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Anatomy, Head and Neck, Sternocleidomastoid Muscle

Authors

Bruno Bordoni[1]; Matthew Varacallo[2].

Affilations

[1] Foundation Don Carlo Gnocchi IRCCS
[2] Department of Orthopaedic Surgery, University of Kentucky School of Medicine

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Introduction

The sternocleidomastoid muscle (SCM) is one of more than 20 pairs of muscles that act on the neck. SCM has a dual-innervation and multiple functions. The vestibular area has a close relationship with the SCM motoneurons to improve posture and neck movements; the cervico-trigeminal reflexes put in direct contact the occlusive capacity of the temporomandibular joint and the electrical activity of the SCM, with a reciprocal influence, in particular with the masseter muscle. The inspiratory act is facilitated by the contraction of the SCM muscle.

The latter is a muscle capable of adapting to external and internal influences for which it is stressed, both for physiological stressors (hypertrophy) and for pathological stressors (change in metabolism). The article describes the anatomy, its innervation and vascularization, as well as the double embryological derivation. The text will highlight the clinical, surgical, and related pathologies, with a look at the SCM's manual therapeutic approach.

Structure and Function

The unilateral contraction of the sternocleidomastoid muscle (SCM) determines a triple movement, associating the rotation of the head on the side opposite to that of its contraction, the inclination from the side of its contraction, and extension.[1]

The effects of the simultaneous contraction of the two muscles depend on the state of contraction of the other muscles of the cervical spine:

- If the cervical spine is not fixed, this bilateral contraction determines a hyperlordosis of the cervical spine with an extension of the head and a bending of the cervical spine on the dorsal one.
- If the cervical spine is rigid and rectilinear due to the contraction of the paravertebral muscles, the simultaneous contraction of the SCM determines the flexion of the cervical spine on the dorsal spine and a flexion of the head forward.

The SCM can also have inspiratory muscle action by taking a fixed point on the temporal bone and then lifting the sternum and the clavicles.[1]

SCM plays an important role in the posture of the neck and the body. It has been shown that a stimulation of the vestibular area electrically activates the sternocleidomastoid with evidence of a close connection between the vestibular area and the motoneurons of the SCM.[2] The movement with which the SCM expresses its maximum capacity for speed and force is the lateral inclination.[3]

Another important function of SCM is to allow a correct function of the temporomandibular joint (TMJ). During mastication a trigeminal-cervical reflex stimulates the activity of SCM, there is evidence that SCM intervention is fundamental for optimal TMJ occlusion.[4] An occlusal alteration of the mandible causes an alteration of the function of the SCM, with disorders of muscular incoordination (inclinations of the neck).[4] The correction of an altered

occlusion or the treatment of a tooth has solved, in some cases, the problem of torticollis.[4] During mastication on one side, the activity of the SCM is synchronous with the masseter muscle, while with bilateral chewing the SCM anticipates the intervention of the masseter, probably to stabilize the neck.[4]

Anatomy

The sternocleidomastoid muscle (SCM) divides the neck area into an anterior triangle and a posterior triangle. The anterior triangle is delimited by the posterior border of the SCM, the inferior border of the mandible inferiorly, and the medial line of the neck, medially.[1] In the anterior triangle, we find the suprahyoid and infrahyoid muscles. The posterior triangle is delimited by the SCM anteriorly, by the clavicle inferiorly, and by the trapezius muscle posteriorly. Scalene muscles reside in the posterior triangle. The SCM is a large and easily recognizable and palpable muscle.[1]

SCM can be divided into four portions:

- Sterno-mastoid
- Sterno-occipital
- Cleido-mastoid
- Cleido-occipital

The muscle originates from the upper edge of the sternal manubrium, from the medial quarter of the upper face of the clavicle; the two muscle heads merge into a single muscle belly that is directed upwards and laterally. Insertions arrive at the mastoid process of the temporal bone and at the anterior portion of the superior nuchal line.[5] SCM has fibers arranged in parallel; it is not a pennate muscle.[5] SCM expresses greater strength and thickness in men than women; the sterno-mastoid portion is the muscle area that develops a greater percentage of contractile strength than the other portions. The cleido-occipital portion is the muscular area where less force develops.[5]

Embryology

SCM derives from paraxial mesoderm (preoptic) and occipital (postotic) somites; in part, it also derives from the neural crests.[6][7] On an animal model, the SCM muscle appears on the 14th day of gestation. According to a recent study, cells that will form the muscles of the neck share space with the progenitor cells of the heart, within the cardiopharyngeal mesoderm.[8]

