Articulation Proficiency and Error Patterns of Preschool Cleft Palate and Normal Children

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The importance of articulation disabilities for several groups of cleft palate individuals has been emphasized in several research reports in the periodical literature (*2, 5, 9, 14, 18*). The frequent early appearance of distinctive patterns of articulation errors (*3, 18*) in groups of young cleft palate children and the frequent persistence of such syndromes of articulation errors in older groups (*5, 19*) indicate the need for systematic analysis of differences in the maturing articulation skills of children born with velopharyngeal incompetencies and comparable normal children.

The present study was carried out as part of a broader investigation (*2*) comparing a large number of factors on similar groups of cleft palate children and children born without cleft palate. The data from that study, describing differences in articulation skills and specific articulation errors, have been valuable in providing a rationale for retaining young cleft palate children and for designing clinical studies of the efficacy of various surgical and prosthetic findings of the comparative study of early articulation skills. Those findings are presented and discussed here in the hope that they might stimulate further and more limited research on the speech of young cleft palate children.

Methods of Procedure

SUBJECTS. Sixty cleft palate children were selected on the basis of age and cleft-type. All subjects had clefts involving the secondary palate (hard and soft palate posterior to the incisive foramina) or some combination of both primary and secondary palate (*11*). Subjects whose clefts involved the primary palate only were excluded from this study.

Cleft palate children between three and seven years of age were selected so that there were ten children in each of the six half-year ranges covered by the study, making a total of 60 children. The finally-selected group included 37 males and 23 females. All subjects were under the care of either the Northwestern University Cleft Lip and Palate Institute, the

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Cleft Palate Team at the Children's Center at St. Francis Hospital, Evanston, Illinois, or the University of Illinois Cleft Palate Center. Records at these centers showed that none of the children included had socially significant hearing losses or significant concomitant congenital malformations. Social quotients for the group from the Vineland Social Maturity Scale (*10*) ranged from 76 to 145 with a mean of 103, suggesting generally normal distribution of derived intelligence estimates.

A control group of 120 children without cleft palate was selected from Day School Centers in Chicago so as to be similar to the cleft palate group within each half-year age grouping in factors of age, sex, socioeconomic group, and ethnic background. The finally-selected group of normal children contained 20 children in each half-year age range covered and included 74 males and 46 females. The N of the control group was double the N of the cleft palate group primarily to establish better comparative norms of the articulation test developed for this study.

Articulation Examination. Each child was tested individually by the investigator using a set of picture cards to stimulate the single word responses desired. A total of 82 sound elements were included in the articulation test. All of the single consonant phonemes were tested in the initial, medial, and final positions in which they normally occur in English words with the exception of initial /hw/, medial /h/, /j/, /ŋ/, and final /ŋ/. In addition, words were selected and pictures were prepared for twelve vowel phonemes and nine initial two-consonant blends involving the common /r/, /s/, and /l/ blends selected by Bryngelson (*1*).

Direct visual and auditory articulation evaluations were made by the investigator on each child as the evaluation proceeded. Whenever, in the judgment of the investigator, an error occurred on a test element, the specific substitution sound, distortion, or omission was recorded on a prearranged form. That sound element was retested with two additional words of similar phonetic construction to evaluate the consistency of the error pattern.

The judgments of the investigator regarding all errors and correct responses were recorded at the time of each examination, which was completed in one sitting with each child.

Reliability. To establish the reliability of such judgments, the investigator and two other trained graduate clinicians made simultaneous and independent judgments of the articulation errors of five cleft palate subjects. The writer agreed with the two other judges concerning both the number and the type of the errors 91% of the time. This level of reliability was considered sufficiently high to warrant more detailed evaluation of the articulation error data.

Evaluation of Articulation Data. Articulation test data on the cleft palate and noncleft palate groups were compared. The precentage of sounds attempted which were correctly produced was used as an index of articulation proficiency. Articulation proficiency levels were computed for

each child for the plosive, fricative, aspirate, glide, nasal, vowel, and two-consonant blend elements included on the test. Differences between the cleft palate and noncleft palate children were calculated for each of the half-year sub-groups.

Speech sound errors were evaluated as to the frequency of omission, distortions, and substitutions of sound elements. The frequency of specific sound substitutions for each test sound element was calculated and comparisons were made between the cleft palate and the noncleft palate sub-groups.

