
Variations Of The Sternocleidomastoid Muscle: A Literature Review

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Citation

T Hasan. *Variations Of The Sternocleidomastoid Muscle: A Literature Review*. The Internet Journal of Human Anatomy. 2010 Volume 2 Number 1.

Abstract

Introduction - The sternocleidomastoid is a flexor muscle of the neck and an accessory muscle of inspiration. The literature on sternocleidomastoid morphology and its variations is widely scattered in medical literature and is insufficiently mentioned in most anatomy text books. This article highlights the biodynamics of the sternocleidomastoid muscle and the clinical significance of its morphological variations. **Discussion**- This unique muscle has a high relevance in cases of painful myofascial trigger points, physiology of neck equilibrium, muscle flap harvests and the vital structures lying under its cover. Physiotherapy related considerations of the muscle include active sternocleidomastoid syndrome, torticollis, upper-crossed syndrome, neck-shoulder strain conditions and functional limitation of neck flexion. The knowledge of the sternocleidomastoid morphology is important during non invasive and invasive reconstructive or rehabilitative procedures of the head and neck. **Conclusion**- The anatomical and developmental aspects of the sternocleidomastoid muscle and its morphological variations are a must know for anatomists, chiropractors and surgeons alike. More elaborate mention of the same in our standard anatomy text books would be a welcome change.

Abbreviation: SCM – Sternocleidomastoid.

INTRODUCTION

Standard anatomy text books describe the sternocleidomastoid muscle (synonym musculus sternocleidomastoideus) as a paired muscle of the neck which acts to flex and rotate the head. It also serves as an auxiliary muscle of inspiration, along with the scalene muscles.

It is given the name Sternocleidomastoid because of its origin from manubrium sterni (sterno) and clavicle (cleido) and its insertion at the mastoid process of the temporal bone. (Fig1) Creature designers have a unanimous opinion about the muscle's uniqueness as a "classic mammalian feature"¹. Prominence of this muscle has been considered a symbol of Homo sapiens beauty. The SCM shows a wide range of variations; (Table 1 and Fig 2) specially at its clavicular head of origin and in the layered arrangement of its fibers². The variations at its insertion are very rare³. Although SCM variations are often encountered during routine neck dissections and surgeries, they are insufficiently mentioned in most anatomy text books and available literature about them is widely scattered.

MATERIAL AND METHODS

The relevant literature on SCM and its variations was identified by searching electronic database, hand-searching key journals, and reference list harvesting. The authors used two search strategies in the retrieval of information from electronic database. One based on the use of medical subject heading; Mesh The second one was based on text word searching. The retrieval of information from various digital libraries including Cochrane, National Library of Medicine, Embase, directory of open access journals, open j gate, gray literature database, Indian database, etc. was done using Pub Med and Meva as search engine. Once the "key article" was identified; the author used the "related articles" feature. Anatomy books and journals were searched from the Jazan medical library of Saudi Arabia. A total of 800 articles were scanned out of which 100 met inclusion criteria based on the context relevance of their content.

Figure 1

Figure 1: Schematic representation showing normal posterior neck triangle formed between sternocleidomastoid (SCM) and trapezius

