The following report summarizes the deliberations of participants in a series of three conferences titled A Seminar for the Establishment of a Uniform Method to Assess Hypernasality in Cleft Palate Patients in North America. The seminar was organized by Dr. William C. Grabb and addressed the establishment of a procedure for the evaluation of hypernasality. The procedure was to be useful in the evaluation of operations or speech therapy for patients with cleft palate.

The report describes a series of observations to be employed in making clinical decisions pertinent to patients with questionable velopharyngeal sufficiency. It leaves unanswered the question of what measure or measures must be used for the evaluation of velopharyngeal function for research purposes. The latter question is important to the evaluation of many papers submitted to this *Journal*. The report implies that use should be made of instrumental measures: aeromechanics, videoendoscopy, multiview motion radiography, or a combination. Investigators evaluating operations might also differentiate between establishment of a velopharyngeal mechanism capable of closure and the use the patient makes of that mechanism in talking.

The Editor

Methods of Assessing Speech in Relation to Velopharyngeal Function

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Seven speech pathologists with expertise in the evaluation of the speech of individuals with cleft palate agreed that the following parameters should be assessed: case history, oral-peripheral mechanism, articulation, and voice quality. From such information and observations the clinician should be in a position to make inferences about velopharyngeal function. If velopharyngeal function is not normal, it is mandatory that additional information about the mechanism be obtained.

In 1978 Dr. William Grabb, a plastic surgeon with a long-term commitment to the treatment of individuals with velopharyngeal incompetence, invited seven speech pathologists with expertise in evaluating speech of individuals with cleft palate to a conference. The charge to this group was to determine if they could agree upon a standard or uniform set of procedures to evaluate the speech of individuals with cleft palate. This group met on three occasions (1978, 1980, 1981) to explore problems related to development of specific procedures and criteria for assessing speech in relationship to velopharyngeal function. The present report is the outcome of those and subsequent deliberations.

As a fundamental tenet, the group recognized that no one observation, speech, or instrumental assessment is sufficient to evaluate velopharyngeal function (McWilliams and

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This project was supported in part by the Division of Plastic Surgery, University of Michigan and the Department of Communication Disorders, School of Allied Health Professions, Louisiana State University Medical Center.

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Philips, 1979; McWilliams et al, 1981; Morris, 1978; Morris et al, 1973; Van Demark, 1974). Similarly, no general set of criteria is suitable for all patients nor for all of the needs of any individual patient. Rather, the concensus was that the goal should be to establish a set of core procedures that could provide a minimum set of data for speech assessment of individuals with cleft palate by qualified speech pathologists. Four interrelated areas were considered essential: (1) history, (2) oral-peripheral examination, (3) perceptual analysis of articulation proficiency, and (4) voice quality-resonance evaluation.

Case History

Evaluation of velopharyngeal function in relation to speech must include a comprehensive case history. Questions should be formulated to obtain information concerning the child's current health status with special attention to possible existing problems which may affect speech (Bzoch, 1979; Darley, 1978; Westlake, 1968).

In the psychosocial area, the clinician should determine the family's perception of the quantity and quality of speech in the home environment. For example, is the child's speech intelligibility highly inconsistent? Do voice quality, articulation, or both deteriorate when the patient tires? It is also imperative to determine whether the family or the child feels there is a communication problem (Shelton and Trier, 1976).

Specific information that should be obtained in the case history should include at least the following: (1) history of nasal regurgitation, (2) family history of clefting or oral/facial syndromes, (3) history of tonsillectomy and adenoidectomy, (4) history of ear disease, and (5) history of speech problem: course, therapy, variability.

