STRESS VELOPHARYNGEAL
INCOMPETENCE:
A RESOURCE FOR MUSICIANS

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ABSTRACT

Stress Velopharyngeal Incompetence (SVPI) is a potentially career-ending condition for wind musicians. SVPI manifests due to the high intraoral air pressure required to play wind instruments, producing nasal air emission occurs and causing a loss in pressure and a distracting sound during playing. Despite the effects of SVPI, it is not well known to musicians and symptoms are often dismissed as fatigue. While there is still much that is unknown about SVPI, there are surgical and nonsurgical options to treat it. This study provides information about SVPI, how it may be treated, the current knowledge of the condition, and a discussion with a laryngologist to provide further context.
ACKNOWLEDGEMENTS

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LIST OF DEFINITIONS

Cleft palate. A fissure in the roof of the mouth, resulting in an opening between the mouth and the nasal cavities. Specifically, where the two sides of the maxilla fail to fuse during embryological development.

Endoscope. A thin tubular instrument used to examine internal parts of the body.

Esophagus. The passageway from the pharynx to the stomach.

Eustachian tube. The passageway from the pharynx to the middle ear.

Hypernasal. An excess of nasality in speech.

Intraoral. Within the mouth.

Larynx. The portion of the respiratory tract containing the vocal cords.

Nasopharynx. The portion of the pharynx leading directly to the nose.

Oropharynx. The portion of the pharynx leading directly to the mouth.

Palate. The roof of the mouth; consisting of two sections: the hard palate in front, and the soft palate in back.

Pharynx. The passageway from the mouth and nasal cavities to the esophagus.

Prosthesis. An artificial body part.

Soft palate. The velum.

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1 All definitions from Christopher Allan Gibson, “The Soft Palate Air Leak in Clarinetists: A Multiple Case Study of Stress Velopharyngeal Insufficiency” (DMA diss., University of Missouri - Kansas City, 1995), pp. ix-x.
Stress velopharyngeal insufficiency (SVPI). The inadequate closure of the opening between the nasal and oral pharynxes only during periods of muscular stress. Insufficiency is often interchanged with incompetence.

Velopharyngeal. Pertaining to the area of the velum and pharynx.

Velopharyngeal insufficiency (VPI). The inadequate closure of the opening between the nasal and oral pharynxes. Insufficiency is often interchanged with incompetence.

Velum (soft palate). A soft and mobile wall of tissue connected to the back of the hard palate and to the walls of the pharynx. The velum divides the pharynx into its oral and nasal divisions. Also called the soft palate.

See Appendix A for a visual diagram of the mouth and throat.
CHAPTER 1: INTRODUCTION

Being a musician is a profession where it is imperative to take good care of yourself. Many musicians find themselves in a situation where an injury to their hands can ruin a career, or the symptoms of a slight fever can drastically reduce their ability to make music. To minimize these risks, musicians take many precautions for a career where it is not abnormal to be playing three hours a day. This playtime can go as high as eight or nine hours on days with multiple rehearsals and a performance. Singers will often avoid many types of drinks like coffee or milk because of the effect it has on their voices (drying your throat and thickening mucus respectively). Instrumentalists are very careful about strain on arms and wrists to avoid injuries or long-term problems like carpal tunnel. Posture is extremely important, with classes on Alexander Technique, a type of alternative therapy based on the idea that poor posture gives rise to a range of health problems,\(^2\) becoming more prevalent as more musicians focus on reducing tension where they can. Hearing damage due to exposure to noise is also an ongoing concern, with many players keeping earplugs on hand. In addition to these extrinsic problems, musicians also deal with fatigue in playing. In most cases this fatigue manifests as strained vocal cords, an inability to maintain an embouchure (the position and use of the lips, tongue, and teeth in playing a wind instrument), or general exhaustion. One symptom of fatigue that many wind players do not properly understand

is stress velopharyngeal incompetence (SVPI), when air starts to leak from their nasal cavity while playing.

SVPI is a condition where air leaks between the oral and nasal cavities while woodwind and brass musicians play their instrument. This can manifest as a reduction of intraoral air pressure or noise during playing due to a nasal air leak and leads to a feeling of low stamina. In some cases, these symptoms can start appearing after 30 minutes of playtime despite the player physically appearing fine. For many musicians SVPI is a potentially career-ending condition.

The main cause behind SVPI is thought to be the prolonged exposure to high intraoral pressure while playing a wind instrument. Wind musicians generate higher than normal intraoral pressure when they play, up to 130mm Hg, while normal speech rarely exceeds 6 mm Hg. Normally the passage between the nasal and oral cavities is closed by the soft palate. SVPI then occurs when the stress of playing causes air to escape past the soft palate and other pharyngeal muscles and the gap is no longer closed, as seen in Figure 2. Other causes that are speculated to cause SVPI include poor playing technique causing too much tension, a heavy practice load, and muscular fatigue. The exact cause of the condition is still difficult to know, due to the complexity of velopharyngeal physiology.

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FIGURE 1. An oboist whose velopharyngeal structures are showing fatigue under stress. A small leak is pointed to by the arrow. (Figure sourced from Dibbell DG, Ewanowski S, Carter WL. “Successful correction of velopharyngeal stress incompetence in musicians playing wind instruments.” Plast Reconstr Surg. 1979 Nov;64(5):662-4. PMID: 504488.)

Those experiencing SVPI will notice air leaking through their nose while they are playing. This leads to a loss of air pressure making it difficult to maintain a proper tone and creating a distracting noise for the performer and listeners. Symptoms of SVPI can persist after returning to normal intraoral pressure. The abnormal nasal airflow can also result in hyper nasal speech and difficulty attaining normal speech patterns. The symptoms remain present after returning to normal intraoral pressure.

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SVPI is most commonly found in undergraduate music majors due to the increased practice time as the musicians strive to become professionals.\textsuperscript{5} Many times, musicians often dismiss symptoms as poor endurance and do not seek any medical help. As such, the prevalence of SVPI is likely underdiagnosed and undertreated. Musicians suffering from SVPI will find great difficulty in playing once symptoms appear. Those affected will have problems with playing for the long durations that are needed for the concerts and recitals that professional musicians routinely perform. If left untreated, SVPI can therefore be career-ending for those affected.

Treatment for SVPI has surgical and non-surgical options. Unfortunately, there is no consensus on how treatment should be approached. Treatment is typically decided on a case-by-case basis after examination. This is partly due to a variety of contributing causes. Non-surgical interventions typically consist of rest, muscle training, lowering throat tension, and changing instrument setup (reeds/ mouthpiece). Surgeries such as a pharyngeal flap or injection pharyngoplasty that are already used to treat velopharyngeal dysfunction (a condition in which air leaks through the nasal passage during normal speech and is typically caused by an congenital defect) may be used if minor soft palate or pharyngeal defects are observed. Surgery typically has a significant recovery period and may pose risks to speech production after recovery.\textsuperscript{6}

Due to all these factors, this paper’s purpose is to provide a resource for musicians about the condition and discussions with medical professionals about SVPI.

\textsuperscript{5} Schwab B., A. Schultze-Florey Velopharyngeal insufficiency in woodwind and brass players, \textit{Med Probl Perform Art}, 2004, vol. 19 (pg. 21-25

CHAPTER 2: MY EXPERIENCE WITH SVPI

My experiences with SVPI first started in high school. During this time, I found that I struggled during music festivals and long rehearsals with youth orchestras and bands, experiencing what I thought was fatigue. At the time, I was not practicing as much as I should have and believed any issue was due to poor endurance, including any air leaking from my nose. I did find it odd that I also had very poor endurance when playing slow pieces in a band, especially those where the bassoon would be playing constantly. Despite the short duration of such pieces, I would start experiencing what I believed to be fatigue as well. This experience was my first thought that the issue might not be my endurance. I attempted to find information about what might be going on online but could not find anything at the time (ca. 2010). I had also consulted my private lesson teacher at the time, who noticed I was putting too much pressure on the reed and said that would contribute to any fatigue issues I was having. From there I did not address any of the issues I was having until halfway through my undergraduate degree. In college I started off pursuing a music education degree. As I progressed through the program, my issues with endurance became harder to deal with. Longer and more practice sessions, combined with playing in the university’s wind ensemble and orchestra, forced me to deal with SVPI frequently. The issues culminated in my junior recital, where I struggled to put on a 30-minute program that ended with a very audible noise as air leaked through my nose. Following the recital, my professor and I made a conscious effort to find the root of the problem.
At my professor’s suggestion, I scheduled an appointment with an ENT. The appointment was disappointing because the ENT did not seem to have any insight of what was happening. They looked at my throat and saw that everything was fine and suggested that I might have acid reflux. I was left doubtful about the diagnosis, as every sign that would indicate acid reflux was negative (e.g., spicy diet, heartburn, citrus). What gave me hope was that I could potentially see a different ENT, but this time bring my bassoon so that I could demonstrate the issue. With that in mind I scheduled another appointment with a different ENT. This ENT had seen the problem a few years prior in a horn player and was able to diagnose me with SVPI. The reason given for the diagnosis was that I had a short soft palate. The soft palate functions to block the flow of air between the pharyngeal and nasal cavities. While mine was short, it was not short enough for it to cause problems in my normal life. It was suggested that the muscles in my soft palate would help close the passageway when needed, however, they would tire, and air leaks would occur due to the prolonged muscle tension.

