Correlation between altered lingual function and speech disturbances

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Abstract

Background: The lingual frenum plays a crucial role in oral motor function, and alterations in its position or morphology can contribute to speech disturbances in children. Understanding the correlation between altered lingual frenum and speech difficulties is essential for effective diagnosis and intervention.

Objectives: To compare oral motor function parameters between children with and without speech difficulties associated with altered lingual frenum.

Method: A prospective, observational cross-sectional study was conducted on children aged 6-15 years presenting at an Ear Nose and Throat (ENT) outpatient department. Participants underwent speech evaluation and oral motor function assessment, including maximum mouth opening, tongue positioning, and protrusion. Statistical analysis was performed using independent sample t-tests.

Results: Significant differences were observed between groups in maximum mouth opening, tongue positioning, and protrusion. Children with speech disability (SD) demonstrated significantly reduced maximum mouth opening (16.30mm vs. 32.09mm), shorter distances to incisive papilla (15.26mm vs. 22.65mm) and hard palate (11.17mm vs. 17.65mm), and less tongue protrusion (17.00mm vs. 23.22mm) compared to those without speech difficulty (WSD). These findings suggest impaired oral motor function in SD, emphasizing the importance of tailored interventions.

Conclusions: Children without speech difficulties exhibited greater ranges of motion and more favourable distances in maximum mouth opening, tongue positioning, and protrusion.

(Key words**:** Altered lingual frenum, Frenectomy, Speech difficulty)

Introduction

A frenum is a fibromuscular element covered by the mucous membrane connecting the tongue or lips to the supporting alveolar bone in the oral cavity; thus, a lingual frenum is a fibro-muscular attachment between the body of the tongue and floor of the mouth involving the adjacent alveolar bone[1]. The first, third, and fourth pharyngeal arches are necessary for the development of various tongue segments. The oral portion of the tongue forms a U-shaped sulcus during the sixth week of intrauterine life. The future primordial lingual frenum, which appears as the anterior midventral mucosal attachment, undergoes apoptosis and retracts away from the tip of the tongue, enhancing the mobility of the tongue[2].

A speech-language pathologist will describe an attachment of the lingual frenum as being altered when there is a restriction or disturbance in orofacial function, including speech. They also analyse the tone of the tongue and position of the lingual frenal attachment[3]. Ankyloglossia, or tongue-tie, restricts tongue movement due to a tight lingual frenulum, primarily affecting breastfeeding and is associated with speech issues, malocclusion, and gingival recession. Evaluation of tongue-tie involves various medical and dental specialties, with surgical frenotomy being the main treatment, albeit controversial[4]; thus, an inter-professional team is vital for comprehensive management[5]. The correlation between altered lingual frenum and speech disturbance is extensively discussed in the medical literature. Studies provide significant insights into how a shortened or misplaced lingual frenum impedes tongue mobility, leading to difficulties in speech articulation such as lisping and challenges in pronouncing certain sounds. Surgical interventions are sometimes crucial for improving speech outcomes by correcting lingual frenum abnormalities. Understanding these findings aids in the accurate diagnosis and management of speech disorders associated with altered lingual frenum[6,7]. Thus. the study aims to correlate the speech disturbances associated with altered lingual frenum in normal children and children with speech disturbances.

Objectives

To compare the following parameters between children with and without speech difficulty:

- Mouth opening
- Position of tongue on incisive papilla
- Tongue against the hard palate
- Protruded tongue

Hypothesis

A. Alternate hypothesis: Children with speech difficulties are associated with alteration in the position of the lingual frenum and its function.
B. Null hypothesis: Children with speech difficulties are not associated with alteration in the position of the lingual frenum and its function.

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Method

Study design: This was a prospective, observational, cross-sectional study to compare children with and without speech difficulties and associated position of the lingual frenum who reported to the Ear Nose and Throat (ENT) outpatient department of Chettinad Academy of Research and Education, Chennai, India.

