Academy of PHYSICAL MEDICINE

Research Paper Review

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Review Title: The Cervical Myodural Bridge – Review & Clinical Implications

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Date Posted:

January 2016

Study Title:

The cervical myodural bridge, a review of literature & clinical outcomes

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Publication Information:

Journal of the Canadian Chiropractic Association 2014; 58(2): 184-92.

Summary:

The spinal cord is protected by the dense connective tissue that links the suboccipital muscles to the cervical dura mater (3). It has been suggested that this provides at least a partial mechanical explanation for the efficacy of cervical massage and manipulation for treatment of headaches (4).

Soft tissue connections which cross the cervical epidural space have been recently examined and described as linking suboccipital muscle fascia and the cervical dura – coined a 'myodural bridge' (see images below). These epidural connections may act as passive dural anchors and even active stabilizers of the spinal cord (1, 2). The myodural bridge has been shown to play a role in cervical neuromuscular control (5-9) and is thought to play a role in cervicocephalic pain syndromes, sensorimotor function and postural control (10-13). The clinical relevance of these cervical epidural membranes and their relationship with cervicogenic and tension headache syndromes has been previously discussed by multiple authors (10-14).

Recent anatomical and histological human cadaveric specimen studies have described myodural bridges communicating between the epidural spaces between rectus capitis posterior minor (RCPMi), rectus capitis posterior major (RCPMa), and inferior oblique (IO) (all suboccipital muscles)

and the dura mater of the cervical spine (5-9). Recently, the prevalence of these structures were examined using MRI and it was found that 64% of 240 individuals demonstrated a posterior concavity of the cervical dura mater consistent with a ligament attachment site (9). Of this group, 24% also had oblique, linear, hypointense fibers which appeared to attach to the cervical dura mater (9). The number of studies examining these soft tissue dural connections precludes them from being considered anatomical variants (5-9, 15).

Anatomy of Suboccipital Muscles:

The RCPMa and IO muscles share innervation by the suboccipital nerve as well as some actions (i.e. RCPMa acts to extend and slightly ipsilaterally rotate the head and neck while IO ipsilaterally rotates the cervical spine) (1, 3). Cervical suboccipital muscles are richly innervated and have high muscle spindle fiber concentrations (16). Muscle spindle fibers found in RCPMa and IO are a source of primary afferents which contribute to cervical spine neuromuscular control (3, 16). These muscle spindle concentrations are typically rich in slow twitch fibers, a blend of unevenly dispersed type I and type II fibers and are found in smaller muscle groups responsible for fine motor skills (16, 17). The unique configuration of muscle types suggests that these muscles may serve multiple functions including:

- Monitoring kinesthetic changes
- Maintaining constant force for eccentric head posture
- Creating fast phasic movements when needed (16, 18)

The cervical muscles are subject to conversion from slow twitch to fast twitch muscles with injury (17, 19). This alteration in muscle type creates a muscle prone to facilitation (17), which can alter the discharge of primary afferents to the central nervous system, affecting cervical neuromuscular control (17, 18).

Neuromuscular Stabilization of the Spinal Cord:

Active contraction of RCPMa, RCPMi and the IO puts the myodural bridge under tension, transmitting forces across it and subsequently placing the dura under tension as well, which serves to stabilize the spinal cord (1, 2). The suboccipital muscles also respond reflexively to involuntary and unanticipated head and neck movements (20). Suboccipital muscle contraction regulates dural tension via a feedback or feedforward mechanism of control (1, 2). Tension regulation across the myodural bridge as a spinal cord stabilizer may prevent dural infolding, thus reducing stimulation of nociceptive pain mechanisms (5, 7). Hence, failure of this system to maintain constant tension may result in clinical manifestations arising from increased dural tension (1, 5, 9).

Functional Anatomy of the Myodural Bridge:

The cervical myodural bridge traverses the epidural space between the posterior elements of the C1 and C2 vertebrae. The RCPMi and RCPMa fascia are linked to the cervical dura mater. A myodural bridge extends from the anterior fascia of the RCPMa and IO muscles, attaching to the dura mater. The authors noted that during dissection of the dura, manual traction applied to the RCPMa caused movement of the spinal root within several levels (1). The authors suggest that the RCPMa myodural bridge may exert greater mechanical traction on the dura than the RCPMi, due to its larger cross sectional area (1). Similar to the RCPMa and RCPMi, the IO myodural connection to the posterior sleeve of the dura mater functions dynamically to prevent dural infolding during cervical extension (6, 7). RCPMa and IO appear to form a single atlantoaxial myodural bridge due to their proximity, however they are separate structures (7). In a previous study, the authors were unable to find a similar connection between the dura mater and the superior oblique (7). There appears to be agreement among authors that all three myodural bridges provide stabilizing functions.

Clinical Implications:

The spinal canal's midsagittal diameter of 10 mm increases with flexion and decreases with extension. This can impact the patency of the cervical spinal cord (19). Inward buckling of the cervical ligaments and dura mater have been reported with cervical extension (19). In addition, the role of the posterior cervical epidural ligaments is to provide an anchor to stabilize the dura mater from anterior translation during flexion (20). Without this posterior epidural attachment, the dural canal can shift anteriorly, compressing the spinal cord, causing flexion myelopathy (20). The myodural bridge crosses the epidural space to anchor the spinal dura during head and neck motion (1, 2). The authors suggest that the myodural bridge provides passive and active anchoring of the spinal cord and may monitor dural tension to prevent dural infolding, as well as maintain patency of the spinal cord.

Clinical Application & Conclusions:

The suboccipital myodural bridges actively and passively modulate dural tension, while anchoring and stabilizing the spinal cord. Injury or failure of this system could result in altered cerebral spinal fluid flow, sensorimotor function changes, cervicocephalic headaches and dura-related pathologies (subdural hematoma, nerve root compression, etc). Keeping this unique anatomical relationship in mind may help provide us with (at least) a partial mechanical explanation for the efficacy of cervical manipulation and/or massage/soft tissue methods for treating suboccipital headaches. Further examination of the relevant biomechanical forces and potential mechanical implications for manual treatment of the myodural bridge are necessary.

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