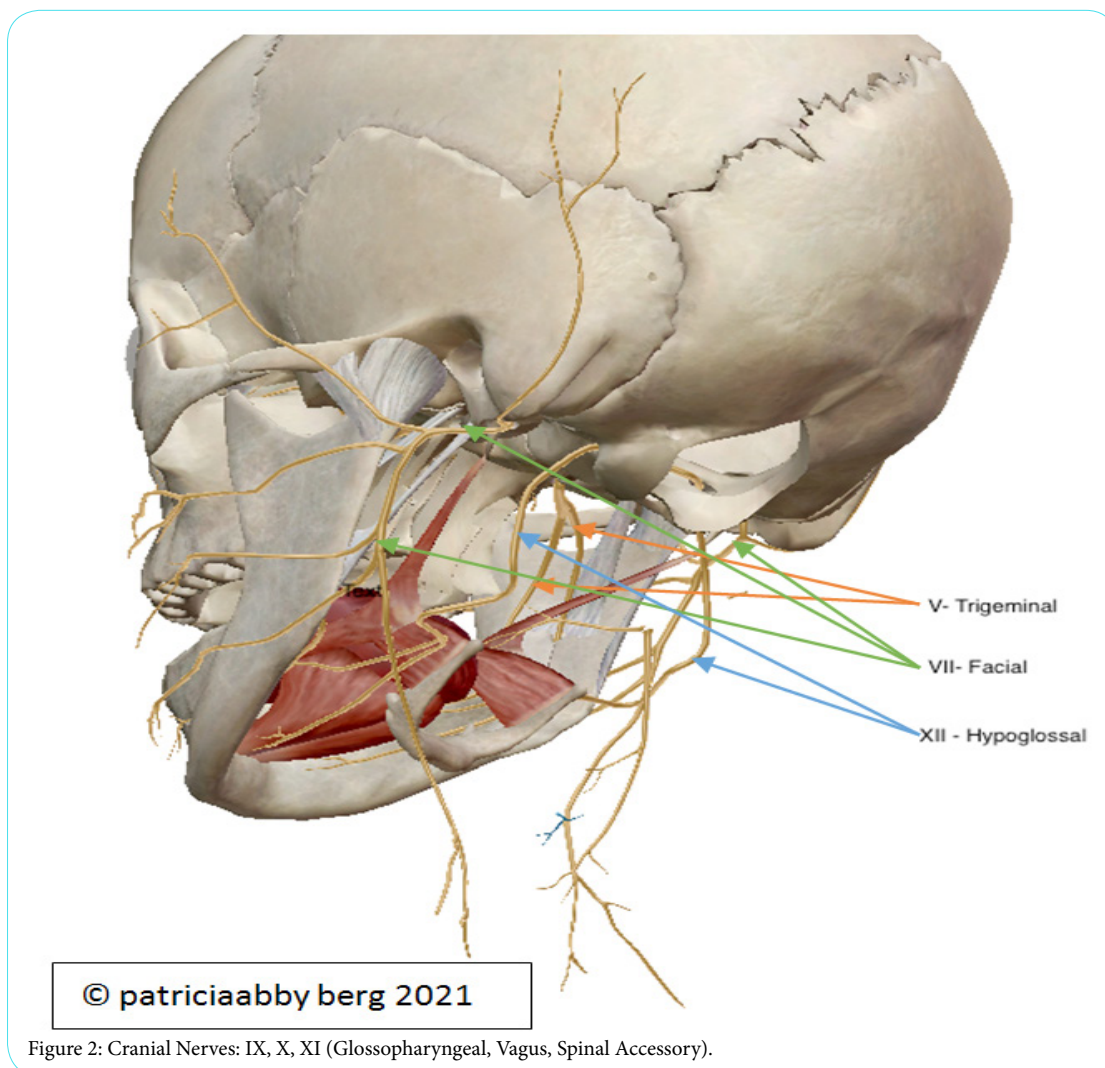
Postural alignment has been shown to be an integral component for feeding and swallowing [29]. Head control is influenced by trunk alignment. Lack of postural control has been correlated with colic as has arrhythmic suck, swallow and breathing [30]. Both a lack of postural control and arrhythmic suck, swallow and breathing may be secondary to ankyloglossia.

