Patterns of Articulation Abilities in Speakers With Cleft Palate

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The purpose of this study was to report the *articulation scores* of 351 subjects with *cleft palate* from the ages of 2–6 to 18–0. Analysis of the data indicate that, as a group, subjects with cleft palate are retarded in articulation skills. However, they continue to improve in this regard past the age at which normal speakers have achieved articulation maturation. This information should be compared with that acquired from other centers in order to determine how typical these findings are.

There are considerable data in the literature about the articulation proficiency of individuals with cleft lip and palate, but more information is required. The primary purpose of this study is to present data acquired from a large number of patients managed in a generally consistent fashion and observed over an extended period of time (Krause, Tharp, and Morris, 1976). These data provide an overview of the general patterns of development and the status of articulation skills in individuals with clefts treated in one center.

A second purpose is to describe performance on several different articulation tests for inter-test comparison. A third purpose is to provide information about performance of individuals with clefts on a test for which there are normative data.

Procedure

These data come from a longitudinal study at the University of Iowa in which 351 patients with cleft palate have been studied since birth. All subjects are examined every six months, plus or minus one month, until five years of age, after which they are examined annually within one month of their birth dates until at least age 16.

The speech pathologist evaluates each child at each visit and administers, among other things, a 105-item articulation test which includes the 43-item Iowa Pressure Articulation Test, referred to as the IPAT (Morris, Spriestersbach, and Darley, 1961), the 50-item Screening Test of Articulation (Templin and Darley, 1960), and several additional items. The 105-item test consists of 149 consonant and vowel sounds if each element in each blend is scored separately (Van Demark and Tharp, 1973). The IPAT can also be scored by counting only the responses on plosive, fricatives, and affricatives with glides and vowels being disregarded. Thus, there are a number of ways in which observations may be made from the 105-item test.

Approximately 90% of the 2160 articulation tests were administered and scored by the two senior authors, both speech pathologists with extensive experience in cleft palate. Their inter- and intra-judge reliability in articulation testing had been examined in other projects (Morris, 1960; Van Demark, 1964 and 1974) and had been found to be acceptable in all instances. The remaining 10% of the tests were administered and scored by other speech pathologists who also were experienced in cleft palate. While a yearly reliability check would have been appropriate, randomized examination of the articulation

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scores of individual subjects indicates that rating of errors and types of errors were remarkably consistent.

Each test was scored by the examiner at the time of testing. The scoring procedure was designed for machine storage of data (Van Demark and Tharp, 1973) and included a number of options for analysis. The data reported here are based on correct-incorrect judgments only.

SUBJECTS. The 351 subjects in this study consisted of all cleft palate patients (with or without cleft lip) enrolled in the research program for whom at least one articulation test was available. Since data were collected on a longitudinal basis, the majority of subjects in the data pool had had more than three tests. Some had had as many as twelve. The data were collected over a fifteen-year period and are heterogeneous for factors such as cleft type (except that no cleft lip only subjects were included), sex, hearing status, social class, palatal surgery, age of surgery, and speech and dental treatment. This heterogeneity was permitted because our objective was to make descriptive statements about the trends of articulation proficiency for the entire population of cleft palate children available to us from early childhood through adolescence.

A total of 2160 articulation tests for the 351 subjects were available for study. Subjects ranged in age from two years, six months, to 18 years. A small portion (less than 2%) of the tests, generally those administered to very young children, were incomplete because subjects were expected to complete at least 64 elements of the 43-item Iowa Pressure Articulation Test. Since the number of incomplete tests was so small in comparison to the total sample, those incomplete records were included in the study.

The longitudinal nature of the project made it probable that subjects would have had articulation scores for several of the various age levels reported. More subjects (133 of 351) were first tested at four years of age than at any other age level. The age of final testing was highly variable because some subjects have discontinued treatment for a variety of reasons. Although the data were collected longitudinally, actual presentation is cross-sectional in that all results are presented for specific age levels and no attempt has been made to assess change over time for individual subjects. The numbers of subjects at the various age levels are presented in Table 1.

As was true in the Van Demark and Tharp paper (1973), the following articulation scores were computed from the 105-item articulation test: 1) Iowa Cleft Palate Research Articulation Test (105 items), 2) Iowa Cleft Palate Research Articulation Test (149 elements), 3) Iowa Pressure Articulation Test (43 items), 4) Pressure elements within the Iowa Pressure Articulation Test (50 elements), and 5) the Templin-Darley Screening Test of Articulation (50 items).