To address this, the doctors performed pharyngeal flap surgery on me. In this surgery a flap tissue from the back of the throat is raised and attached to the soft palate to allow it to close. The surgery is a common procedure typically performed in children who cannot close the passage to the nasal cavity at all. Having it done to an adult is not common, and I was warned that recovery was going to be rougher than what they normally expect. Recovery was indeed rough; I was put on heavy painkillers for two weeks at first and told not to play for a month. During this time swallowing was an extremely painful endeavor. It would take me about two hours to poke through a small portion of my meals, despite trying to only have food that would be easier to eat. After
two weeks, I was recommended to switch to acetaminophen for lighter pain relief. This resulted in me being in constant heavy pain, and I was put on the heavy painkillers for another week. By the time I was able to eat normally again, I had gone from around 170 pounds to about 148 pounds. After two weeks, I felt normal again. I experienced no long-term issues, and once I was able to play again, I experienced no symptoms of SVPI. In terms of my bassoon performance, there were no complications aside from the usual adjustments from not having played in a month.
CHAPTER 3: SURVEY OF RELATED LITERATURE

The first mention of SVPI in scholarly literature is found in a case study of an oboe player by J. Weber and R.A. Chase, published in the October 1970 issue of the *Cleft Palate Journal*. The condition was called stress velopharyngeal incompetence (SVPI) due to it functionally being velopharyngeal incompetence but induced by stress of high intraoral air pressure rather than physical defects. The name of the condition comes from the velum (soft palate) and the pharyngeal wall (back of the throat).

“Velopharyngeal incompetence is usually manifest in speech and is seen in patients with cleft palates, submucous clefts, trauma, tumors, surgical resections and neuromuscular disorders.” 7 Specifically, these characteristics cause the soft palate to be incapable of closing against the back of the throat and blocking off the nasal passage. VPI and its related disorders are well known in speech-language pathology. In most cases, as mentioned, there is a specific cause to the air leak or speech impairment due to either poor muscle movement, a condition like cleft palate, or recovery from surgery for such a condition. In the Weber and Chase study, however, they could find no apparent abnormality in the patient and symptoms only presented while playing oboe. The paper then discussed the high intraoral pressure caused by playing wind instruments and questioned if only a certain percentage of the population can handle

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the demands of playing a wind instrument.\textsuperscript{8} No mention was made of addressing the problem.

Since this initial study, the literature on SVPI has been limited to several case studies, a few surveys on prevalence, and little spreading of awareness outside of the clarinet community. As of 2014 there were a total of twelve case studies and four prevalence reports on SVPI.\textsuperscript{9} The most common case studies are a record of how an instance of SVPI was dealt with.\textsuperscript{10}

\textbf{The long-term consequences of a musical lifestyle}

Concerns over the long-term effects of being a musician are not anything new.\textsuperscript{11} Musicians are constantly reminded in lessons about their posture in technique not just for a better sound, but to also prevent issues in the future. While for many instrumentalists these concerns typically are about back and hand problems, there have been questions about the long-term consequences specifically of wind playing. This issue unfortunately is relatively understudied in medical literature. Most of the time, when musicians have issues, they are addressed anecdotally and passed down from

\textsuperscript{8} Weber, “Stress Velopharyngeal Incompetence in an Oboe Player.”
teacher to student. Due to this, most early medical knowledge of air related problems comes from studying glassblowers and is relatively understudied. The most extreme concern of these conditions is that of brain damage, stemming from the high intraoral pressure. However, no evidence has been found to support this hypothesis, although high intraoral air pressure can contribute dizziness and fainting. Other potential conditions related to air uses in musicians noted in “Functional disorders of the upper airway associated with playing wind instruments” are:

- Pneumoparotitis, a swelling of the parotid duct from air being forced through it.
- Patulous eustachian tube dysfunction, a condition causing said tube to remain open, causing the patient to hear their own voice or breathing too loudly, or even their blood pumping.
- Palatal paralysis, another name for SVPI describing a loss of seal from the soft palate not being able to move.
- Laryngocele, an enlargement of the ventricle or saccule of the larynx.
- Pharyngocele, an expansion of the pharynx with enlargement of the entire common conduit of the air passageway and food passageway often resulting in an enlargement of the neck when it occurs.

Another concern is the consequences of the fatigue that many musicians encounter often. In singers, singing for too long without rest can cause long-term issues

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13 Levine, “Functional disorders of the upper airway”
that can endanger a career. These same problems can also happen to wind players. As a musician tries to counteract their failing endurance, many increase their overall tension to try to keep a proper tone. The tension created from this can have long-term effects on wind players such as pulmonary function and potentially cause pulmonary disease, but a connection between the two has not been well studied.\textsuperscript{14}

Pulmonary function in wind players, in contrast, has been the subject of research. The nature of a profession that deals intimately with high air pressure has led to questions of how wind players' pulmonary function compares to the average person. Unfortunately, the few studies that have been done have conflicting results. There are studies offering every possible conclusion: there is no difference,\textsuperscript{15} musicians have better pulmonary function than non-musicians;\textsuperscript{16} and musicians have worse pulmonary function than non-musicians.\textsuperscript{17} In a 2006 study led by Omer Deniz, the researchers claimed that the mixed results in previous studies were due to improper selection of the participants.\textsuperscript{18} Smoking is well-known to affect one’s ability to breathe, for instance, and Deniz asserted that this factor was not properly addressed in the previous studies. Of the three contrasting studies mentioned above, one did not discuss the smoking status of the participants; one did, but a non-smoker was defined as not having smoked in a

\begin{thebibliography}{9}
\bibitem{17} Akgun, N, Ozgonul H. “Lung volumes in wind instrument (zurna) players” \textit{Am Rev Respir Dis}, 96 (5) (1967), pp. 946-951
\bibitem{18} Deniz O, Savci S, Tozkoparan E, Ince DI, Ucar M, Ciftci F. Reduced pulmonary function in wind instrument players. \textit{Arch Med Res}. 2006; 37:506-510
\end{thebibliography}
month or having less that a cigarette a day for a year, ignoring the long-term damages of smoking; and the last study compared heavy smoking wind players with a control group that featured heavy smokers and non-smokers. The Deniz study, which excluded smokers from the participants, found worsened pulmonary function in the wind players that got worse the longer they had been performing. Measurements like the musicians’ peak expiratory flow and forced expiratory flow were calculated at around 50-70% of the predicted values on average. Their forced vital capacity and forced expiratory volume measured worse, but only at 90-95% of the predicted amount. Finally, the study suggests the reason for the decreased pulmonary function could be due to constant barotrauma from breathing large amounts of air and inhaling large amounts of irritants, or from developing bronchial asthma. Additionally for standardization, the Deniz study participants included both musicians and non-musicians who were active military non-commissioned officers, and therefore all were likely to be healthy.

**High Intraoral Air Pressure**

The primary cause of SVPI is the high intraoral air pressure that is required to play a wind instrument. For most instruments, the pressure is much higher than the 5-6 mm hg maximum a person would normally encounter. Table 1 shows the maximum pressure each instrument has recorded, typically calculated by playing loudly on a resistant high note.
TABLE 1. *Average mouth pressures played fortissimo on different instruments*

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Highest Pressure Mm Hg</th>
<th>Instruments</th>
<th>Highest Pressure Mm Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Woodwinds:</strong></td>
<td></td>
<td><strong>Brass:</strong></td>
<td></td>
</tr>
<tr>
<td>Bassoon</td>
<td>89.7</td>
<td>Bass tuba</td>
<td>77.6</td>
</tr>
<tr>
<td>Alto saxophone</td>
<td>56.2</td>
<td>Tenor tuba</td>
<td>64.7</td>
</tr>
<tr>
<td>Bb clarinet</td>
<td>86.4</td>
<td>Trombone</td>
<td>126.0</td>
</tr>
<tr>
<td>English horn</td>
<td>54.7</td>
<td>French horn</td>
<td>115.9</td>
</tr>
<tr>
<td>Oboe</td>
<td>80.8</td>
<td>C trumpet</td>
<td>125.8</td>
</tr>
<tr>
<td>Alto flute</td>
<td>31.7</td>
<td>D trumpet</td>
<td>132.4</td>
</tr>
<tr>
<td>Flute</td>
<td>77.8</td>
<td>A trumpet</td>
<td>107.8</td>
</tr>
<tr>
<td>Alto Recorder</td>
<td>11.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piccolo</td>
<td>58.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source:* Data from Dibbell, Ewanowski, and Carter (1979)

Examining this data on how much pressure is put upon a musician's oral cavity, flutes air pressure is notably higher than many would expect in this table. Additionally, while SVPI is considered underdiagnosed, the data does not explain why SVPI is found most commonly in players of reed instruments, especially the clarinet. While there are cases of SVPI in brass players, they are not nearly as common.

