Assessment of Velopharyngeal Competency for Children with Cleft Palate

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Introduction

The purpose of this project was to describe the velopharyngeal competency of a sample of 108 children with clefts from western Denmark. In a previous article, the population and sample studied, the surgery, and articulation have been reviewed (*7*).

Although there are many methods to evaluate velopharyngeal competence for speech (*2*), all current methods exhibit some limitations, and no single procedure is wholly satisfactory for assessing velopharyngeal competence (*3*). Therefore, this investigator attempted to assess velopharyngeal closure by a number of methods. These methods can be dichotomized into clinical evaluation or clinical judgment and measurement of physical attributes.

Procedure

Eight measures of evaluating velopharyngeal competency were used by the investigator in his examination of each subject. In addition, each subject was administered an articulation test and a sample of conversational speech was obtained (*6*).

The first clinical evaluation of velopharyngeal competence was made on the basis of a composite diagnostic evaluation. The examiner rated each subject as having velopharyngeal competence, marginal competence, or velopharyngeal incompetence based on his observations of the subject's conversational speech, word articulation tests, manometer ratios, and oral mechanism. Observations of a subject's nasal grimace and/or nasal emission were also utilized by the examiner to rate each subject. These ratings were made to the best of my clinical judgment on velopharyngeal adequacy of each subject and are referred to as the "estimate of closure" in the remainder of the text.

A second clinical rating was made in regard to prognosis for velopharyngeal competency. In this rating, a 5-point equal-appearing-interval scale was used, where one indicated a prognosis for very good velopharyngeal competency, three indicated a prognosis for marginal competency, and five

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indicated a prognosis for incompetency. This rating was made on my valuation of the potential exhibited by a subject. For example, if a subject had oral articulation except on the phonemes /s/ and /sh/, which were pharyngeal, yet on stimulation he could modify his behavior, this information was considered in the prognostic rating.

The third method, often used clinically, was the evaluation of the evidence of nasal grimace as an index of velopharyngeal competency. Subjects were rated on a 7-point equal-appearing-interval scale. The rating of one indicated no evidence of nasal grimace and a rating of 7 indicated very severe nasal grimace. The fourth method, evaluation of nasal emission of air during speech, was also assessed on a 7-point scale, where one equaled no nasal emission and seven equaled very severe nasal emission.

The fifth and sixth measures—severity of articulation and severity of nasality—were made by the psychosocial scaling techniques using the 7-point equal-appearing-interval scales. Although these measures have generally not been used specifically to rate velopharyngeal competency, they have been found to be related to velopharyngeal adequacy (*1*).

The seventh method of evaluating velopharyngeal closure was by use of the manometer (*2*) both by positive (n = 107) and negative (n = 88) conditions. A manometer ratio of 1.0 to .90 was considered adequate velopharyngeal closure, while .89 to .50 was considered marginal, and .50 and below was considered inadequate (*4*).

For the eighth method of evaluation of velopharyngeal competency, lateral x-rays of phonations of /u/ were utilized (n = 101). The estimate of closure was rated as follows: (1) tight seal; (2) seal with over 2 mm. of contact but with slight line; (3) contact, touch one with minimal contact area or near contact with no measurable gap; (4) gap of less than 2 mm.; (5) gap of greater than 2 mm. The investigator and the staff orthodontist independently rated all x-rays. When disagreements occurred, the x-rays were re-evaluated until agreement was reached on ratings.

Reliability. Thirty-five tape recorded samples of conversation were judged for velopharyngeal competency by four highly experienced clinicians in cleft palate treatment. This investigator obtained on average agreement in judging degree of competency of 75%. The range of agreement between the investigator and the other judges was from 70% to 85%. Additionally, a native Danish-speaking layman was asked to rate the speech of the 108 samples as normal or not normal. The percent of agreement between this native speaker and the investigator was 94%.

The reliability and validity of estimates of velopharyngeal competency made by the investigator for the specific measures can be questioned; however, as is demonstrated in Table 1 all measures were significantly related to each other at the .001 level of confidence with the exception of negative manometer ratios. The estimate of closure rating made by the investigator exhibited the highest average correlation to the other measures. X-ray

TABLE 1. Correlations of various measures of velopharyngeal competency and severity ratings.

	Blowing	Sucking	Closure prognosis	Artic. severity	Nasal severity	Grimace	Emission	Est. closure x-ray
Est. closure	-.73*	-.32*	.78*	.62*	.77*	.59*	.68*	.61*
Blowing		.48*	-.65*	-.45*	-.65*	-.50*	-.59*	-.47*
Sucking			-.22	-.20	-.29	-.38*	-.30	-.20
Clos. prognosis				.69*	.79*	.57*	.70*	.51*
Artic. severity					.66*	.41*	.52*	.33*
Nasal severity						.60*	.77*	.54*
Grimace							.76*	.40*
Emission								.49*
Est. closure x-ray								

*significant at the .001 level

ratings and positive manometric ratios were also more highly related to estimate of closure than to any other measure.