Results

Data for the five assessments are presented in Tables 1 through 5. Mean percentages of correct phonemes, mean number of correct phonemes, and standard deviations (SD) of means are presented at each age level. Data about age of testing and number of subjects are also presented.

GENERAL TRENDS. Regardless of which scoring system was used, the data indicate that, as a group, these children with clefts continued to improve their articulation skills until at least age 10. The trend continued after age 10 but at a more gradual rate. Approximately 80% of the test items were correctly produced by age 16. Thus, when group data were considered, individuals with cleft palate in this sample did not achieve the articulatory proficiency of eight-year-old children even by early adulthood.

Higher scores were obtained on the 105-item assessment when scoring was done by elements rather than by items (Tables 1 and 2), particularly for the younger children. The same trend was evident for the IPAT (Table 3) in comparison to the results when "pressure" elements (Table 4) only were considered. Generally, scoring by element yielded scores about 10% higher than scoring by items. Such a finding should be expected with children who are in the developmental period of articulation. These children may be able to produce correctly one element within a blend but may misarticulate the second element. Thus, when items are counted, e.g. /sp-/ a three-year-old child may incorrectly produce the /s/ and correctly produce the /p/ making this example an error when counted as an

TABLE 1. Mean number, standard deviation, and percentage of 105 items correct on the Iowa Cleft Palate Research Articulation Test (ICPRAT) for subjects with clefts from 2-6 to 18-0 years of age with sexes and cleft types combined.

testing target age	*mean age at testing*	*n*	*% correct*	*mean correct*	*sd*
2–6	31.00	4	27.05	23.00	14.21
3–0	36.39	23	29.46	23.82	16.59
3–6	42.30	65	35.33	29.09	25.04
4–0	48.24	183	32.66	29.68	23.60
4–6	54.18	191	38.66	36.42	24.62
5–0	60.20	198	42.13	41.09	25.58
5–6*	66.47	23	39.30	33.30	27.19
6–0	72.60	217	50.91	51.06	25.92
7–0	84.25	207	60.37	60.46	25.18
8–0	96.08	189	65.64	66.73	23.93
9–0	108.14	162	72.59	73.99	19.93
10–0	120.15	141	75.48	76.78	22.61
11–0	131.95	121	75.71	76.87	22.27
12–0	144.04	104	76.74	78.24	24.99
13–0	156.21	70	74.68	75.81	23.30
14–0	167.74	71	79.18	80.09	21.64
15–0	180.25	68	76.79	79.19	24.84
16–0	192.30	62	82.68	95.77	17.24
17–0	204.27	33	77.61	79.33	24.53
18–0	226.32	28	71.97	74.03	25.45

* This age group has a small number of subjects because subjects are not routinely tested at $5^1/_2$ years of age. As is demonstrated these subjects are probably not representative of the typical $5^1/_2$ year old with cleft palate.

TABLE 2. Mean number, standard deviation, and percentage of 149 individual elements correct on the ICPRAT.

testing target age	*mean age at testing*	*n*	*% correct*	*mean correct*	*sd*
2–6	31.00	4	34.63	42.25	27.79
3–0	36.69	23	38.96	45.82	28.04
3–6	42.30	65	44.47	52.84	36.92
4–0	48.24	183	41.11	53.40	35.54
4–6	54.18	191	47.70	64.42	35.69
5–0	60.20	198	50.98	71.07	36.47
5–6	66.47	23	49.61	62.00	37.87
6–0	72.60	217	60.13	86.23	34.74
7–0	84.25	207	68.98	98.67	31.87
8–0	96.08	189	73.69	106.64	29.14
9–0	108.14	162	79.51	115.30	23.66
10–0	120.15	141	81.83	118.67	25.43
11–0	131.95	121	82.15	119.01	24.72
12–0	144.04	104	82.50	119.97	29.93
13–0	156.21	70	81.01	117.32	26.98
14–0	167.74	71	84.30	121.80	26.04
15–0	180.25	68	82.43	120.75	28.90
16–0	192.30	62	86.99	128.11	20.07
17–0	204.27	33	82.98	120.78	28.41
18–0	226.32	28	78.16	113.78	30.37