Blood Supply and Lymphatics

The arterial supply is given by branches of the external carotid artery (occipital artery and superior thyroid artery), which can be palpated, feeling the heartbeat in the medial-anterior portion of the muscle. During intense physical activity, the blood supply to the respiratory muscles increases, including the CSM, to the detriment of the muscles of the limbs.[9]

The external jugular vein passes inferiorly and posteriorly the SCM, from which it drains venous blood (external posterior jugular vein and anterior jugular vein).[1]

The lymphatic system of the neck that involves the SCM is the vertical chain, which includes the anterior superficial lymph nodes and the lymph nodes of the posterior triangle (inferiorly).[1]

Nerves

The cutaneous branches of the cervical plexus emerge from the posterior edge of the SCM; these nerve endings help the muscle in its proprioceptive functions. The accessory cranial nerve or XI passes into the posterior triangle to innervate the trapezius and the SCM.[1]

Muscles

The muscles that make up the neck are part of the myofascial system, which determines not only an anatomical but also a functional continuum.[10] This means that a dysfunction of a muscular portion will result in a functional alteration of all the muscles of the neck. For example, an eye disorder alters the electromyographic spectrum of the masseter muscle and neck muscles, including SCM.[11][12]

The neck muscles (superficial and deep) are activated by the cortical system via the reticulo-spinal system; activation is synchronous, regardless of the depth of the muscle layer.[13] A further starting point to understand is that it is a mistake to consider a therapeutic problem that apparently presents itself to a single muscular district. In fact, the whole neck muscle complex is negatively affected, and it must be taken into account for the achievement of a successful clinical result.

The sternocleidomastoid muscle in healthy subjects is rich in white or anaerobic fibers (about 65%), with a lower percentage of red or aerobic fibers (about 35%).[14] The muscle is able to express a lot of strength quickly, with less resistance over prolonged periods. In older people, the percentage of white and red fibers in the SCM changes. Red fibers tend to increase (about 44% in total) to the detriment of white fibers.[15] The muscle adapts itself to the surrounding environment and to old age, adapting specularly.

Physiologic Variants

As with the entire anatomy of the human body, the sternocleidomastoid muscle (SCM) also has anatomical abnormalities.

SCM could present a congenital unilateral agenesis, including the unilateral absence of the trapezius muscle, without significant functional repercussions, probably due to adaptations of the other muscle groups that make up the neck.[16]

Other variations include its origin, which variations can make the difference in the surgery. The attachment to the clavicle could be narrow or wide (about 7 to 8 centimeters), or have more than one clavicular attachment; the attack could also affect the acromion-clavicular joint or present more muscular bellies of the SCM.[17] It is possible to find insertions to the sternoclavicular joint, changing the anatomy of the neck and the palpatory result.[17]

A larger number of SCM muscle heads is not so rare; for example, you can find two sternomastoid, a cleido-occipital and a cleido-mastoid occipital on one side, while on the other side a single sternomastoid, a cleido-occipital and two cleido-mastoids, with a total of four muscle heads.[17],[18]

Rarely, the margin of SCM can be in direct contact with the trapezius, probably due to embryological motivations.[19] Other changes concern its insertions. We can find a cleido-epistrophic, cleido-cervical and cleido-atlantic insertions, with one or more heads on the bone attack.[19]

The innervation affecting the SCM may vary. One study reports the innervation of the lower portion of SCM from a branch of C1 from the ansa cervicalis (descendens hypoglossi); the same can happen only for the upper portion of the muscle.[20] An aberrant branch of the facial nerve has been found to innervate the deep portion of the upper third of the SCM.[21]

The variations of SCM can also be found in the names with which it is known: nutator capitis, mastoideus colli, sternocleidomastoid muscle of Kopfnicker, and sternomastoid muscle.[19]

The reflection of all these anatomical variables is to have caution before approaching with therapeutic intention because an abnormal behavior of the muscle does not necessarily mean pathology. Not only that, it must be remembered that anatomy is always subjective and that anatomy of study books does not always reflect subjectivity.

Surgical Considerations

The sternocleidomastoid muscle (SCM) is often used for the repair of other parts of the body.