Oral-Peripheral Examination

Evaluation of velopharyngeal function in relation to speech must also include completion of a brief, yet careful, orofacial examination (Mason and Grandstaff, 1971; Mason and Simon, 1977). The primary purposes of this phase of the evaluative processes are to determine or identify both the presence of conditions which might be confused with velopharyngeal incompetence for speech and conditions known to be associated with velopharyngeal impairment. Particular effort should be made to identify the following: (1) the child's ability to breathe and hum through both nostrils, (2) evidence of compensatory actions such as facial grimace during speech, (3) whether labial-oral and nasal-oral fistulae are present and if so, the apparent effect on speech, (4) dental problems and their relation to speech-articulation, (5) whether a dental appliance is being used and if so, whether it interferes with speech, (6) whether oral motor control, as measured by standardized tests such as syllable repetition rates, is within normal limits. If not, what is the pattern of deviation? (7) evidence of cul-de-sac resonance and excessive nasal turbulance, (8) whether there are obvious disturbances in physical structure, such as extreme scarring or a submucous cleft, (9) whether movements of the palate appear to be normal in extent and whether movements are symmetrical, and (10) evidence of other vocal tract irregularities such as hypertrophied tonsils or adenoids.

Unless the patient has an obvious open cleft, assessment of velopharyngeal competence cannot be made from oral examination alone (Boone, 1977; Mason and Grandstaff, 1971; McWilliams and Philips, 1979). With the above observations and the history provided by the family, the clinician should determine which factors may contribute to the speech problem. Using these observations (with the additional data discussed below), the clinician should begin to document and delineate the nature, extent, and source of the speech deviations that have been tentatively identified. When the clinician finds the assessment results difficult to interpret, instrumental approaches (e.g., measurement of nasal-flow rates, volume, nasal resistance) are recommended before a definitive diagnosis is made (McWilliams and Philips, 1979; Morris, 1978; Van Demark, 1974).

Articulation

Ultimately decisions about velopharyngeal competence and need for management intervention rest on how the person talks in conversational speech and in daily communicative activities (Moll, 1964; Shelton et al, 1968). Articulation tests are an essential part of the evaluation procedure. Analysis of articulation tests helps the clinician to determine the errors in production of speech sounds and to detect inappropriate nasalization, two of the most common elements of velopharyngeal inadequacy.

In view of this fact, thorough evaluation of articulation proficiency is required. When possible, testing should incorporate standardized articulation tests that permit assessment and differentiate articulation errors related to linguistic development from those related to velopharyngeal incompetence.

Four articulation test procedures are recommended for inclusion in the standard test battery:

1. Assessment of ability and consistency to produce perceptually normal /p/ and /b/ consonant sounds in words, without excessive nasal emission (Van Demark and Swickard, 1980)
2. Evaluation of the pattern of consonant articulation errors identified in standardized articulation tests with particular emphasis on the pressure sounds (Morris et al, 1961; Templin and Darley, 1960)
3. A sentence-repetition test to determine whether articulation is altered during the production of more complex discourse (Fletcher, 1978; McWilliams and Mussgrave, 1971; Templin and Darley, 1960; Van Demark, 1966, 1974; Wilson, 1979)
4. The clinician should engage the patient in conversation to determine whether articulation deteriorates (McCabe and Bradley, 1973). It is recognized that, depending upon the age of the patient being tested, in some cases complete testing information may not be attainable.

Scores on articulation tests *per se* are less important than is the pattern of error types that is exhibited. Particular attention must be given to errors that include nasal emission on pressure consonants and to interjection of glottal-stop and pharyngeal substitutions (Bzoch, 1979; Colburn, 1982; Hess, 1976; Kuehn, 1982; McWilliams, 1982; McWilliams and Philips, 1979; Trost, 1981).

During all forms of articulation tests, the clinician should attempt to determine whether:

1. Nasal emission of air is present during the production of plosives, fricatives, or affricatives. Techniques that may be used to determine the presence of nasal emission include:
   (a) listening in free air, through a stethoscope, or nasal catheter (Weiss, 1974)
   (b) use of a p-paddle, mirror, or finger placed under the nostrils (Bzoch, 1979)
   (c) measurement of the presence and magnitude of nasal air flow (Counihan, 1979; Shelton et al, 1968)
2. Unusual types of articulatory errors, such as glottal-stop and pharyngeal substitutions are present and whether they are consistently produced for specific consonant sounds (Bzoch 1979; Hess, 1967, 1971; McWilliams and Philips, 1979; Morris and Smith, 1962; Trost, 1981)
3. Nasal turbulence, obvious nasal alae, or other facial constriction is present (Bzoch, 1979; Subtelny et al, 1972; Van Demark, 1974).