TABLE 3. Mean number, standard deviation, and percentage of 43 items correct on the Iowa Pressure Articulation Test (IPAT).

testing target age	*mean age at testing*	*n*	*% correct*	*mean correct*	*sd*
2–6	31.00	4	23.87	9.25	8.54
3–0	36.39	23	25.47	10.39	6.92
3–6	42.30	65	26.67	10.52	10.51
4–0	48.24	183	24.67	9.99	10.45
4–6	54.18	191	31.12	13.11	11.27
5–0	60.20	198	33.99	14.25	11.50
5–6	66.47	23	32.48	13.39	12.79
6–0	72.60	217	43.93	18.82	12.04
7–0	84.25	207	52.81	22.65	11.95
8–0	96.08	189	58.36	25.09	11.59
9–0	108.14	162	66.85	28.74	9.59
10–0	120.15	141	69.98	30.08	10.59
11–0	131.95	121	69.36	29.70	10.69
12–0	144.04	104	71.15	30.59	11.57
13–0	156.21	70	68.97	29.65	10.53
14–0	167.74	71	73.33	31.53	10.55
15–0	180.25	68	70.27	30.20	12.26
16–0	192.30	62	77.45	33.30	9.23
17–0	204.27	33	70.89	30.48	12.41
18–0	226.32	28	64.03	27.53	13.43

TABLE 4. Mean number, standard deviation, and percentage of 50 elements correct on the Iowa Pressure Articulation Test excluding non-pressure phonemes, (r, w, l, m, n, and ɚ) (IPAT-X).

testing target age	*mean age at testing*	*n*	*% correct*	*mean correct*	*sd*
2–6	31.00	4	34.19	13.25	9.74
3–0	36.39	23	38.69	15.78	9.49
3–6	42.30	65	37.28	14.70	12.22
4–0	48.24	183	33.14	13.42	11.88
4–6	54.18	191	39.27	16.54	12.28
5–0	60.20	198	41.95	17.59	12.12
5–6	66.47	23	37.86	15.60	13.14
6–0	72.60	217	50.86	21.78	12.35
7–0	84.25	207	58.53	25.10	12.08
8–0	96.08	189	62.26	26.77	11.62
9–0	108.14	162	70.94	30.50	9.08
10–0	120.15	141	73.00	31.37	10.09
11–0	131.95	121	72.45	31.02	10.80
12–0	144.04	104	73.61	31.65	11.52
13–0	156.21	70	71.12	30.58	10.75
14–0	167.74	71	76.08	32.71	10.49
15–0	180.25	68	72.52	31.17	12.38
16–0	192.30	62	79.29	34.09	9.21
17–0	204.27	33	73.07	31.42	12.47
18–0	226.32	28	66.27	28.50	13.68

TABLE 5. Mean number, standard deviation, and percentage of 50 items correct on the Templin-Darley Screening Test of Articulation.

testing target age	*mean age at testing*	*n*	*% correct*	*mean correct*	*sd*
2–6	31.00	4	12.50	5.25	4.57
3–0	36.39	23	13.19	5.17	5.73
3–6	42.30	65	23.84	9.73	11.54
4–0	48.24	183	21.27	9.36	11.03
4–6	54.18	191	27.79	12.68	11.84
5–0	60.20	198	31.13	14.77	12.83
5–6	66.47	23	32.56	15.30	13.12
6–0	72.60	217	41.51	20.35	13.26
7–0	84.25	207	52.33	25.40	12.94
8–0	96.08	189	59.05	28.71	12.73
9–0	108.14	162	67.09	32.65	11.14
10–0	120.15	141	70.66	34.73	11.43
11–0	131.95	121	71.96	35.47	10.80
12–0	144.04	104	72.76	35.92	12.60
13–0	156.21	70	69.84	34.34	11.52
14–0	167.74	71	75.90	37.36	10.66
15–0	180.25	68	73.67	36.13	12.84
16–0	192.30	62	80.73	39.74	9.21
17–0	204.27	33	75.18	36.90	12.67
18–0	226.32	28	68.95	33.00	13.01

item and making one element correct and one element in error when counted as elements.

