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The Vertebral Subluxation premise:

Principle 5, the intent is to correct dysfunction and restore normal function

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Narrative: This is the final paper 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 includes medical and Chiropractic papers in the medical indices and is additional to that available in the electronic *Index to Chiropractic Literature*.

This paper presents the evidence for Principle Five by documenting the evidence that supports a Chiropractor's manual intervention to correct subluxations is associated with changes to dysfunction and neural pathophysiology. These changes are shown to ameliorate symptoms and restore physiology.

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); segmental neural disturbance; neurophysiology; adjustment; correction.

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).

This final paper in our new series of six documents gives evidence supportive of Principle 5, that there are '*a Chiropractor's manual intervention to correct subluxations is associated with changes to dysfunction and neural pathophysiology. These changes are shown to ameliorate symptoms and restore physiology* are documented by medical authors.

This is Paper 6 addressing Principle 5 to complete the series. All papers in the series are listed at the end of this paper.

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

... Principle 5 of the VSC is that a Chiropractor's manual intervention to correct subluxations is associated with changes to dysfunction and neural pathophysiology. These changes are shown to ameliorate symptoms and restore physiology ...'

This series to date ...

The first papers, Parts1 and 2 of Principle One that '*a vertebrae may subluxate*' 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 third 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.

The fourth paper presented evidence for Principle Three, as the clinical findings of altered physiological function associated with the VSC including effects on skeletal muscle, vascular smooth muscle, sphincters and organs.

The fifth paper presented evidence for Principle Four, that there are the signs, symptoms, and a range of conditions associated with segmental and neural disturbance. This final paper addresses Principle Five, which in essence says these dysfunctions may be corrected and the expressed symptoms may be relieved.

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 manual intervention to correct subluxations and its association with changes to dysfunction and neural pathophysiology; changes shown to ameliorate symptoms and restore physiology.

Introduction to Principle 5

'a Chiropractor's manual intervention to correct subluxations is associated with changes to dysfunction and neural pathophysiology. These changes are shown to ameliorate symptoms and restore physiology'

In physically addressing the biomechanical disruption of elements of a vertebral subluxation complex, the intent is directed towards correcting the functional physiology of the zygapophyseal articulations, restoring sensory feedback and the influence of these on neural integrity of autonomic reflexes and innervated structures. In doing so, the direction, degree depth and technique are considered. (Collings, 1960; Macario-Gioia et al, 1984; Paterson, 1985; Bourdillon & Day, 1988; Briggs & Boone, 1988; Dvorak et al, 1988; Breig et al, 1989; Walther, 1991; Franz et al, 1999; Vanaskova et al, 2001; Dvořák et al, 2008; Young et al, 2009; Page, 2011; Paterson & Burn, 2012; Vanaskova et al, 2012; Azizi et al, 2020; Wu et al, 2020)

Apart from the physical, neurological, orthopaedic and spinal examination, other factors to be considered may include duration, acuteness, chronic, severity of initiating forces, patient health status, occupation, hobbies, sports, prior injuries, and previous health conditions.

Subluxation diagnosis

Physico-mechanical components

- Postural observation
- Assess mobility and gait
- Assess and examine region(s) of concern
- Identify region(s) of pain and tenderness

- Assess muscle tonicity (hyper and hypo), weakness
- Identify segment(s) of involvement
  - Palpatory
  - Segment(s) involved
  - Hypertonic intrinsic spinal muscles
  - Hypertonic postural spinal muscles
  - Hypotonic muscles at times - applied kinesiology
  - Dysfunction
- Assess regional and global mobility and range of motion.
- Motion palpation global and segmental
- Hypomobile,
- Hypermobile – instability ligamentous laxity
- Fixation
- Aberrant notion
- End feel
  - Deviated spinous (and direction)
  - Prominent spinous
  - Prominent TVP
  - Tenderness on palpation
  - Ilia landmarks
  - Sacrotuberous ligament
- Considerations for appropriateness of case
  - Red flags
  - Orange flags
  - Patient preferences
  - Signed consent
  - Informed options to care.
- Optimal technique
  - Dermatomes
  - Myotomes
  - Angiosomes
  - Associate patient symptoms
  - Associated signs – e.g. segment associated reflexes
- Observations
  - Hyperaemic dermal surface
  - Posture
  - Muscle profiles
  - Respiration
- Other diagnostic tests including imaging as indicated.

