



Original Article

Effectiveness of tongue-tie division for speech disorder in children

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Abstract *Background:* The aim of this study was to determine the effectiveness of tongue-tie division (frenuloplasty/frenulotomy) for speech articulation disorder in children with ankyloglossia (tongue-tie).

Methods: Articulation test was done in five children (3–8 years old) with speech problems who underwent tongue-tie division. The test consisted of 50 pictures of common Japanese words with 2–3 syllables. The patients were interviewed by a speech therapist and asked to pronounce what the picture card showed. Misarticulations of substitution, omission, and distortion were assessed. The preoperative results were compared with postoperative examinations at 1 month, 3–4 months, and 1–2 years.

Results: Nineteen substitutions that were observed in four patients preoperatively decreased to 10 in three patients at 1 month, 7 in three patients at 3–4 months, and 1 in one patient at 1–2 years postoperatively. Five omissions that were observed in four patients preoperatively decreased to 3 in three patients at 1 month, 2 in two patients at 3–4 months, and 1 in one patient at 1–2 years postoperatively. Thirteen distortions that were observed in five patients preoperatively decreased to 8 in four patients at 3–4 months but increased to 11 in three patients at 1–2 years postoperatively.

Conclusions: Substitution and omission improved relatively early after tongue-tie division and progressed to distortion, which is a less-impaired form of articulation disorder. Thus, distortion required more time for improvement and remained a defective speaking habit in some patients.

Key words ankyloglossia, articulation test, frenuloplasty, frenulotomy, tongue-tie.

The effect of ankyloglossia, commonly known as tongue-tie, on speech has a long and controversial history because of the lack of high-quality evidence to confirm or refute the association between them. Discussions have been based mainly on anecdotal evidence. Plummer, a speech pathologist, considered that speech problems in children with ankyloglossia are caused by restricted mobility of the tip of the tongue.¹ He emphasized that the first step to correct such a speech disorder is surgical removal of the restriction. MacCarthy, a pediatrician, however, argued against the relationship between them.² Block, a speech pathologist, asserted that tongue-tip sounds can be produced with compensatory movements of the tongue, resulting in proper sounds.³ Fletcher and Meldrum studied the relationship between speech articulation and the length of the lingual frenulum in children without speech problems and provided significant evidence that subjects with limited lingual freedom made more articulation errors than those with greater lingual freedom.⁴ They speculated that this trend would be more striking in children with defective articulation.

The incidence of speech disorders in ankyloglossia varies, depending on the specialty of the authors who report such incidences. Wright, a pediatric surgeon, reported speech

problems as a presenting symptom in 32% of 287 patients.⁵ Klockars and Pitkäranta, both otorhinolaryngologists, reported that 64% of 159 patients who underwent surgery had speech problems.⁶ According to a survey in the USA, 60% of otolaryngologists and 50% of speech pathologists believed that ankyloglossia was at least sometimes associated with speech difficulties, but only 23% of pediatricians shared this view.⁷ These different ideas are partly caused by the lack of objective assessment of the efficacy of surgical interventions for articulation disorders.

In this preliminary study, we evaluated the effectiveness of tongue-tie division (frenuloplasty/frenulotomy) for speech articulation disorder in children with ankyloglossia.

Methods

Thirty-two patients with ankyloglossia visited the Pediatric Surgery Department at Atami Hospital, International University of Health and Welfare, from September 2010 to August 2012. The presenting symptoms were related to latching in 20 patients, speech in seven patients, and tongue deformity in five patients. We conducted a prospective study in which an articulation test was performed before and after tongue-tie division in five children with speech problems. The severity of ankyloglossia in children >1 year of age was assessed with an assessment score (Table 1), four items of which were adopted or modified from the Hazelbaker assessment tool.⁸ The fifth item, “speech for age,”

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Table 1 Assessment score for ankyloglossia in children >1 year of age

(1) Attachment of lingual frenulum to tongue
2: >1 cm from tip
1: >6 mm and <1 cm from tip
0: <5 mm from tip
(2) Attachment of lingual frenulum to oral floor
2: Attached to floor of mouth
1: Attached to lower ridge
0: Attached to upper ridge
(3) Appearance of tongue when protruded
2: Round
1: Slight cleft in tip
0: Heart-shaped
(4) Extension of tongue
2: Tip over lower lip
1: Tip over lower gum
0: Neither of the above
(5) Speech for age
2: not disturbed
1: a little disturbed
0: markedly disturbed
Total score

1–3, appearance items; 4,5, function items.

was added to evaluate speech instead of latching. The score consisted of three appearance items and two function items. Ankyloglossia was diagnosed, and surgery was indicated when the total score was <8 of a total possible score of 10, which represents a normal child.

