Review Article

Palatopharyngeus the missing palatal muscles: Anatomical and physiological review

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ABSTRACT

The first true anatomical descriptions of the normal anatomy of the palate and pharynx were published by Von Luschka in 1868, and then in 1935 anatomist James Whillis described pharyngeal sphincter. Later, in 1941 Michael Oldfield noted that the muscular elements of the soft palate have a sling-like function. Although there have been conflicting descriptions of the role of the palatopharyngeus, multiple function such as speech, swallowing, and respiration, it could role in all this function. Although, the palatopharyngeus muscle has many important functions, but it remains the missing muscle that we need to know more about it.

Keywords: Anatomy, palatal muscles, palatopharyngeus, physiology

INTRODUCTION

The first true anatomical descriptions of normal anatomy of the palate and pharynx were published by Von Luschka in Germany in 1868,[1] then in 1935 anatomist James Whillis[2] showed that some fibers of the superior constrictor were inserted into the palatal aponeurosis and constituted lamella he referred to it as the palatopharyngeal sphincter. Later, in 1941 Oldfield[3] noted that the muscular elements of the soft palate apart from the uvular muscle consist essentially of four slings these are actually bilateral muscles which affect the sling-like function through their common insertion into the tissues of the soft palate. Superiorly, these muscles are the levator and tensor palatini inferiorly they are the palatoglossus and palatopharyngeus.

Those complex muscular structures, in particular, the interspersion between muscles from the velum, the nasopharynx, and the tongue. The Passavant's pad made of the fused fibers of the palatopharyngeus muscle and pterygopharyngeal portion of the superior constrictor as described by Zemlin in 1968.[4] This fusion leads to a sphincter like behavior as reported by Amelot *et al*. in 2003.[5]

The wide distribution of the palatopharyngeus suggests that it acts not only to elevate the pharynx or depress the soft palate, but also as a nasopharyngeal sphincter at the time of opening or closing the pharyngeal isthmus.[6] This control effect of the muscle (velopharyngeal port opening or closing) was considered with three dimensions radiological reconstruction of pharynx by Serrurier and Badin.[7]

REVIEW AND DISCUSSION

Anatomy

The palatopharyngeus is a muscle of both the soft palate and the pharynx. Anteriorly, the muscle fibers are attached to the hard palate, and posterior fibers are attached to the palatine aponeurosis. The anterior portion of the muscle is separated by the levator veli palatini (LVP).[8] Then the two bundles unite at the

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posterolateral border of the palate and are joined by fibers of the salpingopharyngeus muscle. The palatopharyngeus muscle passes behind the tonsil forming the posterior tonsillar pillar and inserts into the posterior border of the thyroid cartilage.[9] Huang and Lee note that the palatopharyngeus has two components: The velar component consisting of two heads that clasp around and insert into the levator, and the pharyngeal component which inserts into the superior constrictor in the lateral and posterior pharyngeal walls[10] [Figures 1 and 2].

The palatopharyngeus is innervated by the pharyngeal plexus derived from the accessory and vagus nerves.[11] The palatopharyngeus predominantly consists of fast twitch (Type II) fibers, allowing quick contraction of the muscle but potentially making it more susceptible to fatigue if required to contract for prolonged periods of time.[12] According to Fritzell, during contraction of the palatopharyngeus the soft palate moves posteriorly, the posterior faucial pillars are adducted, the lateral walls of the pharynx move medially, and the larynx and pharyngeal walls are elevated.[13] The palatopharyngeus may also assist in increasing the size of the velum, allowing a greater area to make contact with the pharyngeal wall, also contributing to the medial movement of the lateral pharyngeal walls.[10]

PHYSIOLOGY

Role in velopalatal sphincter (speech and swallowing)

Although there have been conflicting descriptions of the role of the palatopharyngeus, the general consensus is that it lowers the soft palate and narrows the pharyngeal cavity by its action on the lateral pharyngeal walls during swallowing and speech.[14] The palatopharyngeus assists the swallowing of food, and it elevates the larynx, which assists in the phonation of high pitched sounds.[15] The synergistic arrangement of palatopharyngeus and superior constrictor are thought to be important in supporting the primary role of LVP in velopharyngeal closure.[14,16,17] The palatopharyngeus is active in the production of oral sounds as well as nasal speech sounds.[13]

