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Importance of an unclear fascial layer, stylopharyngeal fascia: an anatomical study

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Abstract

Objectives: The stylopharyngeal fascia is an important anatomical structure; however, its exact location and relationship with other neighboring structures have not been clearly demonstrated. Therefore, our aim was to reveal the stylopharyngeal fascia to demonstrate its course and neurovascular relationship in the parapharyngeal space.

Methods: Ten fresh frozen cadaveric necks were dissected through a transparotideal and transcervical approach extending to the parapharyngeal region. All the neurovascular structures and muscles were preserved to demonstrate the stylopharyngeal fascia.

Results: The stylopharyngeal fascia was mostly found on the lateral aspect of the internal carotid artery and could be found by advancing into the plane between the posterior belly of the digastric and stylohyoid muscles at the parapharyngeal space borders. The stylopharyngeal fascia covered not only the parapharyngeal segment of the internal carotid artery but also the cranial nerves X–XII at the parapharyngeal space. The cranial nerve IX coursed laterally to this fascial structure, posterior to the stylopharyngeus muscle in the parapharyngeal space.

Conclusion: Although the stylopharyngeal fascia was previously shown to be related to other neurovascular structures, its anatomical course and histology remain unclear. Moreover, the stylopharyngeal fascia was defined using different nomenclatures in different studies. In this study, the stylopharyngeal fascia was shown to be an important anatomical landmark for dissection at the border of the parapharyngeal space. Further studies investigating its histological structure and defining its proper nomenclature are required. Therefore, we propose the term "parapharyngeal fascia".

Keywords: internal carotid artery; parapharyngeal space; stylopharyngeal fascia

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Introduction

The parapharyngeal space (PPS) is a fascial compartment located in the suprahyoid region of the neck and is surrounded by various important fascial spaces. It is a complex structure that resembles an inverted pyramid, with its superior base at the skull base and inferior apex at the greater horn of the hyoid bone.[1] Inside this complex anatomical compartment located laterally to the pharynx, the cranial nerves IX–XII, cervical sympathetic trunk, internal jugular vein, internal carotid artery, deep lobe of the parotid gland, and lymph nodes are situated.[2–4]

This area, which houses deep-seated and highly significant neurovascular structures, is of great importance in head and neck surgical practice for interventions related to infectious, tumoral, and trauma-related pathologies.[5] Tumors located in this area constitute approximately 0.5% to 1% of head and neck cancers and are primarily treated surgically.[6] Surgery for pathologies located in the parapharyngeal space is challenging because of the potential damage that may occur in the adjacent neurovascular structures. The risk of complications associated with neurovascular structures after surgery is reportedly between 55% and 75%.[7]

The PPS is traditionally divided into prestyloid and poststyloid compartments, and the presence of different anatomical structures within these compartments is important for approaching pathologies in this area.[3] The

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deep lobe of the parotid gland and adipose tissue are located in the prestyloid compartment, whereas the internal carotid artery (ICA), internal jugular vein (IJV), sympathetic trunk and cranial nerves IX–XII are present in the poststyloid compartment.[8] The division of the PPS into anterolateral (prestyloid) and posteromedial (retrostyloid) spaces by the stylopharyngeal fascia (SPF) is crucial for understanding its detailed anatomy and clinical relevance.[9]

According to an anatomical study, SPF covers the parapharyngeal segment of the ICA, IJV, and cranial nerves IX–XII. By incising this fascia, the parapharyngeal segment of the ICA was revealed.[10] Through detailed exploration, we aim to provide further insights into the anatomy of the SPF to facilitate clinical applications and surgical procedures in this challenging region.

Materials and Methods

Ten neck regions of five fresh frozen cadavers were meticulously dissected at the Anatomy Department of Ankara University Faculty of Medicine. A modified Blair incision was made extending to the midline of the neck and 3 cm below the mandible. After the skin incision, a subplatysmal flap was raised. Routine superficial parotidectomy was performed and the main trunk of the facial nerve was identified.

