Velopharyngeal Insufficiency and Eustachian Tube Dysfunction

Question for Dr. Bob:

We have a very interested ENT in our town who is on board with OFM and wanting to help our patients. He asked me an interesting question the other day and I told him I would seek some information for him. He has an 8 year old patient that has velopharyngeal insufficiency and also has Eustachian tube dysfunction. He was wondering if there are any palatal exercises for the Eustachian tube dysfunction. What do you think??? Is there such a thing?

Dr. Bob's reply: Please tell the ENT specialist that I appreciate why he/she asked the question about a possible role for the velum in influencing Eustachian tube functioning because the tensor muscles of the velum pull the membranous lateral wall of the Eustachian tube away from the stationary cartilaginous medial wall, thereby opening the normally closed tube.

Background: The muscles that tense the soft palate during function (the tensor veli palatini muscles, or tensor palatini) tend to tighten their palatal aponeurosis attachment during contraction, but this is not thought to be a necessary or contributory component of velopharyngeal closure. A second, more clinically-important function is also present. This involves participating in opening the nasopharyngeal orifice of the auditory (Eustachian) tube by virtue of those fibers of the tensor palatini that take their origin in the anterolateral wall of the the auditory tube. Sometimes these fibers termed the *dilator tubae* are responsible for opening the auditory tube orifice. Therefore, upon contraction, the tensor palatini may help to refill the tympanic cavity with air and equalize air pressure on the inside and outside. The nerve supply is from a branch of the trigeminal (V) cranial nerve. There are other pharyngeal muscles, however, which are more effective in this operation of relieving the dull tension caused by altitude changes and other causes of internal/external pressure differences.

Dissection studies that I was involved in as a doctoral student in speech pathology under Anatomist Dr. Willard Zemlin revealed that a case can be made for the tensor veli palatini and the tensor tympani muscles being the same muscles. Some fibers from each are seen to interdigitate and they enjoy the same nerve supply from the 5th cranial nerve.

Exercising the velum? It is questionable whether any exercise for the soft palate would improv e Eustachian tube function. Swallowing would represent the best opportunity for the velum to influence the Eustachian tubes since the velum and the other muscles of the velopharyngeal mechanism contract actively up to and around the base of the Eustachian tubes. Where there is a velopharyngeal insufficiency, as with this 8 year old, it would be expected that the entire velopharyngeal mechanism would be functioning at a level lower than normal and failing to achieve a seal of the velopharyngeal port, so I would not expect movements of the velopharyngeal mechanism to participate actively in "milking" the Eustachian tubes open.

As you may know from the speech pathology literature in cleft care, no exercises for the velum have been shown to increase the length, strength, or movement pattern for the velum. The exception is those patients who do not exhibit full elevation of the velum who can show some increase in the height of velar elevation by *over-exaggerating movements* at the oral valve (the lips). The reciprocal relationship between movements of the oral orifice valve and the velopharyngeal valve is well-established and related to the direct anatomical link between these two valves via the buccinator and superior constrictor muscles whose fibers join at the pterygomandibular raphe. For your review: the buccinator arises from 3 locations: a horse shoe-shaped line along the base of the alveolar processes of the maxilla; the mandible; and, ***the most important attachment for clinical purposes***, at the *pterygomandibular raphe*. Dissection studies at the pterygomandibular raphe have revealed that the fibers of the buccinator not only surround the ligament but also continue across the ligament as fibers of the superior constrictor in impressive numbers. In fact, most muscle bundles of the buccinator were found to continue across the raphe as the superior constrictor muscle. This finding was also revealed in dissection studies I participated in with my mentor Dr. Willard Zemlin. A good case can be made for the buccinators and the superior constrictors being the same muscles, but this will not happen because, for descriptive purposes, it remains convenient to designate the two as separate muscles, especially since their innervation differs (buccinator, 7th cranial nerve, and superior constrictor, the pharyngeal plexus with the vagus nerve providing most of the fibers).

Possible exercises for the velum that could positively impact Eustachian tube function: A logical (but probably ineffective) velar exercise might be: with mouth locked wide open, the patient produces alternate loud productions of /n/ and /g/ - an exercise intended to elevate and then depress the velum. A second exercise would

involve having the mouth open wide, *with tongue protruded maximally*, while repeating /n/ and /g/. Rationale? You will recall that the palatoglossus muscles originate at the anterior undersurface of the velum where they are tied to the palatal aponeurosis and from there descend inside the palatoglossal arch (the anterior faucial pillars in front of the palatine tonsils) to insert into the sides of the posterior tongue where they interlace with the transverse fibers of the tongue. Their function is to depress the velum. For this reason, you would never want to evaluate velar elevation with the tongue protruded and mouth open maxillary since both of these postures can inhibit the full elevation of the velum.

An additional suggestion for the 8 year old patient with velar insufficiency: a removable palatal-lift appliance could positively impact the ability of the Eustachian tubes to function more effectively as the velum is held in an elevated position to achieve a velopharyngeal seal. I have found this to be the case in selected patients I have treated with palatal-lift appliances such as those with submucous clefts and other forms of velar insufficiency. Improvements in Eustachian tube functioning have been reported by some patients. In a few patients, the appliance increased velopharyngeal functions to the extent that the appliance was no longer needed.