Specific substitutions of a glottal stop, a pharyngeal fricative, or a nasal snort for a test sound element were recorded as substitutions of sounds in the manner reported by Counihan (*9*). Sounds which were distorted by clearly audible nasal emission, but which close examination revealed were correctly articulated, were recorded as I E (indistinct due to emission) and were calculated separately from sounds which were judged to be indistinct due to faulty articulation of the lips and/or tongue.

Findings

Speech Sound Proficiency. The percentage and the mean number of sound elements correctly produced by each group and for each matched half-year sub-grouping are shown in Table 1. These figures show, as expected, that the cleft palate children were less proficient in articulation skills than were the similar group of noncleft palate children. The extent of the differences found, however, was greater than anticipated. As a group, the children with cleft palate produced only 50% of the test sounds in single words correctly. The mean average for the noncleft palate group was 79%.

It can be seen from Table 1 that the five-year-old cleft palate children were even less proficient in articulation than were the three-year-old normals. The steady but slow and apparent increase in articulation proficiency at the half-year age groupings for the cleft palate group shown in

TABLE 1. Mean scores for correct production of 82 sound elements by normal and cleft palate children.

Age group	*Normal children*		*Cleft palate children*	
	Number correct	*% correct*	*Number correct*	*% correct*
3.00 to 3.49 yrs.	51.4	62.68	28.3	34.51
3.50 to 3.99 yrs.	62.5	76.21	26.4	32.18
4.00 to 4.49 yrs.	64.9	79.14	34.7	42.31
4.50 to 4.99 yrs.	68.0	82.92	39.5	48.16
5.00 to 5.49 yrs.	70.2	85.35	48.4	59.01
5.50 to 5.99 yrs.	74.0	90.24	45.0	54.87
Total Mean Score	65.25	78.99	37.33	49.99

Table 1 suggests a gradual, rather than the normal, negatively accelerated curve of articulation function.

It was found that the two-consonant blends, the fricatives, and the plosives, in that order, were relatively more difficult for the cleft palate subjects than for the normal subjects showing a similarity to reports on older cleft palate groups by Counihan (*8*), McWilliams (*14*), and Starr (*19*). Also, the young cleft palate children were more proficient on the voiced consonant sounds than on their unvoiced cognates as were the cleft palate cases reported by McWilliams (*14*) and by Spriestersbach, Darley, and Rouse (*18*). They were least proficient on sounds in the medial positions in words, a finding consistent with three previous reports (*8, 18, 19*).

In this study the normal children, as a group, were more proficient than the cleft palate group on each consonant sound without exception. However, the differences on the /w/, /m/, /n/, and /h/ sounds were slight.

General Types of Errors. Considering first only a general classification of errors as those of substitution, distortion, and omission, it was found that cleft palate children made substitution errors more than twice as frequently, distorted sounds more than twice as frequently, and omitted sounds almost four times as frequently as the children in the control group. The mean percentages of each of these types of errors are shown for the two groups in Table 2.

Inspection of Table 2 reveals that substitution errors accounted for the majority of all articulation errors in both groups. This differs from the findings of Spriestersbach, Darley, and Rouse (*18*), who reported that omission errors were observed most frequently in their young cleft palate group followed by substitutions and distortions, in that order. This discrepancy may be attributable to the smaller sample (25 subjects), to the wider age range (3 to 8 years), to differences in criteria for judging type of articulation error, or to a combination of these factors.

Specific Errors and Error Patterns. Comparisons were made of the frequency of specific types of articulation errors for each group. Patterns of specific errors by word position and phonetic classification were determined and compared in order to isolate those which were more characteristic of the cleft palate group during this early period of developing skill in articulation.

Substitution Errors. Substitution errors which occurred frequently in each group (2% or more of all recorded substitutions) were compared for

TABLE 2. Percentage of test words in which errors of substitution, distortion, and omission were made by cleft palate and normal children.

	% of test words with substitution errors	*% of test words with distortion errors*	*% of words with omission errors*
Normal children	16.54	4.23	2.12
Cleft palate children	39.75	10.18	8.22

TABLE 3. Common substitution errors on the plosive speech sounds for the normal and the cleft palate groups. When more than one substitution was common, they are shown here and in later tables in the order of frequency found from the most to the least frequent. Listed is the sound which was substituted, glottal stop (G); nasal snort (E); or pharyngeal fricative (PF).

