Bilateral Accessory Clavicular Heads of Sternocleidomastoid Stenosing Supraclavicular Fossa in Human: Case Report

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Abstract: The sternocleidomastoid muscle (SCM) is an important landmark for many clinical procedures performed in the neck. Typically, the SCM consists of two heads of origin, sternal and clavicular. We came across bilateral accessory clavicular fibers of the SCM having extended attachment up to the middle third of the clavicle in an elderly cadaver. On the right side, the accessory fibers formed a distinct, separate belly in the form of cleidooccipital muscle. On the left side, four clavicular heads of SCM were observed, which were partially separated from each other. The presence of accessory clavicular fibers may stenose supraclavicular fossa. Additionally, the SCM with accessory clavicular fibers is not a reliable surface landmark and hence may pose difficulties in important procedures in the region such as central venous catheterization.

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Introduction

The sternocleidomastoid muscle (SCM) is a key muscle of the neck bordering the anterior triangle from the posterior triangle. The SCM is also an important surface landmark in the neck. As the name implies, it has three distinct attachments, namely the sternal, clavicular and mastoid. The inferior attachments are from the sternum and the clavicle, and superior attachment extends onto the mastoid process of the temporal bone as well as the lateral part of the superior nuchal line of the occipital bone (Standring, 2016; Silawal et al., 2022). The rounded, tendinous sternal head arises from the ventral surface of the manubrium and adjoining capsule of sternoclavicular joint which then merges with the flat clavicular head arising from the superior aspect of the medial third of the clavicle. A rounded muscle belly thus forms and ascends laterally upwards (Standring, 2016; Byrd et al., 2022). The muscle is thick and narrow centrally, and broader and thinner at superior and inferior ends. The clavicular head spirals and blends with the sternal head in the middle of the neck and forms a thick round muscle belly. The usual pattern of arrangement is superficial obliquely directed sternal fibers attached to the occiput and the deep clavicular fibers attached on to the mastoid process. The muscle fibers thus have cruciate and spiralized fiber arrangement and therefore the pull of the two heads are different (Standring, 2016). Anteriorly the muscle is related to the carotid arteries, the internal jugular, facial and lingual veins, the deep cervical group of lymph nodes, the vagus nerve and the branches of the ansa cervicalis (Nayak et al., 2006; Standring, 2016). The important posterior relation of the muscle is the accessory nerve appearing just below the middle of the posterior border. The spinal root of the accessory nerve provides motor innervation to the SCM and trapezius muscles, and branches of the cervical plexus provide proprioceptive afferents. Clinical evidence also suggests that some of the branches of the cervical nerves may be motor to the muscle (Standring, 2016).

Based on the fiber arrangement, the SCM has been subdivided into several distinct parts, viz. the sternomastoid, cleidomastoid, sternooccipital and cleidooccipital (Natsis et al., 2009). The sternomastoid portion of the muscle is clearly distinguishable from the cleidomastoid portion in lower mammals only (Mehta et al., 2012). The SCM plays an important role in execution of various head movements and is crucial for maintaining the steadiness of the cervical spine (Byrd et al., 2022). SCM also acts as a short-range and long-range rotator of the neck through its clavicular and sternal fibers respectively (Kim et al., 2015). In addition to this, it also flexes the cervical as well as the thoracic vertebrae and acts as an accessory muscle in deep inspiration (Nayak et al., 2006). Morphological variations of the sternal and clavicular heads of the SCM, including several patterns of accessory clavicular head, have been described in erstwhile reports (Nayak et al., 2006). We report here a rare anatomical variation of SCM wherein bilateral broad and extensive attachment of the clavicular head of SCM has been observed.