A second table shown below (Table 2) from a different study suggests an answer to that question. This study added additional air pressure measurements, the minimum pressure while playing, and average minimum and maximum pressure during “normal” playing. These data points were measured by giving musicians the instruction to “play some notes on your instrument as if you were warming up or playing scales. Play legato runs in a comfortable range and dynamic” for medium “normal” pressure, “play a note with the least possible air pressure in a range and dynamic where this is most easily achieved” for least required pressure, and “play a note in a range and dynamic where maximum air pressure is required” for maximum peak pressure.
The data shows that the normal minimum for reed instruments is much higher than the others, with the exception of trumpet. These coincide with the instruments that comprise most of the subjects of existing case studies. Additionally, this also lines up with the survey about prevalence among different instruments, where SVPI is most commonly found in oboe and clarinet, and to a lesser degree in bassoon, tuba, bass trombone, trumpet, and French horn. The working theory is that the “normal minimum” is a more relevant statistic for causing SVPI. For a musician, that is the minimum pressure they will be constantly exposed to. While the high maximum pressures that many of the brass instruments can reach are concerning, it is unlikely that those are sustained for long periods of time.

TABLE 2. Average (“Normal”), Pressure Measurements for Each Individual Instrument and Minimum and Maximum Pressures

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Minimum</th>
<th>Normal Minimum</th>
<th>Normal Maximum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flute (11)</td>
<td>0.5</td>
<td>1</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>Piccolo flute (9)</td>
<td>0.7</td>
<td>2</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Oboe (19)</td>
<td>28</td>
<td>30</td>
<td>48</td>
<td>94</td>
</tr>
<tr>
<td>English horn (10)</td>
<td>23</td>
<td>26</td>
<td>45</td>
<td>84</td>
</tr>
<tr>
<td>Bb clarinet (12)</td>
<td>15</td>
<td>20</td>
<td>34</td>
<td>53</td>
</tr>
<tr>
<td>Bass clarinet (7)</td>
<td>13</td>
<td>22</td>
<td>33</td>
<td>50</td>
</tr>
<tr>
<td>Bassoon (16)</td>
<td>12</td>
<td>15</td>
<td>39</td>
<td>67</td>
</tr>
<tr>
<td>Contrabassoon (6)</td>
<td>8</td>
<td>10</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>French horn, high (11)</td>
<td>7</td>
<td>11</td>
<td>36</td>
<td>124</td>
</tr>
<tr>
<td>Horn, Low (7)</td>
<td>4</td>
<td>9</td>
<td>34</td>
<td>103</td>
</tr>
<tr>
<td>Horn, various (6)</td>
<td>5</td>
<td>9</td>
<td>35</td>
<td>119</td>
</tr>
<tr>
<td>Bb trumpet (15)</td>
<td>7</td>
<td>13</td>
<td>42</td>
<td>131</td>
</tr>
<tr>
<td>Piccolo-trumpet (6)</td>
<td>8</td>
<td>17</td>
<td>48</td>
<td>142</td>
</tr>
<tr>
<td>Tenor trombone (12)</td>
<td>4</td>
<td>8</td>
<td>28</td>
<td>112</td>
</tr>
<tr>
<td>Bass trombone (9)</td>
<td>3</td>
<td>7</td>
<td>24</td>
<td>77</td>
</tr>
<tr>
<td>Tuba (13)</td>
<td>2</td>
<td>6</td>
<td>22</td>
<td>76</td>
</tr>
</tbody>
</table>

*Source: Data from Schwab and Schultze-Florey (2004)*

Values are in mm Hg. The figures in parentheses indicate the number of musicians.
Treating SVPI

Currently, there is no agreed upon method for treating SVPI. This is partly due to the wide number of potential causes of SVPI. Options consist of both surgical and nonsurgical alternatives. According to a study by Deonne Malick, Jerry Moon, and John Canady, the methods most commonly used by ENTs to treat SVPI and how commonly they are used to treat it are:\(^{19}\)

- Referral to a speech language pathologist (47.50%). A potential cause of SVPI if no physical deformity can be found is too much tension in the throat area. In these cases, a referral to a speech language pathologist is done to help teach the patient how to reduce the excessive tension.
- Sphincter pharyngoplasty (30%). A surgery typically done to correct velopharyngeal dysfunction that occurs when the velopharyngeal port does not sufficiently close. In the surgery, flaps of tissue from behind each of the tonsils are raised and attached across the back of the throat. This narrows the space behind the palate to help close the gap and prevent air from leaking through the nose.\(^{20}\)

\(^{19}\) Malick, Deonne, Jerry Moon, John Canady. “Stress Velopharyngeal Incompetence: Prevalence, Treatment, and Management Practices”

Pharyngeal flap surgery (26.88%). A surgery done again to help correct velopharyngeal dysfunction. “During surgery, a flap of tissue from the back of the throat (pharynx) is raised (Figure 4.1). It is attached to the back of the soft palate (velum) (Figure 4.3). This flap creates a bridge at the back of the throat to help the velopharyngeal valve close and prevent air from leaking through the nose when talking (Figure 4.6).”²¹


- Referral to a cleft palate team (24.38%). SVPI typically occurs when the soft palate fails under stress. Due to these palatal issues, a patient may be recommended to a team that deals with cleft palates and is more familiar with that part of the body.
• Watch and wait (18.75%). SVPI is not something that is commonly seen, and for some only appears after exorbitant play time. In these situations, the patient is advised to take a break from the instrument and see if the problem is recurring or only happened once.

• Posterior wall fat injection (12.50%). Subcutaneous fat is harvested from a small incision in the abdomen. It is then processed and injected into the pharynx. A range of 3-6 cc of fat is injected into the posterior pharyngeal wall where the soft palate has incomplete closure as seen in figure 5.

FIGURE 4. Posterior wall fat injection. (Figure sourced from Cleveland Clinic. “Fat Injection Demonstrates Good Outcomes in Adults with Velopharyngeal Insufficiency, Study Finds” Cleveland Clinic, 2020, 9/11/2022, https://consultqd.clevelandclinic.org/fat-injection-demonstrates-good-outcomes-in-adults-with-velopharyngeal-insufficiency-study-finds/)
• Palatal lift (10%) - In a palatal lift, a device much like a retainer or partial denture is inserted into the mouth to lift and position the soft palate or artificially replace lost tissue structure to restore the function of the palate.\(^{22}\)

“Watch and wait” can be seen as an odd method of treatment. Typically, this occurs because of how relatively unknown SVPI is, or due to special circumstances surrounding a patient experiencing it. There is one case study of SVPI that starts by prescribing the patient to stop playing their instrument for a month.\(^ {23}\) The patient reportedly suffered from symptoms of SVPI, hypernasal voice, and liquid nasal regurgitation after playing trumpet eight hours a day for one week at a high school band camp. After the camp, the latter two symptoms went away, but the patient was now experiencing a nasal air leak after only 30 minutes of play time. After seeing a doctor, the decision was made to take off one month from playing their instrument and see if the muscles recovered through rest. After this time, the patient was able to play for 30 minutes without nasal air emission, but it still occurred afterwards. The speech issues were no longer present, however. After the checkup, the patient was prescribed palatal exercises that consisted of using oral suction through a straw to hold up a piece of paper for ten minutes a day. After a year of this, the patient was able to play for one and a half hours without nasal air escape. While further treatment was necessary in this case, the symptoms were first noticed after eight hours of trumpet playing a day, an amount that is incredibly high by anyone’s standards. It is therefore quite


\(^{23}\) Conley “Stress Velopharyngeal Incompetence in an Adolescent Trumpet Player.”
understandable to recommend a “watch and wait” treatment, to see if it was simply that amount of playing that caused the problem.

Recovery time and side effects for SVPI treatment are dependent on the option for treatment. Nonsurgical options will likely recommend a short break from playing in addition to treatment. Surgical options like pharyngeal flap surgery and sphincter pharyngoplasty will see the patient confined to bed rest and time away from the instrument while stitches dissolve and come out. A study by Macrae reported a further complication from a pharyngeal flap surgery of a patient with a soft palate three standard deviations below average in length and two standard deviations below average in thickness. Due to the surgery the patient understandably found speech difficult, but after further recovery speech became easy and there was no discomfort. Surprisingly, however, the patient’s speech pattern had changed—they had developed what they called a “British” accent. The patient underwent speech therapy to correct this. The theorized explanation was that the subtle change of palate position affected the patient’s articulation. However, this report is an anomaly that has not been seen in any other study. Surgery such as a posterior wall fat injection has a reported short recovery, discussed later in this paper.

Some case studies have tried different injection materials in association with SVPI treatment. The reason for these decisions was the desire for better resorption and long-term success consistency. In a normal injection, the material has potential to move and disrupt the ability to seal. A 1994 study for instance used a Teflon paste

24 Macrae “A Case Description of Speech Disturbance and Treatment Following Corrective Surgery for Stress Velopharyngeal Incompetence.”
which resolved the issue in the patient, but it concluded that this material is not ideal.\textsuperscript{26} A more recent case study in 2018 used a hyaluronic acid compound instead.\textsuperscript{27} This compound was chosen because it had been used successfully in treating vocal cord paralysis and type 1 laryngeal clefts. In both these studies, the importance of tailoring treatment to a patient’s specific needs was distinctly emphasized. The hyaluronic study illustrates how finding a treatment can be difficult for SVPI, and to this day the medical community continues to look for a suitable material that can be injected for tissue augmentation.