Sound tested	*Normal children*	*Cleft palate children*
p	none	G/p, E/p, PF/p
b	p/b	m/b, G/b, E/b
t	none	G/t, PF/t, k/t
d	t/d	G/d, PF/d, n/d
k	t/k	G/k, PF/k, t/k
g	k/g	G/g, d/g, PF/g

each phonetic class of sounds. Table 3 shows the findings for the plosive group of sounds. Inspection of Table 3 reveals a tendency in the normal group for unvoiced plosives to be used as substitutes for their voiced cognates. A second tendency was the substitution of /t/ for /k/.

The cleft palate group, on the other hand, revealed substitution error patterns for the use of the glottal stop or the pharyngeal fricative for each of the plosive sounds. A nasal snort was substituted only for the bilabial plosives /p/ and /b/.

The cleft palate group also showed a tendency to substitute velar for alveolar plosives (k/t). The substitution of homorganic nasal sounds for the voiced bilabial and alveolar plosives was also revealed (m/b, n/d).

Table 4 presents the findings on the fricatives and affricate sounds. Inspection of this table reveals that the children without cleft palate tended to substitute unvoiced fricatives for their voiced cognates (f/v, s/z, tʃ/dʒ), homorganic plosives with the same voicing characteristics (p/f, t/s, b/v), or acoustically similar fricatives (θ/s, f/θ, s/ʒ).

TABLE 4. Common substitution errors on the fricative and the affricate speech sounds which were found for the normal and the cleft palate groups. When more than one substitution was common, they are shown in the order of frequency found from the most to the least frequent. Listed is the sound which was substituted or glottal stop, (G); nasal snort, (E); and pharyngeal fricative (PF).

Sound tested	*Normal children*	*Cleft palate children*
f	none	G/f, PF/f, p/f
v	b/v, f/v	b/v, G/v, m/v
θ	t/θ, s/θ, f/θ	G/θ, PF/θ, t/θ
ð	d/ð	d/ð, G/ð, PF/ð
s	θ/s	PF/s, G/s, t/s
z	s/z, θ/z, d/z	PF/z, G/z, s/z
ʃ	s/ʃ, tʂ/ʃ	PF/ʃ, G/ʃ, E/ʃ
tʃ	ʃ/t, s/tʃ, t/tʃ	PF/tʃ, G/tʃ, E/tʃ
dʒ	tʂ/dʂ, d/ʒ, ʒ/dʒ	PF/dʒ, G/dʒ, ʒ/dʒ

TABLE 5. Common substitution errors on the glide speech sounds found for the normal and the cleft palate groups. When more than one substitution was common, they are shown in the order of frequency found from the most to the least frequent. Listed is the sound which was substituted or glottal stop, (G); nasal snort, (E); and pharyngeal fricative (PF).

Sound tested	*Normal children*	*Cleft palate children*
l	w/l	w/l, G/l
r	w/r	w/r, G/r
j	l/j	G/j, W/j
w	none	none

The cleft palate group tended to make characteristically gross errors, most frequently substituting a pharyngeal fricative or a glottal stop for each of the fricative and affricate sounds. The nasal snort and /m/ sound were substituted with some frequency by these cleft palate children. The remaining substitution errors on the fricative sounds were similar to both groups.

On the glide sounds the normal group substituted /w/ for /r/, /w/ for /l/, and /l/ for /j/. Table 5 shows that the cleft palate children made similar errors and, in addition, frequently substituted the glottal stop for the /l/, the /r/, and the /j/. Like the normal children, they did not have much difficulty producing the /w/ correctly in words.

Table 6 shows one substitution error on the nasal sounds which was characteristic of only some of the children in the cleft palate group. Although the literature generally states that cleft palate children do not have difficulty producing the nasal sounds in speech, this study revealed that as a group the cleft palate children tended to substitute the alveolar for the velar nasal (n/ŋ).

The cleft palate children also frequently tended to substitute the glottal stop for the /h/. The same characteristic error patterns which were revealed on the single consonant elements were revealed in greater frequency on two-consonant blends.

Sounds Used as Substiutions. Another way of considering the differences in the substitution errors found for the two groups is to compare the frequencies at which a given sound was used as a substitution. Inspection of Table 7 shows that there was actually little similarity in the sub-

TABLE 6. Common substitutions on the nasal speech sounds found for the normal and the cleft palate groups.

Sound tested	*Normal children*	*Cleft palate children*
m	none	none
n	none	none
ŋ	none	n/ŋ

TABLE 7. Rank order of sounds used as substitutions by the normal and by the cleft palate children.