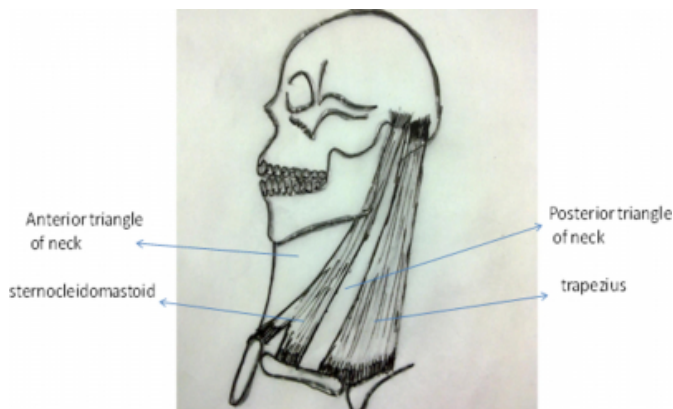


Figure 2

Figure 2- Morphologic variations of the Sternocleidomastoid muscle

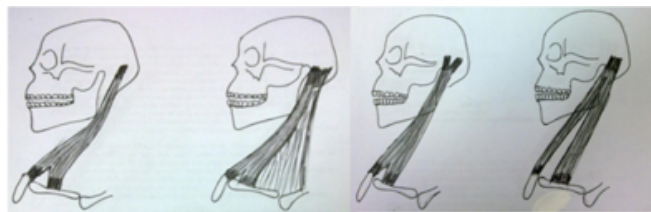


fig 2a

fig 2b

fig 2c

fig2d

Fig 2a- sternocleidomastoid belly with absent mastoid insertion

Fig 2b- fusion of sternocleidomastoid with trapezius

Fig 2c- lateral and medial slips of sternocleidomastoid insertion on mastoid

Fig 2d- separate bellies of sternomastoid and cleidomastoid with extended lesser supraclavicular fossa



fig 2e

fig.2f

fig.2g

fig.2h

Fig 2e- cleido occipital belly separate from sternocleidomastoid belly

Fig 2f- sternomastoid with absent clavicular head

Fig 2g- cleidomastoid with absent sternal head

Fig 2h- supernumerary clavicular heads

DISCUSSION

The SCM forms a prominent land mark across the side of the neck. It has a thick and narrow central part, with broad and thinner ends. The medial / sternal head arises from the anterior surface of the manubrium sterni and is directed superolaterally and posterior. The lateral / clavicular head arises from the anterior and superior surface of the medial third of the clavicle and is directed vertically upwards. The

two heads are separated by the lesser supraclavicular fossa. The clavicular head may be narrow or wide, sometimes up to 7.5cm. Near the middle of the neck, they gradually blend into a thick rounded muscle with tendinous insertion into the lateral surface of the mastoid process, and an aponeurotic insertion into the lateral part of the superior nuchal line of the occipital bone. The sternocleidomastoid muscle normally divides the neck into an anterior and posterior triangle. (Fig.1) SCM receives its blood supply from occipital, superior thyroid and suprascapular arteries. The muscle is innervated by the ipsilateral accessory nerve (motor fibres) and cervical plexus (proprioception).

MORPHOLOGICAL VARIATIONS OF THE SCM

The SCM is a unique muscle, in terms of variations at its origin.^{4,5,6} Also, it has a variable innervations arrangement, the "classical anastomotic pattern" being observed in 50% of the cases.⁷ These anatomical details have a pivotal role in the planning of pedicle muscle flaps in reconstructive surgeries.

In many animals, the cleidomastoid belly is distinctly separate from the sternomastoid belly. (Fig2d) This condition when present in humans is considered to be a variation from normal.² The two separate sternomastoid and cleidomastoid bellies further subdivide the anterior triangle into a supernumerary triangle. This extra triangle can also be considered as an extended lesser supraclavicular fossa which normally separates the sternal and clavicular heads of origin of SCM. The occurrence of such a variation can be explained by fusion failure or abnormal mesodermal splitting during development. In this regard we may refer to Sinohara's law of fusion which states that a muscle supplied by two different nerves is formed by fusion of two separate muscle masses.⁸

Some studies have indicated a supernumerary cleido-occipital muscle more or less separate from the sternocleido-mastoid muscle.⁹ (Fig 2e) The frequency of cleido-occipital muscle occurrence has been reported up to 33%^{10, 11}

Occasionally, the SCM fuses with the trapezius, leaving no posterior triangle. (Fig2b) Such a phenomenon describes Sinohara's law of separation which states that two muscles (SCM and trapezius) having common nerve supply (accessory nerve) are derived from a common muscle mass.⁸ Some authors regard such fusions to be a normal developmental feature, due to their common derivation from the post- sixth branchial arch.²

There are reports of a broad clavicular head splitting into multiple small muscular slips.^{9,12,13} (Fig2h) The number of these extra clavicular slips may vary and such occurrence may be unilateral or bilateral. They cause formation of supernumerary lesser supraclavicular fosse.