Overall, there remain many challenges in treating SVPI. As has been recently argued in the abovementioned hyaluronic study, “Defining a system for objectively classifying stress VPI has proven problematic given the lack of an objective system of classifying velopharyngeal movement. Multidisciplinary planning is essential when addressing and diagnosing stress VPI and should involve professionals with sufficient experience and training to assess velopharyngeal dysfunction and how the aerodynamic and physiologic properties of the human vocal tract are interrelated.”\textsuperscript{28}

**Assessing SVPI**

SVPI has a wide variety of potential assessment tools. Much like how treating SVPI is dependent on the patient and preferred approach of the practicing physician, the same is true for assessment tools. Potential assessment options for SVPI include:

\begin{itemize}
  \item \textsuperscript{26} Gordon “Videoendoscopic Diagnosis and Correction of Velopharyngeal Stress Incompetence in a Bassoonist.”
  \item \textsuperscript{28} Koprowski “Treatment of Stress Velopharyngeal Incompetence with Injection of Hyaluronic Acid”
\end{itemize}
• Case history. This includes looking at the patient’s medical history and that of their family. If VPI, cleft palate, or other conditions involving the pharyngeal area this will be helpful to the doctor.

• Nasendoscopy. A nasendoscopy is where a doctor inserts a thin flexible tube called a nasendoscope up the patient's nose and down into the throat. The nasendoscope has a camera and light on the end of it to allow doctors to see into the nasal cavity and throat. (See Figure 6)


• Laryngoscopy. A laryngoscopy is similar to a nasendoscopy, but with the goal of looking at the larynx instead. (See Figure 7) This can be done directly or indirectly with the use of mirrors and cameras.
• Speech assessment. For many conditions like cleft palate and VPI, it is routing for speech language pathologists to listen to a patient’s speech to evaluate articulation, nasality, nasal air leakage, and hoarseness.

• Measurement of internal air pressure. More often seen early on for SVPI and for research. Many case studies have sought to observe how air pressure in the mouth and throat changes while playing an instrument.

• Oral Examination. The simplest of the assessment tools. A physician visually inspects the oral cavities.

• Video fluoroscopy. A contrasting material such as barium is mixed with food or liquid and then an x-ray is taken during swallowing. This allows the doctor to see movement of air in liquid to determine if the body is functioning normally.
The Delphi Study

An especially important study within the field of SWPI is entitled, “A Delphi Survey on Diagnosis and Management of Stress Velopharyngeal Insufficiency in Wind Musicians.” The Delphi technique is “a well-established approach to answering a research question through the identification of a consensus view across subject experts. It allows for reflection among participants, who are able to nuance and reconsider their opinion based on the anonymized opinions of others.” The study asked a series of questions about SVPI to 14 specialists who have experience working with this condition, featuring a mixture of ear, nose, and throat specialists (ENTs) and speech language pathologists (SLPs). The questions asked include:

- How many musicians have you seen with SVPI?
- What do/did you think were the causes?
- What assessment methods were used to diagnose SVPI?
- What indicators were used to diagnose?
- What treatment was offered?
- What is the timeframe and average number of follow-up consultations?
- What was the outcome?

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29 Evans “A Delphi Survey on Diagnosis and Management of Stress Velopharyngeal Insufficiency in Wind Musicians.”
From the answers given, they developed a second set of questions to measure what the specialists thought were important when it came to causes, assessment tools, indicators used to diagnose, and treatments.

From the initial survey, a list of nine potential causes was made as seen in Table 3. Of these, the only one that was agreed upon by all the specialists was prolonged exposure to high intraoral pressure. This agreement came with a caveat by many though, as SVPI is not prevalent in every musician despite the amount of exposure to high intraoral air pressure not being uncommon. Because of this, there must be some other factor that causes SVPI. Of the other listed causes, however, there was no consensus that any of them was the missing factor. Some of them, such as inadequate muscular closure and anatomical differences and abnormalities, can be reasons for SVPI to occur in patients who have them. The most common of these are patients who have a velum below average length. In more severe cases this would cause VPI at a young age, but if the velopharyngeal muscles can compensate it would go unnoticed. This structural deficiency causes a person to be more affected by SVPI. However, there are still cases of SVPI that did not feature any of the other causes besides prolonged exposure to high intraoral air pressure. Of the remaining causes,ENTs were more likely to agree that biological causes such as anatomical differences were important, while SLPs agreed that causes related to a musician's practice techniques and load were important.
TABLE 3. Importance of suggested causes of stress velopharyngeal insufficiency (VPI)*

<table>
<thead>
<tr>
<th>Causes of stress VPI</th>
<th>ENTs n=7</th>
<th>SLPs (%) n=7</th>
<th>Combined (%) n=14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolonged exposure to high intra-oral pressures during playing instrument</td>
<td>71</td>
<td>86</td>
<td>79</td>
</tr>
<tr>
<td>Inadequate closure**</td>
<td>84</td>
<td>50</td>
<td>67</td>
</tr>
<tr>
<td>Anatomical differences or abnormalities</td>
<td>86</td>
<td>43</td>
<td>64</td>
</tr>
<tr>
<td>Practice load</td>
<td>43</td>
<td>86</td>
<td>64</td>
</tr>
<tr>
<td>Muscular fatigue</td>
<td>43</td>
<td>57</td>
<td>50</td>
</tr>
<tr>
<td>Physiological disposition</td>
<td>29</td>
<td>71</td>
<td>50</td>
</tr>
<tr>
<td>Playing instrument with incorrect technique</td>
<td>29</td>
<td>71</td>
<td>50</td>
</tr>
<tr>
<td>Muscular tension</td>
<td>29</td>
<td>57</td>
<td>43</td>
</tr>
<tr>
<td>Nasal surgery (adenoidectomy)</td>
<td>29</td>
<td>14</td>
<td>21</td>
</tr>
</tbody>
</table>

*All items were ranked on a 6-point Likert scale, where 1 = not very important and 6 = very important.

**Data missing for one ENT and one SLP

Source: Data from Evans, Driscoll, and Ackermann (2014)

The questionnaire on assessment tools in Table 4 resulted in a few agreements, but also showed the biggest differences in opinion between ENTs and SLPs. Case history and nasendoscopy/laryngoscopy were both deemed much more important than the other tools. A video fluoroscopy was deemed as unimportant. A surprising part of this survey was that for ENTs, any option besides case history and nasendoscopy/laryngoplasty was viewed as unimportant.

In contrast, SLPs found case history important but not nearly as much as ENTs did. They were also split about the importance of most of the other tools. Assessment tool usage for VPI has changed drastically over time. In a 1980 survey, video fluoroscopy was used 72% of the time and nasopharyngoscopy was used 8% of the...
time.\textsuperscript{31} A 2012 survey, however, found video fluoroscopy at 19% usage and
nasopharyngoscopy at 59%.\textsuperscript{32} (A nasopharyngoscopy and nasendoscopy are very
similar, only differing on the specific part being observed.) This change is attributed to
nasopharyngoscopies allowing a direct view of the velopharyngeal mechanism without
exposure to radiation. MRIs have additionally seen more usage in assessing VPI but
have not been used for SVPI.

TABLE 4. Importance of assessment options for stress velopharyngeal insufficiency
(VPI)*

<table>
<thead>
<tr>
<th>Assessment tools used to diagnose stress VPI</th>
<th>Important or very important (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENTs n=7</td>
</tr>
<tr>
<td></td>
<td>SLPs (%) n=7</td>
</tr>
<tr>
<td></td>
<td>Combined (%) n=14</td>
</tr>
<tr>
<td>Case history</td>
<td>100</td>
</tr>
<tr>
<td>Nasendoscopy/laryngoscopy</td>
<td>86</td>
</tr>
<tr>
<td>Speech assessment</td>
<td>29</td>
</tr>
<tr>
<td>Measurement of oropharyngeal pressures whilst playing instrument</td>
<td>43</td>
</tr>
<tr>
<td>Aerodynamics (airflow pressure)</td>
<td>29</td>
</tr>
<tr>
<td>Evidence of nasal air leak emission</td>
<td>14</td>
</tr>
<tr>
<td>Oral examination</td>
<td>43</td>
</tr>
<tr>
<td>Video fluoroscopy**</td>
<td>14</td>
</tr>
</tbody>
</table>

*Source: Data from Evans, Driscoll, and Ackermann (2014)*

\*All items were ranked on a 6-point Likert scale, where 1 = not very important and 6 = very important.

**Data missing for one SLP

The specialists agreed on five indicators for SVPI, as noted below in Table 5.

Self-reported symptoms were unanimously agreed upon, as it is how the condition is
typically noticed. The other four important indicators were those that end up being the

\textsuperscript{31} Schneider and Shprintzen “A Survey of Speech Pathologists: Current Trends in the Diagnosis and
Management of Velopharyngeal Insufficiency.”

\textsuperscript{32} Kummer, A. (2011). “Speech therapy for errors secondary to cleft palate and velopharyngeal
symptoms of SVPI or potential causes for it. These were an inability to maintain air pressure, evidence of abnormality in the velopharynx, incomplete velopharyngeal closure, and acoustical evidence of air escape in speech or playing.

