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The Vertebral Subluxation premise:
Principle 3, altered physiological functions

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Narrative: This is the fourth of a 6-paper series which presents a descriptive narrative of the Western medical literature to identify and report evidence for each of the five principles of the Vertebral Subluxation Complex (VSC) premise as established in 1947 by Janse, Houser, and Wells (National College of Chiropractic). This literature comprises predominately medical referencing and includes Chiropractic papers in the electronic *Index to Chiropractic Literature*.

This paper presents the evidence for Principle Three by documenting the evidence for the clinical findings of altered physiological function associated with the VSC including effects on skeletal muscle, vascular smooth muscle, sphincters and organs.

This 6-part series describes the incontrovertible acknowledgement and weight of recognition of the effect of physical, biomechanical, and physiological vertebral disturbances collectively contributing to the VSC and demonstrates strong support of the chiropractic nomenclature, neurophysiological and clinical implications of the Vertebral Subluxation Complex as recorded in the medical literature.

Indexing terms: Subluxation; Vertebral Subluxation Complex (VSC); biomechanics; neurophysiology, connective tissue.

Editor's note:

Rome and Waterhouse continue their exploration of the spinal lesions or levels of dysfunction known to chiropractors as indicative of the Vertebral Subluxation Complex (VSC).

> *... Principle 3 of the VSC is that there are altered physiological functions of skeletal muscle, vascular smooth muscle, sphincters, and organs ...'*

This 4th paper in our new series of six documents includes evidence supportive of Principle 3, that there are '*altered physiological functions of skeletal muscle, vascular smooth muscle, sphincters, and organs associated with the VSC which are clinically evident*' and documented by medical authors.

The reporting of Rome and Waterhouse is so extensive that the *Journal* is publishing these 6 papers as Principle 1 Part a here continued here, Principle 2 here, Principle 4 here and Principle 5 here. This paper addresses Principle 3. These papers are also collected on the *Journal* website as 'MasterClasses' as an invaluable reference base.

To maximise the usefulness of these papers, each key narrative element is immediately supported by a compendium of source references, a departure from the usual practice of collecting cited references at the end of the work.

Phillip Ebrall
Editor

This series to date ...

The first papers, Parts1 and 2 of Principle One that '*a vertebrae may subluxate*' and established that the clinical practices of Chiropractic, manipulative medicine and Osteopathy collectively recognise the biomechanical and physiological phenomena and associated neural ramifications of spinal lesions. The second paper reported the evidence for Principle Two by documenting evidence for the effect of physical, biomechanical, and physiological vertebral disturbances collectively contributing to the VSC. It demonstrated strong support of the chiropractic nomenclature, neurophysiological and clinical implications of the Vertebral Subluxation Complex as recorded in the medical literature

To date we have presented the preponderance of papers from the field of manipulative medicine which support the chiropractic nomenclature of of the VSC and we continue by reporting the literature relating to the altered physiological functions associated with the VSC.

Introduction to Paper 4, Principle 3

'altered physiological functions associated with the VSC include effects on skeletal muscle, vascular smooth muscle, sphincters and organs'

Such altered physiological functions may involve both afferent and efferent pathways. Afferent elements may include somatosensory reflexes, central sensitisation and input to and from the thalamus and cortical regions. There is a distinct association with the autonomic nervous system of somatoautonomic efferent influences having a noted effect upon somatovascular and somatovisceral neural circuits. Occipital headaches and sciatica are suggested as ready examples of nociceptive somato-somatic reflexes. It would be a physiological response for somatovisceral reflexes to be affected. (Sato et al, 1997)

Altered neural transmission as a result of the disturbance is also thought to be involved. This may be reflected in symptoms and signs which can include, pain, cervicogenic headaches, intercostal neuralgia, sciatica, altered tendon reflexes, and paresthesias as basic examples. Even the pain or tenderness of a subluxated joint is a form of neural registration. (Agnati et al, 2012; Airaksinen, 2004; Andersen et al, 2000; Battakova, 2013; Cailliet, 1967; Dalglaish, 1960; Fernandes et al, 2022; Gorman, 2011; Guardado et al, 2022; Hasan, 1992; Hauser, 2021; Jackson, 1966; Keonig, 2020; Krag, 1982; Kunert, 1965; Luz et al, 2015; Meloche et al, 1993; Mueller et al, 2017; Passatore, 2006; Pickar, 2002; Potter et al, 2005; Richards, 2001; Sjstaad, 1983; Smith et al, 2017; Taylor, 2010; Zhang et al, 2014)

