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A COMPARATIVE STUDY OF PRE AND POST- OPERATIVE SPEECH EVALUATION IN CHILDREN WITH TONGUE-TIE

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ABSTRACT

OBJECTIVE: To determine whether ankyloglossia is associated with articulation problems and the effect of frenuloplasty on speech and tongue mobility.

STUDY DESIGN: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram.

SETTING: Government Dharmapuri Medical College Hospital, Dharmapuri.

SUBJECTS: In this study, thirty children with tongue tie were included as experimental group.

MAIN OUTCOME MEASURES: The main outcomes are

1. Compared the percentage of articulation errors during pre and post operative tongue tie release surgery
2. Systematically investigated the type of misarticulations and occurrence of errors among younger (3-6 yrs) and older (6-12yrs) groups.

Results: The SODA error patterns decreased significantly in younger age group after tongue-tie release compared to older age groups followed by speech therapy for a period of 3 months.

CONCLUSION: The tongue-tie release is a simple procedure which will be benefitted for the earlier age groups (3-6 yrs). Misarticulations like substitutions, additions, omissions and deletions have significantly reduced in younger age groups when the tongue-tie release is done in-prior followed by speech therapy for at least six months.

KEYWORDS : Tongue-tie release, Speech Therapy, Substitutions, Additions, Omissions and Deletions

Introduction

Articulation error is the most common type of speech disorder. Good communication depends upon the following four parameters of speech (ISHA, 1990)

1. Articulation
2. Fluency
3. Voice
4. Resonance

Among these, the articulation aspect is important since it affects main communication pattern. A speech clinician must have a thorough understanding of articulation and its disorders. There are several aspects of speech and language but the way in which the speech sounds are produced in one's language needs to be assessed through articulation assessment.

Articulation assessment involves skillful determination of the child's or individual's proficiency in articulation in the phonemic system of language and getting an insight into the prognosis. Tests of articulation are in existence for over five decades. Though it seems to be a simple task of identifying sound errors by listening to the child's speech, in reality it involves skilful perception of the sound errors, phonetic transcription of the errors, awareness of the existing sounds in the language being tested and maintaining motivation of the child during the test procedure.

The articulation test and related articulation assessment procedure are clinical tools that have been developed primarily using most familiar words of a particular language, i.e., the words to be used to develop such clinical tools should be in the vocabulary of the child.

Thus the testing process involves mere selection of such familiar words and making the child to repeat those words. Repetition of words makes the child motivated for test.

An overview of findings

We reviewed 131 dissertations of Post Graduation program of All India Institute of Speech and Hearing (AIISH), Mysore from 1997-2002. Among these, the studies by Shanker (1998) and Seema (1999) were related to the articulation errors. Shanker(1998), in his study, concluded that /d/, /dh/ and /th/ were most difficult sounds to articulate. Seema (1999) reported the prevalence of 3.58 percent articulation errors based on the survey of case files. The Union Health Minister Ramdoss (2005) in his speech, reported that 10 to 13 percent of school children in our country have speech defects, including difficulty in articulation, stuttering and middle-ear disorders.

Ankyloglossia (AG) / Tongue-tie:

The most important articulator for speech production is undoubtedly the tongue. During speech, the amazing range of movements the tongue can make include tip-elevation, retraction, grooving, and protrusion. Relatively short at birth, the tongue grows longer, and thinner at the tip, as we get older. The terms 'ankyloglossia', or 'tongue tie' refer to a restricted lingual fraenum due to a consolidation of tissue, usually leading to reduced mobility of the tongue.

Potential effects of tongue-tie

1. Speech development

It is important to note that tongue-tie does not necessarily impair speech, in fact, it rarely appears to do so. Many children compensate well and have normal sounding speech, even those with the fraenum attached very close to the tongue tip. Some children with tongue-tie may have imprecise articulation, leading to misarticulations.

