



## Posterior belly of the digastric muscle: An important landmark for various head and neck surgeries

Vrinda Hari Ankolekar, Anne D. Souza, Rohini Alva, Antony Sylvan D. Souza, Mamatha Hosapatna

### ABSTRACT

**Objectives:** The digastric muscle is an important landmark in head and neck surgeries. Important neurovascular structures such as the spinal accessory and hypoglossal nerves (HNs), internal jugular vein (IJV) and internal carotid artery lie deep to the posterior belly of digastric (PBD); the study relating to it deserves special mention in anatomical literature. Therefore, the present study aims to describe the PBD in relation to the essential anatomical landmarks.

**Materials and Methods:** This study was carried out using 10 cadavers preserved in 10% formalin. The midpoint of IJV in the neck was identified as the point between the angle of the mandible and midclavicular point. The anatomical landmarks considered for measuring the parameters were tip of the mastoid process (TMP), loop of HN, midpoint of IJV, bifurcation of common carotid artery (CCA) and the midpoint of PBD. Various parameters were measured using the digital calipers.

**Results:** The length of PBD was  $3.77 \pm 1.08$  cm on right and  $3.15 \pm 0.05$  cm on left side indicating slightly longer belly on the right. The extended length did not vary much on both the sides, which were  $6.7 \pm 1.23$  cm on right and  $6.7 \pm 0.75$  cm. The HN crossed PBD  $2.72 \pm 0.8$  cm anterior to the TMP on right side, while on left side it was situated  $2.1 \pm 0.57$  cm anterior to TMP. The distance between the midpoint of PBD and of IJV was  $6.58 \pm 0.99$  cm on right side, whereas it was  $6.1 \pm 0.96$  cm on left side. The distance between the midpoint PBD and bifurcation of CCA was  $3.04 \pm 0.61$  cm on right and  $2.78 \pm 0.74$  cm on left side.

**Conclusion:** As the PBD muscle is an important surgical landmark, the present study adds to the existing knowledge about it. The present study has also included few newer landmarks, which were not given importance in the previous studies.

**Key words:** Carotid arteries, hypoglossal nerve, internal jugular vein, posterior belly of digastric muscle

### Introduction

The digastric muscle is an important landmark in head and neck surgeries. It has two bellies with separate embryological origins and innervations. The digastric muscle is located in the anterior region of the neck, and its bellies are the limits of the submandibular (digastric), submental, and carotid triangles. The posterior belly of the digastric (PBD) muscle originates at the mastoid process, and runs down and forward toward the hyoid bone [1,2]. The important neurovascular

structures, such as the spinal accessory and hypoglossal nerves (HNs), internal jugular vein (IJV), and common carotid artery (CCA) are intimately related to the posterior belly; thus studies about them deserve special attention in anatomical literature [3]. Radical suprahyoid neck dissections are often required to remove metastatic lymph nodes in the carcinoma involving the floor of the mouth. In such dissections, PBD serves as a useful landmark [4]. Any interventional surgery or radiological procedure in this region requires precise

knowledge of the anatomy of this region. In addition, some clinicians recommend palpation of the PDB in cases of temporomandibular disorders [5].

During the surgery, the PBD is the most easily identifiable landmark for facial nerve dissection during parotidectomy, with a consistent anatomical relationship with the facial nerve trunk [6]. Numerous studies pertaining to the anterior belly of the muscle are available, whereas studies on the PBD are limited. Therefore, the goal of the present study was to add to the existing knowledge about this region.