The efferent nerves are associated with visceral innervation via the sympathetic and parasympathetic divisions of the autonomic nervous system. Brodal states that they deal '*... with visceral efferent neurons that form the efferent part of the autonomic nervous system. The sympathetic system is of special importance in stressful situations, whereas the parasympathetic system contributes primarily to maintenance. Both systems consist of two consecutive neurons. Preganglionic neurons have their cell bodies in the cord or brain stem, and their axons terminate in ganglia. Postganglionic neurons send their axons to smooth muscles and glands. The preganglionic sympathetic neurons lie in the intermediolateral column of the cord. All preganglionic neurons use acetylcholine as transmitter in the ganglia. Most postganglionic sympathetic neurons use norepinephrine, while parasympathetic neurons use acetylcholine. The preganglionic sympathetic fibers enter ganglia in the sympathetic trunk. From there postganglionic fibers follow the spinal nerves to the extremities and trunk. Sympathetic fibers to the viscera follow splanchnic nerves. The enteric system consists of neurons in the wall of the gastrointestinal tract.*' (Brodal, 2016.)

Efferent pathophysiology

Under an 'All Fields' key word search of efferent, the ICL presents over40 papers on efferent neural activity as it relates to this profession's model of care.

Pain or degrees of it would perhaps be the most common noxious sensory insult from somatic structures making it likely to be an afferent somatosensory stimulus of somatoautonomic and somatovisceral reflexes. While the sensation of pain is regarded as an afferent response, Raja et al discuss an efferent association to this somatosensory activation. They state '*It is becoming increasingly evident that neuropathic pain is mediated or maintained by the sympathetic nervous system in only a subset of patients and that the interaction between sympathetic efferent fibers and the somatosensory afferent fibers is dynamic*'. (Raja et al, 2012)

Some 25 years ago Budgell and Sato discussed '*the modulations of autonomic functions by somatic nociceptive inputs. A great deal of basic research on somato-autonomic reflex regulation of visceral function has been carried out in anesthetized animals, particularly cats and rats. These animal models have been useful in revealing the underlying neural mechanisms in the absence of emotional influences. Because of the limitations of anaesthesia, most of these studies have necessarily addressed acute effects. Nonetheless, it is apparent that somatic stimulation is capable of causing widespread and, at times, profound visceral responses, both in the short and long term. The most consistent and potent reflexes are induced by noxious stimulation or the activation of unmyelinated afferent fibers. Somato-autonomic reflexes can be sub-divided into A- and C-reflexes, which are elicited by stimulation of myelinated (A) and unmyelinated (C) afferent fibers, respectively, in somatic nerves. As many unmyelinated afferent fibers serve polymodal receptors, autonomic C-reflexes provide an interesting tool for studying the characteristics of somatic nociceptors.*' (Budgell & Sato, 1996)

Neural innervation of target structures, and neural influence of vascular dynamics may influence the integrity and/or the function of those target structures. This may be in the form of:

- Alteration in neural tone of innervated structure
- Alteration in function of innervated structure
- Alteration in function of vascularised structure
- Alteration in sphincter tone e.g. pyloric
- Possible cellular changes of innervated structure
- Loss of the stimulation of neural innervation
- Target structures (somatic or visceral) may be affected by alterations of vascular supply
- Target structures (somatic or visceral) may be affected by alterations in neural supply.

Extended reference compilation

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Somato-autonomic

In their text Bourdillon and Day state '*If autonomic reflex activity is accepted as a vehicle for many of the manifestations of joint or somatic dysfunction, then one can postulate that coronary vasospasm might be a result of somatic dysfunction and, if so, that it might respond to manual management.*' (Bourdillon & Day, 1988)

In further association with pathoneurophysiology, Biedermann's (2004) text on manual therapy in children also includes a chapter by Koch on the influence of the upper cervical spine on the autonomic regulation in infants. (Koch, 2004)

In monitoring cerebral blood circulation, an analysis by Tsapok in 2015 '*has shown association between a vertebral dysfunction and dysfunction in the autonomic nervous system in children. Medical follow-up and electroencephalography, myographic and rheoencephalography findings has allowed concluding (sic) over clinical importance of the complaints on the back pain and changes in the cervical part of a backbone for diagnostics, prevention and treatment of autonomous dysfunction.*' (Tsapok, 2015)