It is commonly observed that a person with tongue-tie cannot protrude the tongue tip beyond the edges of the lower incisors, or to the maxillary alveolar ridge (behind the upper incisors). Sometimes when a person with tongue-tie attempts to protrude the tongue it forms a characteristic 'W' shape. Under-developed oral kinaesthesia is the result of tongue tie having a very poor sense of the geography of the mouth, because they have such a limited range of lingual movements. Speech problems occur which is difficult to correct by conventional means because they cannot memorize the correct movements of speech, or be sure of always achieving them. Adults develop methods of speech which mask their difficulties with sounds. Clarity in rapid speech is almost always impossible for a tongue-tied person to achieve. Thus it is seen that many with tongue tie learn to compensate

for their limited tongue mobility by adopting alterations of movements.

It is being increasingly accepted by disciplines associated with infants, children and adults with tongue tie that there is now no place for 'wait and see' policies when the frenum has been identified and diagnosed as abnormal, and early intervention is the optimal form of management.

Tongue-tie leading to Misarticulations:
There are no significant data to suggest a causative association between ankyloglossia and speech articulation problems. National Institute of Health (NIH, 1994) explained that one of the most common communication disorders in childhood is that of errors in speech sound production (misarticulation). It has been estimated that articulation disorders represent in excess of 75 percent of all speech disorders in children. A large number of these articulation disorders have recognizable organic, neurogenic, or physical correlate. These difficulties may have consequences throughout the lifespan of these children.

Elbert and Mcreynolds (1985) expressed that the children's articulation errors can be viewed in a number of different ways. For the child with few errors, each sound may be taught of a separate problem requiring specific treatment whereas the child with multiple misarticulations, the evidences suggest that the child's errors reflect structural-abnormality.

Test of Articulation:
Articulation testing measures performance on one or more individual sounds of a language. It is a sound-by-sound approach to assessment. For example, the Goldman Fristo Test of Articulation (GFTA-2) (2000) is a measure of articulation. This test measures sound production (articulation) in words and in sentences; it also has a section that dynamically provides information on the stimulability of isolated sounds in multiple word positions. Results gathered from the GFTA-2 should be reported as articulation skills/difficulties.

Assessment of articulation based on auditory impression has been widely used in clinical setting. The advantage of this assessment method is that the characteristics of articulation can be easily and systematically understood. First, auditory impression is essentially subjective and the reliability of the assessment is not always very high. Second, there are some limitations when extracting articulatory characteristics using this method, even with visual observation of articulatory movements. The purpose of screening tests of articulation lies in the identification of the children with articulation disorders and its function lies in assessing the general adequacy of a child's speech and permitting the detection of those children who require speech therapy. These tests only have sounds and sound combinations most likely to be defective. Misarticulations such as substitutions, omissions, deletions and additions are generally termed as SODA errors are assessed using Tamil Articulation Test.These tests help in describing the nature of the problem and in diagnosing the problem but aim mainly at detecting the children having defective articulation as quickly as possible.

Articulation Therapy:
The tongue-tie makes articulation and phonetics a challenge. Hence, production of lingua-alveolar and lingua-palatal sounds such as /r/ or /l/ , is a major concern. The physiological media of speech are respiratory, phonatory, articulatory and resonatory. The tongue plays an important role in the articulation of consonants by airflow obstruction and modification. There is a big controversy whether AG can affect the child's speech ability. Although not correlated with speech delay, it may interfere with articulation and intelligibility. Production of certain sounds such as "t, d, l, th, s" may be impaired due to restriction of the tongue tip, which is unable to reach the palate or the palatal gums of the upper incisors. In case a patient articulates all those sounds properly, the surgical approach is not recommended Ankyloglossia is a condition where the length of the lingual frenulum hinders with speech production. Speech production is impaired based on the extent to which the frenulum restricts the movement of the tongue. Speech problems can be handled with the help of a speech therapist with beneficial results.

Articulation therapy plan includes assessment of phonetic placement and precise production of speech sounds as well. Most of the tongue tip needs to elevate upto the alveolar ridge for production of lingua-alveolar sound /l/, /d/, lingua dental sound/th/and lingua-palatal /r/. Therapy is focused on correcting the production of the errored sounds ranging from sounds of minimal effort of the tongue movement (e.g., lingua-alveolar sound /l/) to increasing tongue effort (e.g.,lingua-palatal retroflex - /r/). The prognosis of articulation therapy for children with SODA errors is based on each child's adaptation to correct phonetic placement for precise speech sound production and regular follow-up.