After the sternocleidomastoid muscle and posterior belly of the digastric muscle were identified, an incision was made through the anterior border of the investing fascia of the sternocleidomastoid muscle. The posterior belly of the digastric muscle was then seen on the same plane as the stylohyoid muscle, and the surface of the fascial plane between these two muscles was dissected. At the point where the fascial plane reached the carotid sheath, the carotid sheath was opened and structures such as IJV, vagal nerve, and ICA were identified. Hypoglossal nerve was observed on the lateral aspect of the external carotid artery (ECA). Branches of the ECA and accessory nerve located deep in the fascial plane were dissected. After following the stylohyoid muscle, the styloid process was palpated. Dissection was advanced into the PPS using the described SPF. The fascial plane was followed by to the stylopharyngeus muscle. In this area, glossopharyngeal nerve and adipose tissue was identified.

Results

After identifying the posterior belly of the digastric and stylohyoid muscles, the fascial plane was seen to continue between these two muscle (**Figure 1**). This fascia was attached to the carotid sheath inferiorly and extended superiorly to the skull base. Moreover, this fascial structure extended from the posterior aspect of the styloid process to the posterior border of the stylopharyngeus muscle. On the surface of this facial compartment, anterior to the styloid process, the fatty tissue of the parapharyngeal space was observed.

In this region, the cranial nerves X–XII originated from the skull base and the parapharyngeal segment of the ICA and IJV was covered by this fascial plane. The parapharyngeal segment of the ICA was located in the deepest position compared to the other neurovascular structures mentioned. In all cadavers, the glossopharyngeal nerve coursed lateral to the fascial plane posterior to the stylopharyngeus muscle (**Figures 2** and **3**).

In addition, the occipital artery and ascending pharyngeal artery, which are posterior branches of the ICA, were also observed to be covered by this fascia. Dissection was advanced along this fascial plane, and as we proceeded medially along the fascial plane, we demonstrated that the SPF enveloped not only the parapharyngeal segment of the ICA, but also the cranial nerves X–XII within the PPS (**Figure 4**).

Discussion

The traditional division of the PPS has been analyzed in different studies using different nomenclature. The presthyloid compartment contains the retromandibular part

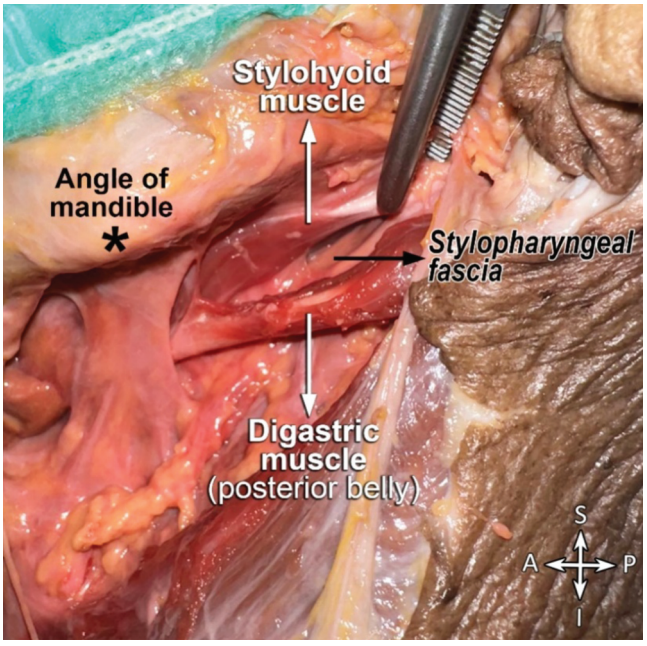

Figure 1. Stylopharyngeal fascia between stylohyoid and posterior belly of digastric.

