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Suboccipital Musculature - Morphology, Functions and Variants - An Update

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Abbreviations: RCPmi: Rectus Capitis Posterior Minor; SOM: Suboccipital Musculature, MDB: Myoduric Bridges

Introduction

The suboccipital muscle plays an important role in the clinical reasoning of osteopaths, but is also examined and treated by masseurs, chiropractors, manual therapists and in physiotherapy in the context of various complaints. It lies in the depth of the craniocervical junction and connects and moves the head joints. However, the SOM is involved in many other functions of the human body and is much more complex than the first glance in the anatomy book makes it appear. The craniocervical junction is the most mobile part of the spine and at the same time it hosts important vital structures such as the brainstem or the transvere artery. In addition to the numerous and tensile band structures that secure this region, the SOM plays an important role in terms of several functional tasks. This makes them the target of numerous therapeutic considerations for various dysfunctions and clinical pictures. For example, in the treatment of tension-type headaches [1], after craniocerebral trauma - as the atrophy of the Rectus capitis posterior minor (RCPmi) significantly correlates with the post-traumatic complaints [2], or in the treatment of neurodynamic dysfunction of the median nerve [3-4]. Since the first description of the myodural bridge of the RCPmi by Hack et al. [5], this connective tissue bridge between the SOM and the highly cervical dura mater is thought to play a significant role in the pathogenesis of headache, changes in sensomotor function and cerebrospinal fluid flow [5-8]. In order to effectively investigate and treat the complex anatomy and functioning of SOM and the structures involved, such as myodural bridges, cervical joints or neurological connectivity using non-invasive, functional methods, this mini-review provides some recent research on SOM and hopefully encourages to integrate this multi-functional tissue into clinical reasoning for various dysfunctions.

Sensomotoric, Coordination and Perception in the Space

The SOM has a high density of muscle spindle per gram. Muscle spindles per gram are found here between 98 (Rectus capitis posterior major - RCPma) and 242 (M. obliquus inferior), which is immense compared to the already well-structured hand muscles (M. opponens pollicis - 17 spindles / gram) [9]. As in other parts of the body, the SOM also shows a higher density of rotational muscles, in this case the obliquus inferior (OCI) and the superior (OCS). The high number of muscle spindles of the SOM seems to be a prerequisite both for the function as a receptor, as well as an effector and for the interaction with various equilibrium and orientation systems. The extraorbital eye muscles appear to have very comparable densities of muscle spindles [10], which seems to be the basis for the oculo-cervical and optokinetic reflexes arising from both organs. In addition to the optokinetic and the oculocervical control circuits, the said density of muscle spindles continues to be the basis for the cervico-vestibular interaction [11]. In addition to this knowledge and various empirical experiments, the long discussed controversial cervicogenic dizziness was recently accepted by the mass of evidence [12].

With regard to the above-described link between the vestibule and the SOM, a pain-free, sufficiently mobile and physiological recruited suboccipital region seems to be the basis for these control circuits. Complementary and alternative medical therapies should define these as treatment goals in the treatment of cervicogenic dizziness and, if necessary, re-train them once these basics have been restored. In addition to balance exercises, numerous oculo-cervical exercises can be used [13]. Through this complex linkage of SOM to other sensory organs and the high number of muscle spindles, the SOM plays a significant role in orientation in space.