AIM OF THE STUDY:
1. To quantify the optimal management of tongue-tie including timely and appropriate surgical intervention, followed by speech therapy when indicated.
2. To find out tongue-tie release candidacy criteria clinically.

MATERIALS & METHOD:
This study included thirty children with pre-operative and post-operative tongue tie release surgery performed in the selected group. Equal numbers of male and female children were selected for this study. Children of age group between 5 yrs to 12 yrs were included in this study. Exclusion criteria were any congenital abnormality in the craniofacial region, abnormal mental development except that attributable to tongue-tie were only included. Misarticulations of substitution, omission, distortion and addition were assessed. The preoperative results were compared with post operative results after 3 months followed

Tamil Articulation Test (TAT)
This test consists of 65 words which included all vowels and consonants of Tamil in initial, medial and final positions. Every child is assessed with TAT test material during pre operative visit and again TAT was administered during post operative period followed by speech therapy for 3 months. The children who were included in the study attended speech therapy on weekly basis.

STATISTICAL METHODS:
SODA errors : Substitution errors, omission errors, deletion errors, addition errors were considered as primary outcome variable. Preoperative and post-operative were considered as primary explanatory variable.

Other explanatory variables: Age, gender
Descriptive analysis: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram.

Inferential statistics:
Quantitative outcome;
The difference in the substitution errors, omission errors, deletion errors, addition errors between pre-operative and post-operative was assessed by comparing the mean values. The mean differences along with their 95% CI were presented. Paired t- test was used to assess statistical significance.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.(1)

1.IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

Result:
A total of 30 subjects were included in final analysis.

Table 1: Descriptive analysis for age in study population (N=30)

Parameter	Mean ± SD	Median	Min	Max	95% C.I.	
					Lower	Upper
Age	6.23 ± 2.47	6.00	3.00	12.00	5.31	7.16

The mean age was 6.23 ± 2.47 in the study population. Ranged between 3 years to 12 years (95% CI 5.31 to 7.16). (Table 1)

Table 2: Descriptive analysis of gender in study population (N=30)

Gender	Frequency	Percentage
Male	15	50.00%
Female	15	50.00%

Among the study population male participants were 15 (50%) remaining 15 (50%) were female participants. (Table 2 & Figure 1)

Figure 1: Pie chart of gender in study population (N=30)

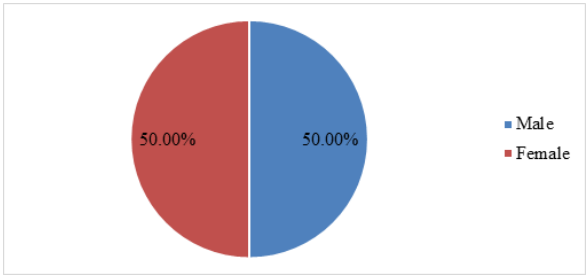


Table 3: Descriptive analysis for preoperative in study population (N=30)

Pre-operative Parameter	Mean ±SD	Median	Min	Max	95% C.I.	
					Lower	Upper
Substitution errors	22.47 ± 2.61	23.00	17.00	26.00	21.49	23.44
Omission errors	7.67 ± 1.65	8.00	4.00	12.00	7.05	8.28
Deletion errors	6.9 ± 1.45	7.00	4.00	10.00	6.36	7.44
Addition errors	5.7 ± 1.58	6.00	3.00	9.00	5.11	6.29

The pre-operative mean substitution error was 22.47 ± 2.61 in the study population, minimum error was 17 and maximum error was 26 in the study population (95% CI 21.49 to 23.44). The pre-operative mean omission error was 7.67 ± 1.65 in the study population, minimum error was 4 and maximum error was 12 in the study population (95% CI 7.05 to 8.28). The pre-operative mean deletion error was 6.9 ± 1.45 in the study population, minimum error was 4 and maximum error was 10 in the study population (95% CI 6.36 to 7.44). The pre-operative mean addition error was 5.7 ± 1.58 in the study population, minimum error was 3 and maximum error was 9 in the study population (95% CI 5.11 to 6.29). (Table 3)