A flap of SCM can be used for the resection of the parotid gland, in the case of tumors. The muscle makes it simpler to obtain an adequate length and a rotation of the flap on the incision area during the intervention, decreases the

depression of the parotidectomy area, and lowers the risk of necrosis thanks to the rich vascularization of SCM. [22] Currently, there is no absolute safety for the prevention of Frey's syndrome (auriculotemporal nerve injury).[22]

SCM is used for many other situations where it is necessary to repair or reconstruct the orofacial and pharyngeal area. Some muscular flaps or the latter with bony portions are used, depending on the surgical objective.[23] Examples of reconstructive intervention are:

- Reconstruction of the tongue and/or buccal floor
- Oral cavity and/or oropharynx, laryngotracheal complex
- Portions of the head and/or neck
- Bone of the jaw, defects of the mastoid area
- Esophagopharyngeal complex
- Reconstruction of the cheek

Another surgical area where SCM muscle flaps are used is in the presence of congenital muscular torticollis (MT), although the cause is not entirely understood. When SCM is shortened and fibrotic (MT) it affects the position of the head and shoulder, ipsilateral lateral flexion, a contralateral rotation of the child's face.[24] With this disorder, there are two options to follow, based on the doctor's evaluation: rehabilitation or surgery. If too much time is passed from the diagnosis and no type of therapeutic intervention is performed, in the shortening SCM a band of stiff muscle is formed, or in severe cases, MT persists, causing deformity of the craniofacial morphology.[24] Within the child's 5 years of age, good results can still be achieved, but it is better to work early.[25] In the cases where an adult has an untreated congenital stiff neck, the surgeon's goal is to release the rigid band of the SCM; the result is never comparable to a baby, but some facial and cervical deformities can improve.[24]

Clinical Significance

Sternocleidomastoid Muscle Function Evaluation

The assessment begins with a patient sitting to observe any hypotrophy of sternocleidomastoid muscle (SCM) as well as postural abnormalities of the neck and head, shoulder and scapula, clavicle, and sternal manubrium.

The patient is asked to perform some voluntary actions with the neck to understand if there are motor or pain limitations and perform a forced inhalation and mimic chewing to observe how the SCM behaves.

The reflexes are evaluated by striking with a small hammer the insertion of the SCM at the clavicular level. To evaluate the strength, always with the patient seated, he is asked to move his head (flexion, rotation and inclination), putting our hand on his head at the same time to apply a minimum of resistance.

The lesions that can affect the SCM can affect the accessory nerve, but they are infrequent as a finding. [26] A lesion of the XI nerve causes the reflex to be removed with the hammer, with atrophy of the SCM and trapezius, a lowering of the shoulder and the appearance of the sign of Sicard (increase in the depth of the supraclavicular fossa). Paralysis of SCM can cause a form of torticollis.

There are different types of torticollis: [27]

- Paralytic torticollis (from injury of the cranial nerve XI)
- Congenital torticollis
- Spasmodic torticollis (a phenomenon of segmental dystonia)
- Ocular torticollis, where diplopia influences the posture of the SCM

- Symptomatic torticollis (the causes may be different, such as pain, inflammation, infection or cervical vertebral positioning)
- "Psychic pillow" is a position of patients with serious neurological diseases (Parkinson's, catatonic disorders), where they keep their head bent forward as if they were resting on a pillow, even when lying on their backs
- Psychogenic torticollis where the patient is afraid of moving his neck correctly to avoid the onset of pain or vertigo symptoms

The precise diagnosis of these disorders must follow an electromyographic examination, magnetic resonance or computed tomography, ultrasonography.

The surgical approach generally performed in children and adults is to remove part of the SCM. [28]

- Unipolar or bipolar release
- Release of the fibrous band
- Release with a Z-plasty or Z-plasty alone cut
- Release with endoscopy (less invasive)
- Muscular resection of some of his insertions

Other Issues

Manual Approach: Physiotherapy

When a sternocleidomastoid muscle (SCM) dysfunction needs to be addressed, all the superficial and deep muscular layers must be considered.

In the case of congenital torticollis, which represents a third of congenital muscular abnormalities, physiotherapy plays an important role in solving the dysfunction or accelerating recovery after a possible surgery. Recommended conservative therapy includes stretching exercises, voluntary movements to improve posture (if the child is not too small), or placements in the child's posture made by the parents.[24]

Fortunately, the problem is solved in many cases. [28][29] Congenital torticollis may appear not only after birth but also after a few weeks, making parental vigilance becomes crucial. [29]

Physiotherapy is called into question not only because of the SCM problem due to the presence of torticollis but also as a result of surgical interventions of the muscle itself. There may be some pathologies that need a surgical approach such as the following:

- Intramuscular hemangioma
- Pseudosarcomatous proliferative myositis (when necessary)
- Pseudotumor of infancy (fibromatosis colli)
- Rupture of the sternocleidomastoid

Other physiotherapy interventions concern the dysfunction of the neck or jaw movements following whiplash impact, chronic cervical pain, headache of neurogenic origin, and trigger points.[5] The goal is always to restore proper proprioception, complete movement without pain, and allow the disappearance of headaches. The approaches to SCM may be different, depending on the therapist's assessment and the medical indication.