Anecdotally, if we listen to what adults share pre and post release we may have some insight into what infants and children are experiencing and are unable to express.

Adults have spoken of the elimination of headaches, experiencing greater ability to open their mouths and improved speech. One woman shared that her hip alignment improved [31,32]. Another woman shared her difficulty swallowing pre-release and its improvement after [33].

Several adults, in an adult tongue-tie group, have shared structural changes and greater height measurements post tongue-tie release. This would follow the strain of the sternohyoid which runs from the hyoid to the sternum. One of these adults recently shared: "I have noticed much easier swallowing, a more defined chin less pooch under there, infinitely softer shoulders and better nasal breathing." A health care professional shared: "I could immediately breathe through my nose better, stopped snoring/ mouth breathing at night, and did a sleep study before and after going from mild obstructive sleep apnea to within normal range" [34].

Following the musculature and looking at the infant depicted in Figure 2, you can see how the restrictions of the tongue travel down the body through the fascia. The stylohyoid pulls from the styloid



process to the hyoid, the sternohyoid pulls from the hyoid to the sternum. The thyrohyoid pull from the hyoid to the thyroid cartilage, the sternothyroid pulls from the thyroid cartilage to the sternum. The omohyoids are pulling on the scapula. The arm raising may help relieve some of the tension created by the tension in the omohyoids.

The Cranial Nerves

The next step along this journey is to look at the cranial nerves that are functionally involved with suck, swallow and breathing. Depending on what source you use, the consensus is that five (5) or six (6) of the twelve cranial nerves participate [35-37]. The core nerves are the trigeminal (CN V) - branch 2 which provides sensory innervation to the maxilla and branch 3 which provides both motor and sensory innervation to the mandible. The facial nerve (CN VII) provides sensory innervation to the anterior 2/3 of tongue and the vagus (CN X) provides both sensory and motor innervation to the palatoglossus as well as motor innervation to the larynx. The glossopharyngeal (CN IX) provides sensory innervation to the posterior 1/3 of the tongue and motor innervation for swallowing. The hypoglossal (CN XII) provides motor and sensory innervation to the extrinsic and intrinsic muscles of the tongue (Table 3, Figures 3&4). I will reveal how seven (7) of the twelve (12) play a significant role.

Marsha Walker includes the olfactory nerve (CN I) on her chart [37]. The olfactory nerve has been extensively studied in the research on the "Breast Crawl" [38]. Varendi found that "natural breast odours,

unsupported by other maternal stimuli appear to be sufficient to attract and guide neonates to the odour source" [39]. This has been corroborated by Mizuno [40]. Therefore, adding the olfactory nerve (CNI) to the list of cranial nerves involved seems appropriate.

The spinal accessory (CN XI) nerve provides motor innervation for the trapezius and sternocleidomastoid muscle (SCM). The spinal accessory nerve is important in reinforcing the postural control that has been shown to be essential for feeding and swallowing [29]. This nerve, therefore, plays an integral role in suck, swallow and breathing.

When we look at the cranial nerve system and potential strains on it, which can affect nerve function, it is essential to look at nerve pathways. The infant skull contains more bony segments and they are more malleable than those of an adult. The segments that are of particular importance for us are: the ethmoid, temporal and sphenoid, frontal and occiput. They are unossified in the infant. The ethmoid, temporal and sphenoid are all in three (3) pieces. The frontal bone is in two (2) pieces and the occipital bone is in four (4) [38-40].