Study sample: The participants of the study included children in the 6-15-year age group who were in the pre-operational and concrete operational stages of development. These children reported with their parents for routine general check-up to the ENT department of Chettinad Academy of Research and Education. After initial clinical diagnosis and screening, children were referred to the Department of Paediatric and Preventive Dentistry, Chettinad Dental College and Research Institute. The relevance in targeting these samples is to select healthy children whose speech and oro-motor function are not impaired due to other neurological or orofacial anomalies. A total of 250 sample was referred and was selected according to the following selection criteria;

Inclusion criteria:

- Children in the age group of 6 -15 years.
- Children without any systemic illness.

Exclusion criteria:

- Children experiencing mental or cognitive challenges that may hinder their understanding or participation in the study.
- Children who had medical conditions affecting their overall health that may impact their ability to take part in the study.
- Children whose parents refused participation in the study.
- Children with temporomandibular joint dysfunction
- Special children with altered cognitive ability who cannot follow the investigators' instructions.

After the complete screening of the participants, 120 children were selected for the study. All 120 children underwent speech evaluation. Every child's speech was evaluated using vernacular language (Tamil). Initially, children were asked some questions like "Say your name and how old you are", "Count from 1 to 20 and say the months of the year". Then participants were asked to repeat Tamil words with letters, ல(la), ள(La), ழ(Zha)" (Table 1) and they were observed for any alterations and disturbances while pronouncing these letters and words. Out of the 120 children, 53 with speech difficulties had difficulty in pronouncing these words.

For equalization of participants in the two groups the sample size was calculated using G*power software with the effect size = 0.645, α error of 0.05 and β power of 0.95 as 53 children in each group accordingly. Thus, the group included:

- Group I: Children without speech difficulties (WSD) (n=53)
- GROUP II: Children with speech difficulties (SD) (n=53)

Before commencement of the study the purpose and procedure of the study was explained in terms of the participant information sheet.

Figure 1 is a flowchart of the study procedure.

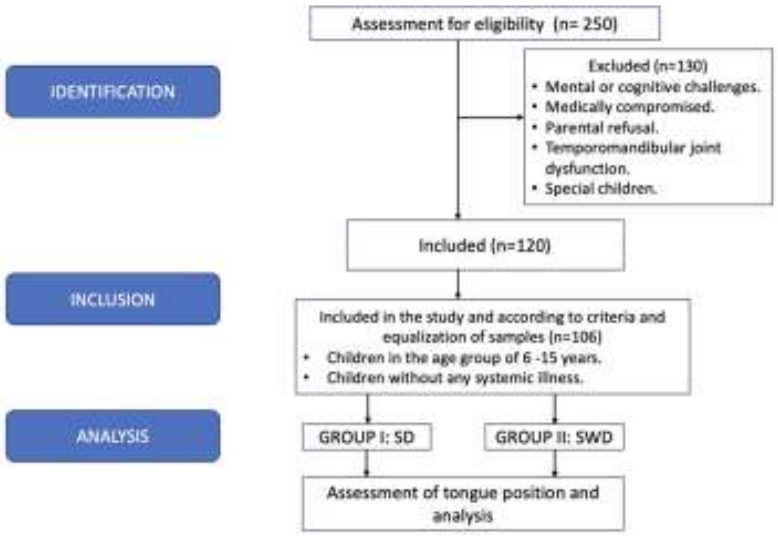

Figure 1: *Flowchart of study procedure*

Data collection: The following parameters were included in the study:

- *Maximum mouth opening (P1)* (Figure 2)**:** Measured from the incisal edge of the left maxillary central incisor to the incisal edge of the left mandibular central incisor, with the right maxillary and mandibular central incisors utilized for measurement in the absence of the aforementioned teeth.

Figure 2: ***Maximum mouth opening***

- *Tongue to incisive papilla (P2)* (Figure 3)*:* Participants were instructed to position the apex of their tongue on the palatine papilla, maintaining this position, and then to reopen their mouths to achieve maximal gap opening. Measurement was taken from the incisal edge of the left maxillary central incisor to the incisal edge of the left mandibular central incisor.

Figure 3: ***Tongue to incisive papilla***

- *Tongue to hard palate (P3)* (Figure 4)*:* The participants were instructed to place the tongue against the hard palate while maintaining this position with the mouth open, and the interincisal distance between the left maxillary and mandibular central incisors was measured.