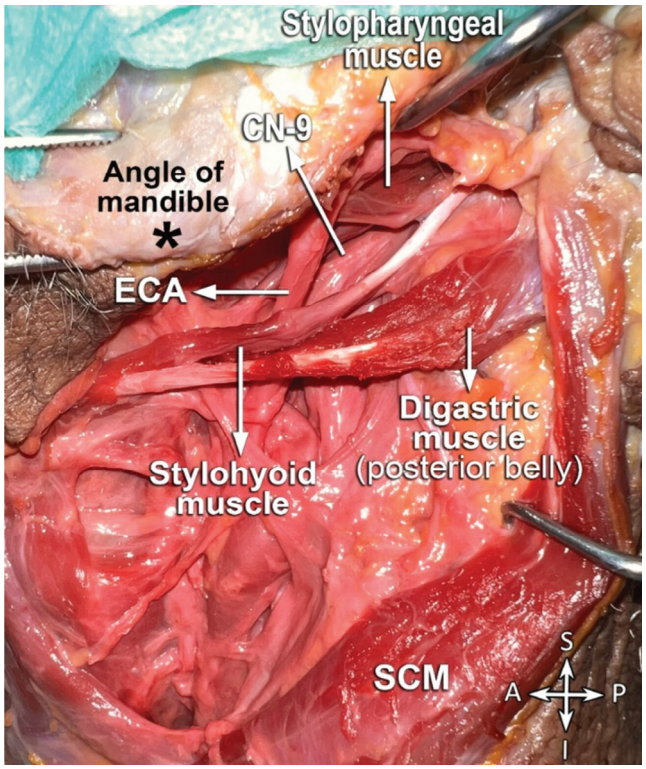

Figure 2. Glossopharyngeal nerve on the lateral aspect of the fascial plane. **CN-9:** glossopharyngeal nerve; **ECA:** external carotid artery; **SCM:** sternocleidomastoid muscle.

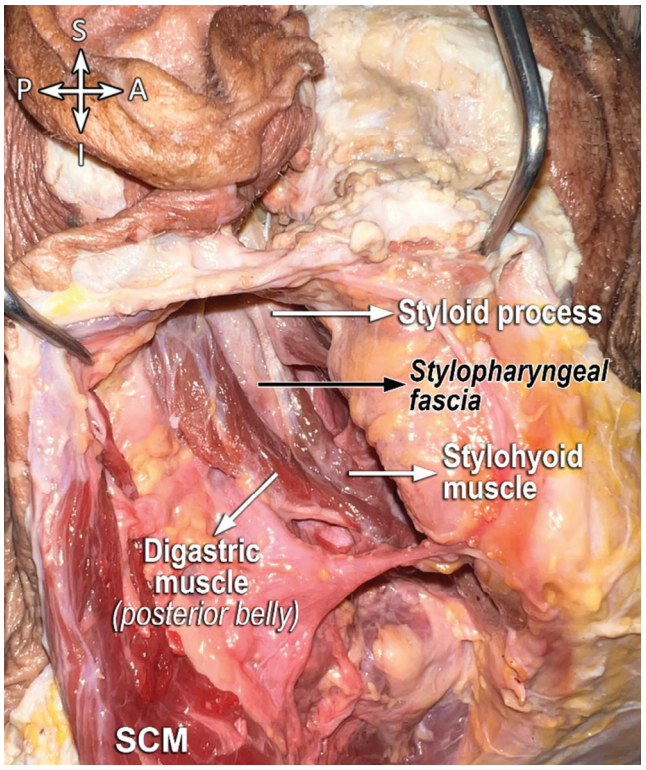

Figure 3. Stylopharyngeal fascia envelops the cranial nerves X-XII at the parapharyngeal space. **SCM:** sternocleidomastoid muscle.