Comparison of the data from the Templin-Darley Screening Test of Articulation (Table 5) and the IPAT (Table 3) indicates that, until age eight, subjects generally achieved somewhat higher scores on the IPAT, After that age, scores on the Templin-Darley were slightly higher than on the IPAT. These slight differences probably reflect the different purposes of the two tests. The IPAT was developed to discriminate between individuals with velopharyngeal competency and those without. The Templin-Darley Screening Test of Articulation, on the other hand, was developed to determine if articulation was normal at specified ages up to eight years of age. Although Templin and Darley indicate that essentially normal articulation is achieved by age eight, scores obtained in this study for both the Templin-Darley and the IPAT demonstrate that this is not true for subjects with cleft palates. Subjects with clefts continue to improve their articulation skills until at least age 10 even though, as a group, they have not achieved "normal" articulation by that age. After age 10, a slight improvement in articulatory performance is observed.

Variance in performance appears to be related in part to the length of the test. Standard deviations between 25 and 35 were obtained when the 105-item test was scored by two different methods, the counting of items vs. the counting of elements. As would be expected, for the element method, larger standard deviations were obtained. Standard deviations between 10 and 12 were obtained for the other three tests, all of which have possible scores between 43 and 50.

Comparison with normative data. Data for normal children are available for both the IPAT and the Templin-Darley Screening Test (Templin and Darley, 1960). Those comparisons are made in Table 6. As expected, both comparisons indicate that children with cleft lip and palate consistently demonstrated lower levels of articulation proficiency between the ages of three and eight years, regardless of whether the test was designed to identify general articulation disorders (the Templin-Darley Screening Test) or to predict velopharyngeal competency (the IPAT). Variance in score distribution for the two subject groups and for the two tests are relatively comparable.

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TABLE 6. IPAT and Templin-Darley Screening scores compared with test norms.

	Iowa cleft palate subjects		*Templin-Darley norms (normal Ss)*	
age	*mean no. correct*	*sd*	*mean no. correct*	*sd*
3	10.4	6.9	26.4	12.5
3–6	10.5	10.5	28.8	12.5
4	10.0	10.5	35.1	9.7
4–6	13.1	11.3	34.1	9.4
5	14.3	11.5	33.8	11.2
6	18.8	12.0	35.5	10.3
7	22.7	12.0	39.6	5.7
8	25.1	11.6	42.0	3.3

	Iowa cleft palate subjects		*Templin-Darley screening test of articulation (normal Ss)*	
age	*mean no. correct*	*sd*	*mean no. correct*	*sd*
3	5.2	5.7	21.3	13.2
3–6	9.7	11.5	27.8	14.2
4	9.4	11.0	34.4	10.9
4–6	12.7	11.8	35.8	11.8
5	14.8	12.8	37.7	13.3
6	20.4	13.3	41.4	11.3
7	25.4	12.9	45.9	6.2
8	28.7	12.7	47.8	4.4

TABLE 7. Mean percentage of phomemes correct as to manner of production on the ICPRAT when 148 elements are considered (/h/ omitted).

age	*plosives*	*fricatives*	*affricates*	*glides*	*nasals*	*vowels*
2–6	56	10	0	38	83	44
3–0	54	16	10	28	71	33
3–6	52	20	24	45	84	48
4–0	49	17	18	42	78	51
4–6	55	22	22	53	89	60
5–0	60	24	26	60	88	63
5–6	51	21	27	67	87	65
6–0	67	34	36	73	94	69
7–0	77	43	46	82	95	77
8–0	81	49	51	88	98	85
9–0	88	59	59	90	96	87
10–0	89	62	66	92	97	89
11–0	86	64	72	93	97	91
12–0	84	66	72	94	96	93
13–0	86	61	64	95	95	92
14–0	88	69	75	93	95	92
15–0	83	66	74	95	97	94
16–0	90	74	81	95	97	96
17–0	83	69	77	94	96	92
18–0	76	62	71	94	91	96

TABLE 8. Mean percentage of specific phonemes correct on the ICPRAT. Number of subjects (*N*), reported for plosives, is the same for all other phoneme groups.