Figure 4: ***Tongue to hard palate***

- *Tongue on protrusion (P4)* (Figure 5)*:* A wooden spatula was positioned against the vestibular surface of the lower central incisors, with the subject instructed to protrude their tongue beyond the oral cavity, stretching it to its maximum extent onto the spatula. The spatula was subsequently marked with a black pencil at the point of maximal tongue protrusion. Parameters were measured at a single timeline. Children of both groups were assessed for P1, P2, P3 and P4. The collected data were tabulated and analysed.

Figure 5: ***Tongue on protrusion***

Ethical issues: Approval for the study was obtained from the Institutional Human Ethics Committee (CARE IHEC II) of Chettinad Academy of Research and Education, Chennai, India (Ref No: IHEC-II/0512/24) on 31.01.2024. Informed written consent was obtained from the parents of the participating children before commencement of the study.

Statistical analysis: Descriptive and Inferential statistics were analysed by IBM SPSS version 20.0 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp). Mean and standard deviation were used to summarize quantitative data. Intergroup comparison of two groups for the parameters (P1-P4) was done using a independent sample t-test. A p value <0.05 was considered statistically significant.

Results

Age distribution was similar between groups ($p = 0.870$) (Table 1).

From Table 2 it is seen that gender distribution was similar between groups ($p = 0.80$).

Table 3 shows the inter-group comparison of mean and standard deviation for P1-P4

Table 1: ***Age-wise distribution of participants***

Group	Mean age (years)	Standard deviation	p-value
Group 1 (WSD)	10.79	1.65	0.870
Group 2 (SD)	10.67	1.73	

Table 2: ***Gender-wise distribution of participants***

Gender	Group 1 (WSD) n (%)	Group 2 (SD) n (%)	p-value
Male	21 (39.6)	22 (41.5)	0.80
Female	32 (60.4)	31 (58.5)	
Total	53 (100.0)	53 (100.0)	

Table 3: ***Inter group comparison of mean and standard deviation for P1-P4***

Parameter assessed	Group	Mean	Standard deviation	p-value
Maximum mouth opening (P1)	without speech difficulties	32.09mm	2.73	0.0001
	with speech difficulties	16.30mm	4.20	
Tongue to incisive papilla (P2)	without speech difficulties	22.65mm	3.64	0.0001
	with speech difficulties	15.26mm	3.33	
Tongue to hard palate (P3)	without speech difficulties	17.65mm	2.52	0.0001
	with speech difficulties	11.17mm	2.29	
Tongue on protrusion (P4)	without speech difficulties	23.22mm	5.79	0.0001
	with speech difficulties	17.00mm	2.97	

Maximum Mouth Opening (P1): Results suggest that individuals without speech difficulty (WSD) tend to have a significantly greater range of motion in opening their mouths compared to those with speech disability. This increased mobility can have positive implications for tasks such as speaking, eating, and maintaining oral hygiene in the WSD group.

Tongue to Incisive Papilla (P2): Results suggest that individuals without speech difficulty (WSD) tend to have a greater distance between their tongue and the incisive papilla compared to those with speech disability. This increased distance suggests more flexibility in tongue movement and positioning, potentially contributing to clearer speech production in the WSD group.

Tongue to Hard Palate (P3): Results suggest that individuals without speech difficulty (WSD) tend to have a greater distance between their tongue and hard palate compared to those with speech disability. This increased distance may indicate better tongue mobility and control in the WSD group, potentially leading to clearer speech articulation.

Tongue on Protrusion (P4): Results suggest that individuals without speech difficulty (WSD) tend to protrude their tongues more compared to those with speech disability. This increased tongue protrusion suggests better control over tongue movements in the WSD group, which can contribute to clearer speech production and more effective swallowing.

The values provided underscore the significant differences in oral motor function between individuals without speech difficulty (WSD group) and those with speech disability (SD group). These differences have important implications for speech production, swallowing, and overall oral health, highlighting the need for tailored interventions to address the specific needs of individuals with speech disability. Thus, from the above findings group II children had alteration in the movements of the tongue which was related to the altered tongue position.