Developmentally, these additional muscle slips indicate abnormal mesodermal splitting in posterior sixth branchial arch. They may not cause any functional advantage or disadvantage in neck movement but might be physically interfering during invasive procedures. However, they can be effectively utilized for muscle flap harvests.

There are also cases presenting with extra sternal and clavicular heads of origin in SCM.^{6,9,14} These additional heads, may be unilateral or bilateral and cause significant stenosis of the lesser supraclavicular fossa, imposing complications for anesthesiologists during the anterior central venous catheterization approach.

Benign fibrosis, hypoplasia or aplasia of SCM is the most common cause of congenital torticollis. Abnormal head positioning in utero or difficult birth can lead to development of the compartment syndrome and congenital muscular torticollis sequela¹⁵. Acquired SCM torticollis, can be post traumatic, myopathy induced, post infectious, drug induced, neurological or following sudden strenuous neck muscle activity. Studies report that morphometric and cross-sectional area a-symmetry between SCM of two sides result from unequal growth in utero and play an important role in the genesis of tension type headache¹⁶.

About a dozen cases have reported complete unilateral absence of the muscle^{17,18,19}. Such cases represent the developmental defect of muscular agenesis and are diagnosed by Ultrasound or Magnetic Resonance Imaging scans. The absence of SCM cover may lead to complicated congenital neck hernias in children, in addition to functional limitations²⁰.

A coexisting unilateral absence of SCM with the ipsilateral absent trapezius is an extremely rare variation and till date, only about three such reports are present in literature²¹. Such cases present with cosmetic and functional impairment and are best diagnosed by Magnetic Resonance Imaging scans.

Occasionally, the lower portion of the SCM muscle is intercepted by tendinous intersections which indicate the origin of this muscle from different myotomes². The organizational pattern of the SCM can be arranged into five distinct topographical parts, namely the superficial

sternomastoid, profound sternomastoid, sterno occipital, cleidomastoid and cleidooccipital parts which are arranged in superficial and deep layers. The muscle fibers of all these layers lie within a common fascial sheath and traverse in the same direction^{2,5}. Knowledge of this layered arrangement and the changes in cases of muscle variations is helpful during muscle flap harvesting procedures.

Figure 3

Table 1:- Variations of the sternocleidomastoid muscle

| | SCM variation | Rationale | Relevance |
|---|---|---|--|
| 1 | Separate Sternomastoid and Cleidomastoid bellies | Fusion failure | Extended lesser supraclavicular fossa |
| 2 | Supernumerary cleidooccipital Muscle | Abnormal mesodermal splitting | -Supernumerary division of anterior triangle -Physical interference during invasive procedures |
| 3 | Fusion of sternocleidomastoid with trapezius | Common derivation from posterior sixth branchial arch | -Absent posterior triangle -Physical interference during invasive procedures |
| 4 | Multiple muscular slips of clavicular | Abnormal mesodermal splitting | -Supernumerary lesser supraclavicular fossa -Physical interference during invasive procedures -Use in muscle flap harvests |
| 5 | Extra sternal or clavicular heads of origin | Abnormal mesodermal splitting | -Stenosis of lesser supraclavicular fossa - Physical interference during anterior venous catheterization approach |
| 6 | Aplasia, hypoplasia, benign fibrosis | Abnormal head positioning in utero and compartment syndrome sequale | Congenital torticollis |
| 7 | Complete unilateral absence of SCM | Congenital developmental Agensis | -functional limitation of neck flexion -postural defect -complicated congenital neck hernias |
| 8 | Ipsilateral combined absence of SCM and Trapezius | Congenital developmental Agensis | -functional impairment -cosmetic impairment |
| 9 | Bilateral cross sectional area morphometric asymmetry | Unequal muscle development rate in utero | -tension type headache |