In 1989, Jinkins et al discussed in detail the autonomic syndromes of referred pain and autonomic reflex dysfunction as related to a lumbar disc extrusion. While the degree of extrusion would be far greater than a minimalist subluxation, the mechanism for the influence is noted. (Jinkins et al, 1989)

In-depth somato-autonomic research in animals was conducted by Sato and reported in 1997, he opined '*The somatically-induced reflex responses of autonomic, hormonal and immune functions demonstrated in anesthetized animals, as have been discussed herein, appear to function even during conscious states. We need further studies to evaluate the physiological meaning of these somato-autonomic reflex responses. The analysis of neural mechanisms of these reflex responses seems to be very important for clinical application to regulate visceral function by physical treatment.*' (Sato b, 1997)

In citing numerous studies, Schmörl and Junghanns (1971) reference a wide range of so-called visceral conditions associated with biomechanically disrupted vertebrae.

A further study suggested that upper cervical manipulation has positive effects on the ANS activity, stress resistance, and fatigue index. (Seunggu & Yong, 2021) It is also noted that acupuncture is thought to have a significant somato-autonomic component. (Ma, 2020)

A 2019 physiotherapy study '*... observed that thoracic chiropractic manipulation has an immediate effect on the autonomic nervous system activity.*' The authors stated further that *'a decrease in the parasympathetic activity while there was an increase in sympathetic activity.*' (Cakir et al, 2019)

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Somato-sympathetic reflexes

The sympathetic branch of the autonomic nervous system has been explained in *Principles of Manual Medicine* involving '*facilitated segments*' (euphemism for VSC element). The author(s) outline a role for the somato-sympathetic reflex as '*Manipulative treatment can be used to reduce afferent input from associated facilitated structures, which can help to restore normal reflex activity by reducing somato-sympathetic activity to the affected viscus … Segmentally related postganglionic fibers in the sympathetic trunk may then stimulate cutaneous receptors resulting in dilation of blood vessels and reddening of the skin*.' (Michigan State University. Accessed Oct 15, 2022)

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Somato-parasympathetic branch of the autonomic nervous system

Cranial nerves

Hadley notes a number of cranial and cephalic conditions and vasomotor disturbances that have been associated with what he calls a chronic cervical syndrome under foramen encroachment. (Hadley, 1976 p. 438)

The spinal somatic element of the parasympathetic component of the autonomic nervous system includes the cranial and sacral nerve distributions. However, Espinosa-Medina et al question this classification. (Espinosa-Medina et al, 2016; 2018) Indeed Jänig et al and others challenge the traditional differentiation of the two divisions of the autonomic nervous system. (Nuehuber et al, 2017; Miglis & Muppidi, 2017; Jänig et al, 2018; Horn, 2018)

While the cranial nerves have distinct parasympathetic functions and distributions, an association with the cervical spine is evident in the literature. Headaches and migraines appear to attract relatively frequent citations (see '*Trigeminal*' and '*Headache*' in this series).

A 2018 paper by da Silva et al suggested that posture had an influence on the parasympathetic nervous system. As such, disturbed posture would seem to be a natural association with a manipulative, manual model of care. The results of this study suggest that parasympathetic

activity can also be influenced positively by body corrective measures of posture, upper thoracic compression, and manual contact affecting baroreceptor reflex, breathing, and the presence of pain. (da Silva, 2018)

A 1994 study by Likhachev and Borisenko noted '*spontaneous nystagmus and parameters of vestibuloocular interaction in patients with reflex syndromes of cervical osteochondrosis accompanied by vestibular dysfunction, under the influence of manual therapy*.' (Likhachev & Borisenko, 1994)

A 2020 physical therapy study from Spain '*found that application of cervico-mandibular manual therapies in combination with exercise and education resulted in better outcomes than application of exercise/education alone in individuals with tinnitus attributed to TMD*.' (Delgado de la Serna et al, 2020)

Extended reference compilation

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CRANIAL NERVES

Ear Nose and Throat

A range of ENT conditions have been identified as being related to disturbances of the cervical spine and its association with cranial nerves. These include cases of tinnitus, *Ménière's Syndrome*, vertigo, dizziness, blurred visual, as well as nasal, otic and laryngeal symptoms. However, it is recognised that ENT conditions may have a variety of aetiologies, see citations given below.