{Note: that the number of pieces is not consistent through the references, although all agree that there are multiple pieces.}

Of the seven cranial nerves, three - the glossopharyngeal, the vagus, and the spinal accessory all pass through the jugular foramen which is located between the temporal and the occipital bones. Any strain on either the temporals or the occiput which could occur from



Figure 3: Cranial Nerves: V, VII, XII (Trigeminal, Facial, Hypoglossal).

fascial strain or altered muscular activity of either the digastric or the stylohyoid muscles could put tension on these nerves potentially reducing their functionality (Figure 3).

The third branch of the trigeminal nerve (CN V) passes through the foramen ovale which is situated in the posterior portion of the sphenoid. The sphenoid borders the frontal, parietal, temporal and occipital bones. Strain on any of these could cause compression on the nerve. "The trigeminal nerve is related to the reticular alarm system in the central nervous system" [41] (Figure 4).

The facial nerve (CN VII) passes through the stylomastoid foramen, a rounded opening on the inferior surface of the petrous temporal bone between the base of the styloid and mastoid process. Strain on the styloglossus and the stylohyoid pull on the styloid process. The mastoid process is not developed in the newborn potentially leaving the facial nerve more exposed to damage or strain (Figure 4).

"Compression or traction of the fascial sleeve of the vagus nerve (CN X) can result in an alternation in vagal 'tone' or autonomic dysregulation which could affect heart rate and blood pressure, respiratory rate, colic-like symptoms, swallowing - and the suck-swallow-breath synchrony- and cause an alteration in gut motility and excretion" [42].

The hypoglossal (CN XII) which provides motor innervation to both the extrinsic and intrinsic muscles of the tongue passes through

the hypoglossal canal in the occipital bone. This canal may not be fully closed at birth [43] (Figure 4).

Muscular strain from tethered-oral-tissues can put tension on the cranial bones. It has been well established that muscles pull bone. If the bones are out of alignment there is potential for strain on the nerve sleeves. Strain on the cranial nerve sleeves have the potential to impact functioning of the cranial nerves (Figure 3 and 4).

The elevation of the palate has been associated with obstructive sleep apnea [9,25]. When the palate is elevated both the nasal and the oropharyngeal airways are contracted making breathing more difficult. If breathing is difficult, the sympathetic nervous and reticulating activating systems will be activated. Brian Palmer said: "the key to life is one's ability to breathe" [25].

Releasing frenular restrictions does not necessarily translate to the relaxation of the muscles or fascia that has been constricted for many months or possibly many years. Neural and muscular components need to be educated for correct firing and movement patterns. The sympathetic and reticular activating systems need help to calm down and regulate. This is where Craniosacral therapy (CST) can play a fundamental role in the body reaching optimal functionality.

Craniosacral Therapy and Ankyloglossia

"Listening", with their hands, to the motion of the Craniosacral system the Craniosacral therapist is able to locate areas of restriction