ANATOMICO-CLINICAL RELEVANCE OF SCM

SCM has a keen role in the physiology of head - neck balance. It acts as a check rein to prevent the head from falling backwards. The clavicular division specially contributes to the sense of equilibrium. The head position is characteristic of the action of the SCM and is suggestive of contraction or shortening of the muscle; if involved. Significant spasm of the SCM can be seen and tenderness can be elicited in the body of the muscle in various medical conditions. The SCM may develop myofascial trigger points, presenting a wide spectrum of symptoms ranging from headache, facial pain and lacrimation to dizziness and blurred vision. The condition is referred to as the “Sternocleidomastoid syndrome”. Both the clavicular and sternal divisions of SCM produce referred pain if activated. The chiropractic approach, combined with appropriate rehabilitation tools and neuro-emotional techniques, can prove a valuable asset in the corrective treatment of such conditions.

The SCM has many vital structures lying under its cover, like the common carotid artery, accessory nerve, brachial

plexus roots, cervical plexus nerves and lymph nodes. It can be rightfully called a Pandora box. The utility of SCM extends far beyond mere neck flexion or as covering agent of neck structures. It is useful for reconstructive procedures of mandible, oral floor, myocutaneous cervical oesophageoplasty, suture line for carotid artery protection, anterior venous catheterization, facial deficits etc.

^{3,13,22} Reports indicate that parathyroid tissue transplanted into the SCM muscle rather than other sites has a high success rate because of easy accessibility, single operative site and excellent blood supply²³. The use of SCM flaps in superficial parotidectomy may have benefits other than cosmetic improvement, like reducing the incidence of Frey's syndrome and Facial nerve dysfunction although the exact mechanism of this action is yet unclear²⁴.

DEVELOPMENT OF THE SCM

When trying to understand the biodynamics of the SCM and its morphologic variations, it is imperative to elucidate the derivation of this muscle. Developmentally; SCM shares a common origin with the trapezius from the posterior sixth branchial arc¹³. The muscle is said to develop from several myotomes². Anthropomorphology studies of SCM on human fetuses indicate that the SCM muscle most frequently consists of sternal and the clavicular heads which terminate in a very wide attachment on the cranium - from the external acoustic foramen to the occiput¹². Very frequently the muscle heads exhibit additional bands. The Wood's cleido-occipital muscle is present in several cases during the intrauterine phase.²⁵ During the developmental period, the muscle attachments significantly increase; between the 4th and 5th months²⁵. Dimorphism and bilateral a-symmetry in the dimensions of muscle are statistically non significant²⁶. The collagenous fibers of the perimysium of SCM form complex structures from 24 weeks of gestation in contrast to fibers of the endomysium²⁶. The cross-sectional area of the bundle of muscle fibers and the cross-sectional area of the individual muscle fibers of the SCM increase during development from 12 to 32 weeks gestation, in a process linked to the development of the perimysium²⁶.

Unlike the sternalis muscle, where the incidence varies according to sex and ethnicity, there is yet no reported influencing factor on the incidence of SCM variations²⁷. We can assume these variations to be an independent factor unless proven otherwise. However, the above reported presentations of SCM variations could possibly have suffered from troublesome neck positioning, active myofascial trigger points, tension type headache, shoulder-

neck-strain syndromes or functional limitation of neck flexion .

CONCLUSION

The SCM is an amazingly complex muscle and has a multi faceted relevance not only for anatomists, but also for clinicians ,chiropractics and surgeons. Better knowledge of its anatomy and its myriad variations can help physiotherapists to deal more effectively with SCM syndromes .Surgeons will be better oriented so as not to be confounded by the sudden appearance of any anatomical variations during invasive neck procedures. Acquired torticollis can be dealt with more effectively if the biomechanics of the muscle and its variants are considered in detail. The diversity of its multi-layered arrangement is a "must know" for all those who attempt muscle flap harvests. We suggest an elaborate mention of its morphologic variations in our standard anatomy text books. More research needs to be done on its developmental aspects as available literature for the same is scant and it would help in better understanding of the muscle biodynamics.

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