TABLE 5. Importance of various possible indicators of stress velopharyngeal insufficiency (VPI)*

<table>
<thead>
<tr>
<th>Indicators of stress VPI</th>
<th>ENTs n=7</th>
<th>SLPs (%) n=7</th>
<th>Combined (%) n=14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-report symptoms**</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Inability to maintain oral air pressure when blowing instrument</td>
<td>71</td>
<td>86</td>
<td>79</td>
</tr>
<tr>
<td>Evidence of abnormality of the velopharynx</td>
<td>71</td>
<td>86</td>
<td>79</td>
</tr>
<tr>
<td>Incomplete velopharyngeal closure as evidence on radiographic, endoscopic, or aerodynamic studies</td>
<td>57</td>
<td>86</td>
<td>71</td>
</tr>
<tr>
<td>Acoustical evidence of nasal air escape during speech or playing</td>
<td>71</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Regurgitation of fluid into nose with drinking</td>
<td>71</td>
<td>57</td>
<td>64</td>
</tr>
<tr>
<td>Aerodynamic measures consistent with VPI</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Low maximum expiratory pressure measured at the mouth</td>
<td>14</td>
<td>29</td>
<td>21</td>
</tr>
</tbody>
</table>

*All items were ranked on a 6-point Likert scale, where 1 = not very important and 6 = very important.

**All SLPs indicated very important

Source: Data from Evans, Driscoll, and Ackermann (2014)

Tables 6 and 7 concern various treatments for SVPI. The experts were asked to first rank each item in order of importance and then to rank them on which treatments had been recently used. There were no agreed upon treatments for SVPI among those surveyed. The most agreed upon, with eight out of thirteen agreeing, was for the patient
to rest and for the doctors to watch and wait. This approach, however, will not help those who experience symptoms often or professional musicians whose livelihood is attached to playing. The main reason for the disagreement in treatment options is that treatments tend to be highly individualized. In some patients, pharyngeal flap surgery or injection pharyngoplasty that can fix visible deficiencies may work. For patients who lack those problems, those procedures would not be helpful, and looking at what the patient is doing with their embouchure or trying to strengthen the muscles may be more helpful. Another reason for the disagreements is an expert's individual training and preference for types of surgeries.

**TABLE 6. Importance of various treatment options stress velopharyngeal insufficiency (VPI)**

<table>
<thead>
<tr>
<th>Treatment for stress VPI</th>
<th>ENTs n=7</th>
<th>SLPs (%) n=7</th>
<th>Combined (%) n=14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest “watch and wait” **</td>
<td>50</td>
<td>71</td>
<td>62</td>
</tr>
<tr>
<td>Injection pharyngoplasty</td>
<td>57</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Conservative treatment with speech-language pathology</td>
<td>43</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Changes to instrument equipment (reed or mouthpiece)</td>
<td>0</td>
<td>71</td>
<td>36</td>
</tr>
<tr>
<td>Muscle training of m. tensor veli palatini</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Pharyngeal flap</td>
<td>29</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>Increased subglottic management of expiratory pressures</td>
<td>0</td>
<td>29</td>
<td>14</td>
</tr>
</tbody>
</table>

*Source: Data from Evans, Driscoll, and Ackermann (2014)*

*All items were ranked on a 6-point Likert scale, where 1 = not very important and 6 = very important.

**Data missing for one ENT**
Table 7’s results were ranked by twelve out of the fourteen participants. As a ranking in order, as compared to the independent rankings in the previous tables, the numbers are slightly different. As shown in Table 6 no treatment is agreed upon as a preferred first option, though rest and recovery is a common choice. Interestingly, changes to instrument equipment and increased subglottic management of expiratory pressures, which were both unanimously agreed by ENTs to be unimportant, saw surprisingly high rankings in Table 7. The reasoning behind both this and the surgical option being ranked low is a general desire to avoid surgical intervention unless needed.

TABLE 7. Rank order of various treatment options stress velopharyngeal insufficiency (VPI)*

<table>
<thead>
<tr>
<th>Treatment for stress VPI</th>
<th>Frequency of treatment prescribed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rest “watch and wait”</strong> **</td>
<td>ENTs n=7</td>
</tr>
<tr>
<td>Changes to instrument equipment (reed or mouthpiece)</td>
<td>86</td>
</tr>
<tr>
<td>Conservative treatment with speech-language pathology</td>
<td>71</td>
</tr>
<tr>
<td>Increased subglottic management of expiratory pressures</td>
<td>86</td>
</tr>
<tr>
<td>Muscle training of m. tensor veli palatini</td>
<td>71</td>
</tr>
<tr>
<td>Injection pharyngoplasty</td>
<td>71</td>
</tr>
<tr>
<td>Pharyngeal flap</td>
<td>43</td>
</tr>
</tbody>
</table>

*All items were ranked between 1-6 in order of treatment prescribed, where 1 = the first method used

Source: Data from Evans, Driscoll, and Ackermann (2014)
One SLP questioned how effective conservative treatment would be and suggested that palatal exercises and muscle training would not be effective. This sentiment is backed by previous literature in studies done on VPI, where these kinds of exercises called NSOME (non-speech oral motor exercise) were ineffective in treating the symptoms of VPI. Instead, it is suggested that speech-language pathology intervention is best applied after surgery to correct speech errors developed from dealing with SVPI.

Despite the lacking evidence that NSOMEs are effective in treating VPI, there are a few studies that show improvement in a patient after being prescribed these exercises. In the aforementioned study that initially prescribed waiting, the patient was then told to do daily sucking exercises that resulted in remarkable improvement. Additionally, there is an older study from 1974 including a follow up that also prescribed the same exercises, and the patient had no problems after completing them. In a report done on SVPI in 2009, it was recommended that patients have six months of therapy before considering surgery.

These results are much more promising than compared to VPI. While the author of this paper lacks any medical training, his theory for this difference lies in the main difference in the condition. For SVPI the air leak is not a continuous thing, and in some

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34 Kummer, “Speech Therapy for Errors Secondary to Cleft Palate and Velopharyngeal Dysfunction.” 198
cases it occurs due to muscles becoming tired. In these cases, the problem can be solved if those muscles can be strengthened to deal with the stress. The effectiveness of the palatal exercises compared to any training normal playing would give, however, is outside the author’s expertise and warrants further study.

**Non-surgical solutions**

Similarly to NSOMEs, a dissertation by Christopher Gibson describes numerous clarinet instructors who taught students to practice minimizing the air leak and advocated equipment/set up changes.\(^{37}\) One teacher recommended “concentrating 50% of practice on not leaking” and that eventually becomes “second nature to hold things closed.” This teacher suggested that the “air leaks can also be caused by improper embouchure formation and function, articulation, and poor breathing techniques.” Another teacher found the air leaks are usually from excess resistance in some part of the tonal production process, either from mouthpiece/reed and/or a constriction in the throat that put excess pressure on the soft palate. Exercises to fix this consisted of practicing focusing the airstream.

A medical editor of *The Clarinet* magazine, who had experience dealing with VPI in trumpeters, reached out to Gibson and had this to say about resolving the condition: “voluntary control of the soft palate is only possible through manipulation of the facial muscles, and . . . proper embouchure formation will raise the soft palate.” He describes a technique called an “inside smile” in which the player, with lips closed and teeth

parted, smiles slightly. “It should be as if smiling at someone, but without the smile
being noticeable to anyone else. If properly performed, the clarinetist will feel the soft
 palate lift and the nasopharynx close. [He] also uses the exercise of grimacing as if
smelling a foul odor, which produces the same physical effect.”

Gibson also cites three of his subjects and a responding teacher, who considered
equipment to be a potential solution to SVPI. In some cases, this was adjusting reeds to
better fit a student’s mouthpiece; in others it was switching to thinner reeds. This is likely
more of a solution specific to reed instruments rather than brass instruments. An article
published in The Clarinet had found that the configuration of the setup can affect
intraoral air pressure.\textsuperscript{38} Clarinet players have the option to play an instrument with a
narrower bore, thinner reeds, and a more open mouthpiece to lower resistance. While
lowering resistance using these may cause the tone to lose its core and center, there
are enough makers of mouthpieces that are readily available such that adjusting setup
is unlikely to negatively affect a musician’s career.\textsuperscript{39} For double reed instruments, it is
more common for players to make their own reeds. While each player develops their
own style, the amount of resistance between styles can vary drastically. If adjusting a
musician’s setup can prevent symptoms of SVPI, it would present a simpler solution
than surgery or months of practice or exercises. There is a concern that the restrictions
in available equipment could affect the development and potential of the musician. For
example in bassoon playing, less resistant reeds can struggle to consistently hit the
instrument’s highest notes.

\textsuperscript{38} Gibson, L. 1990. Claranalysis: Intonation, tone, focus, wind resistance, and flexibility in the clarinet
\textsuperscript{39} Molina, O. In discussion with the author. February 2023
Many of the instances of SVPI described by Gibson include examples of how those affected have managed the condition.\textsuperscript{40} Several of the case studies reported that nasal air leaks were under control, often by changing their equipment setup. As mentioned earlier, several of the teachers Gibson spoke with recommended managing a palatal air leak through a modified practice regime. In a survey of SVPI, the two trombone players surveyed mentioned being aware of nasal air leaks and that they occurred in their playing.\textsuperscript{41} Discussions with teachers reveal that nasal air leaks caused by play time are not uncommon, but they are seen as a result of extreme fatigue caused by abnormally high amounts of playtime.