Extended reference compilation

Regarding spinal examination and diagnosis

Aino M, Oka S, Haruguchi K, et al. Comparison of spinal column alignment and autonomic nervous activity using the intersegmental tenderness test in the segment above. J Phys Ther Sci. 2021 Aug;33(8):570-5. DOI 10.1589/jpts.33.570.

Azizi S, Rezasoltani Z, Najfi S, et al. The relationship between dorsal spine dysfunction and gastrointestinal pain and efficacy of manipulation on them. Phys Med Rehab Electrodiag. 2020;2(1):2-6.

Beal MC. Incidence of spinal palpatory findings: a review. J Am Osteopath Assoc. 1989;89(8):1027-30, 1033-5.

Breig A, Dvořák J, Dvořák V, et al. The vertebral subluxation complex. Colorado Springs: Renaissance. 1989.

Consorti G, Basile F, Pugliese L, et al. Interrater reliability of osteopathic sacral palpatory diagnostic tests among osteopathy students. J Am Osteopath Assoc. 2018;118(10):637-44. DOI 10.7556/jaoa.2018.132.

Dvořák J, Dvořák V, Manuelle Medizin Diagnostik. Stuttgart: Thieme. 1997. (In German and English)

Fritz JM, Koppenhaver SL, Kawchuk GN, et al. Preliminary investigation of the mechanisms underlying the effects of manipulation: exploration of a multivariate model including spinal stiffness, multifidus recruitment, and clinical findings. Spine (Phila Pa 1976). 2011;36(21):1772-81.

Harvey D, Byfield D. Preliminary studies with a mechanical model for the evaluation of spinal motion palpation. Clinical Biomechanics 1991; 6(2):79-82.

Henderson CNR. The basis for spinal manipulation: chiropractic perspective of indications and theory. J Electromyogr Kinesiol. 2012;22(5):632-42. DOI 10.1016/j.jelekin.2012.03.008.

Horn, D L. Vertebral subluxation complex. Physical Therapy Scholarly Projects. Univ. North Dakota. 1993. https://commons.und.edu/pt-grad/223.

Leung, S. The value of cineradiographic motion studies in the diagnosis of dysfunctions of the cervical spine. Bull Eur Chiro Union 1977;25(2):28-43.

Page P. Cervicogenic headaches: an evidence-led approach to clinical management. Int J Sports Phys Ther. 2011;6(3):254-66.

Paterson JK, Burn L. An introduction to medical manipulation. Dordrecht: Springer. 2012.

Paterson JK. Vertebral manipulation: a part of orthodox medicine. Kluwer Academic Publishers: 1985.

Pickar JG, Bolton PS. Spinal manipulative therapy and somatosensory activation. J Electromyogr Kinesiol. 2012;22(5):785-94. DOI 10.1016/j.jelekin.2012.01.015.

Pickar JG, Wheeler JD. Response of muscle proprioceptors to spinal manipulative-like loads in the anesthetized cat. J Manipulative Physiol Ther. 2001;24(1):2-11.

Shaw KA, Dougherty JJ, Treffer KD, et al. Establishing the content validity of palpatory examination for the assessment of the lumbar spine using ultrasonography: a pilot study. J Am Osteopath Assoc. 2012;112(12):775-82. DOI 10.7556/jaoa.2012.112.12.775.

Sterling M, Jull G, Wright A. Cervical mobilisation: Concurrent effects on pain, sympathetic nervous system activity and motor activity. Man Ther 2001;6(2):72-81.