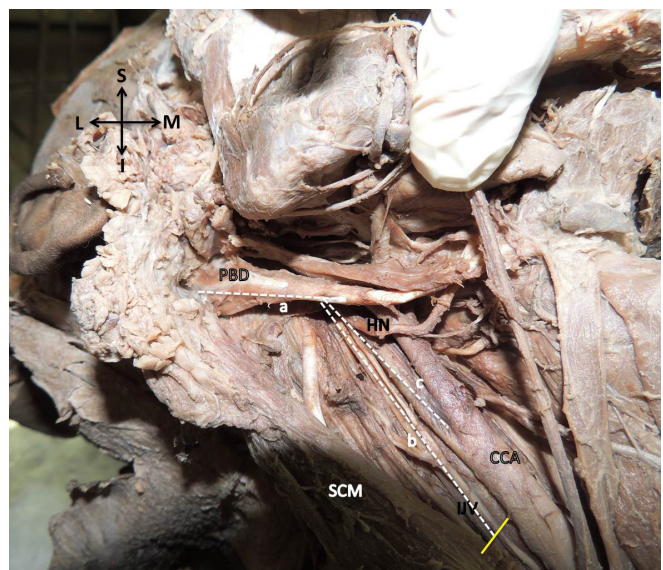
### Materials and Methods

This study was carried out in the Department of Anatomy, Kasturba Medical College (Manipal, India) using 10 cadavers (20 sides of the neck) preserved in 10% formalin. The sternocleidomastoid muscle was retracted to visualize the PBD from the tip of the mastoid process (TMP). The midpoint of the IJV in the neck was identified as the point between the angle of the mandible and the midclavicular point. This parameter was considered in the study because of the close relationship of the IJV to the jugulo-digastric and jugulo-omohyoid group of lymph nodes, which are commonly resected during radical neck dissection. Since there are no bony landmarks around the HN, anatomical landmarks such as the PBD, internal carotid artery, and IJV are used in surgeries involving this nerve [7]. Because the hyoid bone is an important landmark in this region, attachment of the intermediate tendon of the digastric at the junction of the body with the greater cornu of the hyoid bone was performed as a novel technique to extend the length of the PBD.

The anatomical landmarks considered for measuring the parameters were the TMP, the loop of the HN, the midpoint of the IJV, bifurcation of the CCA and the midpoint of the PBD. The measured parameters are shown in Figures 1 and 2 and were as follows: (1) Length of the PBD (length of the fleshy part of the muscle); (2) Extended length of the PBD measured from the TMP to the junction of the body and greater cornu of the hyoid bone; (3) Midpoint of the IJV to midpoint of the PBD; (4) Bifurcation of the CCA to midpoint of the PBD; and (5) TMP to the posterior end of the HN loop. The midpoint of the PBD is the midpoint between the TMP to the junction of the body and greater



**Figure 1.** Parameters measured in the PBD muscle. PBD: Posterior belly of the digastric muscle, HB: Hyoid bone, TMP: Tip of the mastoid process, HN: Hypoglossal nerve, a: Length of the PBD, b: Extended length of the PBD.



**Figure 2.** Relationship between the PBD and essential anatomical landmarks. PBD: Posterior belly of the digastric muscle, HN: Hypoglossal nerve, CCA: Common carotid artery, IJV: Internal jugular vein, a: Distance between the tip of the mastoid process to crossing of the HN, b: Distance between midpoint of IJV to midpoint of PBD, c: Distance between bifurcation of CCA to midpoint of PBD, Yellow line: Midpoint of IJV (i.e., midpoint between angle of mandible and midclavicular point).

cornu of the hyoid bone. The distances were measured using digital calipers, and statistical analysis of the data was carried out using SPSS version 16.

### Results

The length of the PBD was  $3.77 \pm 1.08$  cm on the right and  $3.15 \pm 0.05$  cm on the left, indicating a slightly longer belly on the right side. The extended length did not vary much on both sides, with measurements of  $6.7 \pm 1.23$  cm and  $6.7 \pm 0.75$  cm on the right and left sides,

respectively. The HN crossed the PBD  $2.72 \pm 0.8$  cm anterior to the TMP on the right side, whereas on the left side it was situated  $2.1 \pm 0.57$  cm anterior to the TMP. The distance between the midpoint of the PBD and of the IJV was  $6.58 \pm 0.99$  cm on the right side and  $6.1 \pm 0.96$  cm on the left side. The distance between the midpoint of the PBD and bifurcation of CCA was  $3.04 \pm 0.61$  cm on the right and  $2.78 \pm 0.74$  cm on the left side. There was no significant difference between the values of the right and left sides.

### Discussion

Since 1847, there have been descriptions of anatomical variations in the digastric muscle as pointed out by Bergman et al. [3]. In temporomandibular disorders, palpation of the PBD is a mandatory procedure. An anomalous posterior belly may lead to perplexing situations while diagnosing these disorders [5]. In this study, the length of the PBD was  $3.77 \pm 1.08$  cm on the right side and  $3.15 \pm 0.05$  cm on the left side. In a study by Shin et al., the length of the PBD was  $6.22 \pm 0.60$  cm and  $5.29 \pm 0.72$  cm on the right and left sides, respectively. It was also noted that the length of the PBD was longer in females than in males [7].

There is very limited literature available on the extended length of the PBD. The extended length was measured from the TMP to the junction of the body and greater cornu of the hyoid bone, and was  $6.7 \pm 1.23$  cm on the right side and  $6.75 \pm 0.75$  cm on the left side. These parameters may help radical suprahyoid neck procedures designed to remove metastatic lymph nodes in carcinoma involving floor mouth. In such dissections, PBD serves as a useful landmark [8]. The present morphometric study of PBD is relevant to the interpretation of radiological and surgical explorative procedures.