In support of the concept and clinical observations, Franz and Anderson state '*in this hypothetical reflex pathway, irritation of facet joints can first lead to an activated anterior cervical*

sympathetic system via an independent pathway in the mediolateral cell column; it can simultaneously lead to an axon reflex involving nociceptive neurons, resulting in neurogenic inflammation and the prospect of a eustachian tube dysfunction'. (Franz et al, 2007)

Extended reference compilation

Otic disorders

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Auditory Disorders

Hearing

The association here is historically significant as it has been recorded that the very first chiropractic patient suffered sudden hearing loss which was restored following spinal; manipulation.

Extended reference compilation

Auditory Disorders

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Trigeminal – CrN V

Neurones in the trigeminocervical complex are the major relay neurones for nociceptive afferent input from the meninges and cervical structures; therefore, they are the neural substrates of head pain. We highlight the importance of two basic mechanisms in headache physiology: convergence of nociceptive afferents and sensitisation of trigeminocervical neurones.

These physiologic findings have clinical correlates such as hypersensitivity and spread and referral of pain frequently seen in patients with primary headache, such as migraine. Special reference is made to the influence of structures from the upper cervical spine in generating and contributing to migraine headaches: '*The pathophysiology and functional relevance of these basic mechanisms to headaches is discussed in the context of recent experimental findings with regard to pain processing*.' (Bartch & Goadsby, 2003)

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Cranials - Vagus CrN X

It is now thought that the left vagus has a slightly different neurological role to the right vagus when stimulated by implant or through percutaneous activation. (Howland, 2014; McIntire et al, 2021)

There is also evidence to suggest that vagus nerve stimulation could be employed in the treatment of lupus, RA and other autoimmune and inflammatory diseases. (Das, 2011; Ramkissoon et al, 2021)

'*Results of this study supported the concept that vagal and/ or sympathetic afferent activation of C1-C3 STT neurons might provide a neural mechanism for referred pain that originates in the heart or other visceral organs but is perceived in the neck and jaw region. Additionally, C1-C3 STT neurons processed sensory information from widespread regions of the body.*' (Chandler et al, 1996)

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Vestibular CrN VIII

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Vertebrogenic

This term has been associated with a number of conditions, not necessarily subluxation-related, but in a somato-autonomic manner as opposed to being a confined musculoskeletal model. While vertebrogenic does not necessarily mean subluxogenic, similar neurological reflexes, signs and symptoms may be generated.

The term vertebrogenic encompasses a similar etiological connotation. Such a situation would lead into conditions somato-autonomic, somatovascular, somatovisceral and visceral dysfunction as discussed.

- Vertebrogenic ...
  - Vertebrogenic cardialgia, (Shakhnazarov et al, 1977; Sokov etal, 2009)
  - Vertebrogenic cervicoencephalic, (Fengler et al, 1986)
  - Vertebrogenic chest pain, (Grgić, 2007)
  - Vertebrogenic dizziness, (Carrasco et al, 2021)
  - Vertebrogenic dysphagia, (Walther, 1991; Ansersen & Fagerlund, 2000)
  - Vertebrogenic headache, (Vernon, Dhami, 1985; Walter, 1985; Leone et al, 1998); Haldeman & Dagenais, 2001; Bogduk, 2001)
  - Vertebrogenic pseudoangina pectoris (Grgić)
  - Vertebrogenic thoracoalgia, (Simonenko et al, 2007)
  - Vertebrogenic vestibular dysfunction. (Likhachev et al, 1994)

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Cervicogenic

'*The spine, and in particular the cervical spine, is treated primarily for joint disorders characterized by a variety of symptoms (e.g.headache, vertigo, dizziness, blurred vision). Manual medicine should be an integral part of modern clinical otolaryngology*'. (Scott et al, 2001)

In terms of effects on the nervous system, the cervical spine may be seen as one of the most structurally and functionally influential regions. The evidence indicates that its influence is biologically extensive via sympathetic and parasympathetic pathways to include the head, brain, vascular and visceral function, and to the upper extremities, via vagus innervation.