Careful assessment of articulatory ability is vital in evaluating velopharyngeal function. The pattern analysis of articulation error types, the number of articulation errors, the consistency of errors, and the stimulability of the child help the clinician to determine the probable adequacy or inadequacy of the speech mechanism. For example, nasal emissions, glottal-stops, pharyngeal substitutions, and reduced intraoral pressure point toward the need for definitive examination of the mechanism. Conversely, if errors are limited to substitutions, such as /w/ for /r/ and /l/, more invasive procedures such as radiographic studies are contraindicated.

VOICE QUALITY AND RESONANCE

The terms "nasality" and "hypernasality" have been used in the literature to describe the rather unique resonance characteristics of the speech of individuals with cleft palate (McWilliams and Philips, 1979; Peterson-Falzone, 1982). Unfortunately, because these terms have been so widely used, they are often misapplied to describe velopharyngeal function rather than nasal resonance. The misuse of these terms should be avoided since nasality is not necessarily related to adequacy of velopharyngeal function (Shelton et al, 1968). Nasality is a voice attribute which occurs in production of vowels and diphthongs and is not necessarily related to the adequacy of velopharyngeal function (Perkins, 1977). The perceptual observation of excessive nasality may be related to certain dialects in the language and in some cases reflects personality attributes.

Nasality is an extremely difficult vocal characteristic to judge reliably on an individual

basis (Culinan and Counihan, 1971; Sherman and Hall, 1978; Wilson, 1979). Individual rater's judgments of the severity of nasalization of speech are known to be characterized by questionable reliability and unknown validity, may be biased by the presence and severity of other primary speech attributes, and are not linearly related to the size of the velopharyngeal orifice or gap. Scaling the degree of nasality should be performed by group reference observations (judges) or by comparisons to standardized stimuli, which have been demonstrated to show adequate reliability (McWilliams and Philips, 1979; Philips, 1980; Wilson and Rice, 1977). Nasality is a perceived voice quality that may occur with or without adequate velopharyngeal function, and thus it is not a measure of velopharyngeal function.

Finally, we recommend that the clinician evaluate other aspects of vocal quality, particularly perceptual assessment should be completed to identify the presence of phonatory-based voice characteristics (hoarseness, breathiness) that are present in some individuals with velopharyngeal incompetence (Bzoch, 1979; McWilliams et al, 1969).

Synthesis of Test Results

From the information obtained in the case history and observations made in the oral-peripheral examination, articulation tests, and voice quality and resonance evaluation, the clinician should be in a position to make inferences about velopharyngeal function (Krause et al, 1976; McWilliams and Philips, 1979; Morris, 1978; Philips, 1980, Van Demark, 1974). If observations are made which suggest that velopharyngeal function is not normal, it is mandatory that additional information about the mechanism be obtained.

Inferential data either to verify or refute the data gained from the clinical evaluation should be obtained by instrumental assessment of the velopharyngeal mechanism. Although all instrumental procedures have limitations, they are appropriate and necessary to document velopharyngeal function. Since these instrumental procedures have been discussed elsewhere, they are not described in detail in this report; however, the following instrumental procedures are recommended:

1. Video and cinefluorographic evaluation of velopharyngeal port function (Kuehn, 1982; McWilliams et al, 1981; Schneider and Shprintzen, 1980; Williams and Eisenbach, 1981).
2. Aerodynamic assessment of velopharyngeal port function (Counihan, 1979a, 1979b; Kuehn, 1982; McWilliams and Philips, 1979; Warren, 1979, 1982).
3. Nasopharyngoscopy or nasoendoscopy of velopharyngeal port function (David, 1982; Kuehn, 1982; Pigott, 1980).

