# The Morphology of Musculus Uvulae

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The *morphology* of the *musculus uvulae* was studied utilizing detailed gross *anatomical dissection* and *histological sectioning* of the soft palate in seven adult human cadavers. The results indicated that the musculus uvulae is paired as previously described in most anatomy texts. Each bundle takes origin lateral to the midline from the tendinous palatal aponeurosis posterior to the hard palate and just anterior to the insertion of the levator veli palatini muscle. The two bundles converge in an area overlying the sling of the levator muscle and course along the dorsum of the soft palate terminating as two separate bundles which subdivide and insert between the mucous glands of the uvula proper into the connective tissue and basement membrane of the mucosa.

Because of its location and size, it appears that contraction of the musculus uvulae would add bulk to the dorsal surface of the elevated soft palate thus aiding in *occlusion* of the *velopharyngeal portal* during speech and deglutition.

The musculus uvulae (MU) forms part of the soft palate and must therefore be taken into account in a complete description of the structure and function of the velopharyngeal mechanism. MU is generally described as a paired muscle although some anatomy texts continue to describe it as unpaired, thus the term "azygos." Its origin is usually specified as the posterior nasal spine and the palatine aponeurosis. However, it is not clear from this description whether the muscle fibers originate from the hard palate directly or via tendinous slips since Callender (1939) and later Dickson (1972) described the anterior velum as being amuscular. Although the insertion of MU is consistently described as being within the uvula, the details of this termination are lacking. The term "uvula" will be used throughout this paper to refer to the pendulous structure which is suspended from the pillars of the fauces and can be seen in peroral examination. The terms "uvula" and "musculus uvulae" should not be confused since the latter refers only to the substance of the muscle.

With regard to innervation, textbook descriptions are in general agreement that the palatal muscles including MU but excluding the

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tensor veli palatini receive their nerve supply through the pharyngeal plexus. Contrary to this, Broomhead (1957) concluded on the basis of histological evidence obtained from human fetal material that MU receives its innervation from the lesser palatine nerves. However, these nerves are generally described as sensory and autonomic, not motor.

The function usually ascribed to MU is to elevate the uvula and shorten the soft palate. The significance of this activity for speech or deglutition is uncertain. According to Zemlin (1968) MU may function as an important articulator in some languages although it seems to play no particular role in the English language. This suggestion perhaps refers to the fact that some languages other than English utilize a "uvular place of articulation" (Peterson and Shoup, 1966) for the production of certain speech sounds. The uvula itself is often considered as a vestigial structure serving no important function in man (Palmer, 1972). However, Kaplan (1971) has objected to this view pointing out that the uvula is a fairly recent addition to vertebrate phylogeny and as such is not a vestigial remnant.

In view of the fact that MU is a midline structure, it is of interest to know how the muscle fibers are distributed in the cleft palate mechanism and whether they might actually be absent completely in these individuals. Gross anatomical investigation of stillborn infants with palatal clefts (Fara and Dvorak, 1970) and histological study of submucous cleft palates (Calnan, 1954) suggest that MU fibers are present in the cleft palate mechanism, but may be grossly different from normal. Pigott and his associates observed the nasal surface of the soft palate in 25 cleft palate and 25 normal subjects using nasendoscopy (Pigott, 1969; Pigott, Bensen, and White, 1969). During velar elevation, most of the cleft palate subjects did not exhibit the bulge on the dorsum of the soft palate which was consistently observed in the normals and attributed to MU contraction. Pigott, et al, (1969) cited Broomhead's finding regarding innervation of MU by the lesser palatine nerves and pointed out that these nerves are routinely cut in primary palatal operations. The authors assumed that the lack of a pronounced bulge on the velar dorsum might be the result of MU atrophy caused by surgical denervation which in turn resulted in velopharyngeal incompetency for speech. In view of this possibility, they recommended preservation of the lesser palatine nerves in primary palatal surgery to avoid atrophy of MU.

The possible functional significance of MU in aiding occlusion of the velopharyngeal portal as suggested by the work of Pigott and his colleagues appears to be quite plausible but requires additional investigation. For example, it is not clear from the information available regarding the relative size of MU that its physical bulk (cross-sectional area) is commensurate with the pronounced elevation on the dorsal surface of the palate reported by Pigott (1969). Because of the lack of detailed information and conflicts regarding MU anatomy and its possible functional significance, which may be overlooked in palatal surgery, the present study was carried out to provide additional information regarding the morphology of MU.

