

The role of the soft palate in woodwind and brass playing

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Expired air provides the basis for sound production for musicians playing a wind instrument. This air stream must be controlled and directed into the mouthpiece of the instrument via a reed mechanism at the mouth. To be able to do this, firm velopharyngeal closure is required to prevent air leaking out through the nose from the oral cavity. In some musicians impairment of soft palate function may result in this air leak occurring, which is known as velopharyngeal insufficiency (VPI). A review of the functional anatomy of the soft palate and how it relates to wind and brass playing is discussed with a brief review of VPI as it is reported in musicians. A better understanding of the soft palate anatomy will assist students and music teachers to optimize their performance and prevent performance related medical problems.

Keywords: soft palate; wind musicians; functional anatomy; velopharyngeal closure; velopharyngeal insufficiency

To play a wind instrument requires a sustained mouth pressure and a constant airflow through the instrument. As the air stream reaches the mouthpiece of the instrument, it causes a variety of mouth pressures, depending on the amount of resistance applied by the particular instrument. Bouhuys (1964) found that the normal maximum pressures sustained in playing a wind instrument can range from 10-126 mmHg, with the highest pressure of 158 mmHg measured in a muted trombone. These pressures are at least 30 times greater than required for normal speech production (Dibbell *et al.* 1979).

These high levels of intra-oral pressures can result in a serious medical condition that can terminate the career of a wind musician, known as stress velopharyngeal insufficiency (Klotz *et al.* 2001, Schwab and Schultze-Florey 2004). VPI results in the seal of the soft palate between the oropharynx and

the nasopharynx being incomplete, allowing air to escape from the nose when playing (Ingrams *et al.* 2000). Other than in musicians, this condition is most frequently reported as a consequence of a structural cleft palate deformity, hence is often termed “stress VPI” when it occurs as a result of the stresses imposed by playing a wind instrument. It has been observed that this condition usually occurs in advanced students pursuing a professional career, due to an increase in physically demanding practice and performance regimen which imposes undue stress on the soft palate over a prolonged period of time (Schwab and Schultze-Floreay 2004).

The majority of research into VPI has been by speech pathologists or otolaryngologists, and the literature deals primarily with cleft palate or speech disorders. Of only ten articles investigating VPI in musicians, fourteen cases were reported (see Table 1).

A dissertation thesis presented a case series of clarinetists with VPI (Gibson 1995). The author later published two articles summarizing his research and outlining recent trends in the treatment of VPI (Gibson 1998, 2008). There have been three questionnaire studies conducted in London, Germany, and the USA. The authors reported, respectively, that 7%, 31%, and 34% of the participating student and professional wind musicians have experienced VPI (Ingrams *et al.* 2000, Schwab and Schultze-Floreay 2004, Malick *et al.* 2007). Due to the small sample sizes of these studies, these figures do not accurately represent the significance of this condition, although informal discussions with fellow musicians and music teachers suggest that this condition is a well-known phenomenon.

The purpose of this review is to present the functional anatomy of the soft palate and how this anatomy potentially relates to wind and brass instrument performance.

MAIN CONTRIBUTION

When playing a wind instrument, air passes from the lungs up into the upper respiratory tract and is eventually channeled into the mouthpiece of the instrument via some form of reed mechanism. As the air meets this resistance when flowing into the instrument there is an increase in pressure in the upper respiratory cavity, requiring firm control of the soft palate.

The soft palate, also known as the velum, separates the nasopharynx from the oropharynx. This closure of the two parts is known as velopharyngeal or palatopharyngeal closure and is important for swallowing, speech, and blowing. The soft palate extends posteriorly from the hard palate, and five muscles control its movement. Each of the paired muscles can be divided into

Table 1. Review of published cases of musicians treated for VPI.

<i>Authors</i>	<i>Instrument</i>	<i>Sex</i>	<i>Age (years)</i>
Weber and Chase (1970)	oboe	female	23
Massengill and Quinn (1974)	bassoon/saxophone	male	18
Dibbell <i>et al.</i> (1979)	oboe	female	20
Dibbell <i>et al.</i> (1979)	trumpet	male	23
Peterson-Falzone (1985)	clarinet	female	n/a
Gordon <i>et al.</i> (1984)	bassoon	female	31
Conley <i>et al.</i> (1995)	trumpet	male	17
Wolff (1995)	trumpet	male	n/a
Wolff (1995)	trombone	female	n/a
Ingrams <i>et al.</i> (2000)	trombone	male	20
Ingrams <i>et al.</i> (2000)	clarinet	male	18
Klotz <i>et al.</i> (2001)	french horn	female	19
Klotz <i>et al.</i> (2001)	oboe	female	20
McVicar <i>et al.</i> (2001)	clarinet	male	18

their principal actions on the soft palate. The levator veli palatini and the musculus uvulae are elevators, the palatoglossus and palatopharyngeus are depressors, and the tensor veli palatini is a tensor.