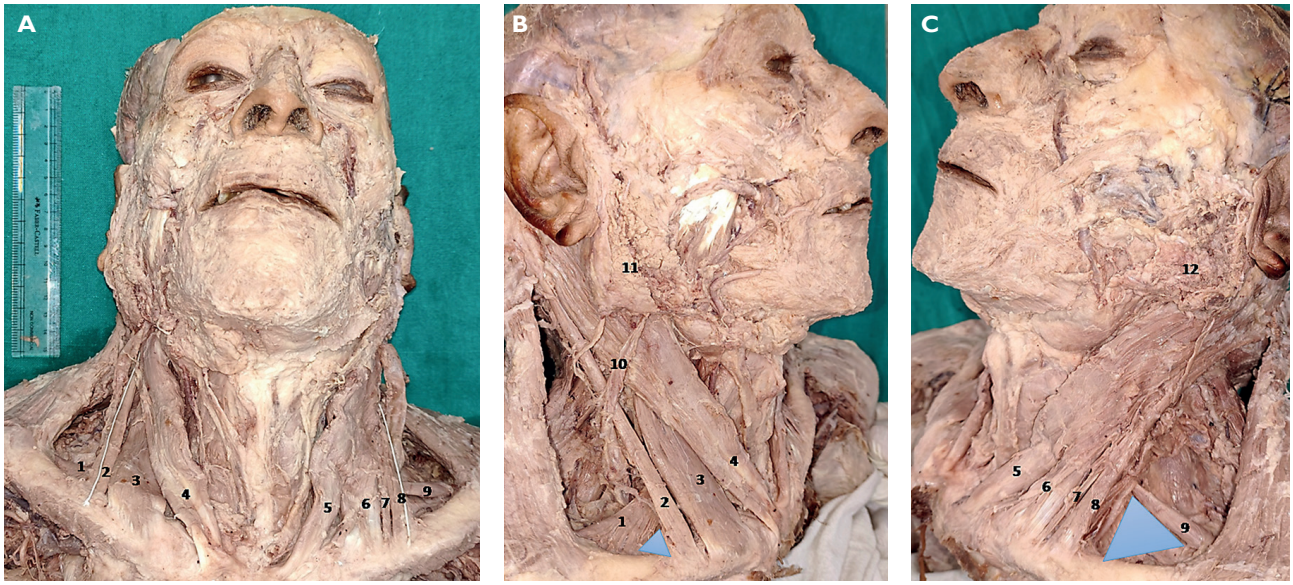

Figure 1(A–C): Dissected triangles of the neck; 1 – right omohyoid muscle (inferior belly); 2 – cleidooccipital fibers of the right sternocleidomastoid muscle (SCM); 3 – main clavicular head of the right SCM; 4 – sternal head of the right SCM; 5 – sternal head of the left SCM; 6 – main clavicular head of the left SCM; 7, 8 – cleidooccipital fibers of the left SCM; 9 – left omohyoid (inferior belly); 10 – right external jugular vein; 11 – right parotid gland; 12 – left parotid gland; blue shaded areas on either side depict the dimension of the supraclavicular fossae. The white cotton thread placed over the lateral edges of the cleidooccipital fibers for taking the measurements.

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Case report

The neck region of a male cadaver aged 70 years was dissected following standard steps, and the findings were recorded and photographed. There were bilateral variations of the clavicular fibers of the SCM. The SCM on the right side had an extra clavicular head originating from the superior surface of the middle third of the clavicle located lateral to the main clavicular head. The dimensions of the extra clavicular head on the right side were 8.5×1.2 cm. The clavicular head ascended obliquely and laterally upwards to gain attachment on the superior nuchal line as a separate cleidooccipital muscle lateral to the attachment of the main belly of the SCM (Figure 1A and B). The nerve point corresponding to the emergence of superficial cutaneous branches of the cervical plexus and spinal accessory nerve was observed along the posterior border of the cleidooccipital muscle (Figure 1A and B). On the left side, four separate bundles of the clavicular fibers were observed, which did not appear as distinct individual heads, but were organized in different fascicles at the root of the neck. The widths of the four heads at its clavicular origin were 2.6 cm, 3.2 cm, 0.4 cm and 2.1 cm respectively from medial to lateral aspect respectively (Figure 1A and C). These four fascicles of the SCM merged into a single belly at the level of the upper border of the cricoid cartilage, and then ascended laterally upwards and attached on the lateral part of the superior nuchal line. In addition to that, the right external jugular vein was observed to be lying deep to the investing layer of the deep cervical fascia and passed deep to the investing layer at the level of midpoint of the posterior border of the SCM (Figure 1A).

Discussion

There is considerable variation in the extent and manner in which the heads of the SCM originate, fuse and arrange (Saha et al., 2014). Prevalence of supernumerary clavicular heads of SCM is up to 33% (Kim et al., 2015; Tubbs et al., 2016). The cleidooccipital muscle is a distinct entity from the main clavicular heads as observed on the right side of the cadaver. Such a case is extremely rare in occurrence and therefore clinically relevant because it can stenose the supraclavicular fossa (Raikos et al., 2012; Tubbs et al., 2016). The width of the any variant of the clavicular head of SCM is variable, and it can have attachment anywhere from sternal end to the acromial end (Tubbs et al., 2016). Slips from the SCM can get attached to a variety of neighbouring structures such as the cervical vertebrae, parotid gland, thyroid gland etc. Reports of accessory sternal heads (Nayak et al., 2006; Natsis et al., 2009; Kim et al., 2015) and accessory clavicular heads (Mehta et al., 2012; Saha et al., 2014; Kim et al., 2015; Oh et al., 2019; Fulmali et al., 2020; Heo et al., 2020) of the SCM have been described in previous literature. 13 headed SCM has also been reported in erstwhile literature (Nayak et al., 2016). Some notable and clinically relevant variants of SCM reported during the last decade with their significant findings are tabulated in Table 1. Even though cases of accessory clavicular fibers of the SCM are not infrequent, bilateral extensive attachment that encroaches the posterior triangle which has the potential to stenose the supraclavicular fossa is however very rare.