Exactly what is occurring in some of these scenarios is unknown, but it does seem that in some cases SVPI is more of a minor annoyance than a condition that could end a musician's career. It may be that those cases that get resolved fall at the lower limits of endurance of a human's palatal muscles, or that proper training through practice can resolve the issue. Unfortunately, the amount of time spent playing before symptoms appear is often a missing factor in more casual discussions of the teacher's experience with SVPI. Comparisons of the nasopharynx of multiple patients that deal with SVPI is a topic that warrants further study.

**Prevalence of SVPI**

Another important issue concerning SVPI is that many of those experiencing it are unaware it is a medical condition that can be treated. As mentioned before, many

\textsuperscript{40} Gibson, "Soft Palate Air Leak"

musicians experiencing SVPI will dismiss the symptoms as fatigue. For many players, symptoms start occurring during an undergraduate music degree or in high school, around the time their practice time would start increasing to meet the demands of a music career. As such, it is difficult to ascertain how prevalent SVPI is in musicians. Asking musicians if they are affected by SVPI is unlikely to be helpful. Another ongoing problem is that many medical personnel are not aware of SVPI, let alone musicians.

The few surveys that have been done on this issue ask about the symptoms, specifically focusing on if the musicians experience an air leak that occurs during play time. To the author’s knowledge at the time of writing, four surveys have been conducted on the prevalence of SVPI. For two of them, the sample size is low enough to cause low confidence in the results. For the first study, an online survey of 77 student instrumentalists at a conservatorium in Australia, 39% mentioned experiencing SVPI. This survey also found that the amount of play time before symptoms occurred was evenly distributed, from ten minutes to two hours. The manner of presentation for the results of this survey cast doubt on its validity, however. The survey presents its results as if the instrumentalists are being directly asked about VPI: “The online survey asked students whether they had heard of VPI, were they aware of other student musicians with the disorder or had personally experienced VPI while playing a wind instrument.”

Discussion of the results also presents the responders being aware of or experiencing VPI. However, in the appendix containing the questionnaire, the term “VPI” is not used

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43 Evans “Prevalence of velopharyngeal insufficiency in woodwind and brass students”
instead “air leak” is. The questionnaire has the 3 relevant questions phrased as follows with an additional note.44

11. Have you heard of air leak while playing a wind instrument?
12. Are you aware of other musicians that have had air leak while playing a wind instrument?
13. Have you personally experienced air leak while playing a wind instrument.

For questions 11, 12, and 13 the term ‘VPI’ was deliberately not used to avoid confusion. The more descriptive term ‘air leak’ was used instead for easier recognition.

As mentioned before, SVPI is not a well-known condition and so two of the other surveys ask about a “nasal air leak.” Asking about just an air leak in instrumental playing is a vastly different occurrence from SVPI. This could include any form of air leak occurrence, from an embouchure failing to a leak from instrumental setup. Although there is a chance that this did not affect the results, the data is nonetheless presented deceptively, which raises questions about the results.

In the second of the smaller studies, a survey sent to players of two semi-professional orchestras. Of the 24 responding wind players, 17% mentioned experiencing SVPI at some point as well as one of the 31 string players.45 This survey was the only one to specifically mention SVPI, potentially lowering the results for

44 Evans “Prevalence of velopharyngeal insufficiency in woodwind and brass students”
respondents not aware of the condition. The survey puts the prevalence of SVPI at the lowest of all the surveys.

A third survey omitted the term VPI and phrased the question as, “Are you aware of the problem of involuntary air exhalation from the nose when playing your instrument? If so, do you have you any personal experience of this?”46 The survey was sent to a wide demographic of 148 people, consisting of professional orchestra musicians, students, freelancers, teachers, and members of youth orchestras. Of the respondents, 56% mentioned being aware of the problem, with 31% having experienced it personally. Notably, nearly half of those who mentioned experiencing it no longer suffered from an air leak, and all of them mentioned it only occurring under specific circumstances such as stress, pressure, or a cold. The study also noted that symptoms seemed to ease over time and marked the prevalence among each instrument: The percentage of musicians who had experienced VPI in the past, but were asymptomatic at the time of the study, were as follows:

- clarinet/bass clarinet, 37%
- French horn (high/low/various), 20%
- tuba, 15%
- bass trombone, 11%
- bassoon/contrabassoon, 14%
- trumpet/piccolo trumpet, 5%
- tenor trombone, 8%
- oboe/English horn, 3%

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46 Schwab, B., and A. Schultze-Florey. “Velopharyngeal insufficiency in woodwind and brass players.”
• flute/piccolo, 0%

The distribution of the 24 musicians who showed symptoms of VPI at the time of the study was as follows:\(^{47}\)

• clarinet/ bass clarinet, 26%
• oboe/English horn, 25%
• bass trombone, 22%
• tuba, 15%
• bassoon/contrabassoon, 14%
• trumpet/piccolo trumpet, 14%
• French horn (high/low/various), 12%
• tenor trombone, 10%
• flute/piccolo, 0%

The last study had the most respondents at 156.\(^{48}\) The survey asked for responses to two statements: “I have had air leak through my nose while playing my instrument,” and “I have heard nasal sounds while playing my instrument.” The survey found 53 out of the 156 (33.97%) reported having experienced symptoms. Notably, nine reported only experiencing an air leak, sixteen reported only experiencing the nasal sounds, and the remaining twenty-eight reported having both. The survey additionally asked when symptoms occurred both in time and register, with the highest results being

\(^{47}\) Schwab, B., and A. Schultze-Florey. “Velopharyngeal insufficiency in woodwind and brass players.”
after 30 minutes of play time (45.28%) and when playing in the middle register (41.51%).

These surveys all mention similar factors that may influence the results. The nature of the surveys had many questionnaires sent out, with only a small portion of them being returned. It is likely that someone that suffers from SVPI is more likely to respond than someone who does not. Additionally, many of the surveys are of either professional musicians or music students at a university. Musicians affected by SVPI to the degree that it affects their ability to play are less likely to pursue a career in music or participate in a youth orchestra.

An unacknowledged problem

As previously mentioned, musicians do not typically visit medical personnel for their problems. Most problems a young musician has are brought up to their teacher, who provides an answer from the accumulated experience they have gathered. In matters of music, this approach works well, and some share their teachings with the community at large rather than just their students. For medical matters, the efficacy of this approach is more questionable. Correcting posture is a commonplace idea; many colleges encourage physically warming up and doing hand stretches, and ideas from Alexander Technique, a type of therapy based on the idea that poor posture causes health problems, have been brought into the music sphere. However, outside of posture, medical ideas are not commonly embraced. Wrist stretches should be paramount for instrumentalists due to the potential effects of carpal tunnel, but they are not done enough. Alexander Technique, despite being taught at many schools, still
lacks firm evidence of its effectiveness. Overall, musicians lack the medical knowledge to properly address many of the potential health problems they face.

Musicians not talking to medical personnel was an issue in one of the abovementioned surveys. The survey presented follow-up questions for those with air leaks, one of which asked if they sought medical attention and if they had gained control of their symptoms. Of the thirty self-reported cases, only seven had gained control over their symptoms. In most of these cases, the musician did not seek medical attention. This raises the question of whether the symptoms were simply minor enough to ignore, but from the same survey sixteen out of nineteen respondents reported on-set of symptoms between ten minutes to two hours. For musicians in a music conservatory, this would not be an abnormal amount of playing time.

One of the main problems for SVPI is that most musicians do not acknowledge it as a problem beyond fatigue, or as an issue that could be solved with treatment. In the six cases found in clarinets discussed by Gibson, four of them made no attempt to seek medical help in dealing with the condition, even though one of them was specifically recommended for medical attention by their teacher. The other two did seek help, but the condition was not properly diagnosed and no treatment was done. Since Gibson completed his dissertation, he has given several presentations and written articles on SVPI. This effort, along with the help of other online musicians who have written about SVPI, has increased awareness of the condition especially among clarinetists. However, awareness among other wind instrumentalists still remains low.

50 Schwab, B., and A. Schultze-Florey. “Velopharyngeal insufficiency in woodwind and brass players.”
51 Gibson “The Soft Palate Air Leak”
52 Gibson “Current trends in treating the Palatal Air Leak”
At the time of Gibson’s study knowledge about SVPI was extremely low, with a total of three case studies and a mention of the condition in a survey of airway disorders in wind instrumentalists.\(^5\) One of the frustrations of this condition is that many times when a doctor is consulted, they are unaware of SVPI and offer no help. A 2007 survey was done of otolaryngologists and doctors registered with the American Cleft Palate-Craniofacial Association. The survey asked if the physicians had heard of SVPI and if they had treated someone with it. Only 45.28% responded that they had heard of SVPI, and 26.92% had seen a patient with one.\(^6\) Due to this low percentage, it is likely that a musician who does seek help will not find a solution, due to continued unawareness of SVPI. The only recourse in this case is for musicians themselves to be aware of SVPI beforehand.

\(^5\) Gibson “The Soft Palate Air Leak”
\(^6\) Malick “Stress Velopharyngeal Incompetence: Prevalence, Treatment, and Management Practices”
CHAPTER 4: INTERVIEW

SVPI is a very complex subject. While the purpose of this paper is to provide help for those affected by SVPI, the author does not have any medical training. In order to provide a perspective of trained medical professional an interview with a practicing laryngologist was held. Below is the transcript of the interview; some comments have been slightly edited for the sake of clarity.

MH: What is your general medical background?