The term *cervicogenic* itself, would appear to have enhanced its reputation clinically with many cephalalgias being regularly noted as cervicogenic headaches. (Welch & Boone, 2008; Rome & Waterhouse Part 9, 2021), other conditions are also recorded. (Rome & Waterhouse Parts 7 & 8, 2021)

While a number of spinal conditions are noted as having a vertebro-mechanical association, the conventional medical intervention appears to have been the application of drugs, injections or perhaps surgery. Studies of spinal manipulation as an initial conservative measure would seem to have been an exception under a conventional model. (Urits et al 2021; Sherman et al, 2004; Wolsko et al, 2003)

On the other hand, while the term craniocervical and its ramifications seems to be more recognised, the term vertebrogenic may relate to nociception of the lumbar, thoracic and cervical regions of the spine. Many of the biomechanical citations are of European origin. Vertebrognic may however also be applied to certain pathophysiological conditions. (Walther, 1991; Conger et al, 2022; Grgić, 2007)

- Cervicogenic
  - Cervicogenic dizziness (Chu et al, 2019; Reiley et al, 2017; Cleveland Clinic, 2022)
  - Cervicogenic dysphagia (Chu & Lee, 2021; Grgić, 2013)
  - Cervicogenic dysphonia (Hűlse, 2013; Kurkurin, 2004)
  - Cervicogenic exophthalmos (Wu, 2020)
  - Cervicogenic headache (Leone et al, 1998; Bogduk, 2001; Haldeman & Dagenais, 2001; Drottning et al, 2007)
  - Cervicogenic migraine (Anarte-Lazo et al, 2021)
  - Cervicogenic otoocular syndrome (Franz et al, 1999)
  - Cervicogenic oesophageal dysfunction (Vaňásková et al, 2001)
  - Cervicogenic tinnitus (Bechter et al, 2016)
  - Cervicogenic vertigo (Brown et al, 1992; Cleveland Clinic 2022)
  - Cervicogenic vestibulo-ocular and post-concussion disorders (Ellis et al, 2015)

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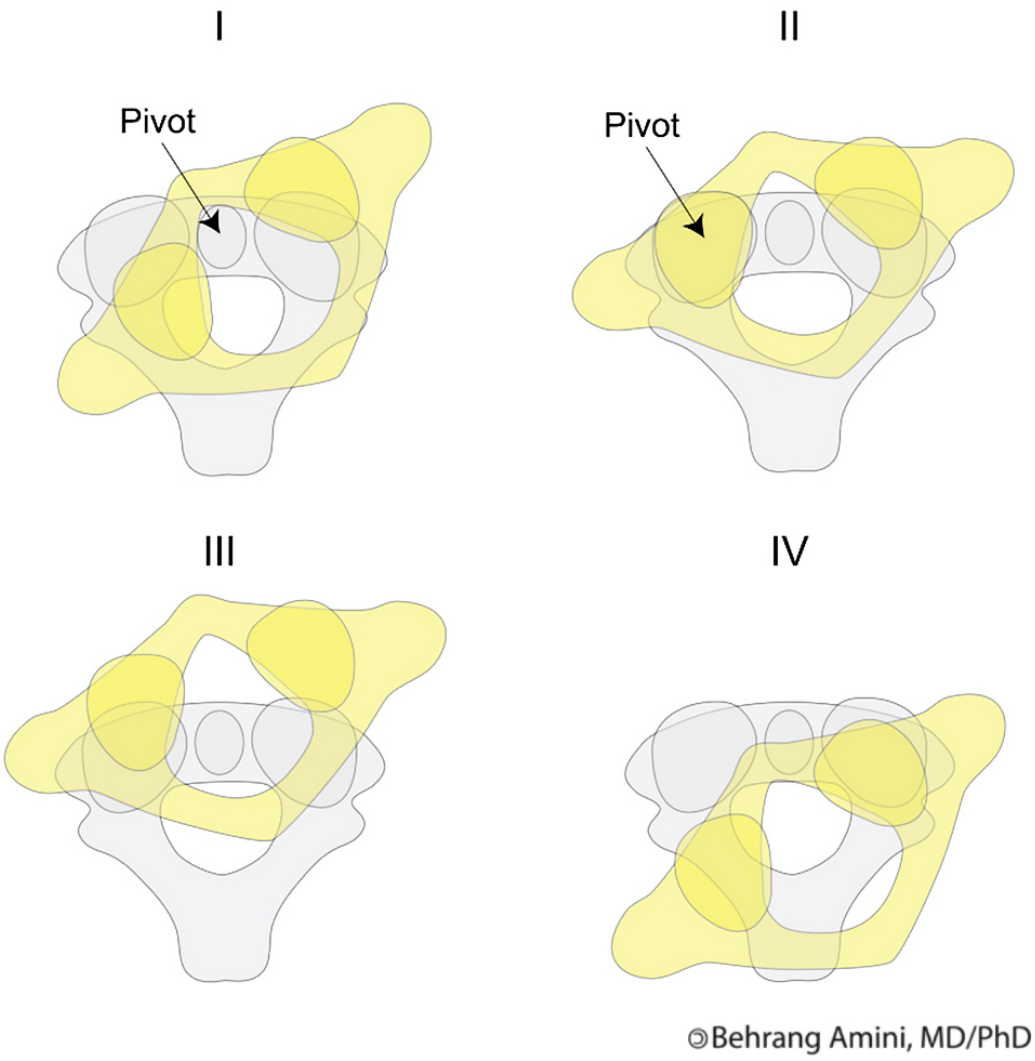
Sub-occipital subluxation complexes