**Procedure**

Seven adult human cadavers, four males and three females, in the fifth or sixth decade at the time of death, were utilized in this study. These cadavers were randomly selected from the pool of deeded bodies donated to the University of Iowa for medical research. Neither the information about the cause of death nor the available medical histories for any of the cadavers indicated any gross orofacial pathology. All of the specimens were preserved by perfusing them with an acceptable phenol-formalin-alcohol-glycerin solution.

In all specimens a posterior approach to dissection was utilized. The calvaria was cut and the brain removed. A wedge of the occipital bone was also extracted and the vertebral column was then removed maintaining the prevertebral fascia as a marker and keeping all dissection posterior the retropharyngeal space. This procedure left the posterior wall of the pharynx undisturbed. A longitudinal incision was then made along the midline of the posterior pharyngeal wall and the flaps were reflected exposing the lateral aspect of the pharynx and the dorsum of the soft palate (Figure 1). The mucous membrane and the submucous fascia were removed from the soft palate with surprising ease, thus revealing the substance of MU. The boundaries of the muscle were defined by utilizing blunt dissection. The bundles of the levator veli palatini were also identified and the overlying mucosa and fascia were removed (Figure 2).

Caliper measurements were made of the diameter (lateral extent) of both MU bundles in an area overlying the levator veli palatini at a point midway between the anterior and posterior margins of the levator insertion into the soft palate. This dimension includes both MU bundles which were juxtaposed in the region measured. The diameters of the levator bundles were measured for comparison. These measurements were made at a position midway between the medial extent of the cartilage of the auditory tube and the point of levator insertion into the soft palate for each levator bundle. It should be pointed out that these measurements may deviate somewhat from muscle size in vivo because of fixation artifacts.

After the muscles were measured, the entire soft palate with levator tags was removed and post-fixed in 10% formalin for a few days prior to processing for paraffin embedding and histological sectioning. The soft palate was flattened so that the tip of the uvula and the anterior palatal aponeurosis occupied approximately the same plane. However, a slight curvature remained resulting in some portions of the MU bundles having to be cut more obliquely than other portions. Sectioning proceeded from the dorsal (nasal) surface of the soft palate to the ventral (oral) surface. Serial sections (10 $\mu$) were stained by a variety of histologi-

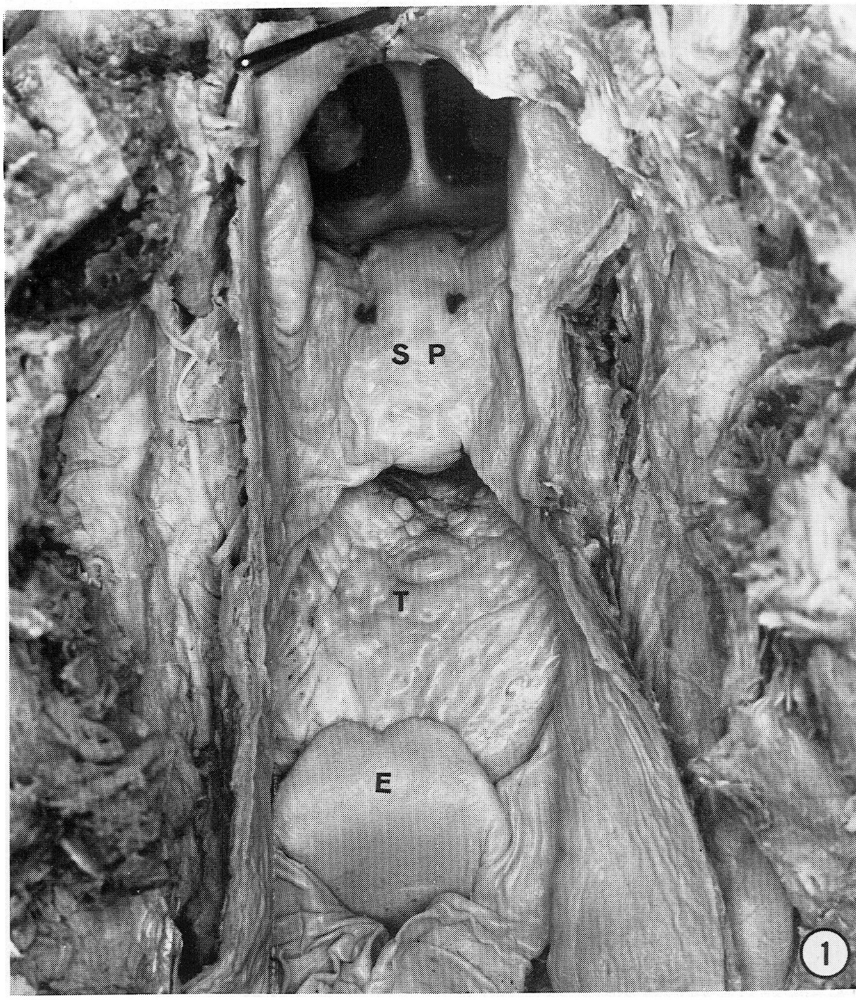


FIGURE 1. Posterior view of the interior of the pharynx. The nasal surface of the soft palate (SP), the dorsum of the tongue (T), and the epiglottis (E) are clearly visible. Note the pairs of dots on the velum marking the anterior and posterior margins of the insertion of the levator veli palatini muscle.