Osteopathy and Manual Therapy

Osteopathic treatment to help the recovery of SCM after surgery should also affect the scar. With gentle and non-invasive techniques, the osteopathic touch can take care of all myofascial layers of the neck and of the spaces between

the neck vertebrae.[30][31][32]

Questions

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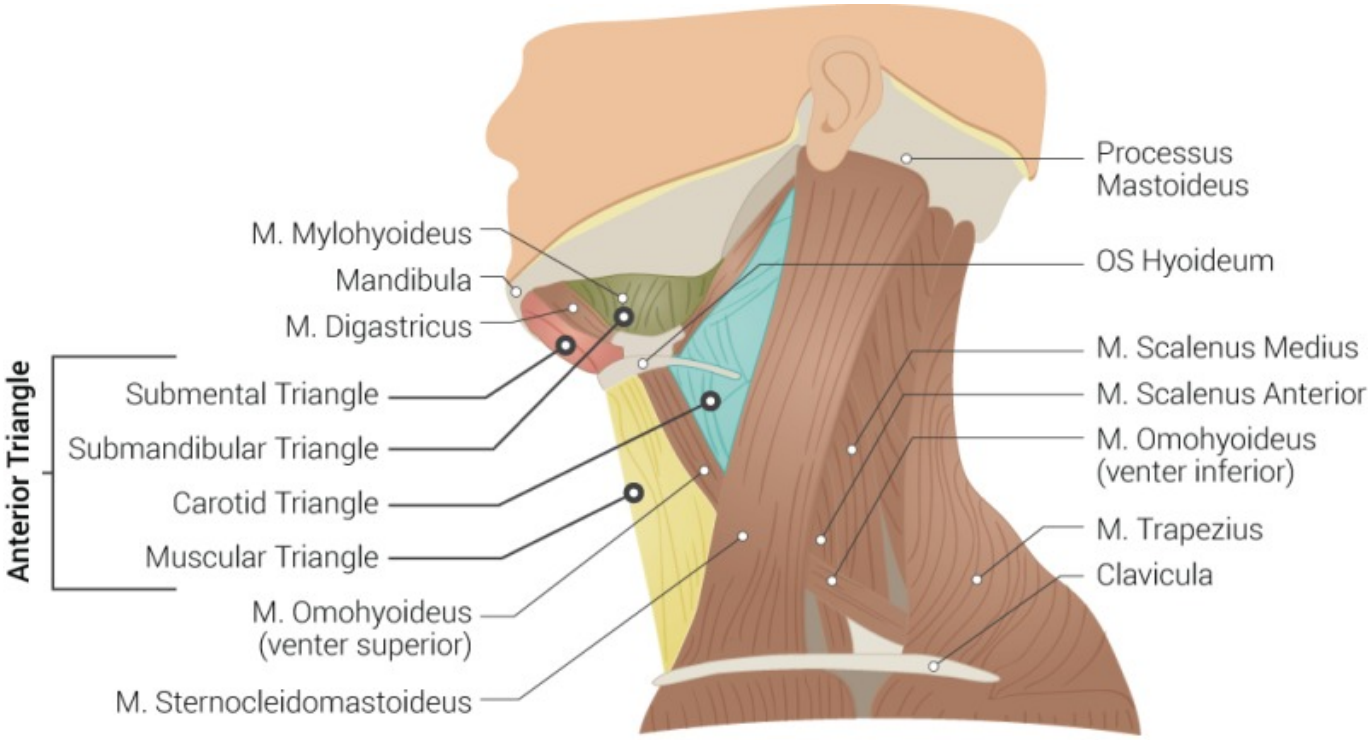
Figures



Anterior Triangle, M. Mylohyoideus, Mandibula, M. Digastricus, Submental Triangle, Submandibular Triangle, Carotid Triangle, Muscular Triangle, M. Omohyoideus (venter superior), M. Sternocleidomastoideus, Processus Mastoideus, OS Hyoideum, M. Scalenus Medius, M. Scalenus Anterior, M. Omohyoideus (venter inferior), M. Trapezius, Clavicula. Contributed Illustration by Beckie Palmer

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