Sub-occipital subluxation complexes include: Atlanto-Axial Subluxation, CO/C1, C1/C2, Atlantooccipital, Craniocervical, Upper Cervical and, Suboccipital, Atlantoaxial Rotatory Subluxation or Fixation (AARF), and *Grisel's Syndrome*:

'*Malformation and misalignment of the craniocervical junction can cause a constellation of cerebral and other neurological signs and symptoms collectively called craniocervical syndrome (CCS). The signs and symptoms of craniocervical junction syndrome may be due to mechanical strain causing deformation of dura mater, vasculature and other structures of the cranial vault resulting in irritation of and dysfunction of affected tissues.*' (Rosa et al, 2015



Jin TY. - Based on Fielding and Hawkins classification. (Jin Undated, Accessed July 2022)

Medicine's apparent interest in displacement of the upper cervical spine apart from traumatic injuries to the region, seems focused on children. These have been regarded as primarily idiopathic or related to upper respiratory infection as in *Grisel's Syndrome*. (Discussed further under Paediatrics)

The influential suboccipital region covered in the medical literature appears to only reveal limited interest to biomechanical lesions in other regions of the spine. However, the medical evidence that does exist exposes a distinct neural somato-autonomic association particularly with headaches, functional cardiovascular, and functional gastrointestinal disorders.

There is recent mounting evidence in the medical literature of a growing interest in segmental vertebral disturbances in the suboccipital region, a region of noteworthy afferent influence, and one that has received particular attention from chiropractors over decades. This interest has been both a biomechanical subluxation or an upper respiratory infection *(Grisel's syndrome*). (Epstein, 1976; Fielding & Hawkins, 1977; Kawabe et al, 1989; Maheshwaran et al, 1995; Subach et al, 1998; Muniz & Belfer, 1999; Roche et al, 2001; Keats, 2001; Theiler, 2004; Ishii et al, 2011; Webb et al, 2011; Pilge et al, 2011; Powell et al, 2017; Sferopoulos, 2018; Hill et al, 2021; Jin, 2022; Agrawal & El-Feky, 2022; He et al 2011; 2017)

Roche et al stated '*atlanto-axial rotatory fixation (AARF) is a rare condition which occurs more commonly in children than in adults*.' The terminology can be ambiguous and the condition is also known as '*atlanto-axial rotatory subluxation*' and '*atlanto-axial rotary dislocation*'. (Roche. 2001).

In relation to the following depiction of C1/C2 'displacements' we would suggest that clinically in the manipulative sciences, categories I and II in Jin's presentation are common presentations, with categories III and IV extremely rare in general practice as they are beyond their normal physiological range of motion.

In relation to a segmental flexion in the cervical spine, Goel and Knipe presented observations on *Radiopaedia*. They opined that an '*Anterior subluxation of the cervical spine, (is) also known as hyperflexion sprain, is a ligamentous injury of the cervical spine*.' (Goel & Knipe, 2018) We would suggest that associated segmental dysfunction and and sensory activation are also critical.

The suboccipital region of the spine is a most vulnerable area as the head is balanced on two articular facets each averaging only 158mm^2 to allow almost 180° of head rotation and other motions when functioning normally. This region also has great influence on the spinal cord if subject to severe trauma such a whiplash. (Motagi et al, 2013)

A comparatively recent development is the adoption of the acronym of AARS to an *Atlantoaxial Rotary Subluxation*. The authors state that it is a rare condition which can be associated with torticollis. We would suggest that this has been a common condition managed by chiropractors and osteopaths for over a century, although we acknowledge some extreme cases require more involved medical intervention. (Neal et al, 2015; Powell et al, 2017)

The US Federal Science Agency website at *science.gov* has established Topics by Science. One such topic is '*Sample records for atlanto-axial subluxation due*' and recognises a rather large collection of abstracts on the topic. The PubMed website lists 265 papers under a general search for atlanto-axial subluxation. Other forms of subluxations are also listed on this site. (Science.gov, undated; Maheshwaran, 1995; Chiapparini, 2005)

A 1977 study by Fielding and Hawkins is used as a reference base for this condition in many subsequent papers.