Results

On the first measure, estimate of velopharyngeal competency, 52 subjects (48%) achieved competence, while 44 (41%) had a marginal mechanism, and 12 (11%) exhibited velopharyngeal incompetence. The ratings for these three groups and for the total group on the seven other velopharyngeal competency measures are presented in Table 2.

For the second measure, prognosis for velopharyngeal competency, 36 subjects (33%) were rated as having an excellent prognosis for velopharyngeal competency, while the prognosis of slight incompetency was judged for 42 subjects (38.9%). A prognosis of moderate incompetence was rated in 19 subjects (17.6%) while the prognosis of marked velopharyngeal incompetence was made for 7 subjects (6.5%) and very marked incompetence was made for 4 subjects (3.7%).

For the third method, evidence of nasal grimace, 88 subjects (81.5%) exhibited no nasal grimace or questionable perception of nasal grimace (so slight that the examiner was not sure that it occurred). Twelve subjects (11.1%) exhibited some nasal grimace and five subjects (4.6%) exhibited moderate nasal grimace, while the remaining three subjects (2.8%) exhibited severe nasal grimace.

With the fourth method, rating of nasal emission of air during speech, 78 subjects (72.2%) were rated as one or two, no nasal emission or questionable perception of nasal emission (so slight that the examiner was not sure that it occurred); 24 subjects (22.2%) were rated as three or four; and 6 subjects (5.6%) were rated as more severe.

TABLE 2. Presented below are the percent of subjects who were rated as achieving closure, marginal closure, or incompetency and totals for the following measures: closure prognosis, articulation severity, nasal severity, grimace severity, nasal emission, degree of closure by lateral x-ray and manometer ratios.

	Ratings (N)	Closure 52=48.1% %	Marginal 44=40.7% %	Incompetent 12=11.1% %	Totals 108 %
Prognosis of velopharyngeal closure	(1)	61.5	9.1		33.3
	(2)	38.5	50.0		38.9
	(3)		34.1	33.3	17.6
	(4)		6.8	33.3	6.5
	(5)			33.3	3.7
Articulation severity ratings	(1)	1.9			.9
	(2)	46.2	9.1		25.9
	(3)	25.0	34.1		25.9
	(4)	19.2	25.0	16.7	21.3
	(5)	5.8	20.0	16.7	13.0
	(6)	1.9	4.5	33.3	6.5
	(7)		6.8	33.3	6.5
Nasal severity ratings	(1)	48.1	6.8		25.9
	(2)	20.4	13.6	8.3	26.9
	(3)	7.7	50.0		24.1
	(4)	1.9	15.9	8.3	8.3
	(5)		9.1	25.0	6.5
	(6)		2.3	25.0	3.7
	(7)		2.3	33.3	4.6
Grimace ratings	(1)	90.4	38.6	8.3	60.2
	(2)	5.8	34.1	41.7	21.3
	(3)	3.8	18.2	16.7	11.1
	(4)		9.1	8.3	4.6
	(5)			16.7	1.9
	(6)			8.3	.9
	(7)				
Nasal emission ratings	(1)	78.8	22.7	8.3	48.1
	(2)	17.4	34.1	16.7	24.8
	(3)	3.8	29.5	8.3	14.8
	(4)		11.4	25.0	7.4
	(5)		2.3	8.3	1.9
	(6)			25.0	2.8
	(7)			8.3	.9
X-ray ratings	(0)	9.6	4.5		6.5
	(1)	36.5	15.9		24.1
	(2)	28.8	27.3	8.3	25.9
	(3)	19.2	6.8		12.0
	(4)	5.8	27.3		13.9
	(5)		18.2	91.7	17.6
Positive manometer ratios	(100)	67.3	15.9		38.9
	(.99-90)	19.2	20.5	8.3	18.5
	(.89-80)	9.6	40.9	8.3	22.2
	(.79-70)	1.9	15.9	25.0	10.2
	(.69-60)		6.8	16.7	4.6
	(.59-50)			8.3	.9
	(.49-40)				
	(.39-30)			25.0	2.8
	(.29-20)			8.3	.9
	(.19-10)				
	(.9-00)	1.9			.9

For the fifth method, severity of articulation, 29 subjects (26.8%) were rated as one or two, normal or near normal articulation. Fifty-one subjects (47.2%) were rated as three or four, mild to moderate articulation defectiveness. Twenty-four subjects (19.5%) were rated five to six, moderate to severe articulation defectiveness. Seven subjects (6.5%) were rated as having very severe articulation defectiveness.

For severity of nasality ratings, 57 subjects (52.9%) were rated as one or two, normal nasality to very mild hypernasality. Thirty-five subjects (32.4%) were rated three or four, moderate nasality; 11 subjects (10.2%) were rated as five or six, moderately severe nasality, and 5 subjects (4.6%) were rated as exhibiting very severe hypernasality.