age	*N**	*plosives: % correct*					
		/p/	/b/	/t/	/d/	/k/	/g/
2–6	4	56	65	54	56	52	50
3–0	23	58	62	36	38	62	58
3–6	65	62	64	39	47	50	52
4–0	183	54	58	37	43	46	48
4–6	191	60	66	43	52	54	57
5–0	198	64	70	46	58	59	61
5–6	23	56	56	45	42	52	51
6–0	217	71	74	56	66	69	70
7–0	207	82	85	69	77	76	78
8–0	189	85	88	71	80	81	83
9–0	162	92	93	82	86	87	88
10–0	141	91	92	83	89	89	90
11–0	121	90	90	80	86	86	86
12–0	104	86	90	79	87	82	86
13–0	70	87	89	82	89	85	87
14–0	71	89	92	84	90	88	89
15–0	68	85	87	77	88	82	84
16–0	62	93	96	82	95	88	91
17–0	33	88	90	74	86	81	84
18–0	28	80	86	74	79	72	74

age	*fricatives: % correct*							
	/ʃ/	/ʒ/	/s/	/z/	/f/	/v/	/θ/	/ð/
2–6	0	0	10	0	25	8	12	0
3–0	18	2	12	11	46	14	1	6
3–6	16	10	14	11	45	30	11	13
4–0	14	8	11	11	45	22	13	14
4–6	19	11	14	13	55	32	16	24
5–0	22	16	14	12	59	38	25	28
5–6	18	11	13	17	44	26	21	35
6–0	31	24	22	22	70	52	34	42
7–0	36	31	27	33	78	70	55	60
8–0	41	37	33	40	81	75	66	67
9–0	50	44	42	48	92	88	78	78
10–0	56	46	47	55	90	86	79	80
11–0	64	53	51	55	87	84	81	78
12–0	64	52	55	63	86	81	77	81
13–0	53	48	49	52	85	84	76	75
14–0	65	58	56	64	89	93	85	89
15–0	67	48	53	57	87	83	82	85
16–0	72	60	60	67	96	92	90	92
17–0	68	62	56	68	90	86	86	82
18–0	64	59	49	58	82	80	69	76

age	*affricates: % correct*		*glides: % correct*				*nasals: % correct*		
	/tʃ/	/dʒ/	/r/	/l/	/w/	/j/	/m/	/n/	/ŋ/
2–6	0	0	34	27	70	25	92	75	50
3–0	10	11	23	17	69	37	76	62	48
3–6	19	24	40	33	78	51	89	76	52
4–0	19	18	36	33	70	57	83	76	57
4–6	22	19	48	46	81	66	92	87	63
5–0	28	22	52	52	85	76	91	88	68
5–6	28	28	66	57	85	80	92	82	37
6–0	38	34	68	67	93	89	95	94	78
7–0	47	45	78	79	94	92	97	96	80
8–0	51	51	86	86	98	95	97	98	86
9–0	61	58	88	88	98	94	99	96	83
10–0	68	66	90	92	99	97	99	98	83
11–0	73	70	93	90	99	95	99	99	86
12–0	72	71	93	90	99	98	98	96	83
13–0	67	61	95	91	99	97	98	94	81
14–0	76	74	94	89	97	99	96	95	80
15–0	76	71	94	93	99	96	99	96	91
16–0	81	82	96	91	99	99	99	96	90
17–0	83	71	93	92	99	97	100	95	82
18–0	74	69	96	90	98	98	95	92	77

* These numbers remain the same for all classifications of phonemes.

TABLE 8. *Cont.*

age	vowels: % correct		
	/ju/	/ɝ/	/ɚ/
2–6	0	50	50
3–0	4	26	39
3–6	45	32	46
4–0	45	37	52
4–6	58	43	62
5–0	64	55	62
5–6	65	61	59
6–0	68	62	69
7–0	66	72	77
8–0	72	81	85
9–0	73	85	86
10–0	80	85	89
11–0	81	84	92
12–0	80	86	95
13–0	81	87	92
14–0	84	87	93
15–0	74	88	95
16–0	84	90	96
17–0	82	85	92
18–0	50	89	98