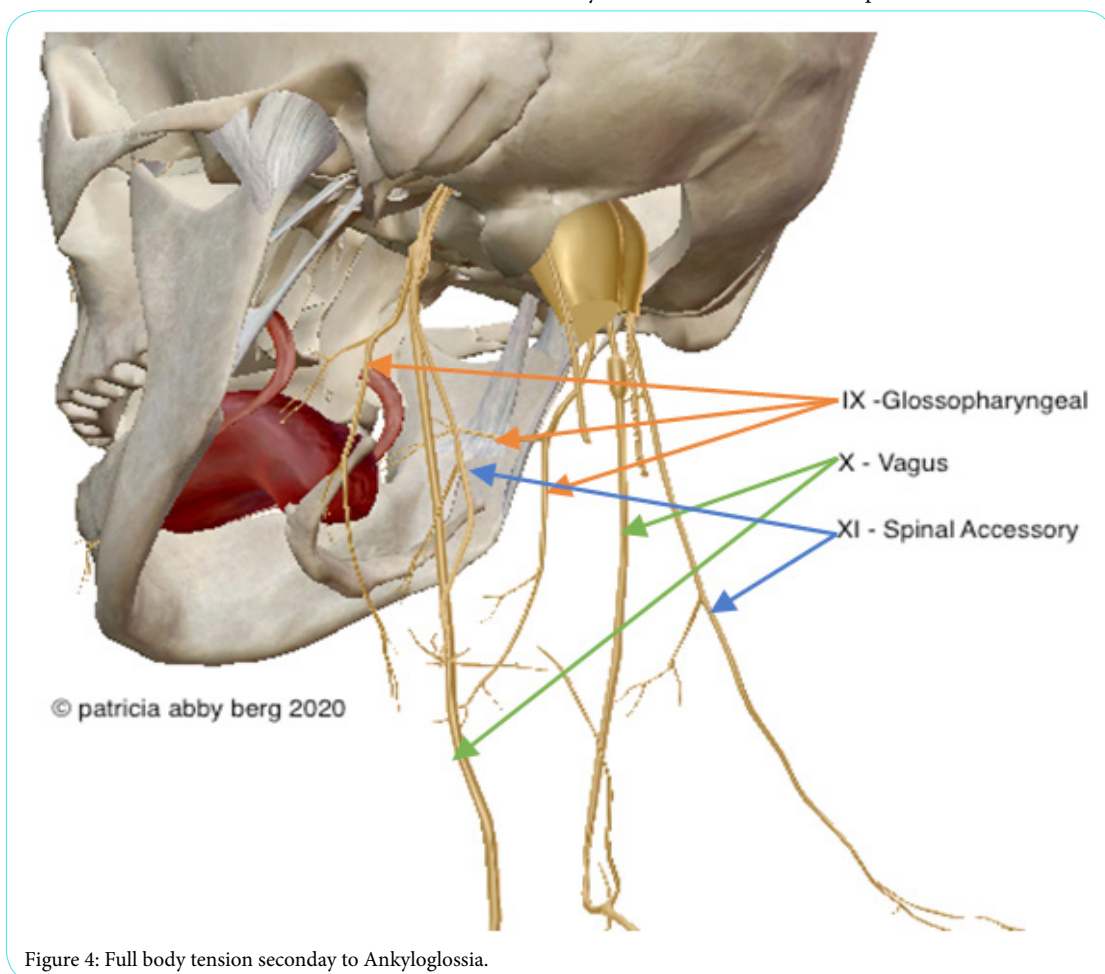


Figure 4: Full body tension secondary to Ankyloglossia.

secondary to the strain on the system from frenulum restraint. Using very light touch, between zero and one gram for an infant, the Craniosacral therapist facilitates improved functioning of all of the body's systems. Facilitating the release of restrictions allows all of the systems fluids to move more effectively which will allow them to function better. Release of the restrictions may enable all of the body systems- organs, tissues, cells, nerves to move better and allow for improved operating. Full functioning is essential for optimal performance.

CST is also able to help balance and give flexibility to the nervous system. The nervous system is made up of the sympathetic and the parasympathetic nervous systems. The sympathetic nervous system responds to danger, whereas the parasympathetic monitors bodily functions. There are stressors in all of our lives on a regular basis. The sympathetic nervous system is activated with each of these occurrences. Sometimes, the body has difficulty dispersing the accumulated stress. The Craniosacral therapist working with the whole body and the cranial nerves supports the nervous system's flexibility so that system is able to respond more effectively to stresses and challenges.

Babies go through many transitions which can be extremely stressful. Some manage these transitions (stressors) better than others. After birth, infants must learn to manage all of the tasks that previously have been taken care of for them. Add difficulties sucking, swallowing and breathing and the sympathetic and reticular activating systems can become over-activated. Babies have few mechanisms for calming and down regulation.

The musculature that has been restricted often needs assistance to know that it is now safe to let go and learn to move as the body intends. The sympathetic nervous system needs assistance dispersing the accumulated stress. These are areas that CST can play a pivotal role.

Case Presentation

Baby Jane (fictional name) was born by cesarean section due to a breach presentation. Mother reported that Jane was latching on within an hour of delivery and appeared to be breastfeeding well during their 4-day hospital stay. On Day 5, mother and baby saw their pediatrician who made no mention of lip or tongue-tie.