Laryngologist: I'm a laryngeal surgeon. My primary clinical responsibilities include management of laryngeal disease. That extends from everything from the velopharynx down through the upper esophagus through the larynx and the trachea. I would say that my personal practice is primarily focused on the larynx. I'd say about 50 to 60 percent of my practice is minimally invasive endoscopic management of laryngeal cancers. Twenty percent or so of my practice is dedicated to all things related to pharyngeal dysfunction. That includes things like velopharyngeal insufficiency, and dysphagia. That's basically what I do.

MH: What I also want to ask. For a normal person, when they hear about pharyngeal insufficiency, what exactly is that condition? What's happening? What's going on?
Laryngologist: Yeah, basically the velopharyngeal dysfunction or velopharyngeal insufficiency refers to a condition wherein the palate or the velum and the posterior pharyngeal wall don't make contact as they should. And the situations in which that's important are during swallowing and during voice or speech production primarily. Typically, the people that we see, VPI in on the adult side are people that have had radiation treatment for oropharyngeal or nasopharyngeal tumors. Or patients that have had primary surgical treatment that require that a portion of one of those structures is removed.

Soft palate tumors, for example and typically nasopharyngeal tumors are treated with chemotherapy and radiation. From my perspective, those are the kinds of people that I see. I will say that in general, velopharyngeal insufficiency is not a terribly common phenomenon that we have to treat surgically or even clinically. I think the other patient population that I'm not routinely exposed to are patients with cleft palate, for example, and other conditions that might affect normal embryologic development of you know, the soft palate and the nasopharynx. You know, people in Vacterl syndrome, things like that.

MH: So, in general, it is just the inability for the soft palate to close against the posterior wall. And in the case of it being something like cleft palate, that would typically be something dealt with very early on for the patient,

Laryngologist: Generally speaking, yeah. And typically, that's handled by plastic slash pediatric ENTs. So yes, you're right. Those people will be dealt with earlier on.
MH: Okay. The next question is, what are the differences between SVPI and VPI? Why do we add the stress to it?

Laryngologist: Well I think fundamentally, as we said, you know, whether or not it's stress related or not is irrelevant insofar as what's fundamentally happening is, as I said, the velum isn't contacting the posterior pharyngeal wall.

I think that the circumstances are probably different and again, the caveat is we don't know, I've never actually seen someone with stress VPI because, I think you know, it's not a terribly common condition. But I think what I would say is that as opposed to the standard conditions that create VPO, which is radiation, which is VPI in that situation is basically fibrosis and scarring of the underlying muscle.

The muscle doesn't contract as well as it should, and that results in ineffective closure or surgical resection. You are physically removing tissue that would otherwise contact the posterior pharyngeal wall. The conditions there are different. In stress VPI my understanding of the condition is simply that there's so much collective back pressure pushed against the velum in the posterior pharynx, that eventually what happens is you just get natural dilatation of the region. I think that's the difference.

MH: So there might not be anything structurally wrong with the patient?

Laryngologist: That's right. I mean, I guess it depends on what you consider to be structurally wrong. I think there is a structural change. There must be if there is VPI, but
it is probably also a combination of dilatation of the region, but also gradual ineffectiveness of the muscle to contract against it, to compensate. And I think that's probably what stress VPI is really about.

MH: How would you, if you were seeing a patient and they were seeing these symptoms that we do associate with SVPI, how would you help diagnose them with it?

Laryngologist: Yeah. I think that the stress VPI is actually would be quite straightforward because, you know, if it is a musician, they will report an inability to efficiently play the instrument. And I think in that situation it would be easy for us to consider why that might happen. In general, there are a few different ways to diagnose VPI. And oftentimes this is done in concert between one of us, so a laryngeal surgeon or a laryngologist and a speech language pathologist. There are invasive means, and there are non-invasive means. Invasive means include flexible endoscopy. So every patient that comes in independent of what's going on in my clinic, gets a flexible transnasal endoscopy.

And basically in that situation, what I can do is I can position the tip of the camera in the nose right before the velum so I can see while they're saying things. Pop, pop, pop for example, what you want to see is that there's complete closure and approximation of the velum against the Posterior pharyngeal wall.

And in situations where they're not, you can actually see the gap. That's one way. The other way in a common situation that presents especially, you know, amongst standard VPI patients, is nasal regurgitation. A barium swallow study, which requires
that they swallow barium. And as I said, Velopharyngeal efficiency is important for an effective swallow.

If there's no closure, then what you'll see is that barium on the x-ray escape into the nasal cavity. That's the other way you can diagnose it. And then the other way, which I never do is, and this is primarily under the purview of a speech language pathologist, is nasometry, and I'm sure you know about it, but it is simply a non-invasive mechanism to understand. To diagnose VPI it measures things like nasal escape of air, and I think nasometry as a diagnostic field just becomes sophisticated enough. Now you're developing 3D models based on what they find. And there are different devices that you can use to sort of help with nasal geometry. But that, that's basically how you would diagnose patient symptoms. And then a few telltale signs on endoscopy and barium esophagram.

MH: Okay. You would then recommend that for a musician who's thinking they're suffering from this, that they should definitely bring their instrument with them to be able to create conditions for it.

Laryngologist: Yep. Absolutely. I would and what I would do in that situation is if it's suspicious for stress VPI, I would ask them to play the instrument while I have the endoscope in the nose.

MH: What surgeries are used to treat SVPI and why are certain ones picked over other ones?
Laryngologist: I think the data underlying surgical management of stress VPI, is actually quite sparse. But if you look at the VPI literature I think there's some more data about that. But I think fundamentally the approaches are similar, right? You're just trying to fill a defect where there's a functional problem with closure. I think the most straightforward way to do it is if you can predict where to put the injection in an injection pharyngoplasty. And I just did one last week, actually two weeks ago actually.

And basically what the surgery is, is you expose the back of the nose, the nasopharynx in one of two ways. You can either go through the mouth or you go through the nose. And we have a special instrument that's designed to be able to inject things that are far away from where you're injecting. It's a long cannula basically.

And my go-to initially is something called restylane. And what restylane is hyaluronic acid that's bound to some sort of curia. I actually don't know what it is, but it originated as a dermal filler initially. It's quite inert historically, if you look at treatment.

velopharyngeal insufficiency with the injection, pharyngoplasty, all sorts of stuff were being used, right? Teflon parafin, which was the first material I believe to be used as an injection next to the vocal fold, can be poorly tolerated by the body. You get this problem of extrusion inflammation in the back of the nose. I like to use something that's inert and well tolerated. And that's restylane.

That's what I do. I like to go through the nose because that is how I understand the location, the source of the VPI, I can correlate exactly what I see in the clinic with what I do in the operating room. And I inject as much as I need to fill the gap, which is typically less than about a half a cc, but that's entirely contingent on how severe the
issue is, and someone that had a large soft pal resection you may need a little bit more. That is one way to treat it. The other options, I think there are several of them, are surgical injection, surgical pharyngoplasty that either stipulates rotation of muscle or muscle with overlying mucosa and to fill the defect better.

This is probably a little bit nuanced and granted, I have not done this very much because in general it doesn't, at least in my experience, has not come to this point. Or I should say before I move on. If restylane works, this is my formula. If restylane works, restylane only lasts for about three months before it gets resorbed. The more permanent option is autologous fat. What I do is I harvest fat basically using a liposuction device from next to the belly button, the embolus. I spin that down, get all the blood out, and then I inject it basically the same way into the posterior wall. The beauty about fat is fat also resorbs over time.

But what you do by removing it from the periumbilical region is you also extract adipocyte stem cells. Even if you have atrophy of the fat that you inject by 50 to 60%, which is in general what happens, you have these adipocyte stem cells that basically sustain the fat. It effectively, what it becomes is a permanent injection.

My ideal option is for people to respond to the restylane because it doesn't require something more morbid to take place in the way of rotating muscle. That is generally my formula. And so far I haven't seen anybody that didn't respond to an injection. The other options, non-surgical as an obturator. Say for example that someone has a soft palate resection, you see a prosthodontist, someone who specializes in this area, and they basically fashion you something to plug up against the
soft palate to close the gap. All right, so other surgical options where injection
pharyngoplasty doesn't work.

You can basically rotate anything that you want from the posterior oropharynx up
to fill that gap. There's a description of technique where you take muscle from the
posterior faucial pillar. You basically make an incision on the mucosa, and you cut the
muscle from its interior aspect, and you basically rotate it up into the nasopharynx.

And again, all you're doing is you're just filling the gap with a muscular flap. And
there are different ways I think you can do that. That is the only one that I've personally
seen, so I can't comment on anything else that's available empirically. But I'm certain
there's literature talking about different methods of surgical pharyngoplasty, but they all
basically focus on filling the gap. How that translates to someone with stress VPI, I don't
know. Because I think the mechanics that whatever you do by rotating tissue from a
different part of the throat up until the nasopharynx, I don't know how someone that
plays a wood or a wind instrument would actually perceive that and how that would
affect their ability to play the instrument effectively, even if it overcomes stress VPI. I
think that's the one caveat, but an injection pharyngoplasty, I think avoids any of those
complications and should theoretically give you the opportunity to fix the problem as
long as it's done right.