data from the 105-item test (in which each of the 149 phoneme elements were scored) are further analyzed to show achievement at the various age levels by manner of production (Table 7) and by specific phonemes (Table 8). As expected from other findings, these children had greater proficiency with glides, nasals, and vowels since those categories do not require velopharyngeal competency. Subjects with cleft palate, as a group, however, exhibited more errors even in these categories than did normal subjects. Their errors on the various /r/ and /l/ phonemes and phoneme combinations are clearly reflected in these data. On nasal productions they did not reach the 90% level of accuracy until age six. On glides they reached that level at age nine and on vowels, including the vocalic /r/, at age 11. Of the so-called "pressure" consonants, fricatives and affricatives proved more difficult for these children to produce than did plosives. Plosives reached the 90% level of success at age 16, but that level was never attained for fricatives and affricatives. Although specific research has not been directed to determine why subjects with cleft palate have so much difficulty with fricative and affricative sounds, more adequate velopharyngeal competency is generally considered essential in the production of these sounds. Additionally, particularly on this test, a large number of fricatives and affricative phonemes are produced with contact being made on the alveolar ridge. Dental deviations, orthodontic treatment, and/or maxillary deficiency might have been contributing factors, particularly at ages when subjects should have been developing correct production of these phonemes.

The generally depressed level of articulation skills in these subjects is demonstrated further by comparisons of the data reported by Prather and associates (1975). The Prather data indicate that normal children reach the 90% level of correct articulation for the nasal /n/ at 24 months, /m/ at 28 months, and /n/ at 36 months, whereas the cleft children did not produce /n/ correctly 90% of the time until age six (see Table 8). For plosives, the Prather data demonstrate that 90% correct production is achieved at three years of age, yet that level was not attained by these cleft children until approximately 16 years of age. Although the subjects tested by Prather were tested only for a sound in the initial or final position, and the subjects reported here were tested for sounds in all positions including blends, one would not expect such a large difference in sound acquisition especially at the older age levels.

The final comparison to be made is with the data reported by McWilliams (1958) for cleft subjects who were adults (mean age 24.5 years). In Table 9, we compare the McWilliams data with the data from this study for 16 year-old cleft subjects. Although McWilliams did not use the same articulation test, the two sets of data are similar in rank order of phonemes correctly produced. It seems likely that the differences obtained re-

TABLE 9. Comparison between Iowa adult (16 yrs.) subjects with adults reported by McWilliams.

sound	*McWilliams % correct*	*Iowa % correct*
/s/	.37	.60
/z/	.39	.67
/dʒ/	.52	.87
/tʃ/	.56	.81
/θ/	.68	.90
/ʃ/	.68	.72
/k/	.68	.88
/g/	.70	.91
/ð/	.80	.92
/d/	.82	.95
/f/	.83	.96
/v/	.83	.92
/t/	.84	.82
/p/	.89	.98
/ŋ/	.90	.90
/b/	.91	.96
/j/	.92	.99
/r/	.95	.96
/l/	.97	.91
/n/	.97	.96
/w/	.98	.99
/h/	.98	—
/m/	.99	.99

flect improvement in treatment procedures that have become available to patients since the McWilliams group was treated in childhood. We selected the 16-year-olds for comparison since this was the largest set of observations at the older testing ages. Hence the data are more likely to be reliable.

Discussion

We present these data in an attempt to provide information about patterns of articulation for children and adolescents with cleft lip and palate. The data are for a relatively large heterogeneous group of subjects. The findings are probably representative only for subjects whose physical and behavioral management is comparable to that received by these subjects. On the other hand, based on our knowledge of cleft lip and palate treatment provided in the U.S. and Canada, and perhaps in Western Europe, treatment for these subjects is probably more similar to methods used elsewhere than it is different. A possible exception might be that other treatment centers may elect to do the palatoplasty at somewhat earlier ages. Currently, most patients have had palatoplasty by at least two and a half years of age, often earlier. However, some of the subjects considered in this study did not have initial surgery until after two and one-half years.

Several generalizations appear warranted. First, these data support previous reports that, by any standard used, children with cleft palate, with or without cleft lip, have obvious deficits in articulation ability. This is true not only for phonemes which clearly are adversely affected by velopharyngeal dysfunction and dental and occlusal anomalies but also for phonemes, such as vowels and glides, that are not directly affected by those factors.

A second generalization, related to the first one, is that children with clefts have articulation deficits that are apparently strongly influenced by maturation. This is not a new finding, but never before have such data indicated that conclusion so strongly. The implication is that speech pathology procedures used with these children must allow for observation of factors related to maturation or spontaneous changes over time. Our best explanation is that the inability to match the normal articulation models for the so-called "pressure" consonants must be generalized to other phonemes or that verbal output, thus verbal practice, is sufficiently limited to influence articulation development. The frequently fluctuating hearing losses often observed in these children may also be a factor.