We used the speech articulation test defined by the Japan Society of Logopedics and Phoniatrics. The test consists of 50 pictures of common Japanese words with 2–3 syllables. The patients were interviewed by a speech therapist and asked to pronounce the picture card they were shown. Word production accuracy and intelligibility were assessed by counting the number of errors. Misarticulations of substitution, omission, and distortion³ were checked using the international phonetic alphabet on a test sheet. Substitution means replacement of a sound with another sound, such as “wed” for “red.” Omission, which is the severest form of misarticulation, means no production of a sound within a word, such as saying “pay” for “play.”⁹ Distortion in ankyloglossia mainly consists of two types. The first type is interdental lispings, which is produced with the tongue protruding between the front teeth because of limited freedom of the tongue tip. The second type is muffled lateral sound, which is a compensatory articulation to produce similar sounds without elevating the tongue tip.³ The mouth is closed so that the tongue tip touches the alveolar ridge or front of the palate. As a result, the air

stream of the sound is blocked by the tongue and must escape laterally along the sides of the tongue.

The interviews with the patients were audio- and video-recorded for later reevaluation. The preoperative results were compared with postoperative examinations at 1 month, 3–4 months, and 1–2 years.

Statistical analysis was not performed because of the low number of subjects.

Results

The age of the five examined patients (four boys, one girl) ranged from 3 to 8 years (Table 2). The preoperative score ranged from 4 to 7 points. Three children had attended speech training class for 6 months–2 years, without much improvement before their first visit to the clinic at Atami Hospital. Patient 5 received an additional 6 months of speech training in vain at Atami Hospital. Four of the patients underwent horizontal-to-vertical frenuloplasty with sutures under general anesthesia, and the youngest boy (3 years of age) received frenulotomy without anesthesia, in which the frenulum was divided without stitches because it was relatively thin and avascular. No significant complications were observed.

The patients primarily had misarticulations of the consonants *s*, *t*, *d*, and *r*. Nineteen substitutions that were observed in four patients preoperatively decreased to 10 in three patients at 1 month, 7 in three patients at 3–4 months, and 1 in one patient at 1–2 years postoperatively (Table 3; Fig. 1). Five omissions that were observed in four patients preoperatively decreased to 3 in three patients at 1 month, 2 in two patients at 3–4 months, and 1 in one patient at 1–2 years postoperatively (Table 3). Thirteen distortions that were observed in five patients preoperatively decreased to 8 in four patients at 3–4 months but increased to 11 in three patients at 1–2 years postoperatively. This increase in the number of errors was attributable to lateral sounds acquired by an 8-year-old girl (patient 2; Table 3).

Discussion

Speech problems in children with ankyloglossia are considered articulation disorder caused by restricted mobility of the tip of the tongue.¹ Speech sounds that may be adversely affected by impaired mobility of the tip of the tongue include lingual sounds and sibilants, such as *t*, *d*, *n*, *l*, *s*, *r*, *z*, and *th*.^{1,3,5} The same phenomenon was observed in the present cases, with the exception of the *l* and *th* sounds, which do not exist in the Japanese language. Thus, a logical prediction is that the freedom of tongue movement afforded by frenulum division would improve speech. The present study showed that phonetic and philological assess-

Table 2 Summary of surgery for articulation disorder

Patient	Age (years)	Sex	Severity score	History	Operation
1	5	M	5	Attending speech training class; hereditary	Frenuloplasty
2	8	F	7	Attending speech training class	Frenuloplasty
3	5	M	6	Pointed out by a nursery teacher	Frenuloplasty
4	3	M	4	Pointed out by a local physician	Frenotomy
5	6	M	6	Attending speech training class	Frenuloplasty