In the seventh method of evaluating velopharyngeal closure by use of the manometer, for the positive blowing task with bleed, 42 subjects (38.9%) achieved a ratio of 1. An additional 20 subjects (18.5%) achieved a ratio greater than .90 but less than 1. Forty subjects (37%) fell within the marginal category, while 5 subjects (4.6%) fell within the inadequate category. On the negative sucking task, a slightly higher percentage of subjects achieved ratios of 1.00 (50%) and fewer subjects achieved ratios between 1.00 and .90. The percentage of subjects falling in the marginal and inadequate categories was essentially the same as on the positive blowing task.

The eighth method of evaluating velopharyngeal competency, lateral x-rays on phonation of /u/, indicated that 62% of the subjects achieved velopharyngeal closure or approximate palatal contact (ratings of 1, 2 or 3) while for 31.5% palatal contact (ratings of 4 and 5) was not achieved. No x-rays were available for 6.5% of the subjects.

Discussion

As was mentioned previously, no specific measure of velopharyngeal competency seems adequate. However, as is demonstrated in Table 1, all velopharyngeal competency measures used in this study are significantly related (.001) to each other and to the investigator's composite measure of estimate of competency. The correlations indicate that measures of velopharyngeal competency were interrelated, yet if the measures were evaluating the same factor, one would expect higher correlations. It, therefore, appears that in evaluating velopharyngeal competency a composite measure should be used. Further research in defining an "optimal" composite measure is needed.

For example, as is presented in Table 2, lateral x-rays for velopharyngeal incompetent subjects demonstrated that 92% exhibited a gap greater than 2 mm., yet subjects judged as competent did not always achieve a tight velopharyngeal seal. Although the correlations of lateral x-rays with other measures were somewhat low, this measure clearly predicts those subjects with an obviously incompetent mechanism.

Nasal grimace and nasal emission ratings also appear helpful in predicting those subjects who achieve closure, since in subjects with velopharyngeal competency these attributes are not generally exhibited. However, a considerable portion of the subjects with marginal closure did not exhibit nasal grimace. Furthermore, these two measures also can be unreliable if a subject who exhibits velopharyngeal incompetency does not produce pressure phonemes or has not learned the compensatory techniques of constricting the alae. It would seem more likely that observation of nasal emission and nasal grimace indicates that velopharyngeal function is less than optimal.

Although the validity of manometer ratios in evaluating velopharyngeal competency can be questioned because they are not acquired on a speech task, positive manometer ratios with bleed demonstrated a strong relationship to other measures of velopharyngeal competency. In the sample studied, 86.5% of those subjects who were judged as having a competent mechanism obtained manometer ratios of .90 or higher and none of these subjects had ratios below .50. In the marginal group 64% of the subjects achieved ratios between .89 and .50, with the remaining subjects achieving scores higher than .90. In the incompetent group, only one subject achieved a ratio above .90. It would appear that if manometer ratios of .90 or higher are achieved, consideration of further palatal management should be done with caution.

When negative manometer ratios are considered, the same trend is evident; however, fewer subjects are able to do this task, particularly at younger ages. Both measures were related to other measures of velopharyngeal competency; however, positive measures appeared to be the better of the two.

In Table 2, subjects' rating on various attributes of velopharyngeal competency were presented as classified by estimate of closure. For subjects who achieved closure, articulation and nasality ratings were less severe than for the marginal and no closure groups. For the marginal group, the range of severity ratings tended to be large, i.e. severity of nasality. On some tasks, but not all, the marginal group was able to perform as well as the closure group. For the incompetent group, higher ratings were obtained, particularly in the evaluation of lateral x-rays where 92% were judged to have a gap on phonation of /u/ greater than 2 mm.

In determining the strength of relationships between measures of velopharyngeal competency, it appears that the make-up of the sample studied becomes crucial. For example, in this study the relationship between severity of articulation defectiveness and nasality for subjects who achieved velopharyngeal closure was low (.27). As competency decreased, the relationship became higher and a correlation of .71 was obtained for the incompetent group. Likewise, correlations obtained on articulation tests (7) and competency variables increased for the incompetent group. It, therefore, appears that if a sample studied generally exhibits velopharyngeal competency, correlations will be lower. This finding is supported by the previous work of Van Demark (*5*), who indicated that articulation defectiveness for subjects who achieve velopharyngeal closure is related to other factors, where for subjects who do exhibit closure, velopharyngeal closure appears to be a primary factor of articulation defectiveness.

Summary

In this investigation, a sample of 108 Danish children with a cleft palate was examined to determine their adequacy of velopharyngeal competence. Velopharyngeal competency was assessed by eight measures: estimate of velopharyngeal closure (a composite measure), prognosis for velopharyngeal closure, evidence of nasal grimace, evidence of nasal emission, severity ratings of nasality, severity ratings of articulation defectiveness, manometer ratios and lateral x-ray on phonation of /u/. The estimate of velopharyngeal closure demonstrated a significant relationship at the .001 level with other measures and was considered a reliable measure of competence. Forty-eight percent of the subjects were judged competent, while 41% were judged to demonstrate marginal velopharyngeal competence, and 11% were judged to exhibit velopharyngeal incompetence.

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