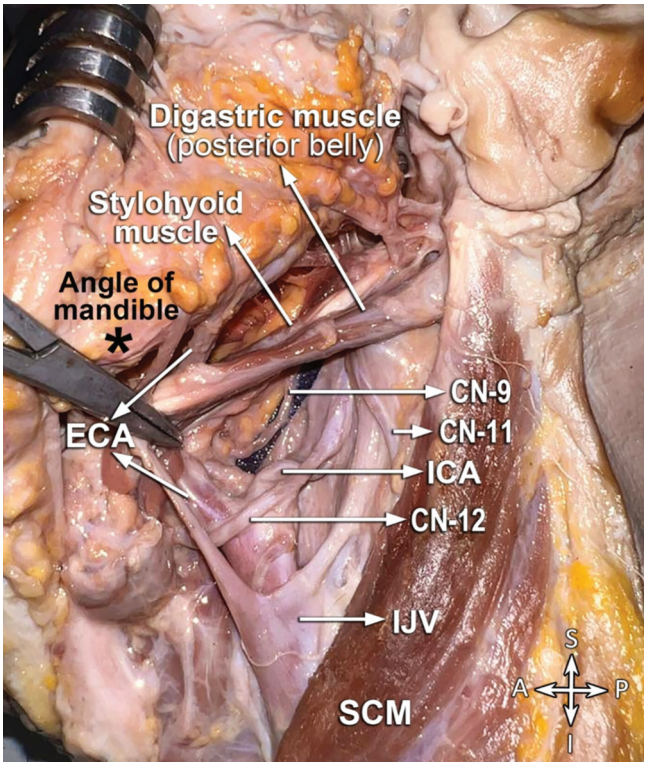

Figure 4. Anatomical structures that can be encountered when moving medially along the fascial plane. **CN-9:** glossopharyngeal nerve; **CN-11:** accessory nerve; **CN-12:** hypoglossal nerve; **ECA:** external carotid artery; **ICA:** internal carotid artery; **IJV:** internal jugular vein; **SCM:** sternocleidomastoid muscle.

of the parotid gland, adipose tissue and lymph nodes. The ICA, IJV sympathetic trunk, cranial nerves IX–XII and lymph nodes are located.[3,4]

According to Lopez et al.,[4] the fascia extending from the posterior aspect of the styloid process towards the tensor veli palatini muscle, named 'tensor vascular styloid fascia' divided the PPS into the prestyloid or anterolateral compartment and the posteromedial or retrostyloid compartment.

Kawai et al.[11] noted a structure named 'styloid diaphragm' dividing the PPS into prestyloid and poststyloid compartments. The styloid diaphragm is described as an anteroinferiorly coursing fibrous band containing the posterior belly of the digastric muscle, stylohyoid muscle, styloglossus muscle, stylopharyngeus muscle, stylohyoid ligament, and stylomandibular ligament. Additionally, it is mentioned that the styloid diaphragm covers the distal cervical part of the ICA, IJV, cranial nerves IX–XII,and the ECA and its branches pass through this structure. Therefore, it is mentioned that the structure of the styloid diaphragm is not continuous.[11]

Komune et al.[12] demonstrated a fascial plane covering the ICA from the inferior border of the tensor veli palatini muscle and including the levator veli palatini muscle, a small part of which was defined as SPF. In another study, tensor vascular styloid fascia structures, defined as layers of the carotid sheath, merged with the SPF as they covered the ICA below the skull base.[13] Varoquaux et al.[9] named the anatomical structure separating the prestyloid and retrostyloid compartments of the PPS as the 'stylopharyngeal fascia'. SPF was defined as a structure extending from the styloid process to the tensor vascular styloid fascia.

In a study by Soriano et al.,[10] excision of prestyloid adipose tissue revealed posterolateral localisation of the styloglossus and stylopharyngeus muscles. Medial to this styloid muscle group is a white-grey fibrous structure called the stylopharyngeal fascia. The styloid muscles and the stylopharyngeal fascia cover the parapharyngeal segment of the ICA, IJV and cranial nerves IX–XII in the poststyloid compartment. When this fascial structure is cut, the parapharyngeal segment of the ICA is exposed and it is seen that it is covered by this fascial structure up to the carotid canal at the skull base.

