

Lingual frenulum and malocclusion: An overlooked tissue or a minor issue

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ABSTRACT

Context: Tongue-tie (more formally known as ankyloglossia) is a congenital anomaly characterized by an abnormally short lingual frenulum, which may restrict mobility of the tongue tip impairing its ability to fulfill its functions. The clinical significance of ankyloglossia is varied; rarely symptomatic to a host of problems including infant feeding difficulties, speech disorders, malocclusions, and others.

Aims: The need of this study was to evaluate the occurrence and severity of tongue-tie and its association with the type of malocclusions in two populations and also to correlate the various malocclusion traits with the grades of tongue-tie.

Subjects and Methods: A total of 700 school children in the age group of 9–17 years were examined for the presence of tongue-tie, 350 from regular schools and 350 from special schools. The presence was evaluated, measured, and graded into Grades I–V according to Kotlow's method. The malocclusion was assessed according to Angle's classification. Severity of crowding was assessed by Little's irregularity index in each case. Various other malocclusion traits were visually assessed, in relation to the positions of the teeth.

Statistical Analysis Used: Spearman's rank correlation method was used to test the relationship between type of malocclusions, grades of tongue-tie and severity of crowding. Significance was considered at the ($P < 0.05$) level.

Results: Statistically significant differences were seen between grades of tongue-tie and Angle's types of malocclusion and Spearman's correlation between them showed negative correlation. The Spearman's correlation showed a negative correlation between tongue-tie grades and severity of crowding.

Conclusions: As the grade of tongue-tie increased, its association with Classes I and II malocclusion decreased. The lower grades of tongue-tie are associated with increased lower incisor crowding. Shorter, tight frenulums are more associated with maxillary constriction, anterior open bite, and spacing of the lower anteriors.

Key words: Classification, lingual frenulum, malocclusion, tongue-tie

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Etymologically, "Ankyloglossia" originates from the Greek words "agkilos" (curved) and "glossa" (tongue). The English synonym is "Tongue-tie." The first use of the term ankyloglossia in the medical literature dates back to the

1960's, when Wallace^[1] defined tongue-tie as "a condition in which the tip of the tongue cannot be protruded beyond the lower incisor teeth because of a short frenulum linguae, often containing scar tissue." It is manifested by an abnormally short and thick lingual frenulum. It normally represents a congenital oral anomaly that may affect (limit) the mobility of the tongue.

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The soft-tissue position and activity in the etiology of malocclusion has been well documented.^[2] The effect of the upper labial frenum on the etiology of upper anterior midline diastemata and on the subsequent relapse of such cases is well documented in the literature. A frenum that attaches too close to the gingival margin of a tooth can cause gingival detachment and the resultant loss of bone.^[3]

While literature with regard to the labial frenum and malocclusion is available, there seems to be scarcity of literature with regard to the lingual frenum. Keim^[2] in his editorial affirms the same and impresses on the need for a research into the lingual frenulum.^[2,4,5]

The clinical significance of ankyloglossia is varied; some authors feel it is rarely symptomatic^[6,7] whereas others believe it may lead to a host of problems including infant feeding difficulties, speech disorders, and various mechanical and social issues.^[8-13] Two elements of physiology are essential to understanding the influence of the lingual frenum on the dentition according to Northcutt:^[4] First, muscles determine the shape of bone; and second, food is swallowed by vacuum force in the mouth. To create a vacuum, the tongue is normally elevated to the roof of the mouth, creating a seal and giving the palate its normal shape.^[4] The lingual frenum acts more like a tendon than a muscle; small as it is, it rigidly establishes the height to which the tongue can rise. When upward tongue movement is restricted due to a short lingual frenum, the tongue must thrust forward to create a seal at the front of the mouth, often causing maxillary protrusion and anterior open bite.^[4,12]

Horton *et al.*, is of the view that the low lying position of the tongue and its interposition between the upper and lower arches is instrumental in its causation of an anterior open bite and Class III malocclusions.^[12,14,15]

The clinical significance of this anomaly and the best method of management have been subject of debate for some time. Much of the controversies regarding management of ankyloglossia probably are related to the paucity of relevant scientific data in this area with regard to its incidence, clinical effects and management. Horton^[12] and Keim^[9] have also emphasized the need for such data on this tissue, that is, the lingual frenulum, which has been long overlooked.