Table 3 Misarticulations and sounds expressed according to international phonetic alphabet

Patient	Preoperative evaluation	Postoperative evaluation		
		1 month	3–4 months	1–2 years
Substitutions				
1	3 (s, dz, ts)	0 (–)	0 (–)	–
2	0 (–)	0 (–)	0 (–)	0 (–)
3	6 (k, g, n, ŋ, tʃ, gʃ)	3 (k,g,ŋ)	1 (k)	1 (s)
4	5 (s, tʃ, ts, ʃ, r)	5 (s, tʃ, ts, ʃ, r)	4 (s, ts, ʃ, r)	0 (–)
5	5 (s, dz, ts, ʃ, r)	2 (ʃ, r)	2 (d, r)	0 (–)
Total	19	10	7	1
Omissions				
1	1 (r)	0 (–)	0 (–)	–
2	0 (–)	0 (–)	0 (–)	0 (–)
3	1 (r)	1 (r)	0 (–)	0 (–)
4	2 (t, r)	1 (t)	1 (r)	0 (–)
5	1 (r)	1 (r)	1 (r)	1 (r)
Total	5	3	2	1
Distortions				
1	2 (s, r)	0 (–)	0 (–)	–
2	3 (tʃ, tʃ, ʃ)	2 (tʃ, s)	2 (tʃ, s)	8 (ki, kjm, gi, pi, ʃi, tʃo, tʃi, ri)
3	5 (s, tʃ, dz, ts, r)	4 (dz, s, r, k)	4 (dz, ts, s, r)	2 (s, r)
4	1 (r)	1 (r)	1 (r)	0 (–)
5	2 (ki, gi)	2 (ki, çi)	1 (ki)	1 (tʃi)
Total	13	9	8	11

ments effectively evaluated articulation disorders in children with ankyloglossia and that the disorders were improved by tongue-tie division in four of five patients (80%), with the exception of an 8-year-old girl (patient 2) who had already acquired lateral sounds as compensation long before her visit to the clinic.

Only a few articles have reported the efficacy of frenuloplasty for speech problems associated with ankyloglossia. Messner and Lalakea conducted a prospective study to determine the association between ankyloglossia with articulation problems and the effect of frenuloplasty on speech.¹⁰ They assessed outcomes by

measuring tongue mobility, evaluating speech, and parent questionnaires. They concluded that speech intelligibility was improved in nine of 11 patients (82%) by 3 months after frenuloplasty. Heller *et al.* compared two different surgical methods (four-flap z-frenuloplasty and horizontal-to-vertical frenuloplasty).¹¹ Articulation errors were judged based on a 4-grade scale: zero; mild; moderate; and severe. For four-flap z-frenuloplasty, 10 of 11 patients (91%) had at least two orders of improvement in speech. In contrast, for horizontal-to-vertical frenuloplasty, only two of five patients (40%) had one order of improvement. They emphasized the superiority of four-flap z-frenuloplasty over horizontal-to-vertical frenuloplasty. Adverse effects of frenuloplasty, such as massive hemorrhage or fusion of the tongue by scar formation, have not been reported.^{6,7,10} Reoperation, however, is needed when the frenulum division is inadequate.⁶ Care needs to be taken so that sutures do not occlude the sublingual ducts.

No English-language articles and only one Japanese-language article have discussed operative outcomes of speech disorders assessed on standardized articulation tests. Ito reported that articulation disorder was improved in 11 of 13 patients (84.6%) by 7 months postoperatively.⁹

In the present study, speech disorders were evaluated using standardized articulation tests defined by the Japan Society of Logopedics and Phoniatics up to 2 years postoperatively. The study showed that substitution and omission improved relatively early after frenuloplasty. Serious articulation disorders of substitution and omission appeared to progress into distortion on the way to improvement, which is a less-impaired form of misarticulation. Therefore, distortions took more time to decrease in number, and they remained a defective speaking habit in three patients after 1–2 years postoperatively (Table 3).