According to our study, the SPF is located between the posterior belly of the digastric muscle and the stylohyoid muscle and extends inferiorly from the carotid sheath towards the skull base. This fascial structure extends from the posterior aspect of the stylohyoid process to the posterior border of the styloopharyngeus muscle and its surface is covered with adipose tissue anterior to the stylohyoid process. As the fascial plane exits the skull base, it covers the X–XII cranial nerves and the parapharyngeal segment ICA and IJV. The parapharyngeal segment of the ICA is located in a deeper position compared to other neurovascular structures, indicating its relative depth within the anatomical space. The glossopharyngeal nerve runs continuously lateral to the facial plane, parallel to the posterior border of the stylopharyngeal muscle. Our observations also revealed that the occipital and ascending pharyngeal arteries, the posterior branches of the ECA, were covered by this fascial structure.

During the lateral approach from the neck, as we proceeded anteromedially between the posterior belly of the digastric muscle and the stylohyoid muscle, we encountered a compact fascial structure extending across the parapharyngeal space that could not be dissected into separate layers. This fascial plane appeared as a fascial structure encircling the parapharyngeal segment of the internal carotid artery deep in the fatty tissue of the parapharyngeal space. Injury to the parapharyngeal segment of the internal carotid artery is among the most lethal complications that can occur during surgical procedures within the borders of the PPS.[14,15] According to previous studies, the risk of injury to the parapharyngeal segment of the internal carotid artery in open surgical approaches is between 3–8%.[16] Therefore, it is of great importance to have reliable anatomical markers that reveal the parapharyngeal segment of the internal carotid artery during surgical approaches in or around this region.

We believe that this fascial plane enables the spread of deep neck infections and the formation of abscesses in this area to be easily, quickly, and safely drained. Also, mass excisions performed in this area can be carried out more safely by considering the proximity of the described neurovascular structures to the fascia.

The diverse nomenclature and varied descriptions of the anatomical structure traditionally divided into the PPS present a challenge in anatomical studies. While previous studies have designated this structure as the stylopharyngeal fascia, tensor vascular styloid fascia, and other terms, inconsistencies in naming persist across the studies mentioned above. We propose to term as the "parapharyngeal fascia" emphasizing its consistent localization and extensions in fresh frozen cadavers, distinct from the previously described fascial layers. In our recent dissections, specifically conducted on fresh frozen cadavers, we observed a lack of clearly delineated fascial layers distinguishing this structure, reinforcing the need for a simplified designation. Given its vital role in safeguarding essential structures such as the parapharyngeal segment of the ICA, we advocate the adoption of the term "parapharyngeal fascia" to replace the complex nomenclatures utilized in prior studies.

Conclusion

We believe that this study provides valuable information about the complex anatomical arrangements within the PPS and emphasises the importance of understanding these structures for surgical intervention and diagnostic approaches targeting the PPS. The consistent presence of the SPF spanning important structures such as the parapharyngeal segment of the ICA and cranial nerves X–XII emphasises its importance as a key anatomical landmark. Further investigation of the histological aspects and standardisation of nomenclature is needed to better understand this fundamental anatomical entity for clinical applications. By proposing the term 'Parapharyngeal Fascia', we aim to improve clarity and facilitate better communication in future anatomical research and surgical practice.

Future research should focus on examining the histological composition and functional effects of the SPF within the PPS in more depth. The fascial structure extending to the skull base, which we observed in our study not to be

composed of separate and distinct layers, can be examined in more detail using endoscopic approaches.

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Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

PSO: project development, data collection, manuscript writing; AB: data collection, manuscript writing; HİA: Project development, manuscript editing.

Ethics Approval

The ethical approval for this study has been granted on by the University of Ankara Ethical Committee (November 2021, approval number: 19-615-21).

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