Table 4: Descriptive analysis for postoperative in study population (N=30)

Post-operative Parameter	Mean ± SD	Median	Min	Max	95% C.I.	
					Lower	Upper
Substitution errors	11.87 ± 2.53	11.00	8.00	21.00	10.92	12.81
Omission errors	4.73 ± 2.1	5.00	1.00	9.00	3.95	5.52
Deletion errors	3.8 ± 1.19	4.00	1.00	6.00	3.36	4.24
Addition errors	2.53 ± 1.04	2.00	1.00	6.00	2.14	2.92

The post-operative mean substitution error was 11.87 ± 2.53 in the study population, minimum error was 8 and maximum error was 21 in the study population (95% CI 10.92 to 12.81). The post-operative mean omission error was 4.73 ± 2.1 in the study population, minimum error was 1 and maximum error was 9 in the study population (95% CI 7.05 to 8.28). The post-operative mean deletion error was 3.8 ± 1.19 in the study population, minimum error was 1 and maximum error was 6 in the study population (95% CI 3.36 to 4.24). The post-operative mean addition error was 2.53 ± 1.04 in the study population, minimum error was 1 and maximum error was 6 in the study population (95% CI 2.14 to 2.92). (Table 4)

Table 5: Comparison of mean pre and post-operative in substitution error (N=30)

Parameter	substitution errors Mean ± SD	Mean Difference	95% CI of mean difference		P-value
			Lower	Upper	
Preoperative	22.47 ± 2.61	10.60	9.67	11.53	***<0.001***
Postoperative	11.87 ± 2.53				

The substitution error, mean pre-operative was 22.47 ± 2.61 and the post-operative was 11.87 ± 2.53 and the mean difference (10.60) between two groups was statistically significant (P value <0.001). (Table 5 & Figure 2)

Figure 2: Error bar chart of comparison of mean pre and post-operative in substitution error (N=30)

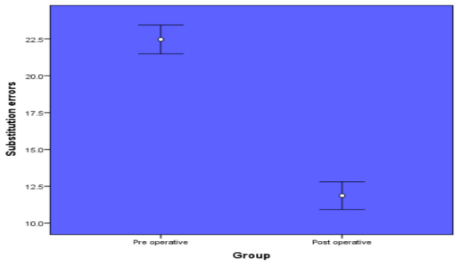


Table 6: Comparison of mean pre and post-operative in omission error (N=30)

Parameter	Omission Errors Mean ± SD	Mean Difference	95% CI of mean difference		P-value
			Lower	Upper	
Preoperative	7.67 ± 1.65	2.93	2.27	3.60	***<0.001***
Postoperative	4.73 ± 2.1				

The omission error, mean pre-operative was 7.67 ± 1.65 and the post-operative was 4.73 ± 2.1 and the mean difference (2.93) between two groups was statistically significant (P value <0.001). (Table 6 & Figure 3)

Figure 3: Error bar chart of comparison of mean pre and post-operative in omission error (N=30)

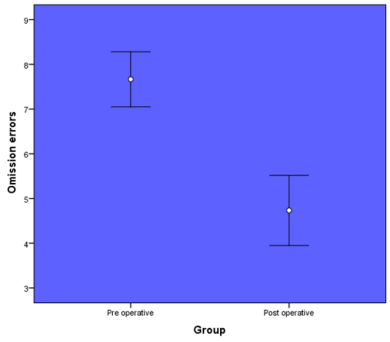


Table 7: Comparison of mean pre and post-operative in deletion error (N=30)

Parameter	Deletion Errors Mean ± SD	Mean Difference	95% CI of mean difference		P-value
			Lower	Upper	
Preoperative	6.90 ± 1.45	3.10	2.53	3.67	***<0.001***
Postoperative	3.80 ± 1.19				