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The *Rectus Capitis Posterior Major* Muscle

Anatomically speaking, a comparatively recently discovered anatomical structure by Hack et al would seem of particular relevance to biomechanical disturbances in the upper cervical region. This triangular structure has been identified as a connecting myodural bridge of soft tissue which connects the spinous process of C2 and the *semispinalis capitis* muscles and the cervical dura mater. Partland and Brodeur opined that this was an important suboccipital muscle, while Yuan and colleagues found an association between this muscle and chronic headaches as well as an effect on cerebrospinal fluid circulation. We suggest that disturbance of the C0/C1 articulations, dysfunction with or without displacement, may be a key contributing factor in associated cervicogenic headaches. Since 1999 (Alix) seven chiropractic papers on this structure are listed in the ICL. (Hack et al, 1995; Partland & Brodeur, 1999; Yuan et al, 2016 x 2; Alix & Bates, 1999)

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Lumbogenic and Thoracogenic

Unlike cervicogenic, reference to other spinal segments in the medical literature, use of the term lumbogenic seems to be rarely cited in *PubMed*, except in relation to discogenic pain. Similarly, thoracogenic seems to be mostly related to pain in the presence of scolioses. It is submitted here however, that functionally disrupted segments may indeed be related to generated symptoms from all three levels of the spine, as well as biomechanically disturbed pelvic articulation. A somatovisceral or somatoautonomic sensory reflex association with these terms appears to be absent in the traditional literature.

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Intercostal neuralgia

In a biomechanical condition such as intercostal neuralgia, and depending on the aetiology, it would seem appropriate for a conservative initial step to be tried considering the possible severity of more invasive interventions.

It is noted that clinically, this condition may simulate certain somatovisceral conditions regarding cardiovascular or respiratory symptoms.

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The sacroiliac joint

Gray's Anatomy stated in reference to the sacroiliac joint that '*locking may occur …*' and that '*This so-called subluxation of the sacro-iliac joint causes pain*' and that '*reduction by forcible manipulation may be attempted*.' Symptomatic recognition of somatosensory activation joint pain could be considered as involving the autonomic nervous system. Pain is a sensation which registers further into the central nervous system through the spinothalamic tract to the higher centres of the brain indicating or indeed confirming that the subluxation or joint locking could be more than a mechanical phenomenon. (Williams & Warwick, 1980; Yam, 2018)

Forty years after Gray's 36th edition, a radiological description of the mechanical element of a subluxation complex by Baba (2021) essentially identified a vertebral sprain when he opined that a '*Subluxed facet joint is the mildest form of facet dislocation in which the ligamentous injury leads to partial uncovering of a facet joint (cf. complete uncovering in perched facet)*.'

The Cedars Sinai Hospital website also notes that '*Dysfunction in the sacroiliac joint is thought to cause low back pain and/or leg pain*' and further that '*Manual manipulation provided by a chiropractor, osteopathic doctor or other qualified health practitioner may help. This can be highly effective when the sacroiliac joint is fixated or "stuck." It may be irritating if the sacroiliac joint is hypermobile*.' While the physical-mechanical aspect of this lesion is noted, recognition of the symptoms conducted by afferent somatosensory mechanoreceptors and somato-autonomic reflex associations were omitted. (Cedars Sinai (a), undated; Cedars Sinai (b), undated)

Subluxation must comprise fixation or a degree of it, otherwise if would exhibit aberrant motion, but a fixation may not be subluxated if it is 'locked' in its neutral centre of rotation.

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Somatovascular, smooth muscle, and sphincters

In his extensively referenced tome *Anatomico-Roentgenographic Studies of the Spine*, the radiologist Hadley stated, '*Certain vasomotor disturbances are also included as a part of this (chronic cervical) syndrome namely; sweating, flushing, lacrimation and salivation.*' (p. 438) He notes that in the cervical spine '*normal physiological movements are of diagnostic value in evaluating or eliciting symptoms.*' (p. 432) and that '*Constriction of the intervertebral foramen may be caused by a posterior joint telescoping and by wedging the superior articular processes forward.*' (p. 432) (Hadley, 1976)