Sound substituted	*Normal children*		*Cleft palate children*	
	Rank order	*% of substitutions*	*Rank order*	*% of substitutions*
s	1	18.49	11	1.84
t	2	16.66	9	3.69
d	3	14.42	8	3.76
b	4	11.94	6.5	4.10
t͡ʃ	5	8.62	19	0.27
w	6	5.30	3	6.29
p	7	4.56	15	0.82
ʃ	8	4.22	13	1.36
k	9	3.98	10	1.91
f	10	3.23	18	0.34
θ	11	2.32	21	0.13
ʒ	12	1.57	14	0.95
l	13	0.91	16	0.75
G	14	0.82	1	32.14
j	15	0.74	12	1.82
PF	16.5	0.49	2	24.96
n	16.5	0.49	5	4.71
z	18	0.33	23.5	0.00
d͡ʒ	19.5	0.24	23.5	0.00
v	19.5	0.24	20	0.20
m	21	0.23	6.5	4.10
g	22	0.08	17	0.54
E	23.5	0.00	4	5.12
ŋ	23.5	0.00	22	0.06

stitution sounds used by the two groups. Substitutions of the glottal stop or the pharyngeal fricative accounted for 57% of all the substitution errors of the cleft palate children. They accounted for only 1% of these errors in the comparable noncleft group. These two sounds and the nasal substitutes (the nasal snort: E, /m/, and /n/ accounted for 71% of the cleft palate substitution errors and only 2% in the control group.

Indistinct Sound Errors. Counihan (*9*) has reported that a considerable proportion of consonant sound distortions in the speech of an adult cleft palate group could be attributed directly to distortion from audible nasal emission rather than to less precise or imperfect articulation. A similar attempt was made to differentiate these types of distortion errors in the present study. Of the 371 indistinct sound errors recorded for the children in the cleft palate group, 166, or 45%, were judged to be indistinct due to nasal emission. The normal group made no errors on this basis.

If we consider only those articulation errors judged to be indistinct due to poor articulation, the cleft palate children still made more such errors in each classification of sounds than the normal group.

ERRORS OF OMMISSION. The cleft palate children omitted a greater percentage of the plosives, the fricatives, the affricates, the glides, and the nasals. Most of their omission errors were in the plosive and fricative categories, while the normal group made most of their omissions on the glides. Both groups made most of their omission errors on test elements in final word positions. These findings suggest that omissions of all types of consonant sounds tend to occur more frequently in the speech of young cleft palate children than in the speech of similar normal children.

Discussion

Several studies of older cleft palate groups (*8, 14, 19*) have shown relatively more distortion errors than was found in this study. However, these findings are compatible in the light of the suggestion of Snow and Milisen (*17*) that distortion of speech sounds represents a relatively higher level of articulation proficiency than substitution or omission errors. Distortion errors might, therefore, be expected in greater relative frequency in older groups of any handicapped population.

The relatively high frequency of omission errors found in this study of preschool cleft palate children emphasized further the extent of the deficiency of articulation skills for many cleft palate children.

It seems possible from this evaluation to draw two or three generalizations regarding the substitution error patterns which seem to be characteristic of many of these young cleft palate children, but not of similar children without cleft palate. Gross substitution patterns involving the use of the glottal stop or the pharyngeal fricative for consonant elements normally articulated in the oral cavity are the most prominent differences.

This finding is consistent with previous reports in the literature (*7, 12, 13, 15, 20*). However, Sherman, Spriestersbach, and Noll (*16*) have shown that when cleft palate speech samples are compared with those of children with functional articulatory disorders this difference is not as distinctive. Even in this type of comparison, however, the authors found that glottal stops were likely to be more prominent in cleft palate speech.

This error pattern and the high frequency of substitutions of glottal stops and pharyngeal fricatives indicate a general characteristic of laryngeal and pharyngeal constrictions initiating the syllables in the utterances of many young cleft palate children. The articulation movements of these error patterns involve the habituation of coordinated patterns of neural integration very different from that involved in the normal developmental patterns. These abnormal patterns are frequently present before three years of age.

A second pattern of substitution errors frequently found in the cleft palate group, but not typical of the control group, was the use of the /m/ and /n/ and the nasal snort as substitute sounds. Such substitutions could be due directly to velopharyngeal incompetency. However, correlated studies of the structure and function of the organs of speech for this cleft

palate group (*3*) revealed that for most cases these errors were continued by habit after the establishment of adequate velopharyngeal function. The continuation of the habit of substitution of nasal for non-nasal consonants suggests a partial reason for the close relationship of misarticulation and hypernasality in cleft palate speech reported by Van Hattum (*20*).