The aim of this study was to evaluate occurrence and severity of tongue-tie and its association with the type of malocclusions in general and mentally challenged populations and to correlate the various malocclusion traits with the grades of tongue-tie seen.

SUBJECTS AND METHODS

A total of 700 children were examined for the presence of a tongue-tie, 350 of them went to regular schools and 350

were mentally challenged children from special schools. The children belonged to the 9–17 years age group. An informed consent was obtained from all the subjects/parents/teachers, who participated in this study. An ethical clearance was obtained from the Ethical Clearance Committee of the college where the study was designed.

The tongue-tie, if present, was graded according to the classification given by Kotlow^[16] Measurements of the free tongue were carried out with a scale and divider and with maximum mouth opening and tip of the tongue touching the palatal papilla with results expressed in and read to the nearest millimeter and graded into Grades I–V according to Kotlow^[16] as under; clinically acceptable, normal range of free tongue: >16 mm.

Classification of ankyloglossia:

Class I: Mild ankyloglossia - 12–16 mm

Class II: Moderate ankyloglossia - 8–11 mm

Class III: Severe ankyloglossia - 3–7 mm

Class IV: Complete ankyloglossia - <3 mm

The malocclusion was assessed in each case according to Angle's (1899) classification. Various other morphological findings were also visually assessed, in relation to the positions of the teeth and these included.

- Maxillary constriction
- Crowding
- Spacing
- Open bite
- Deep bite
- Cross bite

The malocclusion traits were however, assessed by a single observer.

Statistical analysis

Data were analyzed using SPSS software (IBM® SPSS® Advanced Statistics version 20.0) for statistical computations. Spearman's rank correlation method was used to test the relationship between type of malocclusions, grades of tongue-tie, and severity of crowding. Significance was considered at the ($P < 0.05$) level.

RESULTS

One hundred and thirteen (16.4%) of 700 subjects were identified as having significant tongue-tie, of which 65 (18.57%) were from general population and 48 (13.71%) from mentally challenged population, however, the differences were not statistically significant [Table 1]. When the males and the females were compared, it was evident that the males had predominance over the females with regard to the incidence in both populations studied; however, the difference between the genders was not statistically significant [Table 2].

When the different grades of tongue-tie were correlated with the type of Angle's malocclusion, it was seen that the milder forms of tongue-tie (Grades I and II with the free tongue between 12 and 16 mm and between 8 and 11 mm, respectively) were associated with Angle's Class I (22.12%, 23.01%, respectively) and Angle's Class II malocclusions (12.38%, 13.27%, respectively) and Class III (7.08%, 1.77%, respectively) while the Grade III tongue-tie was associated with Classes I and II (1.77%, 0.88%, respectively) with Class III (3.54%) malocclusions showing predominant values. However, the more severe form of tongue-tie showed a low incidence and association with any form of Angle's malocclusion [Table 3, Figure 1]. This finding was seen in both the populations studied. However, the differences were statistically significant and a Spearman's Correlation between the tongue-tie and types of Angle's malocclusion showed negative correlation [Table 4, Figure 1].

The various traits of malocclusion were visually assessed and the findings recorded in Table 5 and graphically represented in Figure 2. It was seen that maxillary constriction constituted the greatest amount of malocclusion traits seen followed by crowding, spacing, and anterior open bite.

The Little's irregularity index was obtained^[17] and the same was associated with the grades of tongue-tie. It was evident that the lower the grade of tongue-tie, the higher was the Little's irregularity index. A correlation test, the Spearman's correlation [Table 6] was seen to also show a negative correlation indicating, thus, that the lower grades of tongue-tie are associated with high lower incisor crowding.