Some 30 years ago, Russian researchers noted a subluxation factor in an association between somato-autonomic and smooth muscle influence in somato-autonomic-vascular reflexes. They reported that:'*In subluxation of a vertebra, changes in the vegetative connections of spinal cord gray matter and the microcirculatory vessels arise simultaneously; this suggests interdependence between them*'. (Gongal'skii & Kuftyreva, 1992; 1992)

In monitoring cerebral blood circulation, an analysis by Tsapok in 2015 '*has shown association between a vertebral dysfunction and dysfunction in the autonomic nervous system in children. Medical follow-up and electroencephalography, myographic and rheoencephalography findings has allowed concluding* (sic) *over clinical importance of the complaints on the back pain and changes in the cervical part of a backbone for diagnostics, prevention and treatment of autonomous dysfunction.*' (Tsapok, 2015)

Earlier in this paper mention was made of the potential role of manipulative influence upon cranial nerves. This case was taken further when it was found in 2022 that '*cholinergic parasympathetic-mediated hemodynamics evoked by trigeminal somatosensory inputs are closely related to ABP changes.*' (Ramadhani et al, 2022)

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Sudomotor

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Sphincters, smooth muscle

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Visceral dysfunction

There are a number of visceral conditions that have been regarded as functional biological disturbances and essentially idiopathic, functional dyspepsia and functional dysphagia seem to be common diagnoses.

The Rome Foundation in Europe has been established as '*an independent not for profit [501(c) 3] organisation that provides support for activities designed to create scientific data and educational information to assist in the diagnosis and treatment of Disorders of Gut-Brain Interaction (DGBI), also known as functional gastrointestinal (GI) disorders.*' [https://theromefoundation.org/ (Circa 2021)] [https://www.mdcalc.com/calc/10283/rome-iv-diagnostic-criteria-functional-dysphagia. (Circa 2022)]

Collaborative research into the possible role of biomechanical vertebrogenic factors may prove to be a positive development.

A gastroenterology study noted that '*Patients with fibromyalgia commonly have symptoms of abdominal pain, suggesting that altered somatic afferent activity may influence visceral sensations*'. It is hypothesised that a noxious somatic stimulus increases input to the projection neurons in the dorsal horn, resulting in visceral hyperalgesia. The authors concluded that on rat subjects '*Noxious somatic afferent input from the hind limb facilitates visceral hyperalgesia, which is due to viscerosomatic convergence in the lower spinal cord. This can be blocked by ionotropic glutamate receptor antagonists*'. (Miranda et al, 2004)

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Visceral Dysfunction

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A number of clinical presentations have been identified with many not responding to conventional treatment (Mayer & Tillisch, 2011), typical examples of the functional effects from neurological disturbance of a vertebral subluxation complex may include:

- Neck-tongue syndrome
- Neurogenic dysphagia
- Functional dysphonia
- Functional dyspepsia
- Functional dystonia
- Cervicogenic headache
- Intercostal neuralgia
- Other radicular syndromes

'*The most likely cause of the simultaneous occurrence of suboccipital pain and ipsilateral numbness of the tongue is an abnormal subluxation of one lateral atlanto-axial joint with impaction of the C2 ventral ramus against the subluxated articular processes.*' (Bogduk, 1981)

Extended reference compilation

Neck-Tongue Syndrome

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Neurogenic dysphagia

The *US National Institute Health* stated that dysphagia may occur ' ... *when there is a problem with the neural control or the structures involved in any part of the swallowing process.*' While there is a range of other possible aetiologies, this particular cause would appear to be corroborated by further medical evidence when a vertebrogenic factor may be involved.

Extended reference compilation

Neurogenic Dysphagia

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Dysphonia

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Dyspepsia, Vertebrogenic Dyspepsia, Reflux, & GERD

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Tone

The importance of tone in human physiology has been noted by McDowall et al. They state that '*Tone is closely aligned with functional neurology and can be understood as an interface between the metaphysical and the biomedical.*' (McDowall et al, 2017)

Earlier, Person had stated that '*Modulation of the nucleus tractus solitarius by somatic afferents may then adjust sympathetic tone, via modulation of other medullary centers, in visceral and somatic tissues to match somatic metabolic needs.*' (Person, 1989)

Extended reference compilation

Tone

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To be continued

This series will continue as Part 5 by reporting evidence supportive of Principle 4, that '*segmental and neural disturbance is associated with signs, symptoms, and a range of conditions*'.

We consider this principle critical to understanding the *Vertebral Subluxation Complex*.

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See also

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