The importance of early speech therapy for many young cleft palate children is indicated by the discrepancy found in articulation proficiency between the matched groups. The need for developing specific and effective techniques for altering early patterns of laryngeal and pharyngeal constrictions and nasal substitutions in the syllable utterances of young cleft palate children is suggested by the findings of the error pattern analysis.

Summary

The findings of speech articulation test analysis of 60 cleft palate children between three and seven years of age and a matched group of 120 normal children are presented and discussed. It was found that the articulation proficiency of five-year-old cleft palate children was below that of three-year-old normal children. Specific articulation errors of the cleft palate children not characteristic of the errors in the noncleft group were identified for each classification of sounds, and patterns of articulation errors characteristic of the cleft palate group were described. Consistencies and inconsistencies with other studies in the literature are discussed. The need for early and specific speech therapy procedures are suggested from the findings.

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References

1. Bryngelson, B., and Glaspey, E., *Speech in the Classroom: Teacher's Manual for Speech Improvement Cards.* Chicago: Scott Foresman, 1951.
2. Bzoch, Kenneth R., Clinical studies of the efficacy of speech appliances compared to pharyngeal flap surgery. *Cleft Palate J., 1,* 275–286, 1964.
3. Bzoch, Kenneth R., The effects of a specific pharyngeal flap operation upon the speech of forty cleft-palate persons. *J. speech hearing Dis., 29,* 111–120, 1964.
4. Bzoch, Kenneth R., An investigation of the speech of pre-school cleft palate children. Ph.D. dissertation, Northwestern Univ., 1956.
5. Bzoch, Kenneth R., Six mechanisms of disturbance in cleft palate speech. *Cleft Palate Bull., 11,* 26–28, 1961.
6. Bzoch, Kenneth R., A study of the speech of a group of pre-school cleft palate children. *Cleft Palate Bull., 9,* 2–3, 1959.
7. Cobb, Y. H., and Lierle, D. M., An analysis of the speech difficulties of 56 cleft palate and harelip cases. *Arch. Speech, 1,* 217–230, 1936.
8. Counihan, D. T., Articulation skills of adolescents and adults with cleft palates. *J. speech hearing Dis., 25,* 181–187, 1960.
9. Counihan, D. T., A clinical study of the speech efficiency and structural adequacy of operated adolescent and adult cleft palate persons. Ph.D. dissertation, Northwestern Univ., 1956.

10. DOLL, E. A., *Vineland Social Maturity Scale.* Minneapolis: Educational Publishers, Inc., 1947.
11. KERNAHAN, D. A., and STARK, R. B., A new classification for cleft lip and cleft palate. *Plastic reconstr. Surg., 22,* 435–441, 1958.
12. MASLAND, M. W., Testing and correcting cleft palate speech. *J. speech Dis., 11,* 309–320, 1946.
13. MCDONALD, E. T., and KOEPP-BAKER, H., Cleft palate speech: An integration of research and clinical observation. *J. speech hearing Dis., 16,* 9–20, 1951.
14. MCWILLIAMS, BETTY JANE, Articulation problems of a group of cleft palate adults. *J. speech hearing Res., 1,* 68–74, 1958.
15. MORLEY, M. E., *Cleft Palate and Speech* (3rd ed.). Baltimore: Williams & Wilkins Co., 1954.
16. SHERMAN, D., SPRIESTERSBACH, D. C., and NOLL, J. D., Glottal stops in the speech of children with cleft palates. *J. speech hearing Dis., 24,* 37–42, 1959.
17. SNOW, K., and MILISEN, R., The influence of oral versus pictorial presentation upon articulation testing results. *J. speech hearing Dis.,* Monog. Suppl., 29–36, 1954.
18. SPRIESTERSBACH, D., DARLEY, F., and ROUSE, V., Articulation of a group of children with cleft lips and palates. *J. speech hearing Dis., 21,* 436–445, 1956.
19. STARR, C., A study of some of the characteristics of the speech and speech mechanisms of a group of cleft palate children. Ph.D. dissertation, Northwestern Univ., 1956.
20. VAN HATTUM, R. J., Interrelationships among measures of nasality and articulation in cleft palate speakers. Ph.D. dissertation, Pennsylvania State Univ., 1954.