Ratings of Velopharyngeal Closure During Blowing and Speech

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The relationship between velopharyngeal behavior during blowing and during speech has remained unclear although there has been a tendency to assume that the two activities, both presumably requiring integrity of the valving mechanism, are in some way similar.

Kantner (*6*) suggested that the aim of blowing was "to exercise the muscles of the soft palate and adjacent structures having to do with closure of the opening into the nasopharynx." His three major underlying assumptions for the use of blowing were: a) Blowing exercises would enable the patient to learn better voluntary control of muscle function. b) Blowing would lead to actual strengthening of the muscles. c) Blowing would teach the patient to direct the air stream through the mouth. He doubted, however, that the skill developed through blowing exercises could be expected to carry over into equivalent skill in speech and questioned the use of such exercises in cases of gross palatal inadequacy. In a later discussion (*5*), he reiterated his contention that adequacy of structures for one activity should not be accepted as proof of adequacy for another.

Morley (*10*) also emphasized blowing exercises in the speech training of children with clefts as did Moser (*12*) and Gaines and Wepman (*4*). Implicit in the use of these procedures was the assumption that purposeful blowing would help the patient direct the expired air stream through the mouth rather than through the nose. In the most recent edition of her book, Morley (*11*) places somewhat less stress upon blowing but continues to recommend it as a means of directing the breath stream and of developing full use of muscles responsible for velopharyngeal closure.

Van Riper (*14*), like Morley, currently appears to de-emphasize blowing exercises. However, he recognizes that such procedures have probably been used more frequently than any other single device for strengthening the palate and he contends that they have a place in therapy if properly understood. He suggests that an "increasingly greater ratio of mouth air

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flow to nasal air flow" might be one evidence that the palate is actually being strengthened.

Direct observations of the valving mechanism during blowing and speaking were made by Bloomer (*2*) in his study of a patient whose structures were visible following the surgical removal of portions of upper face. He concluded that the palatopharyngeal valve was a complex one reflecting an interaction of elevator, sphincter, and depressor effects and that the movements observed during speech more closely resembled the movements of blowing than of swallowing.

Spriestersbach (*13*) reported, from an x-ray study of 47 patients, that 38 of the subjects used the tongue and palate to valve for puffing the cheeks, while only six used the velopharyngeal valve. Although puffing is probably not an equivalent activity to blowing, these results lead to serious questions relative to the effects of blowing attempts upon velopharyngeal function in cleft patients.

Calnan and Renfrew (*3*) studied still x-ray films of 225 subjects with nasal speech during the phonation of /i/ and while blowing a carnival blower. All of the subjects showed palatopharyngeal incompetence during phonation, but 85 achieved closure during blowing. They concluded that the closure achieved during blowing resulted from compensatory movements of the speech mechanism but that such compensatory movements were probably not useful in speech.

It is obvious from this brief discussion of blowing as it relates to speech production that there are contradictions in current philosophies. In spite of the evidence which suggests that blowing and speech may be physiologically different, writers continue to refer to blowing as a possible avenue for improving articulation and voice quality in cleft palate patients, and blowing continues to be used by many clinicians. It is apparently difficult to discard an historically accepted clinical procedure without substantial evidence regarding its ineffectiveness.

The purpose of this study was to investigate velar-pharyngeal behavior during blowing and speech using the Televex technique.

Subjects

Subjects were 37 patients with surgically repaired clefts of the palate and are described in Table 1. They were selected from the files of the University of Pittsburgh Cleft Palate Program (although several had previous management elsewhere). There were 17 females ranging in age from three years and five months to 21 years and one month, with a mean age of 9.12 years. The 20 males ranged in age from four years and two months to 20 years and five months, with a mean age of 8.92 years. The mean age for the entire group was nine years. It is recognized that this represents a considerable age span, but it was not the original intent of the study to view the behavior under consideration as a function of age. Further consideration of this matter will be presented later.

TABLE 1. Description of the 37 subjects according to age, sex, and type of cleft.