Professionals involved with the management of individuals with potential velopharyngeal incompetence should either have access to these forms of instrumental evaluation or refer patients to centers where such evaluations can be undertaken.

It is important to reiterate that despite irregularities and even abnormalities in patterns of velopharyngeal valving, speech may be acceptable to the patient and family (Morris, 1979; Shelton and Trier, 1976). Structural deviations are not in and of themselves justification for intervention if speech competence is normal. The task is to relate the structural observations to the perceptual findings.

References

Boone D. The Voice and Voice Therapy. Englewood Cliffs, N.J.: Prentice Hall, 1977.

Bzoch K. Measurement and assessment of categorical aspects of cleft palate speech. In: Bzoch K, ed. Communicative disorders related to cleft palate. Boston: Little, Brown, 1979:161.

Colburn N. Noninstrumental assessment of velopharyngeal adequacy in children. Sem Speech Lang Hear 1982; 3:212.

Counihan D. Oral and nasal airflow and air pressure measures. In: Bzoch K, ed. Communicative disorders related to cleft palate. Boston: Little, Brown, 1979a:269.

Counihan D. Oral and nasal sound pressure measures. In: Bzoch K, ed. Communicative disorders related to cleft palate. Boston: Little, Brown, 1979b:277.

Cullinan W, Counihan D. Ratings of vowel representativeness. Percept Motor Skills 1971; 32:395.

Darley F. The case history. In: Darley F, Spriestersbach D, eds. Diagnostic methods in speech pathology. New York: Harper and Row, 1978:37.

David D. Nasendoscopy: significant refinements of a direct-viewing technique of the velopharyngeal sphincter. Plast Reconstr Surg 1982; 70:423.

Fletcher D. Diagnosing Speech Disorders from Cleft Palate. New York: Grune and Stratton, 1978.