cal methods in an attempt to follow the muscle bundles. These methods included the use of hematoxylin eosin stain for histological details, the periodic acid-Schiff method for staining the salivary glands, the Mallory triple stain to differentiate between muscle and collagenous fibers, and Verhoeff and Van Gieson stain to differentiate muscle from connective tissue elements.

## Results

MACROSCOPIC OBSERVATIONS. In all of the specimens studied MU was found to be a paired structure (Figure 2) composed of two individually

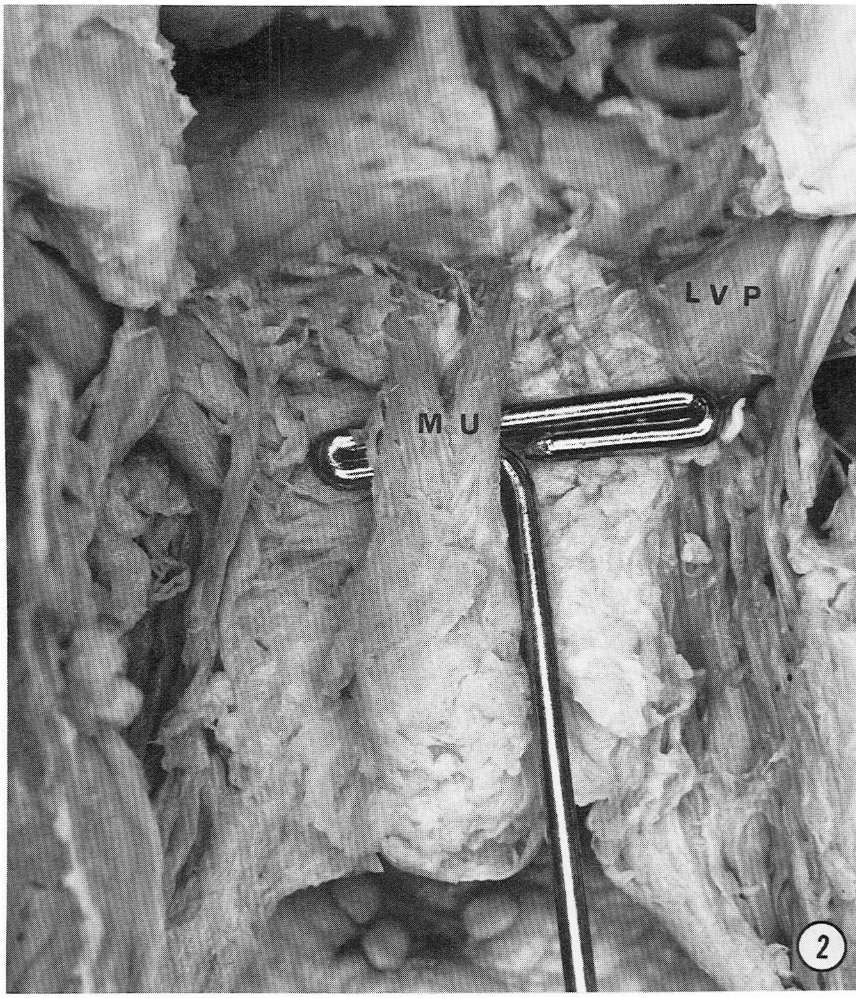


FIGURE 2. The nasal surface of the soft platate after removal of the mucosa from the same specimen as shown in Figure 1. The levator veli palatini (LVP) and the paired bundles of the musculus uvulae (MU) are clearly visible. Note that the blunt probe lies within the fascial plane separating MU from LVP.

identifiable bundles. Each bundle originated compactly from the palatal aponeurosis lateral to the midline in an area approximately one-third the distance between the anterior margin of the levator sling (the region of mutual insertion of the levator bundles into the soft palate) and the posterior border of the hard palate. Therefore, the muscle fibers of MU originated closer to the levator sling than to the posterior nasal spine.