Sex	*N*	*Age*		*Lip and Palate*			*Palate Only*		*Unknown*	*Totals*
		Range	*M (yrs.)*	*Unilateral*		*Bilateral*	*Incomplete*	*Soft*		
				Left	*Right*		*Soft & Hard*			
Male	20	4–2 to 20–5	9.1	5	3	9	2	4	1	24
Female	17	3–5 to 21–1	8.9	4	0	2	3	1	3	13
Totals	37	3–5 to 21–1	9.0	9	3	11	5	5	4	37

Eleven of the 37 had bilateral cleft lips and palates. Twelve had unilateral cleft lips and palates; 10 had cleft palates only. Information about cleft type was not available on four of the subjects.

Since this was not a study of competent versus incompetent mechanisms but, rather, involved comparisons of behavior observed under three different conditions, the subjects were not initially classified in terms of velar-pharyngeal competence.

Procedure and Equipment

Each subject was brought to the Department of Radiology, Children's Hospital of Pittsburgh, where the Westinghouse Televex closed circuit television fluoroscopic and video tape recording system was used. The image was mediated through an Orthicon television camera optically coupled to a nine-inch Phillips image amplifier. Viewing on a closed circuit television monitor occurred simultaneously with the recording on an RCA video recorder, TRTLA. Scotch video tape type 379 was employed. The same low levels of radiation required for television viewing alone were possible even with the utilization of the tape recording system. Satisfactory recordings were obtained with settings ranging from .13 to .50 ma and from 60 to 80 kv.

The actual recording was done by a board-qualified radiologist aided by an engineer who managed the technical parts of tape recording. A speech pathologist was present during the studies and was responsible for proper positioning of the patient, presentation of speech materials, monitoring of the television screen, and maintaining the proper examination sequence.

The patient was first placed in a Wehmer electric powered cephalometric chair which could be raised or lowered. The next step was to adjust the Wehmer Cephalometer to the patient, positioning the patient by means of ear rods to assure as nearly as possible a lateral view, and stabilizing his head with a plastic forehead bumper. This method did not completely eliminate head movements, but it reduced them to the acceptable limits suggested by Bjork (*1*).

After the patient was positioned, an RCA Model 396 microphone was placed around his neck so that sound and audio signals might be recorded simultaneously.

The patient was then instructed to repeat after the examiner:

1. My name is _____ _____.
2. I am _____ years old.
3. I am project number _____.
4. (Count from one to ten).
5. My name may mean money.
6. Sissy sees the sun in the sky.
7. Kindly give Grace the chocolate cake and the short blue pen.

Certain other verbal activities were also recorded but are not reported here because they do not relate to the portion of the work under consideration in this paper.

The next segment of the examination involved instructing the patient to blow as hard as possible into a Hunter oral manometer with constant leak, first with nostrils open and then with nostrils closed.

Analysis of Data

The limitations and advantages of the Televex system have been reported elsewhere (*8*). In general, transfer of the image from the video tape to conventional motion picture film is not practical. For that reason, evaluation of tapes by rating scale rather than by frame-by-frame measurement is the procedure of choice. The scale has been described elsewhere (*7*).

For purposes of this study, only the seven-point scale describing palatopharyngeal closure was used. Evaluations of closure during connected speech, during blowing with nostrils open, and during blowing with nostrils closed were made. The values assigned to the various points on the scale were: one, total blending of the palate and pharyngeal wall; two, partial blending; three, touch; four, narrow opening; five, moderate opening; six, wide opening; and seven, no movement in the direction of closure. Figure 1 illustrates each of the seven points on the rating scale.