In the present study, the HN crossed the PBD  $2.72 \pm 0.8$  cm anterior to the TMP on the right side, whereas it was situated  $2.1 \pm 0.57$  cm anterior to the TMP on the left side. Shin et al. found that the HN appeared under the PBD, and the crossing point corresponded to about 65.5% of the whole length of the PBD from the digastric groove [7]. These parameters may be given consideration in surgical procedures in the neck region, especially in relation to submandibular gland resection, since this muscle and its tendon are anatomical refer-

ence points during operations [9].

The distance from the midpoint of the IJV to the PBD was  $6.58 \pm 0.99$  cm on the right side and  $6.1 \pm 0.96$  cm on the left side. The study done by Hinsley et al. found that transition of the spinal accessory nerve from the lateral to medial occurred high in the neck and deep in the PBD. Dissections at or above the level of the digastric muscle, where operating deep to the IJV may place it at risk to nerve injury. Therefore, it is necessary to recognize the morphometric anatomy of the digastric muscle in order to avoid complications to the IJV and spinal accessory nerve during therapeutic procedures [10]. The distance from the bifurcation of the CCA to the midpoint of the PBD was  $3.04 \pm 0.61$  cm and  $2.78 \pm 0.74$  cm on the right and left sides, respectively. Considering the complicated anatomy of the cervical and submandibular regions, the use of only one surgical landmark is not recommended. The PBD represents a good landmark during the submandibular dissection to identify the HN, facial nerve, and spinal accessory nerves [11-13].

A limitation of this study was that it was difficult to trace the facial and spinal accessory nerves in relation to the PBD. The present study is a preliminary attempt to determine the anatomy of the PBD with respect to important surgical landmarks. Using these novel parameters, further studies should be done using fresh specimens.

### Conclusions

Since the PBD is an important surgical landmark, the present study adds to the existing knowledge about it. The present study also included a few novel landmarks that were not focused on in previous studies.

### Conflict of interest statement

The authors have no conflicts of interest to declare.

### References

1. Ziolkowski M, Marek J, Klak A. The human digastric muscle in the fetal period. *Folia Morphol* (Warsz) 1984;43:243-9.
2. Larsson SG, Lufkin RB. Anomalies of digastric muscles: CT and MR demonstration. *J Comput Assist Tomogr* 1987;11:422-5.
3. Bergmann RA, Afifi AK, Miyauchi R. Muscular system: Alphabetical listing of muscles: D. Available from: <http://www.anatomyatlases.org/Anatomic>



Variants/MuscularSystem/Text/D/06Digastricus.shtml. [Last accessed on May 06 2014].

4. Mehta V, Gupta V, Arora J, Yadav Y, Suri RK, Rath G, et al. Bilateral bipartite origin of the posterior belly of digastric muscle: A clinico-anatomical appraisal. *Int J Exp Clin Anat* 2011;5:44-7.
5. Türp JC, Arima T, Minagi S. Is the posterior belly of the digastric muscle palpable? A qualitative systematic review of the literature. *Clin Anat* 2005;18:318-22.
6. Saha S, Pal S, Sengupta M, Chowdhury K, Saha VP, Mondal L. Identification of facial nerve during parotidectomy: A combined anatomical & surgical study. *Indian J Otolaryngol Head Neck Surg* 2014;66:63-8.
7. Shin DS, Bae HG, Shim JJ, Yoon SM, Kim RS, Chang JC. Morphometric study of hypoglossal nerve and facial nerve on the submandibular region in Korean. *J Korean Neurosurg Soc* 2012;51:253-61.
8. Suen JY, Stern SJ. Cancer of neck. In: Myers EN, Suen JY, editors. *Cancer of Head and Neck*. WB Saunders Co, Philadelphia, 1996;462-84.
9. Liquidato BM, Barros MD, Alves AL, Pereira CS. Anatomical study of the digastric muscle: Variations in the anterior belly. *Int J Morphol* 2007;25:797-800.
10. Hinsley ML, Hartig GK. Anatomic relationship between the spinal accessory nerve and internal jugular vein in the upper neck. *Otolaryngol Head Neck Surg* 2010;143:239-41.
11. Asaoka K, Sawamura Y, Nagashima M, Fukushima T. Surgical anatomy for direct hypoglossal-facial nerve side-to-end "anastomosis". *J Neurosurg* 1999;91:268-75.
12. Vacher C, Dauge MC. Morphometric study of the cervical course of the hypoglossal nerve and its application to hypoglossal facial anastomosis. *Surg Radiol Anat* 2004;26:86-90.
13. Martins RS, Socolovsky M, Siqueira MG, Camp-ero A. Hemihypoglossal-facial neuroorrhaphy after mastoid dissection of the facial nerve: Results in 24 patients and comparison with the classic technique. *Neurosurgery* 2008;63:310-6.