DISCUSSION

Very few studies have reported results comparing ankyloglossia and orthodontic anomalies. Tuerk and Lubit^[14] have reported the presence of open bite and Angle's Class III malocclusion in patients with ankyloglossia. Mukai *et al.*^[18] demonstrated that 84% of the examined patients had Angle's Class III malocclusion, however, Mazzocchi and Clini^[19] and Garcia Pola *et al.*^[20] could not find any relation

between dental or orthodontic anomalies and short length of the frenulum and the occurrence of either dental or orthodontic anomalies. Ruffoli *et al.*^[21] found that 55.5% of the children had Angle's Class I of malocclusion with 61.5% of the enrolled subjects with bite problems (deep bite, open bite) which were related with the anatomical measures used for ankyloglossia.

In this study, the relationship between Angle's class of malocclusion and grades of tongue-tie was assessed, and it was found Grade I tongue-tie was associated with 22.12% of Class I malocclusion. As the grade of tongue-tie increased, its association with Class I malocclusion decreased that is 12.39%; Grade II, 7.08%; and Grade III, 7.08%. It was also seen that Class II div 1 and div 2 malocclusion was associated with Grades I and II tongue-ties to a greater extent than Grades III and IV tongue-ties. However, the Class III malocclusion was found to be highest in (3.54%) Grade III tongue-tie.

Most authors seem to agree that the low positioning of the tongue is responsible for the Class III malocclusion and a Grade III tongue-tie with a free tongue length of 7–11 mm would definitely keep the tongue in a low lying positioning. It is not surprising, therefore, that our study concurs with the views of Horton,^[12] Tuerk and Lubit,^[14] Whitman and Rankow.^[15]

Visual assessment of the malocclusion and comparing our study with the lone study of Northcutt,^[4] in the order of decreasing incidence it was seen that maxillary constriction (84%), open bite, (80%) crowding (52%), spacing (33%), and deep bite (20%) constituted the various occlusal traits.

Table 1: Incidence of tongue-tie in the total population

Group	n=700	Percentage of the total population
General population	65	18.57
Mentally challenged	48	13.71
Total	113	16.14

$\chi^2=3.0507, P=0.0810$, nonsignificant

Table 2: Incidence of tongue-tie according to gender in two populations

Group	Male	Percentage	Female	Percentage	Total	Percentage
General population	42	64.62	23	35.38	65	57.52
Mentally challenged	31	64.58	17	35.42	48	42.48
Total	73	64.60	40	35.40	113	100.00

$\chi^2=0.0094, P=0.9970$, nonsignificant

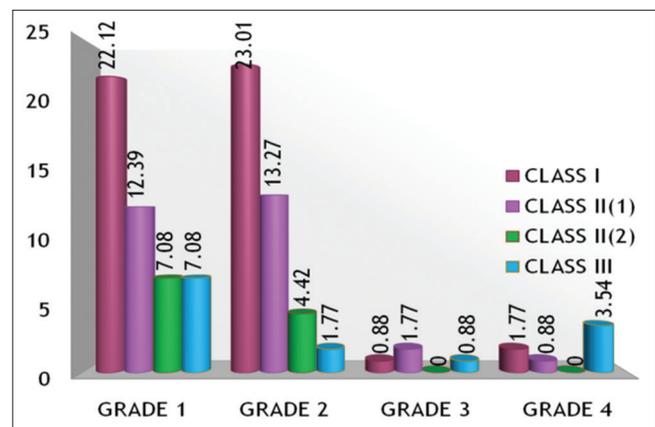


Figure 1: Grades of tongue-tie and its association with malocclusion seen in the total population

Table 3: Association between Angle's types of malocclusion and grades of tongue-tie in the entire population

Type of malocclusion	Grade I	Grade II	Grade III	Grade IV
Class I malocclusion	22.12	12.39	7.08	7.08
Class II (1) malocclusion	23.01	13.27	4.42	1.77
Class II (2) malocclusion	0.88	1.77	0.00	0.00
Class III malocclusion	1.77	0.88	3.54	0.00
Total	47.79	28.32	15.04	8.85