HESS D. Applying research findings to therapy for cleft palate speakers: implications of structural factors. Paper presented at the ASHA Convention, Chicago, 1967.
HESS D. Effects of certain variables on speech of cleft palate persons. Cleft Palate J 1971; 8:387.
HESS D. A new experimental approach to assessment of velopharyngeal adequacy: nasal manometric bleed testing. J Speech Hear Dis 1976; 41:427.
KRAUSE C, THARP R, MORRIS H. A comparative study of results of the Von Langenbeck and the V-Y pushback palatoplasties. Cleft Palate J 1976; 13:11.
KUEHN D. Assessment of resonance disorders. In: Lass N, McReynolds L, Northern J, Yoder D, eds. Speech, language and hearing: Vol. III: Pathologies of Speech and Language. Philadelphia: WB Saunders, 1982:499.
MASON R, GRANDSTAFF H. Evaluating the velopharyngeal mechanism in hypernasal speakers. Lang Speech Hear Serv Schools 1971; 2:53.
MASON R, SIMON C. An orofacial examination checklist. Lang Speech Hear Serv Schools 1977; 8:155.
MCCABE R, BRADLEY D. Pre- and post-articulation therapy assessment. Lang Speech Hear Serv Schools 1973; 4:13.
MCWILLIAMS BJ. Cleft palate. In: Shames G, Wiig E, eds. Human communication disorders. Columbus: Charles E. Merrill, 1982.
MCWILLIAMS BJ, MUSGRAVE R. Diagnosis of speech problems in patients with cleft palate. Br J Dis Comm 1971:26.
MCWILLIAMS BJ, PHILIPS B. Velopharyngeal Incompetence: Audio Seminars in Speech Pathology. Philadelphia. WB Saunders, 1979.
MCWILLIAMS BJ, BLUESTONE C, MUSGRAVE R. Diagnostic implications of vocal cord nodules in children with cleft palate. Laryngoscope 1969; 79:2072.
MCWILLIAMS BJ, GLASER E, PHILIPS B, ET AL. A comparative study of four methods of evaluating velopharyngeal adequacy. Plast Reconstr Surg 1981; 68:1.
MOLL K. Objective measures of nasality. Cleft Palate J 1964; 1:371.
MORRIS H. Velopharyngeal competence and the Demjen V-Y technique. In: Morris H, ed. The Bratislava project: some results of cleft palate surgery. Iowa City: University of Iowa Press, 1978:49.
MORRIS H. Evaluation of abnormal articulation patterns. In: Bzoch K, ed. Communication disorders related to cleft lip and palate. Boston: Little, Brown, 1979:192.
MORRIS H. SMITH J. A multiple approach for evaluating velopharyngeal competency. J Speech Hear Dis 1962; 27:218.
MORRIS H, SHELTON R, MCWILLIAMS BJ. Assessment of speech. ASHA Reports No 9, 1973:19.
MORRIS H, SPRIESTERSBACH D, DARLEY F. An articulation test for assessing competency of velopharyngeal closure. J Speech Hear Res 1961; 4:48.
PERKINS W. Speech Pathology: An Applied Behavioral Science. St. Louis: CV Mosby, 1977.
PETERSON-FALZONE S. Resonance disorders in structural defects. In: Lass N, McReynolds L, Northern J, Yoder D, eds. Speech, language and hearing: Vol. II: Pathologies of speech and language. Philadelphia: WB Saunders, 1982:526.
PIGOTT R. Assessment of velopharyngeal function. In: Edwards M, Watson A, eds. Advances in the management of cleft palate. New York: Churchill Livingston, 1980:206.
PHILIPS B. Perceptual evaluation of velopharyngeal competency. Ann Otol Rhino Laryngol 1980; 89:153.
SCHNEIDER E, SHPRINTZEN R. A survey of speech pathologists: current trends in the diagnosis and management of velopharyngeal insufficiency. Cleft Palat J 1980; 17:249.
SHELTON R, HAHN W, MORRIS H. Diagnosis and therapy. In: Spriestersbach D, Sherman D, eds. Cleft palate and communication. New York: Academic Press, 1968:225.
SHELTON R, TRIER W. Issues involved in the evaluation of velopharyngeal closure. Cleft Palate J 1976; 13:127.
SHERMAN D, HALL P. Nasality and precision of articulation. Percept Motor Skills 1978; 46:115.
SUBTELNY J, VAN HATTUM R, MYERS B. Ratings and measures of cleft palate speech. Cleft Palate J 1972; 9:18.
TEMPLIN M, DARLEY F. Templin-Darley Tests of Articulation. Iowa City: University of Iowa, 1960.
TROST J. Articulatory additions to the classical description of the speech of persons with cleft palate. Cleft Palate J 1981; 18:193.
VAN DEMARK D. Assessment of velopharyngeal competency for children with cleft palate. Cleft Palate J 1974; 11:310.
VAN DEMARK D. A factor analysis of the speech of children with cleft palate. Cleft Palate J 1966; 3:159.
VAN DEMARK D, SWICKARD S. A pre-school articulation test to assess velopharyngeal competency: normative data. Cleft Palate J 1980; 17:175.
WARREN DW. Perci: A method for rating palatal efficiency. Cleft Palate J 1979; 16:279.
WARREN DW. Aerodynamics of speech. In: Lass NJ, McReynolds LV, Northern JL, Yoder DE, eds. Speech, Language, and Hearing. Philadelphia: WB Saunders, 1982.
WEISS C. The speech pathologist's role in dealing with obturator-wearing school children. J Speech Hear Dis 1974; 39:155.
WESTLAKE H. Speech learning in cleft palate children. In: Lencione R, ed. Cleft palate habilitation. Syracuse: Syracuse University Press, 1968:135.
WILLIAMS W, EISENBACH C. Assessing VP function: the lateral still technique vs. cinefluorography. Cleft Palate J 1981; 18:45.
WILSON D. Voice Problems of Children. Baltimore: Williams and Wilkins, 1979.
WILSON F, RICE M. A Programmed Approach to Voice Therapy. Austin: Learning Concepts, 1977.