Evaluation of the velopharynx: past, present, future

Until recently there have been essentially two choices for visualization of the velopharynx: endoscopic and radiographic. The overall intrusiveness of endoscopy limits its clinical utility, especially in young children. As a result of growing awareness of the long-range effects of radiation exposure associated with x-ray imaging, radiographic research on subjects and studies not judged to be clinically necessary have been all but abandoned. The need for a noninvasive, rapid, and easily repeatable method for examination of the velopharynx has fomented the innovative application of an existing technology, Magnetic Resonance Imaging (MRI).

The objective of the authors’ study was to investigate the use of MRI to: (1) visualize the anatomy of the palate and velopharyngeal closure and; (2) examine the func-
tional performance of the soft palate during phonation following palatoplasty. The authors appear to have succeeded admirably on both accounts. They enumerate the advantages of MRI over current methodologies used to study the vocal tract and velopharynx. Rapid functional imaging which allows non-invasive visualization of the entire vocal tract without exposure to radiation or any known biohazards is the focus of the authors’ report.

Results of this study suggest that MRI provides an objective technique for detecting how individual sounds are produced from an anatomical perspective, and for verifying that the soft palate, by assuming the raised position, is capable of directing airflow away from the nasopharynx. Examination of static images acquired during phonation may be used to evaluate the mechanism of velopharyngeal closure, the path of airflow, and the presence of normal muscular control required for speech.

The purpose of my commentary is to provide a comprehensive perspective regarding the role of currently available instrumentation, summarize numerous exciting technological developments, and speculate about future applications of MRI systems for evaluation of velopharyngeal dysfunction. Throughout the discussion, I shall make reference to the term “clinicians”, which should be broadly interpreted to mean the multidisciplinary team involved in management of children affected by velopharyngeal dysfunction, namely radiologists, speech pathologists, otolaryngologists, plastic surgeons, and prosthodontists.

**Currently available instrumental analysis of velopharyngeal function: the days of future past?**

A variety of methods are available for evaluating velopharyngeal and laryngeal dysfunction [1]. Outcome assessments of velopharyngeal dysfunction management can be grouped into two classes: perceptual speech and anatomic function. While there is general consensus regarding the perceptual characteristics of normal and velopharyngeal dysfunctional speech, it is only recently that an attempt has been made to reach consensus regarding indirect evaluations of velopharyngeal function. In 1988, an International Working Group [2] convened to establish a system for quantifying, recording, and describing movements of the velum, lateral pharyngeal walls, and posterior pharyngeal wall, as well as for the size, shape, symmetry, and location of velopharyngeal gaps, based upon indirect velopharyngeal assessments. One outcome of the International Working Group report was the strong recommendation that all patients with velopharyngeal dysfunction be studied with both multi-view videofluoroscopy and nasopharyngoscopy.

**Speech videofluoroscopy**

**Advantages**

Speech videofluoroscopy is an effective means of retrospectively evaluating the functional outcome of both primary palatoplasty and secondary management surgery [3, 4, 5]. Speech videofluoroscopy provides the best information regarding the function of the velopharyngeal valve over the entire vertical and horizontal areas of the pharynx. Still radiographic images of the central velopharyngeal port at rest and maximum closure can be quantified for objective assessment of sphincteric port cross-sectional area [6].

In the lateral view, excursions of the velum, posterior pharyngeal wall, and tongue are easily visualized [7]. This information is believed to be crucial in planning pharyngeal flap surgery or designing a dental prosthesis to treat a speech production disorder. With a barium coat, if there is an insufficiency, air bubbles will be seen in the barium, signaling an air leak through the valve. The barium coat will also allow the tonsils to be visualized if they are positioned posteriorly in the airway. Viewing the articulators is important to understanding the scope of the speech problems related to velopharyngeal dysfunction. For instance, in the presence of an oronasal fistula, adjustments in tongue position can be understood in a lateral view.

The frontal view is excellent for demonstration of lateral wall motion. With a good barium coat on the lateral pharyngeal walls, medial movement is well visualized. It is often possible to see the superior surface of the velum elevating between the lateral pharyngeal walls. If tonsils are visualized in frontal view videofluoroscopy, it is likely that they are excessively large or abnormally positioned and require tonsillectomy [8].

The base view demonstrates the relationship of the velum and lateral/posterior aspects of the pharyngeal wall to each other. This view elucidates the mechanics of the entire sphincteric mechanism of velopharyngeal closure. The margins of the velopharyngeal port are seen to move progressively centrally during phonation. The final closure pattern in a normal subject generally appears on the base view of the velopharyngeal port as a coronally oriented slit or a smaller orifice.

**Disadvantages**

One obvious limitation of speech videofluoroscopy is the inability of still image speech videofluoroscopy to detect directionality of change. That is, the actual site(s) of velopharyngeal closure cannot be assessed accurately with this study. Vector analysis including measurements from the perimeter of sphincter toward midline (i.e., movement of lateral pharyngeal walls); velum toward posterior pharyngeal wall; posterior pharyngeal wall toward anterior velum, would be useful in ascertaining the relative contribution of each of these separate components comprising the velopharyngeal sphincter.