Therefore, in 1968 Orticochea[18] described the construction of a "dynamic" pharyngeal muscle sphincter in cleft palate patients by suturing the tips of the lateral flaps, containing palatopharyngeus, on to the superior end of a third low inferiorly based posterior pharyngeal flap. The flaps were not sutured to the posterior pharyngeal wall laterally. A modification of the latter that has gained so much popularity was introduced by Jackson and Silverton in 1977.[19]

Orticochea in 1999[20] believes that movements and functions of the Passavant's sphincter are represented in the brain rather than the muscles. Therefore, the palatopharyngeal muscle that is elevated and relocated into a transverse incision at the posterior pharyngeal wall (sphincteric pharyngoplasty) is considered more physiological in substituting the Passavant's sphincter because it will have the similar cerebral representation and mimics the same pattern of closure.[21]

Role in respiration and obstructive sleep apnea

Palatopharyngeus demonstrate respiratory activity and reflex activation in response to upper airway negative pressure application. The respiratory activity of palatopharyngeus is greatest when nose-breathing in the supine posture. These observations suggest that levator palatini and palatopharyngeus may play a role in the maintenance of upper airway patency. Palatopharyngeus behaves in a similar manner to genioglossus and the other soft palatal muscles, demonstrating phasic respiratory activity and reflex activity in response to upper airway negative pressure.[22] In normal palatopharyngeus muscles, a normal checkerboard pattern of Type I and II fibers was seen under light microscopy when the fibers were stained for myosin ATPase at pH 9.4. However, the muscle fiber changes in specimens from apnea patients showed differentiation between Type I and II fibers, and new types of fibers (Type IIA and IIB) could be identified in these specimens. The disturbance of motor regulation and the change of muscle fiber properties in the dilating muscles of the upper airway may be an important factor in causing abnormal airway collapse seen in patients with obstructive sleep apnea.[23]

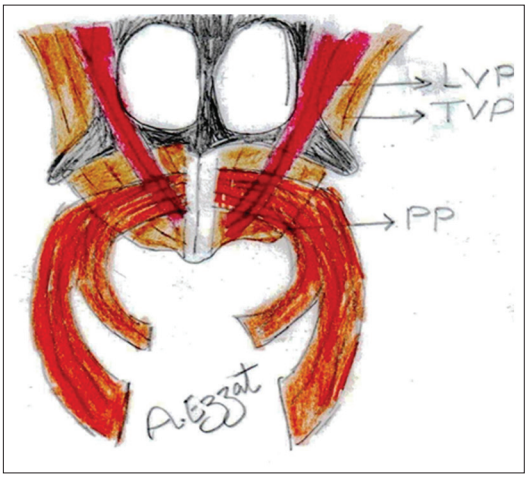

Figure 1: Palatal muscles: (posterior coronal view) LVP, levator palatini; TVP, tensor palatini; PP, palatopharyngeus

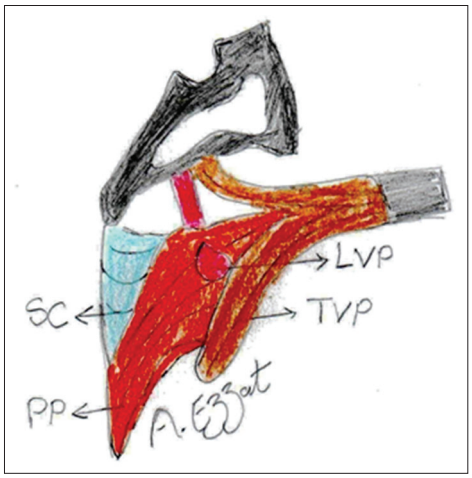

Figure 2: Palatal muscles: (sagittal view from midline). LVP, levator palatini; TVP, tensor palatini; PP, palatopharyngeus; SP, superior constrictor

This suggests several mechanisms which together may compromise the upper airway dilating activity of palatopharyngeus during sleep nasal breathing allowing a retropalatal collapse in sleep apnea/hypopnea syndrome (SAHS) patients.[22] Those include reduced response to negative pressure during sleep of both upper airway muscles[24] and soft palatal muscles.[25] The palatopharyngeus appears to demonstrate a route-dependent response to negative pressure.[26] Yildirim *et al*.[27] also suggested that narrow upper airway combined with the above factors could contribute to retropalatal collapse during sleep in patients with SAHS.

CONCLUSIONS AND RECOMMENDATION

In spite of the importance of the palatopharyngeus muscle in speech, swallowing and respiration, it remains the missing muscle of palate that we need to know more about it.

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Conflicts of interest
There are no conflicts of interest.

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