Third, even by adolescence, many of these subjects still presented a considerable number of articulation errors. Although many appeared to exhibit essentially normal articulation, it is obvious that some subjects still had either velopharyngeal incompetence and/or articulation errors related to dentition and/or poor learning. Since some of these data were collected on subjects who were tested 15 years ago, it is likely that some of these patients had greater problems than is evident at this time. For example, the 17- and 18-year-old subjects, many of whom had little or no early speech remediation, never achieved articulation scores as high as those of the younger subjects. Comparison of subjects aged 10 and 12 with older subjects demonstrates that they were very similar in articulation ability. This probably reflects advances in all aspects of treatment. Hopefully, these 10- and 12-year-old subjects will continue to improve with the

completion of orthodontic treatment and will have access to additional speech services if they are required.

Although it is easy to assume from glancing at the data that many subjects exhibited a marked degree of velopharyngeal incompetency, we do not believe that this is true. Since these subjects were examined over a period of time, any subject with consistent velopharyngeal incompetency was usually managed secondarily. Furthermore the data in Table 8 demonstrate that, on some plosive and fricative phonemes, subjects generally produced these phonemes correctly 90% of the time, e.g. /p/, /b/, and /f/. If subjects were truly incompetent or even marginally competent, one would not expect such high scores on single pressure phonemes. Thus, it appears to us that multifactorial variables contributed to the articulatory errors.

Our findings indicate that the speech pathologist's task is not over when a patient reaches adolescence and that continued evaluation and, in some instances, remediation is needed.

There appear to be no clear advantages to any one articulation test or scoring method if the goal is to identify general articulatory proficiency. Each test or, rather sub-test of the Templin-Darley, was developed for a specific purpose and appears to fulfill that purpose. The IPAT obviously is a useful diagnostic instrument in the evaluation of articulation patterns that may be related to velopharyngeal competency or incompetency. The Templin-Darley Screening Test is useful to compare performance with normative data; and a longer test, such as the 105-item test used here, provides greater breadth and depth for detailed study of articulatory proficiency. The element analysis increases the information that can be derived from the test when it is indicated. If such data are not obtained initially, questions asked in retrospective studies are often unanswerable. It is much easier to delete data for a particular study than it is to rely on inadequate data.

Summary

The purpose of this study was to report the articulation scores of 351 subjects with cleft palate from two years, six months, to 18 years of age. Analysis of the data indicate that, as a group, these subjects with cleft palate were retarded in articulation skills. However, they continued to improve beyond the age at which normal speakers appear to achieve articulatory maturity. It is hoped that other centers will use this information for comparative purposes.

References

KRAUSE, C. J., THARP, R. F., and MORRIS, H. L., "A comparative study of results of the von Langenbeck and V-Y pushback palatoplasties", *Cleft Palate J., 13,* 11–19, 1976.

MCWILLIAMS, B. J., Articulation problems of a group of cleft palate adults, *J. Sp. Hear. Res., 1,* 68–74, 1958.

MORRIS, H. L., Communication skills of children with cleft lips and palates. Ph.D. Dissertation, University of Iowa, 1960.

MORRIS, H. L., Spriestersbach, D. C., and DARLEY, F. L., An articulation test for assessing competency of velopharyngeal closure. *J. Sp. Hear. Res., 4,* 48–55, 1961.

PRATHER, E. M., HEDRICK, D. L., and KERN, C. A., Articulation development in children age two to four years. *J. Sp. Hear. Dis., 40,* 179–191, 1975.

TEMPLIN, M. and DARLEY, F. L., Templin-Darley tests of articulation. Bureau of Educational Research and Service, University of Iowa, Iowa City, Iowa 1960.

VAN DEMARK, D. R., Misarticulations and listener judgments of the speech of individuals with cleft palates, *Cleft Palate J., 1,* 232–245, 1964.

VAN DEMARK, D. R. and THARP, R. F., A computer program for articulation tests, *Cleft Palate J., 10,* 378–389, 1973.

VAN DEMARK, D. R., Assessment of articulation for children with cleft palate, *Cleft Palate J., 11,* 200–208, 1974.