Reliability of Ratings

Before the ratings were made, two investigators spent several hours looking at and discussing taped studies. When these training sessions were

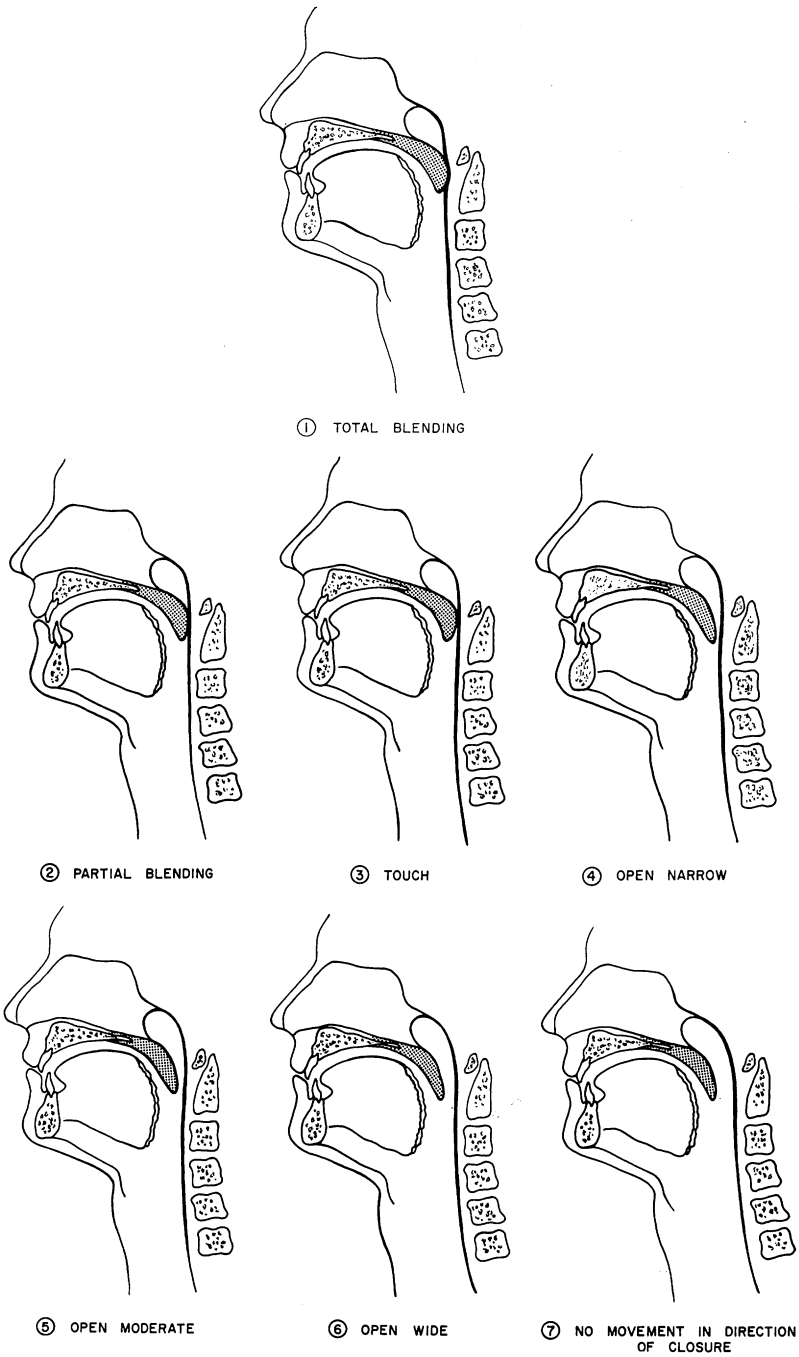

FIGURE 1. Illustrations for the seven points of the rating scale for velopharyngeal closure.

TABLE 2. Data for inter-judge reliability for ratings of velopharyngeal closure for 37 subjects during connected speech, blowing with nostrils open, and blowing with nostrils closed.