The separate bundles coursed posteriorly and converged medially approximating each other in an area overlying the levator sling. However, a fascial plane separated MU from the levator sling to the extent that a blunt probe could be easily inserted between the two muscles

(Figure 2). Moreover, a median septum also separated the two bundles of MU. Table 1 shows the diameters of MU and of the levator veli palatini bundles. It can be seen that the mean diameter of both MU bundles is almost 6 mm. Although the depth of MU (that is, the distance from the superficial margin to the deep margin) was not measured, a good estimate of this dimension would be 3mm on the average since the bundles were cylindrically-shaped in the area overlying the levator sling. Table 1 also shows that the average diameter of both MU bundles is approximately one-third the average combined diameter of the levator bundles.

After converging, the MU bundles continued their course into the uvula proper. It was found that, within the uvula, MU was not a cohesive bundle. Therefore, it was not possible to determine the point of its insertion from macroscopic examination alone.

MICROSCOPIC OBSERVATIONS. The study of histological sections confirmed the finding stated previously that MU is indeed a paired structure. The muscle fibers of each bundle arise cohesively from the palatal aponeurosis in a circumscribed area posterior to the hard palate. The anterior portion of the velum was found to be void of muscle fibers in agreement with Callender (1939) and Dickson (1972). However, Dickson reported that, in the human fetus, the first muscle fibers posterior to the hard palate are transverse which he attributed to levator veli palatini and/or palatopharyngeus. He observed that the first longitudinal fibers, those of MU, were posterior to the anterior margin of the transverse fibers. In the adult specimens of the present study, the opposite was found. That is, the first muscle fibers observed posterior to the hard palate were those of MU which were oriented in primarily an anterior-posterior direction and somewhat obliquely toward the midline. Posterior to the origin of MU, transverse fibers of the levator sling were observed coursing in a direction perpendicular and deep to fibers of MU.

TABLE 1. Diameters in millimeters of musculus uvulae and levator veli palatini muscles.*

| *specimen* | *musculus uvulae (both bundles)* | *levator veli palatini* | |
|---|---|---|---|
| | | *left* | *right* |
| 1 | 4.8 | 7.8 | 7.2 |
| 2 | 5.8 | 12.4 | 12.6 |
| 3 | 8.3 | 9.6 | 9.8 |
| 4 | 5.9 | – | – |
| 5 | 6.5 | – | – |
| 6 | 4.8 | 8.2 | 7.9 |
| 7 | 5.2 | 7.5 | 7.1 |
| Mean | 5.9 | 9.1 | 8.9 |

* The paired musculus uvulae was measured at a position overlying the levator sling. The right and left levator bundles were measured at a position midway between torus tubarius and the levator insertion into the soft palate.

The two muscle bundles of MU converged in their course toward the uvula, but their individual muscle fibers did not cross to the opposite side (Figure 3).A definite fascial plane separated and surrounded the individual bundles (Figure 4) and eventually diverged as they coursed toward the bulb of the uvula (Figure 5).




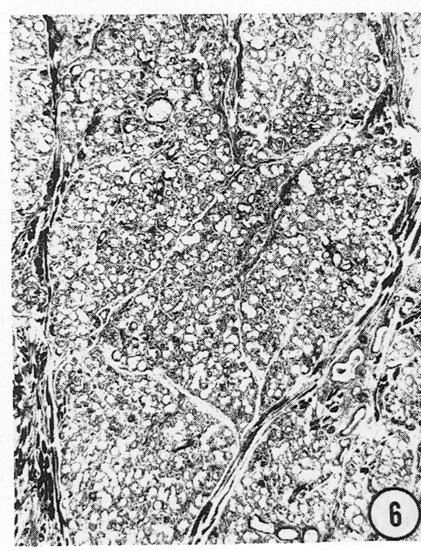


FIGURE 3. The two bundles of musculus uvulae. Note the direction of the individual muscle fibers running parallel to each other and the lack of intermingling between the two bundles. Mallory triple stain; ×20.

FIGURE 4. The two bundles of musculus uvulae in close apposition. Arrow points to the fascial sheath which separates the two bundles. Mallory triple stain; X20.

FIGURE 5. The two bundles of musculus uvulae diverging. Arrow points toward the tip of the uvula. Mallory triple stain, ×20.

FIGURE 6. Fibers of musculus uvulae interspersed among glandular tissue within the uvula. Mallory triple stain, ×20.