Discussion

The study aimed to correlate speech disturbances associated with altered lingual frenum in normal children and those with speech difficulties. The results of the study shed light on the intricate relationship between altered lingual frenum and speech difficulties. The comparison between children with and without speech difficulties revealed significant differences in various parameters related to oral motor function. These parameters include maximum mouth opening (P1), tongue to incisive papilla distance (P2), tongue to hard palate distance (P3), and tongue protrusion (P4). Notably, individuals without speech difficulty demonstrated greater ranges of motion and more favourable distances in these parameters compared to those with speech disability. These findings suggest that altered lingual frenum may indeed contribute to speech disturbances by affecting tongue mobility and positioning.

The results of the current study align with existing literature, which has extensively discussed the impact of lingual frenum abnormalities on various aspects of oral function. Studies by, Ferrés-Amat E, *et al*[8] and Messner AH, *et al*[9] have highlighted the association between altered lingual frenum and speech articulation difficulties. These works emphasize the role of lingual frenum assessment and surgical interventions like frenotomy in improving speech outcomes by correcting lingual frenum abnormalities. Furthermore, the study findings underscore the importance of interdisciplinary collaboration in the management of speech disorders associated with altered lingual frenum. Evaluation of lingual frenum and subsequent interventions involve coordination between speech-language pathologists, paediatric dentists, otolaryngologists, and lactation consultants. This multidisciplinary approach is essential for providing comprehensive care to individuals with speech difficulties[10].

In addition to speech disturbances, altered lingual frenum can also contribute to breastfeeding difficulties in infants. Studies by Buryk M, *et al*[11], Dollberg S, *et al*[12] and Wallace H, *et al*[13] have demonstrated the efficacy of

frenotomy in relieving nipple pain and improving breastfeeding outcomes in infants with ankyloglossia. This highlights the broader impact of lingual frenum abnormalities on oral function and the importance of early intervention to address breastfeeding challenges. The discussion also warrants consideration of the diagnostic criteria and classification of lingual frenum abnormalities. Segal LM, *et al*[14] emphasized the need for standardized criteria to diagnose ankyloglossia, given the variability in assessment methods across studies. Clear diagnostic criteria are essential for accurate diagnosis and appropriate management of lingual frenum abnormalities, ensuring that individuals receive timely and effective interventions.

Indeed, the role of "mazhalai pechu" or child speech should not be overlooked when assessing speech disturbances in children. In many cultures, including Tamil-speaking communities, children may exhibit variations in speech development that are considered normal within their linguistic and cultural contexts. These variations may include phonological processes, articulation errors, and other speech patterns that are typical for children at certain developmental stages. It's crucial for speech-language pathologists and other professionals to differentiate between typical “mazhalai pechu” and speech disturbances that may be indicative of underlying issues such as altered lingual frenum or other speech disorders. This requires a thorough understanding of typical speech development in children, as well as the ability to recognize red flags that may signal the need for further assessment and intervention[15]. Furthermore, cultural and linguistic factors play a significant role in shaping children's speech patterns and communication styles. Therefore, it's essential to consider the cultural and linguistic background of the child when evaluating speech disturbances and designing appropriate interventions. This may involve collaborating with bilingual professionals, using culturally relevant assessment tools, and incorporating family preferences and values into the intervention process[16]. By recognizing the significance of “mazhalai pechu” and understanding its relationship to speech development and cultural context, professionals can ensure that children receive appropriate support and intervention tailored to their individual needs. This holistic approach to assessment and intervention promotes effective communication skills and enhances the overall well-being of children in diverse linguistic and cultural communities.

Correlation between altered lingual frenum and speech disturbances in children is a complex and multifaceted issue that warrants interdisciplinary collaboration and comprehensive management. The study findings, supported by a wide range of literature, provide valuable insights into the impact of lingual frenum abnormalities on oral motor function, speech articulation, breastfeeding, and overall oral health. Moving forward, further research and clinical efforts are needed to optimize diagnostic criteria, intervention strategies, and long-term outcomes for individuals with speech difficulties associated with altered lingual frenum.

Conclusions

Children without speech difficulties exhibited significantly greater maximum mouth opening (P1), tongue to incisive papilla (P2), tongue to hard palate (P3) and tongue on protrusion (P4) parameters compared to children with speech difficulties.

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