Activity	*Percentage of absolute agreement*	*Reliability coefficients (r)*
Connected speech.....	57	.84
Open blowing.....	81	.96
Closed blowing.....	70	.95

concluded, data regarding inter-judge reliability was obtained both in terms of percentage of agreement and correlation coefficients (Table 2). The two judges had absolute agreement on 57% of the judgments made during connected speech. They disagreed on only 16 of the subjects; and on these 16, they differed no more than one point on the scale. The correlation coefficient derived from these judgments was .84. For ratings of blowing with nostrils open (open blowing) the raters agreed absolutely on 30 of the 37 judgments, or on 81% of the cases. The mean difference in scale points for the seven subjects on whom they did not agree was 1.14. The correlation coefficient for these ratings was .96. For ratings on blowing with nostrils closed absolute agreement was obtained for 26, or 70% of the 37 subjects. The mean difference was 1.08 scale points. The correlation coefficient was .95. All three coefficients of correlation were sufficiently high to warrant the conclusion that the judges were viewing the activities under consideration in a similar manner. However, since there was not absolute agreement on the ratings for each subject, the mean of the two judgments was used as the rating in the analysis of data.

Results

CONNECTED SPEECH AND OPEN BLOWING. A total of 26 subjects, or 37%, achieved more adequate closure during open blowing than they demonstrated during connected speech. An additional eight subjects achieved closure that was less adequate in open blowing than it was during connected speech. Only three subjects were rated equally in both activities. Two of these were judged to be poor in both activities and received ratings of 5.0 and 5.5. One subject achieved touch closure with ratings of 3.0 in speech and in open blowing. For the entire group of 37, the mean rating of closure for connected speech was 3.16 while the mean rating for blowing with nostrils open was 2.35. The difference between the two means was significant (Table 3). It was concluded, therefore, that the degree of closure achieved during open blowing is different from that achieved during connected speech.

TABLE 3. Analysis of differences among ratings of velar-pharyngeal closure for connected speech, blowing with nostrils open, and blowing with nostrils closed (N = 37). t values significant at the 1% level are asterisked.

Comparisons	*Ratings*		*Difference*	t
	range	*mean*		
Connected speech	1 to 6	3.16	.81	3.421*
Open blowing	1 to 7	2.35		
Connected speech	1 to 6	3.16	.44	1.285
Closed blowing	1 to 7	3.60		
Open blowing	1 to 7	2.35	1.25	4.096*
Closed blowing	1 to 7	3.60		

CONNECTED SPEECH AND CLOSED BLOWING. The mean ratings of closure for closed blowing and for connected speech were 3.60 and 3.16 respectively. The difference between those means was not significant (Table 3). This finding suggests that closed blowing results in palatopharyngeal closure that is similar to closure achieved during connected speech.

OPEN BLOWING AND CLOSED BLOWING. The mean rating of closure for blowing with nostrils open was 2.35; for nostrils closed, the mean rating was 3.60. The difference between the means was significant, indicating that the velar-pharyngeal mechanism behaves differently during open and closed blowing.

OTHER DIFFERENCES. It would appear, then, that closure obtained while blowing with nostrils open is likely to be more complete than while blowing with nostrils closed and that the degree of closure obtained in the latter activity and in connected speech does not differ significantly. However, further analysis seems indicated since differences may exist in these relationships according to differences obtained for the same subject between any two measures. Data regarding such comparisons are presented in Table 4.

For example, for 14 of the 37 subjects ratings of velar-pharyngeal closure were the same for open and closed blowing. For that group only the difference between ratings for blowing and speech was not significant although better closure was observed during blowing. Three of the 14 subjects, however, demonstrated velar-pharyngeal closure that was better during speech than during blowing. Those three had mean ratings of 6.33 during blowing and of 4.33 during speech. While this number was too small to warrant independent analysis, the ratings of those three appeared to influence the data sufficiently to yield somewhat misleading results. When these subjects were excluded and mean ratings were computed for the 11 subjects who remained, the mean rating was 1.50 for blowing and 2.81 for speech. That difference was significant, indicating

TABLE 4. Differences between ratings of velar-pharyngeal closure for three subgroups: subject who obtained identical ratings for open and closed blowing ($N = 14$); subjects who showed more complete closure on open blowing than on closed blowing ($N = 18$); and subjects who showed more complete closure on closed blowing than on open blowing ($N = 5$). t values significant at the 1% level are asterisked.