Table 4: Correlation between types of malocclusion and grades of tongue-tie

Population (n=113)	Spearman rank	t	P
Type of malocclusion versus tongue-tie	-0.0582	-0.6140	<0.05

P<0.05

Table 5: Breakdown of visual assessment finding

Malocclusion	Findings	Percentage (out of 113)
Anterior open bite	21	18.58
Maxillary constriction	52	46.02
Posterior cross bite	1	0.88
Spacing	24	21.24
Crowding	46	40.71
Deep bite	10	8.85
Anterior cross bite	1	0.88
Normal	4	3.54

Table 6: Spearman's rank correlation between severity of malocclusion (little's irregularity index) and grades of tongue-ties in two populations separately

Population	n	Spearman rank	t	P
General	65	-0.4160	-3.6306	0.0006*
Mentally challenged	48	-0.5666	-4.6635	0.0000*
Total	113	-0.4623	-5.4934	<0.05

This study too found that maxillary constriction made up 46.02% of the occlusal traits studied, however, crowding 40.71%, spacing 21.24%, anterior open bite 18.58%, deep bite 8.85% and anterior and posterior cross bite 0.88% made up for the remaining occlusal traits. This study differed in the incidence of anterior open bite with that of Northcutt.^[4]

When the irregularity index of the lower anteriors were assessed it was ascertained from this study that the milder grades of tongue-ties were associated with the greatest irregularities whilst the higher grades of tongue-ties showed lower grades of irregularities. Northcutt states that; "Ironically, however, the shortest frenums don't cause the greatest harm to the dentition. Unlike N-1 and N-2 frenums, N-3 and N-4 frenums don't always create tongue thrust because the tongue tip is tied down and thus cannot push the upper teeth up and out. The N-1 and N-2 frenums are somewhat longer and therefore allowing the tongue to push out farther, causing more damage to the anterior teeth." The findings of this study seem to agree with that of Northcutt.^[4]

Various surgical procedures, such as frenulotomy, frenectomy, and Z-plasties are advocated to release the tied down tongue and the lack of pertinent data in this regard

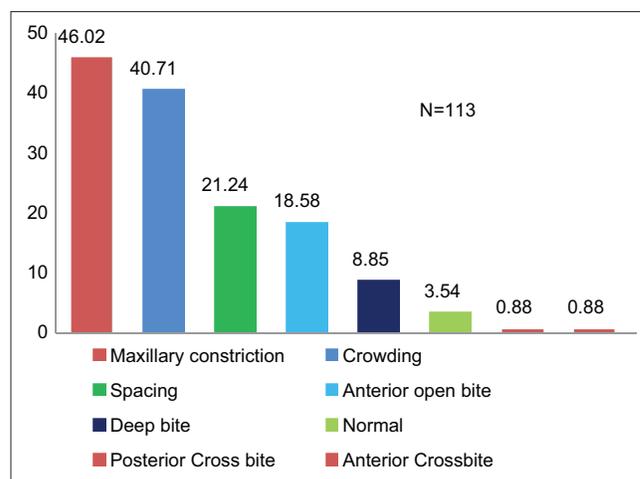


Figure 2: Visual assessment of malocclusion traits

limits the utility of surgery to correct these problems. The association of tongue-ties with relapse is speculated^[4] and until the time the evidence is available it remains but a speculation. Surgeries prior to age five are definitely not indicated.^[22]

We are of the opinion that lower incisor crowding relapse could well be attributed to the undiagnosed, untreated lingual frenulum. As the incidence of this problem, that is lower incisor crowding, is associated with the milder grades of tongue-tie, surgery or lower fixed retention in such cases could be a viable option. Further research could probably enlighten the fraternity.

CONCLUSION

- As the grade of tongue-tie increased, its association with Classes I and II malocclusion decreased, however, Class III malocclusion (3.54%) was found to be highest in Grade IV tongue-tie subjects
- Increase in tongue-tie severity (short, tight frenums) showed decreased severity of crowding in lower anterior region.

Shorter, tight frenums are more associated with maxillary constriction, anterior open bite and spacing of the lower anteriors.

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Conflicts of interest

There are no conflicts of interest.

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