An International Board-Certified Lactation Consultant (IBCLC) come to their home the following week as mom indicated that she was struggling with unresolving engorgement. The IBCLC did not do an intraoral assessment of the infant. Mother reported that the IBCLC told her "everything looked good."

After another week, mom's engorgement progressively got worse, and Jane was having difficulty feeding. The IBCLC returned and this time did a pre and post feeding weigh. Three ounces were transferred in one feeding. The IBCLC looked in Jane's mouth and noticed a tongue-tie.

With Jane's increasing fussiness and difficulty feeding, mom took Jane to another pediatrician who noted a lip-tie and recommended a local dentist who does lip and tongue-tie releases.

The dentist saw Jane that afternoon. He noted that there was also a tongue-tie. Both were released. He graded them as both Class 3 using the Coryllos/Watson-Genna classification [47].

Post-release, the dentist, on hearing the list of difficulties, recommended that mom take "Jane" to a CST to help work through some of the restrictions and stresses that would remain despite the release.

Jane saw the Craniosacral therapist 24 hours post-revision. Both parents came to the session. They shared with the Craniosacral



Figure 5: Baby Jane's presentation pre CranioSacral Therapy.

therapist, prior to the session, that “Jane” was so “tight” that mom was unable to hold and comfort her. Jane was constantly fussy which was making parenting and breastfeeding difficult. Mom also noticed that Jane preferred laying her head to one side as shown in Figure 5. The omohyoids originate in the scapula and insert into the hyoid. When the hyoid is restricted by the tongue-tie the infant raises her arms to reduce the strain from the tension of the omohyoids (Figures 6, Table 2).

A Craniosacral therapist may start by placing babies on a blanket and sharing with the parents a structural assessment. The raised arms or the head favoring one side are indicators that the parents may either not notice or be aware that they are indications of restrictions and tension [48].

Babies are usually treated on a blanket or on the therapist’s lap. Infant sessions are generally an hour in length. Breaks are taken as needed for feeding and changing.

There were significant restrictions in the thoracic area as well as across the scapula. When you follow the pathway from the tongue, as discussed earlier, the restriction in the scapula and thoracic area are understandable. There may be other patterns of restriction as well (Figure 5).

When Jane was handed back to her mother post therapy session, Jane “melted” into mom’s chest. Both parents started to cry. Jane’s mother said that this was the first time Jane had melted into her and that she had been able to hold her.

Upon follow-up, mom shared the following: “when we came home from the Craniosacral therapy, things were amazing. Jane was so calm and seemed so happy. It took about 3 days, but she was able to eat on either breast and in whatever position we wanted. We were

normally doing cradle before the pulling away from the breast started to happen. [After the treatment], Jane was doing great; she was far less fussier and was sleeping better at night, too. She also wasn’t clenching her arms above her head as much. I [mom] noticed she wasn’t always putting her head to the right all the time.”

Discussion

The African proverb: “it takes a village to raise a child,” applies to healthcare professionals from different disciplines working together, sharing knowledge, and skills for the betterment of the child and the family.

The IBCLC assisting struggling new parents are often the first to notice the tongue’s restrictions. Parents may then be referred to local dentists; otolaryngologists; or other medical professionals who have an understanding of ankyloglossia and are trained in releasing [49,5].

A lactation consultant or the provider who may be doing the release, will refer families to a Craniosacral Therapist or other body worker prior to having the release done and again, after the procedure. We are the village-the IBCLC who helps to uncover the cause of the difficulty, the practitioner who releases, and the Craniosacral Therapist, or other body worker, who, with an understanding that structure and function are reciprocally interrelated, can help the infant prepare for the procedure and after support the body to regain its optimal structure and fluidity of movement. We need to work in concert to raise the next generation so that they can rise to their highest potential.

Competing Interests

The author declare that there is no competing interests regarding the publication of this article.



Figure 6: Baby Jane post CranioSacral Therapy.

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