Conditions	*N*	*Mean Ratings*			*Difference*	*t*
		Blowing		*Speech*		
		Open	*Closed*			
Ratings same for nostrils open and closed						
total group	14	2.53	2.53	3.14	.61	.564
more closure during speech	3	6.33	6.33	4.33	Not analyzed	
more closure during blowing	11	1.50	1.50	2.81	1.31	4.704*
More closure for nostrils open than closed	18	2.03	4.78		2.75	7.066*
		2.03		2.94	.91	3.591*
			4.78	2.94	1.84	5.169*
More closure for nostrils closed than open	5	3.00	2.40		.60	6.0*
		3.00		3.90	.90	1.53
			2.40	3.90	1.50	1.81

that blowing with nostrils open and with nostrils closed yielded velar-pharyngeal closure superior to that achieved in speech except in those cases where, for unknown reasons, velar-pharyngeal behavior was less adequate in blowing than in speech.

For 18 subjects, ratings of velar-pharyngeal closure during closed blowing were higher than those obtained during open blowing (that is, less complete closure was observed), and the difference was significant. Velar-pharyngeal closure achieved by these subjects was also significantly better during connected speech than during closed blowing but was significantly poorer than closure observed during blowing with nostrils open.

In five cases, blowing with nostrils closed produced significantly better closure than did blowing with nostrils open. However, in these subjects, speech was never better than either blowing condition nor did either blowing condition produce closure that was superior to that achieved during speech.

Discussion

The results of this study suggest that speech demands velar-pharyngeal behavior that is physiologically different from that required for blowing. While it was thought that some of the findings might be the result of age, inspection of the data did not indicate that possibility, and further analysis was not done. Subjective examination of the television tapes used in the ratings reported lead these authors to suspect that blowing is a gross

activity often utilizing generalized movements of the soft palate and adjacent structures in a way that is utterly impossible in the precise and rapid modifications of movement required in connected speech. Occluding the nostrils appears to present the mechanisms involved with circumstances leading to a different pattern of behavior from that observed in either speech or closed blowing. Probably because the anterior valve is present, the soft palate is observed to offer less resistance to the passage of air than it is found to offer when it serves as the only valve. However, since it does act to close off the nasopharynx even when the nostrils are occluded during the blowing act, it must be concluded that certain automatic function is present even when such function is not absolutely essential. This, of course, casts doubt upon the validity of trying to train the individual to the conscious control of his palate.

Observation of open and closed blowing leads the authors to question the procedure of obtaining breath pressure ratios by having the patient blow first with nostrils open and then with nostrils closed. These might well be in error unless it is recognized that the nasal loss is actually *greater* than the ratio would suggest and that the differential, in order to be accurately measured, would have to include the air trapped in the cul de sac created by the occluded nostrils. This "lost air" may be the explanation for greater perceived nasality than the ratios seem to indicate.

These data further suggest that blowing and speech activities should be observed radiographically and compared before either isolated behavior is used prognostically or is included in a treatment program. Since most subjects whose palates were inadequate for purposes of speech appeared to achieve velar-pharyngeal closure during open blowing, the use of blowing to determine something about the palate's ultimate capabilities is probably not warranted. In addition, it is evident that some patients treated with blowing exercises would be involved in therapy diametrically opposed to their own physiologic demands. For the few who show greater adequacy in speech than in blowing, blowing exercises are to be questioned. It is clear that this study was not designed to settle the clinical questions remaining about the use of blowing exercises in speech therapy. On the other hand, the implications suggested by the data cannot be overlooked.

Attention is also directed to the individual variations in behavior characteristics of the subjects in this study. While it is well to be aware of group trends, it is also imperative in research to be cognizant of the deviations from the central tendency. The very fact of deviation may be an entering wedge to broader understanding of multitudes of problems. This has too often been ignored in cleft palate research.

Summary

This study investigated teleradiographically the velar-pharyngeal closure achieved by 37 patients with repaired cleft palates during blowing

with nostrils open, nostrils closed, and during connected speech. Closure was evaluated on a seven-point rating scale. Comparisons were drawn between the extent of velar-pharyngeal closure achieved under the experimental conditions.

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