MH: I just wanted some clarification on some of those, so for the hyaluronic acid
compound, you mentioned resorption being a problem starting to happen after three
months. Would that mean there would need to be a follow up to seek a more permanent
solution?
Laryngologist: Yeah. Either repeat the restylane, but in my mind at that juncture, if, at least for those three months there was improvement in symptoms, then it makes sense to move to something permanent, which would be fat.

MH: Okay. Then what, for these surgeries, surgical procedures, what is the recovery period looking like in terms of like physical wellbeing, how long would you recommend someone to stay away from their instrument? And if there are any speech problems that are going to be developing from these.

Laryngologist: No speech problems that I would expect after an injection and no time away playing after an injection. Because it is a submucosal injection, there's no incision, so there's no recovery per se. That is the recovery is the periumbilical incision. With the liposuction you just get some edema, some bruising, some pain. Because what you're doing is you have this liposuction device that's connected to a cannula and underneath the skin at the subcutaneous fat level, you're basically just shoving this cannula in and out so that you draw in fat with a suction. That tends to be a little painful or uncomfortable for a week or so. But from a nasopharyngeal, velopharyngeal perspective, there's no downtime, no recovery.

MH: Since I have seen some cases not for the injection, that there have been speech problems, is that an abnormal thing when dealing with VPI for people to have issues speaking or having to relearn how to talk?
Laryngologist: Well, I think a big issue with standard normal VPIs is that you do have hypernasality with normal conversational speech. That is one of the things we're explicitly targeting in the way of an outcome. I have not seen it be an issue and I can't imagine why it would be an issue to the detriment of speech.

I have only seen it help it, and that has been my personal experience. I'm not sure if that's what the data shows, but simply by injecting something into the posterior pharyngeal wall, I can't imagine that that would create issues with speech post-op. I feel like it only helped it. There's one specific reflection that an undergraduate clarinet player gave that specifically mentioned developing a British accent and having to relearn a lot of her consonants after her surgery. I think she had a pharyngeal flap surgery, if I remember.

I don't really understand a British accent. Because that's not a speech or a voice issue, that's a neurologic problem. Because it’s literally impossible to involuntarily develop an accent and certainly wouldn't be the result of a pharyngeal surgery. But I can imagine why if you have a surgical pharyngoplasty, non-injection, how that could potentially complicate speech production because you're, I mean, I can't give you any specifics as to why that might happen, but you're just changing the system. I imagine there's some pain and discomfort. But that does not surprise me, but injection there would be nothing.

MH: Okay. And we had sort of mentioned it for the acid, but can SVPI reoccur after any of the surgeries used to treat it? Assuming like a month in It's fine.
Laryngologist: I think so. I think so because it's the same stressor. It's not, it's not a static etiology, right? It's not like a cancer resection, because in that situation, the tissue's gone. The tissue's gone. You're never going to remove more. Oh, unless you do remove more. If that is the end, end all be all, you've had radiation, you've had a surgery to resect a tumor, you are affecting a condition that was related to a single event.

However, with stress VPI, the issue is that you are continuing to be subjected to that stressor. I think there is a possibility of recurrence, but I think that, again, with injection, I'm not advocating for injection pharyngoplasty. I'm simply saying that if the condition does recur after an injection for pharyngoplasty, you do have the option of putting more of the injectate. That's what I'll say.

MH: Yeah, especially if that surgery seems drastically less invasive then the other options. I do not want to go through the surgery I went through again.

Laryngologist: Well, I think there's probably a reason that surgery is offered. And I think it, and I don't know, maybe you're certainly more familiar with the data than I am cause I haven't actively looked this up, but I'm not sure that there are certainly hasn't been a randomized controlled trial, but even a reliable comparison of surgical technique as it pertains to outcomes and stress VPI and I'm sure that the data's out there for systematic review. Meta-analysis, maybe that's what you're working on. But I don't know if a surgical non-injection pharyngoplasty has been demonstrated to have improved
outcomes compared to injection pharyngoplasty, and it certainly may be that that's the case, but I think with injection pharyngoplasty, there's no downside. Especially since the injectate is one resorbable. And even if you do that, you can remove it.

MH: This next question, just so you know, the viewpoint that I'm asking this one from is I've seen a surprisingly high number of times. I've seen and I've heard other people go to an ENT describe the problems and they (the ENT) just don't know what's happening. How can someone who is dealing with these conditions help a doctor with a diagnosis. What could a musician do?

Laryngologist: I think that this is a common issue amongst people with not just stress VPI, but with voice problems in general. And I think that ENT is interesting in that it is as a field, very specialized because we focus on a relatively narrow portion of the human anatomy, but in spite of that, given the complexity of the physiology and the anatomy, that there is a vast difference between me, a laryngeal surgeon who obviously is an ENT, and just a general ENT.

And I think that a general ENT would find it difficult. One, to diagnose and treat even normal velopharyngeal insufficiency. I think that the, and I think the question you're asking me is, how would a patient approach this differently if, if they are not getting the answers? I think my recommendation would be to find a laryngologist who is part of a voice center.

This would occur primarily at an academic institution. And what that'll give you is someone who has one, familiarity with the anatomy and the physiology treatment of VPI
and two, is also plugged in with speech language pathologists who are critically
important, both in the diagnosis and management of this problem. That's what I would
say is, it is not surprising, but the way around it is to be referred to an academic medical
center with a laryngologist and a voice center.

MH: All right. Then lastly is, do you have any advice from musicians to maintain their
velopharyngeal health?

Laryngologist: That I think is a better question for SLPs. And I think the maintenance of
velopharyngeal health is difficult, and I think you know that because there are a large
percentage of instrument players that don't have stress VPI, so I think to some degree
it's unpredictable. But I think the recommendation would simply be if there are any
concerns, to see a laryngologist and SLP. And there are certainly some nonsurgical
exercises that are designed independent of the reported efficacy to help strengthen the
sphincter. And make it such that when it is less severe, you have the ability to overcome
it. And I think in that situation, delaying surgery as long as you can, is probably in your
best interest. That's what I would say is seek help early and seek the right help. And I
think that's the way I go about things.

MH: All right. Thank you very much.
CHAPTER 5: DISCUSSION

Stress velopharyngeal incompetence remains understudied and relatively unknown by the musicians it affects. Since Gibson’s 1995 dissertation, however, some progress has been made on researching SVPI. There have been several prevalence studies and more case reports, and Gibson has greatly contributed to its awareness among musicians. Seeking proper medical attention can still be troublesome, depending on the knowledge of the physician. If the musician has awareness that they might have SVPI, contacting a specialist in the larynx and pharynx is an option. At the moment, SVPI might simply be too uncommon a condition to expect awareness on the part of general ENTs.

Understanding of the precise causes of SVPI is also quite low. High intraoral pressure is the only agreed upon cause for the condition. Specifically, the high minimum air pressure for normal playing in instruments like clarinet and oboe is related to the prevalence of SVPI. The velopharyngeal structure is inconsistent between cases, though a short velum that makes SVPI occur more often can be remedied through surgery. Outside of structural deficiencies, it is unknown what causes the nasal air emission in some musicians but not others. Intense amounts of play time have been seen to cause nasal air leaks in musicians who do not normally suffer from SVPI, which is resolved by rest. Further research into the musculature differences between onset times of SVPI might yield better results.
Assessing and treating SVPI is complicated by a wide variety of options, with not much agreement. For assessment tools, nasendoscopy has become increasingly prevalent along with a patient's case history. Treatment options are often customized based on the patient. Structural deficiencies are typically resolved with surgery; an injection pharyngoplasty is often highly recommended and has less recovery than similar procedures. Agreement on treatment options may be different if options are limited to more commonly accessible equipment. Nonsurgical options are available and have reported success. Several of these are low effort and can be done in practice, while setup changes in consultation with a teacher can also be attempted. The effects and benefits of strengthening the velopharyngeal muscles remain understudied. Similar exercises not being effective for treating VPI remains a concern for their efficacy in treating SVPI and should be investigated as well.

The actual prevalence of SVPI is still unknown. Different surveys place its prevalence anywhere from 17 to 39% of musicians. More surveys with a high sample size are needed, as well as more consistent demographics. Complicating the issue is that SVPI is likely to stop a musician from pursuing a performing career (thus excluding these musicians from SVPI surveys that focus on music professionals), while responders are likely to have experience with SVPI (and are therefore more likely to respond to surveys, potentially skewing results), making the true prevalence difficult to ascertain. Surveys of younger players would solve part of this issue.

Musicians not seeking medical help is a long-term problem that is unlikely to change anytime soon. More awareness of SVPI will enable teachers to adequately help their students. Encouragement to seek help should be done whenever possible. Wind
playing has several associated medical conditions that often do not get addressed. Musicians more commonly seeking help also allows for more progress to be made on these conditions on the medical side. Greater awareness also prepares a musician to be able to explain themselves if a doctor is unaware of SVPI.

My personal experience with SVPI would have prevented me from having a performing career. Being incapable of playing an entire march was incredibly frustrating. While I encountered many difficulties along the way, I am happy to be free of the condition. It is my hope that others who suffer from SVPI will not have to go through the same struggles I did.

SVPI is a potentially career-ending condition. Despite various treatment options being available, lack of awareness of the condition and its remedies are the primary inhibitors to a solution. These are the primary motivating forces behind this document, which endeavors to provide a central source for explaining SVPI and offering various medical perspectives into its treatment.
REFERENCES


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APPENDIX