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REVIEW

Palpatory phenomena in the limbs: A proposed mechanism

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Abstract Practitioners described as 'cranial' osteopaths and 'cranio-sacral' therapists routinely observe palpatory phenomena within the limbs of patients and use these findings to inform diagnosis and treatment. As current anatomical knowledge is unable to explain this, it is hypothesized that cyclic changes in vascular volume (Traube—Hering—Mayer waves) alter the tension in associated myofascia and create patterns of motion that are palpable. These patterns result from the helical alignment of collagen fibres and may be altered by pathologies, such as 'repetitive strain injury' (RSI) and 'tennis elbow', reverting to normal following successful treatment. Helixes spontaneously appear in self-organizing processes, and a comparison between different species suggests that the proposed pattern may be an intrinsic part of mammalian limb development and responsible for the observed palpatory findings. Confirmation of this mechanism requires more detailed examination of limb myofascia and could lead to wider acceptance of this particular mode of treatment.

Introduction

Practitioners described as 'cranial' osteopaths and 'cranio-sacral' therapists routinely observe palpatory phenomena within the limbs of their patients.[1] They report a sense of rhythmic expansion and contraction within the limbs, with varying amounts of rotation and length change,[2] and a probable amplitude within a few hundred microns. The directional pattern of motion is altered by pathologies such as 'repetitive strain injury' and 'tennis elbow', reverting to normal following treatment.

This information, however, is mostly anecdotal with no studies on efficacy in limb treatment and current anatomical knowledge unable to explain the directional bias in motion. Some writers

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consider the whole concept illusory and attribute any therapeutic benefit to placebo.[3,4] A mechanism that might explain these phenomena, based on a reassessment of the architectural geometry of fascial tissues, is proposed. It is hoped that this will stimulate further research into this modality of treatment.

The 'cranial' approach to treatment

The 'cranial' approach considers an involuntary mechanism, first described (in part) by Swedenborg during the 18th century[5] and elaborated on by Sutherland (1939),[6] whereby connective tissues in the body are subject to a cyclic change in tension and small amount of motion, typically from two to fourteen times a minute (0.03 Hz).[7] Practitioners consider this to be part of normal physiology and the quality of motion an indicator of the 'health' or dysfunction of any particular tissue; Woods and Woods described the palpable sensation as the 'cranial rhythmic impulse' (CRI) in 1961.[8]

Chaitow[9] and Ferguson[10] reviewed different driving mechanisms that have been proposed for this motion, most of which originate in the cranium and transfer through the fascia, or act peripherally through the nervous and vascular systems. Sutherland's[6] suggestion of inherent expansion and contraction of brain tissue was followed by a hydrostatic model, where fluctuations in the production and re-absorption of cerebrospinal fluid (CSF) cause periodic changes in intracranial volume, articular mobility of cranial bones and sacral mobility through meningeal connections.[11,12] Moskalenko et al.[13] extended this model to include changes in vascular tone within the brain that induce similar oscillations in intracranial pressure and outflow of CSF into the spinal cavity, but the precise origin of the mechanism remains unknown.

A key part of the 'cranial' concept is that bones of the skull remain distinct throughout life and have a rhythmic motion that is palpable as the CRI. This differs from the conventional view that considers sutures between the bones as merely accommodating brain growth and fusing in the third decade of life.[14,15] However, there is considerable variation in the pattern and timing of sutural fusion throughout life[15-17] and 'closed' sutures frequently have little more than a mineralized veneer over their outer surface.[16] Animal studies clearly demonstrate sutural patency throughout life,[15] which suggests that complete fusion may be a semi-pathological state in humans. Recent data show that the growing infant brain does *not* push bones of the cranial vault outwards,[18] as previously thought,[14] and an alternative mechanism that allows the vault to retain a certain amount of structural and functional autonomy makes bone mobility feasible.[19]

Sutherland[6] considered cranial bone motion to be one of five distinct 'phenomena' that includes mobility of the meninges and sacrum, motility of the brain, and fluctuation of the CSF within a 'Primary Respiratory Mechanism' (PRM). The term 'PRM' implies a fundamental relationship between the cranium, fascia and cellular respiration and places thoracic breathing as 'secondary'.[1] It should be noted that the phenomena observed in the limbs are not the same as Sutherland's 'five phenomena' but are probably part of the same entity. The CRI is the palpable manifestation of the PRM and is most evident on the head although recognizable on all parts of the body; it can be disturbed by trauma and pathology.[1,2,11,12]

"The PRM/CRI is a decidedly controversial aspect of osteopathic medicine. It is a subtle enough phenomenon to be easily overlooked by untrained clinicians… [which] has led many to doubt its existence".[20] Green et al.[21] reviewed the evidence supporting the 'cranial' concept and found that experimental protocols and subsequent analyses were generally inadequate to justify the conclusions purported by their authors. However, Nelson et al.[20] later measured cyclic changes in blood flow known as Traube–Hering–Mayer waves[22] and demonstrated a statistically significant correlation with the CRI, while Moskalenko et al.[23] found similar periodic movements of CSF based on oscillations of brain vessel tone. Christ et al.[24] measured cyclic changes in limb volume within the CRI range and suggested that they were due to variations in arterial pressure, arteriolar vasomotion and possibly lymphatic diameter. A later review in 2011 by Nelson[7] concluded that 'cranial' manipulation has a significant affect on blood flow but that practitioners can recognize a variety of physiological frequencies, which may have contributed to earlier confusion regarding the precise CRI rate.[25] Karni et al.[26] recognized that variations in vessel calibre might influence limb volume and relate to the palpable CRI, although the protocol and analysis are questionable;[21] even so, rhythmic changes in fluid volume[7,20,24] might be responsible for the sense of limb expansion and contraction observed by practitioners.[2] To understand the mechanism that may explain these findings it is necessary to examine the microstructure of fascia.