Morphological and Anatomical Aspects

In addition to motor innervation of the SOM, the C1 spinal nerve also appears to deliver sensory fibers to the lateral atlanto-occipital articular capsule, sharing the sensory innervation of this structure with the hypoglossal nerve [14]. Irritations of the aforementioned capsule parts could, in addition to the sensory irritation of the tongue in neck-tongue syndrome, also lead to hypertension or altered sensorimotor function in the area of SOM due to nociceptive afferents. The fiber distribution of the SOM is very homogeneous, allowing both postural control and dynamic functions [15]. As with many other structures, the SOM facilities seem to vary quite a bit. Thus, Yamauchi et al. Show that 2.3-4.5% of a population can have, for example, the a bilateral aplastic RCPmi -replaced by adipose tissue: or the RCPma has two to three instead of a single muscle belly [16]. As described above, the RCPmi shows clinically the most morphological chanches in various pathomechanisms. Thus, it is atrophied in craniocerebral trauma [2] and hypertrophied in chronic headache [1]. Both of these changes seem to have a functionally negative influence on the respective symptoms, which has to be considered clinically. Thus, in addition to the reduction of nociceptive inputs and inhibition in headache patients, facilitation and advanced training in atrophy may be in the foreground. It should be noted that the SOM must be palpated very deeply for manual intervention, as the SOM is the third and most profound layer of the high-cervical musculature under the trapezius muscle and the splenius capitis and semispinalis capites muscles represents. Due to their complex, three-dimensional position, the motion functions of the SOM are not always to be classified at first glance. The RPCma and RCPmi lengthen each other by up to 30% in craniocervical flexion, whereas in a heterolateral rotation an extension of up to 40% in the area of the RCPma and the OCI occurs [17]. The SOM is actively involved in both protraction [18] and head retraction [19] after recent electromyographic measurements, helping to maintain joint conformation during sagittal movement. Due to the clearly different mechanics between the craniocervical transition and the lower cervical spine, as well as the complex neurological and vascular interconnections of the SOM, the knowledge of embryological development is very useful [20]. Thus, the three upper segments C0-C2 develop together from four occipital and three cervical somites, which explains the networking of diverse functional and anatomical structures, including possible developmental disorders [21].

Myodural Bridges

Myodural bridges (MDB) denote fibrous connective tissue that crosses from the SOM towards the spinal canal and insert at the dura mater. In the meantime, MDBs have been detected in the RCPmi, RCPma and the OCI [6,22-23]. These have a common approach with the so called "to be named" ligament fibers of the ligamentum nuchae [24] and extend through both the atlanto-axial and atlanto-occipital interspaces [25]. The fibers of the MDB consist of collagen type-1 and are thus resistant to tensile stress and can directly transfer tension to the cervical dura [26]. The function of the MDB seems to be on the one hand the posterior stabilization of the dura mater spinalis [6-8] and on the other hand the drive of the cerebrospinal fluid transport in the spinal canal [7,27-28]. The presence of this connective tissue in between the atlanto-axial and atlanto-occipital interspaces, seems to be of further interest. Membrane-free zones enriched with fatty tissue exist here, which ensures the MDB glides frictionless [29]. This transition zone between the SOM and the spinal canal could be a potential location for dysfunction and lead to various symptoms due to friction, which could be treated by local manual techniques, for example [20]. In particular, the mobility of the head joints, but also symmetric stress patterns of the MDB-forming structures and intraspinal tension vectors could be the target of manual interventions. However, in addition to a potential source of headache and cervical symptoms, further limitations in movement and disbalances in whole-body biomechanics may arise. Thus, first empirical studies carried out multiple effects after manual treatment regarding the SOM, such as mobility improvements of the median nerve [3,4], mouth opening [30] and also far from the intervention area improvements of mobility of the lower extremities [31-32], questionable is whether the effects are due to the superfiscial myofascial chains discussed by the authors. The effects could also be due to an intraspinal mobility or tension regulation by influencing the SOM and MDB. The effects of manual techniques in the area of SOM on the biochemistry of the blood seemed to be little researched. Fernández-Pérez et al. showed that, for example, there is a significant increase in CD-19-encoded B lymphocytes after application of manual techniques in the field of SOM [33]. However, the clinical relevance and breadth of treatment should be underpinned by further investigation and other SOM techniques, such as muscle energy techniques, joint manipulation, or defined technique combinations.

Conclusion

SOM plays a major role in many dysfunctional processes in the human body and need not only be studied and treated in the context of local nociception or movement deficits. Thus, this highly complex muscle group can further influence the balance and coordination mechanisms, the mobility of the temporomandibular joints and neurodynamic situations down to the lower extremity. This should be noted by all SOM treating and investigating disciplines to exploit the potential of this region therapeutically. The role of MDB in these effects needs to be further explored in order to be able to perform functional interventions as effectively as possible.

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