Clinical guidelines for evaluating velar activity: The clinical guidelines for evaluating the velum should include: 1) the patient should be positioned upright (never recumbent) looking straight ahead; 2) the examiner's eye level should be at the patient's mouth level; 3) the mouth should be open 3/4 of maximum - by first instructing the patient to open wide and then close down slightly so as to not hinder full elevation of the velum; and 4) the tongue should not be protruded.

In evaluating velar function, the velum normally elevates up to the level of the hard palatal plane. During elevation, the velum normally shows a& nbsp;"dimple" or inward crease just above the uvula, or at the 70% mark on the velum from the hard palate to the tip of the uvula. The velar dimple is a sign of the location of the levator muscles insertion into the soft palate on the nasopharyngeal surface of the velum. When the dimple appears to be displaced forward, or more toward the 50% mark on the velum, an abnormal insertion of velar muscles is suspected, such as with a submucous cleft of the velum.

Effective velar length: The elevated velum, when measured from its hard palate attachment back to the velar dimple, represents the "effective length" of the velum. It is the effective length of the velum that participates in velopharyngeal closure, while the velar tissue from the dimple back to the uvula does not participate in closing the nasopharyngeal port. For this reason, the overall length of the velum is not a good indicator of the ability of the velum to elevate sufficient to seal the velopharyngeal port. Thus, the potential of the velum to achieve a velopharyngeal seal should be evaluated during a sustained phonation rather than at rest. Further, the location of the dimple influences the ability of the velum to influence the opening of the Eustachian tubes, so those with velopharyngeal insufficiency would be less apt to benefit from any exercise for the velum that could positively impact the opening of the Eustachian tubes.

Summary: In light of all said above, I doubt that there are any specific exercises for the velum that would improve the opening of the Eustachian tubes. In my view, the definitive method of evaluating for such a link would be with nasendoscopy as the patient repeats /n/ and /g/ with mouth open wide and with tongue protruded, and then compared with repeating /n/ and /g/ with tongue not protruded. An alternate suggestion for this patient would be having a dentist construct and fit a palatal lift appliance to achieve velopharyngeal closure that would also likely improve Eustachian tube functions.

I hope that these comments will be helpful. (A drawing is shown below that highlights some of the concepts included in the discussion above. Source: The out-of print text by Bateman and Mason: *Applied Anatomy and Physiology of the Speech and Hearing Mechanism,* Charles C. Thomas Publisher, Springfield, I l, 1984).

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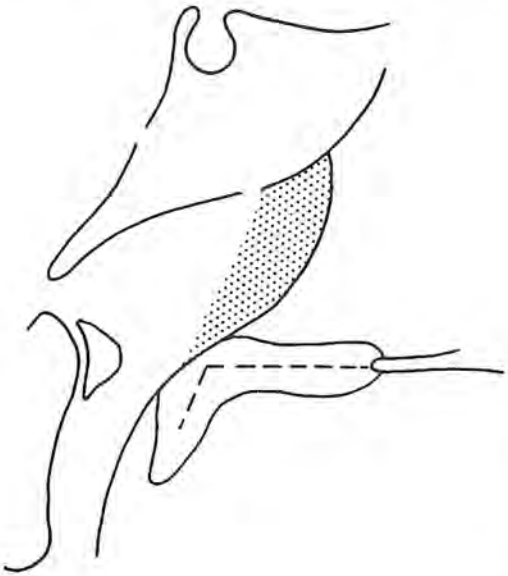

Figure 24-13. Lateral cephalometric x-ray film tracing during sustained /i/ showing a broad velopharyngeal seal and the soft palate "dimple" or flexion. Notice that the velum has elevated to the level of the hard palate plane. The adenoid mass is shown as the stippled area. This patient would maintain a velopharyngeal seal if a total adenoidectomy were performed.

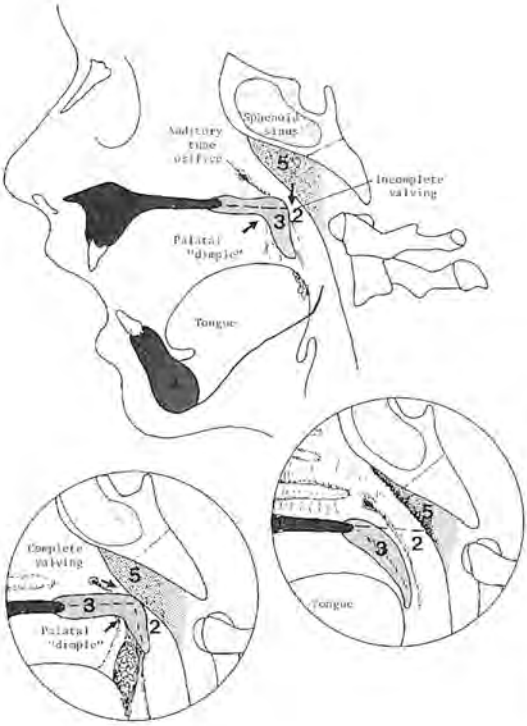

Figure 24-14. Demonstration of the velopharyngeal apparatus through x-ray film analysis. Effective length of the soft palate is measured from the posterior nasal spine (PNS) (which is located at the limit of the hard palate) to the velar dimple. Incomplete valving is shown (top) as well as normal valving (lower left). (Lower right) The palate is at rest, with a dashed line added to indicate the position for velopharyngeal valving. Notice the important role of the adenoid mass in the tracings presented.