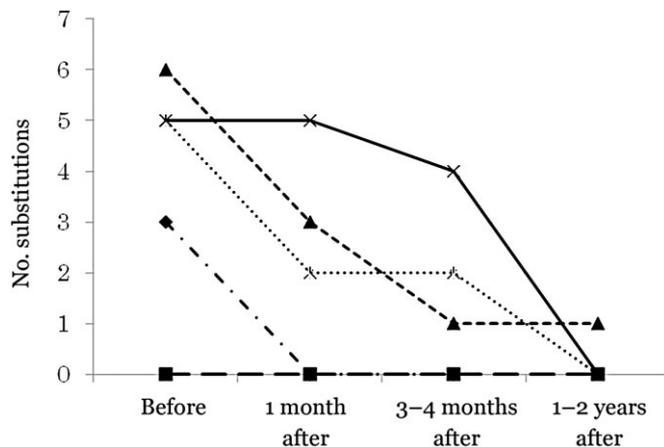


Fig. 1 Number of substitutions before and after tongue-tie division. -♦-, Patient 1; -■-, patient 2; -▲-, patient 3; -×-, patient 4;*, patient 5.

Speech disorders are generally not noticed until preschool age, when children acquire control over most consonants.¹² The number of patients in this study was too small to discuss the appropriate age for surgery. The age of the present patients ranged from 3 to 8 years. Most Japanese children acquire control over most consonants by 5 years of age.⁹ The articulation test used in the present study appeared to be inaccurate in a 3-year-old child (patient 4), and only a slight improvement was observed at 1 month or 3–4 months postoperatively. The test 2 years after surgery showed complete resolution of misarticulation, notwithstanding the fact that this patient's preoperative assessment score was as low as 4, and the operation was simple frenulotomy. In contrast, an 8-year-old girl (patient 2) with a preoperative score of 7 did not have problems with substitution or omission and only had problems with distortion. Her distortion did not appreciably decrease soon after surgery but rather increased in number when she was examined 2 years postoperatively. She had been receiving speech training at school once per week by a speech therapist even after surgery, but she continued to present defective speaking of lateral sounds, possibly based on habit. She could not produce normal sounds, even when stimulated by a speech therapist. This fact demonstrates the difficulty in correcting compensatory speaking habits once they are acquired. Based on our experience, we agree with the opinion that early treatment before 5 years of age provides a better prognosis for speech problems.⁹

Postoperative tongue exercises and speech training by a speech pathologist are necessary for older patients who acquire defective speaking habits.

Considering the mechanically adverse effects of ankyloglossia, in addition to articulation disorder, such as latching problems^{13–15} and difficulties licking ice-cream cones, blowing musical instruments, eating noodles, performing dental hygiene, and kissing, we think that clipping the lingual frenulum in early infancy is preferable. If a patient reaches ≥ 2 years of age, then frenuloplasty under general anesthesia is preferred¹⁶ because the frenulum is thicker, and the child can become less cooperative for surgery. Frenulotomy in infancy is possible without anesthesia^{13–15} and safely performed by trained physicians.¹⁷ Dollberg *et al.* reported that eight children who underwent frenulotomy in infancy had fewer articulation problems than seven untreated children, although the difference was not statistically significant.¹²

The limitations of this study include the small number of patients and the inhomogeneous background with regard to age, gender, surgical technique, and severity of speech disorder. We also had no control group without surgical intervention with which to rule out the effects of speech training and the natural course of improvement. Forming a control group was difficult because patients were referred to us for the purpose of surgery, and the parents of these patients preferred the surgical approach. Another limitation was that the evaluators were not blinded. Blind assessment was not feasible because the same speech therapist evaluated the patient before and after surgery.

Despite these limitations, marked improvements were identified using the objective assessment of the articulation test in individual patients.

The accumulation of objective data is expected to confirm the hypothesis that speech improves after frenuloplasty in children with ankyloglossia.

Conclusion

Articulation disorders in children with ankyloglossia were improved by tongue-tie division (frenuloplasty/frenulotomy), with the exception of one patient. Phonetic and philological assessments were used to evaluate articulation disorders. Substitution and omission improved relatively early after surgery and progressed to distortion, which is a less-impaired form of articulation disorder. Thus, distortion took more time for improvement and remained a defective speaking habit in some patients. Postoperative tongue exercises and speech training by a speech pathologist would be necessary for older patients to correct defective speaking habits.

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