The early development of the trapezius and SCM share a "common embryonic anlage" innervated by the spinal accessory in the mammalian neck. The "common embryonic anlage" is referred to as the trapezius-SCM system and is derived from the lateral plate mesoderm. It has been observed that the caudal part of the "common embryonic anlage" splits at Carnegie stage (CS) 16 corresponding to the 6 weeks of development in human embryo. At CS 18 (corresponding to 7th week of development) and CS 20 (which corresponds to 8 weeks of development), the SCM and trapezius muscles get separated further and extend posteriorly. However, at this stage the two muscles can be identified as two muscles only inferiorly and are connected to each other at their cranial ends. The developing clavicle and the trapezius of the pectoral girdle further augment the separation of the two muscles and are believed to be important drivers of the process along with the pull of the developing digastric muscle (Cho et al., 2020). The completely separated two muscles are observed distinctly during 21st week of intrauterine life. The reason for development of an unusual accessory head is believed to be extensive splitting of the mesoderm of the sixth pharyngeal arch (Mehta et al., 2012; Sirasanagandla et al., 2012). It has been also suggested to be due to failure of fusion of the individual mesodermal units within the mesoderm of the sixth pharyngeal arch before they unite and form a single muscle (Kim et al., 2015). The proper development of the neural crest derived muscles of the posterior cervical region is under the molecular control of *HOX* genes. Aberration of expression of *HOX* genes may be involved in the molecular pathway to lead to the occurrence of the variation (Dupont et al., 2018).

The clinical relevance of the extra heads of the SCM can be understood from the myriads of important relations of SCM that can readily get compressed in the presence of an accessory head. The presence of anatomical variations of the SCM

Table 1: Reports of anatomical variations of the sternocleidomastoid muscle (SCM) across different population groups with their notable findings

Authors, population, study type	Notable findings	
	Sternal head	**Clavicular head**
Nayak et al. (2006), Indian, single case	Bilateral accessory sternal heads	–
Natsis et al. (2009), Greek, single case	Bilateral accessory sternal heads	Bilateral three accessory clavicular heads
Mehta et al. (2012), Indian, single case	–	Bipartite clavicular head of SCM on the left side
Sirasanagandla et al. (2012), Indian, single case	Third head of SCM arising from investing layer of deep cervical fascia	
Saha et al. (2014), Indian, 18 cases	–	5 out of 18 cadavers revealed accessory clavicular heads, 16.7% unilateral and 11.1% bilateral occurrence
Kim et al. (2015), French, single case	Two sternal heads on the left side	Bilateral two accessory clavicular heads, one cleidooccipital muscle on either side
Nayak et al. (2016), Indian, single case	–	Four clavicular heads on the right side, none qualified to be cleidooccipital muscle
Oh et al. (2019), Korean, single case	–	Bilateral supernumerary clavicular heads
Heo et al. (2020), Korean, single case	Atypical muscular slip from the sternal head joined clavicular fibers	Accessory clavicular head on the left side
Fulmali et al. (2020), Indian single case	–	Single accessory clavicular head on the left side
Silawal et al. (2022), German, single case	Muscular slip of the sternal head had attachment to the superior pharyngeal constrictor muscle on the right side	–
Dupont et al. (2018), American, single case	–	Bilateral six clavicular heads, all heads were attached along the entire extent of the superior nuchal line and thus termed cleidooccipital muscle

renders the muscle less utilizable as anatomical landmark for locating desired structures. Branchial cysts are usually located at the junction of the upper and the middle third of the SCM muscle and branchial fistula typically present as a small pit adjacent to the anterior border of the lower third of SCM (Stranding, 2016). Accessory clavicular heads of the SCM may pose difficulty in precise identification of sites for needle insertion during central venous catheterization procedures. Identification of important structures, such as the accessory nerve may be difficult (Nayak et al., 2006; Natsis et al., 2009). Extra SCM heads could serve as excellent vascularized free muscle flaps for reconstruction surgeries involving the face (Mehta et al., 2012). Accessory clavicular heads of SCM are frequently implicated in the causation of torticollis in adults (Mehta et al., 2012; Mansoor and Rathore, 2018). The accessory clavicular head, especially the more laterally placed cleidooccipital muscle is believed to generate more force from the distal clavicle (Byrd et al., 2022). In our case, the cleidooccipital fibers on the right side encroached and thus stenosed the right supraclavicular fossa. It can be a situation that causes hindrance accessing the subclavian or internal jugular vein during central venous catheterization. Clinicians planning an intervention in the region should have knowledge about such accessory clavicular heads of the SCM (Mehta et al., 2012). The deep course of the external jugular vein on the right posterior triangle may additionally pose more difficulty in the central venous access.

Conclusion

The present case highlights that the cleidooccipital portion of the sternocleidomastoid muscle on the right side has the potential to stenose the supraclavicular fossa. The utility of the muscle as a landmark may become non reliable. Furthermore, extensive and broad attachment of clavicular fibers can compress the external jugular vein. Prior awareness about the possibility of encountering such a variation and prompt intervention may ameliorate the complications.

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