The muscles of the soft palate

The *tensor veli palatini* is the only muscle of the soft palate that is innervated by the cranial nerve V (Moore and Dalley 2006). The muscle bellies are attached superiorly to the scaphoid fossa of the medial pterygoid plate, the spine of the sphenoid bone, and the cartilage of the pharyngotympanic tube. It is then inferiorly attached to the palatine aponeurosis. The main action of the tensor is to tense the soft palate which opens the pharyngotympanic tube during swallowing and yawning (Moore and Dalley 2006). In playing a wind instrument, the tensor acts with the levator to maintain velopharyngeal closure which allows the airflow through the mouth.

The *levator veli palatini* is innervated by the pharyngeal branch of the vagus cranial nerve X and is superiorly attached to the cartilage of the pharyngotympanic tube and the temporal bone. Like the tensor, the levator is attached inferiorly to the palatine aponeurosis (Moore and Dalley 2006). The levator is the most important muscle in the elevation of the soft palate during swallowing and yawning. As described above, the action of the levator is im-

portant in closing the oronasal cavity ensuring airflow is directed through the mouth.

The *palatoglossus* and the *palatopharyngeus* are innervated by the vagus cranial nerve X (Moore and Dalley 2006). The palatoglossus is attached superiorly to the palatine aponeurosis and is attached inferiorly to the side of the tongue. The main action of this muscle is to elevate the posterior part of the tongue and may also depress the soft palate onto the tongue (Moore and Dalley 2006). If the palatoglossus depresses the soft palate—opening the nasal cavity and elevating the tongue, thereby closing the oral cavity—then it may be these actions that assist in the breathing technique known in musical pedagogy as circular breathing. This technique, occasionally used by wind instrumentalists, involves the simultaneous expiration of air through the mouth and inspiration through the nose, which allows the player to blow continuously through the instrument. Although circular breathing has been discussed in the music literature, the action of these muscles needs further research.

The *palatopharyngeus* is superiorly attached to the hard palate and the palatine aponeurosis and is inferiorly attached to the lateral wall of the pharynx. The palatopharyngeus tenses the soft palate and pulls the pharynx walls superiorly, anteriorly, and medially during swallowing (Moore and Dalley 2006). Huang *et al.* (1998) found that the inferior action of the palatopharyngeus acts against the inferior action of the levator. Additionally, upon contraction of these muscles the velum stretches to make contact with the posterior pharyngeal wall, enhancing velopharyngeal closure (Huang *et al.* 1998).

The *musculus uvulae* is also innervated by the vagus cranial nerve X (Moore and Dalley 2006). The muscle is attached to the posterior nasal spine and the palatine aponeurosis superiorly and is attached to the mucosa of the uvula inferiorly. The main action of this muscle is to shorten the uvula and pull it superiorly (Moore and Dalley 2006). It also assists the levator veli palatini in palatopharyngeal closure by adding bulk to the soft palate, which seals off the nasopharynx (Kuehn 1979). When the soft palate is elevated, the uvula can be seen drawing upwards and backwards towards the back of the throat.

Two other muscles that belong to the pharynx are also associated with the soft palate. Both the *superior pharyngeal constrictor* and the *salpingopharyngeus* are innervated by the pharyngeal branch of the vagus cranial nerve X (Moore and Dalley 2006). The superior pharyngeal constrictor, which is attached superiorly to the pterygoid hamulus, and the pterygomandibular raphe, inserts into the pharyngeal aponeurosis forming the sides and

back walls of the nasopharynx and the back of upper oropharynx. The salpingopharyngeus is attached to the cartilaginous part of the pharyngotympanic tube and inserts inferiorly to the palatopharyngeus muscle (Moore and Dalley 2006). The superior constrictor, assisted by the salpingopharyngeus which elevates the pharyngeal wall, pulls the pharyngeal wall forward to help gain velopharyngeal closure.

IMPLICATIONS

As can be seen from this review, the function of the soft palate is essential for maintaining upper respiratory tract structure under pressure and hence allowing optimal airflow. It is crucial for wind and brass players to be able to maintain firm velopharyngeal closure for optimum performance. Much more research needs to be conducted into the mechanisms behind the performance related problems, which may be associated with the soft palate. It is important for musicians and music teachers to increase their understanding of the functional anatomy and physiology for optimizing performance and injury prevention.

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