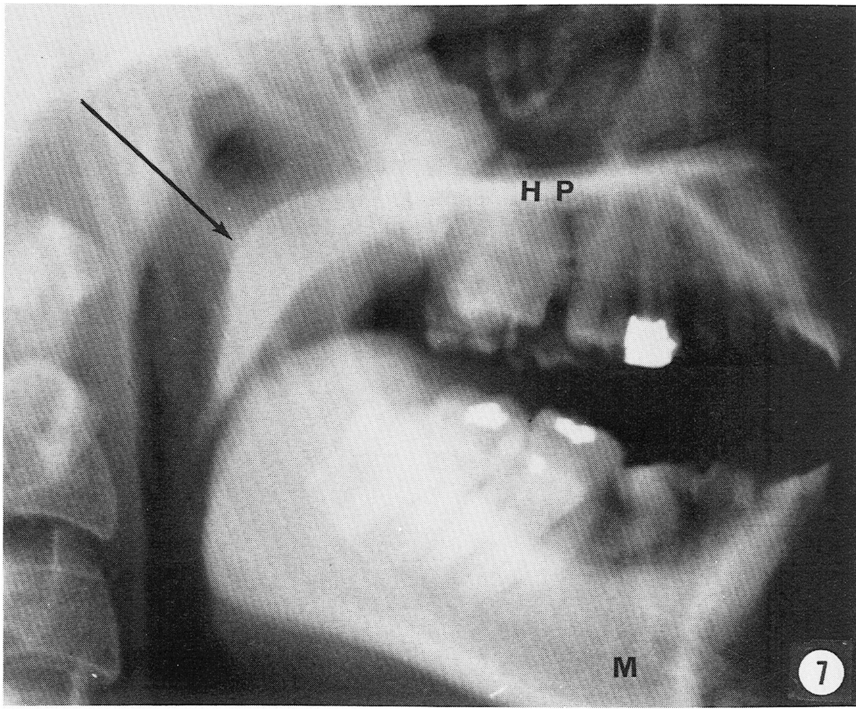


FIGURE 7. Portion of a lateral-view roentgencephalograph of a normal subject with soft palate partially elevated. The arrow points to the region in which MU is in its most cohesive form. This same region is sometimes referred to as the "levator eminence." The hard palate (HP) and mandible (M) are indicated.

Within the uvula, the muscle bundles divided into smaller fascicles, some of which terminated in the connective tissue while others ran all the way to the basement membrane of the mucosa. The bulk of the uvula proper was found to consist largely of glandular nodules between which the muscle fibers interdigitated (Figure 6).

**Discussion**

Although most anatomy texts describe the MU as a paired structure, the term "azygos" continues to be used by some authors in reference to this muscle. In agreement with most other descriptions of this muscle, our gross anatomical and histological results clearly indicate that MU is indeed a paired midline structure. Therefore, it is suggested that the term "azygos" should no longer be used in association with this muscle.

Contrary to most descriptions of the origin of MU, our results show that the muscle does not originate at the posterior nasal spine but rather lateral to it on each side of midline and posterior to the hard palate in an area just anterior to the levator sling. In agreement with Callender (1939) and Dickson (1972), the anterior palatal aponeurosis is a region containing no muscle fibers.

It should be noted that, although MU fibers insert into the uvula as generally described, the bulk of the uvula consists of glandular tissue with diffuse muscle fibers interspersed. The terms "uvula" and "musculus uvulae" should not be used interchangeably especially since the uvula does not encompass the whole of the muscle. Many years ago, the uvula was routinely excised concurrently with tonsillectomy since it was believed that the uvula as well as the tonsils was a primary focus of disease (Proctor, 1960). Apparently no deleterious effects on speech or deglutition result from removal of the uvula alone.

The MU in its most cohesive form lies in an area dorsal to the levator sling and not in the uvula itself. This convex area is indicated by the arrow in Figure 7 and is referred to by some investigators as the "levator eminence." The results of this study suggest that MU contributes substantially to the convexity in this area. Based on direct observations of the nasal surface of the palate reported by Pigott (1969) and the anatomical results of the present study, it would seem that, when the MU is contracted, its primary role is to add bulk to the dorsal surface of the soft palate, which would aid in occlusion of the velopharyngeal portal during speech and deglutition. This would of course be contingent upon properly functioning levator veli palatini muscles to elevate and retract the soft palate so that palate-to-posterior pharyngeal wall apposition would be possible.

Certain cases, such as surgically repaired overt or submucous cleft palates, may present a midline depression on the nasal surface of the soft palate which is perhaps attributable to MU hypoplasia. In such cases, it may be possible to fill this depression with implant material. Placing implant material into this region rather than into the posterior pharyngeal wall has two possible advantages. It would permit more precise localization and, perhaps, better retention.

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