The deletion error, mean pre-operative was 6.90 ± 1.45 and the post-operative was 3.80 ± 1.19 and the mean difference (3.10) between two groups was statistically significant (P value <0.001). (Table 7 & Figure 4)

Figure 4: Error bar chart of comparison of mean pre and post-operative in deletion error (N=30)

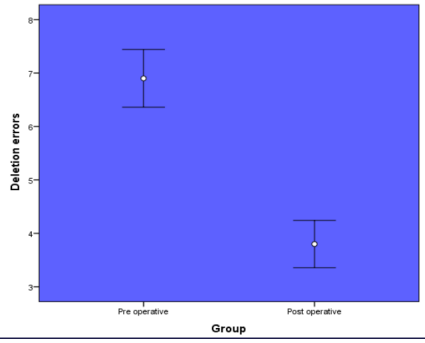
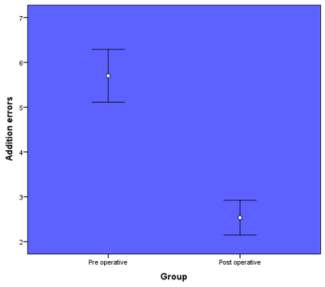


Table 8: Comparison of mean pre and post-operative in addition error (N=30)

Parameter	Addition errors Mean ± SD	Mean Difference	95% CI of mean difference		P-value
			Lower	Upper	
Preoperative	5.70 ± 1.58	3.17	2.60	3.74	***<0.001***
Postoperative	2.53 ± 1.04				

The addition error, mean pre-operative was 5.70 ± 1.58 and the post-operative was 2.53 ± 1.04 and the mean difference (3.17) between two groups was statistically significant (P value <0.001). (Table 8 & Figure 5)

Figure 5: Error bar chart of comparison of mean pre and post-operative in addition error (N=30)



DISCUSSION:

Maximum Substitution error was 26 preoperatively in three children of age groups between 4 years, 8 years and 9 years and minimum substitution errors was 17 post operatively in two younger group children of 3 years. Secondly, maximum omission error was noticed 12 preoperatively in a child of 4 years, minimum error was 4 in a child of 6 years postoperatively. Thirdly, maximum deletion error was10 preoperatively in one child of 4 years and minimum error was 4 postoperatively in one child of 7 years. Fourthly, maximum addition error was 9 preoperatively in 2 children of 3 years and 8 years of age. Minimum addition error was 3 postoperatively in 3 year old child..

The preoperative results were compared with postoperative results soon after tongue-tie surgery followed by speech therapy for a period of 3 months. Comparative results indicated reduced substitution errors among younger age groups of 3 to 6 yrs, postoperatively substitution errors reduced from 22 to 11 errors, omission errors reduced from 7 to 4 errors postoperatively, deletion errors reduced from 6 to 3 postoperatively and addition errors were found least among the errors, six children's were observed preoperatively early after tongue-tie surgery followed by speech therapy in younger group between 3yrs to 6 yrs. This result was consistent with Ito Y11 etal study and Chinnadurai etal[4] study.

CONCLUSION:

Although there is a lack of scientific evidence proving a true relationship between speech disorders and Ankyloglossia (AG). There seems to be a consensus that AG may be the cause of specific speech disorders in certain individuals. AG does not prevent or delay the onset of speech, but may interfere with articulation. A simple speech articulation test has been suggested. If the elevation of the tongue tip is restricted, the articulation of one or more of the lingual, palatal and alveolar sounds such as "t," "d," "l," "th," and "s"—will not be accurate. Patients who have difficulty should be referred to a speech pathologist for evaluation.

The tongue-tie release is a simple procedure which will be benefitted for the earlier age groups (3-6 yrs). Misarticulations like substitutions, additions, omissions and deletions have significantly reduced in younger age groups when the tongue-tie release is done at earliest followed by speech therapy for at least six months.

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. Optimal management of tongue tie including timely and appropriate surgical intervention followed by speech therapy when indicated has the capacity to deliver pleasing results, often in a shorter time than expected. Development of a concise, practical, standardized, validated tool for diagnosing ankyloglossia and a decision rule for surgical corrections are important for further research.

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