Wu C-M, Liao H-E, Hsu S-W, et al. Cervicogenic exophthalmos: possible etiology and pathogenesis. World J Clin Cases. 2020;8(2):318-24.

Young MF, McCarthy PW, King S. Chiropractic manual intervention in chronic adult dyspepsia. Eur J Gastroenterol Hepatol. 2009;21(4):482-3. DOI 10.1097/MEG.0b013e3282fc7370.

Radiological imaging (medical) and the subluxation

Structural and functional analysis

'The radiograph of the spine, and especially that of the cervical spine, yields an amazing amount of information if analysed thoroughly.' (Biedermann, 2004)

As well as diagnostic value, and signs of contraindications to care, Chiropractic radiology incorporates a structural analysis to assess the function and stress points in the spine. The concept of vertebral subluxations has not been appreciated in conventional interpretations but

can be of notable value in manipulative care. It is of further value in the acceptance or declination of appropriate cases for manual care.

If chiropractic radiology was limited to medical interpretation of spinal films, patients would be disadvantaged as would efficacy of treatment. It is recognised however, that serious medical findings would routinely be recognised by members of both the chiropractic and medical professions.

Kent's review of a dissertation by Kwon on spinal radiology and the vertebral subluxation essentially highlights the fact that even using the same imaging hardware, the criteria for chiropractic is in addition to that required for medical purposes. However, the clinical application and even the interpretation emphasis, while encompassing essential and medical aspects are employed differently to the traditional model. (Kent, 2021; Kwon, 2020)

A relatively common spinal region which is subject to biomechanical disturbance is the suboccipital region. (Smith & Dworkin, 2015) Medical recognition of the structural and functional elements of the subluxation were noted that the physical subluxation of the region as an atlanto-axial subluxation may present in a variety of characteristics. (Jin 2022)

Jin recorded several ways in which a subluxation can occur:

- Anteroposterior subluxation
- Rotatory subluxation is known as atlantoaxial rotatory fixation (AARF) is characterised into four different types according to the Fielding and Hawkins classification
- Type I: the atlas is rotated on the odontoid with no anterior displacement
- Type II: the atlas is rotated on one lateral articular process with 3 to 5mm of anterior displacement
- Type III: comprises rotation of the atlas on both lateral articular processes with anterior displacement greater than 5mm
- Type IV: rotation and posterior displacement of the atlas
- Vertical subluxation
- Lateral subluxation.

The radiologist Hadley discussed spinal disturbances under a range of topics including the posterior spinal articulations and innervation studies, intervertebral foramen and spinal nerve studies. He also provided comprehensive details of vertebral subluxations including partial displacement, spontaneous subluxation, traumatic subluxation, and dysfunction. (Hadley, 1976)

Epstein discussed the radiological evidence of subluxations where the articular surfaces are displaced but not over-ridden. (p. 549) Further, he states that cineroradiography '*is particularly useful in demonstrating abnormal motion of the dens or displacement of the upper cervical segments*'. (p. 557). He recognised the role of radiology when he noted that '*Even slight malalignments require clinical and radiological assessment before assuming 'unimportant*' (p. 540) and states '*Even slight displacement of one vertebra on another, or symmetry of the intervertebral foramina, should put one on the alert for a possible fracture dislocation.*' (p. 551) (Epstein, 1976)

The term *physiological subluxation* in 2001 and the term *pseudosubluxation* appears to have been first used in 1998. These terms highlight the difference to that of a *chiropractic subluxation* or *osteopathic somatic dysfunction*. (Keats & Anderson, 2001; Fechtel, 1983) Functional radiology would assist in differentiating these terms. It is suggested here that within the usual physiological range of motion in an articulation, the said joint cannot logically undergo static displacement without it being a dysfunction (fixation), that is, a loss of function. Aberrant motion would also be

a form of dysfunction without fixated displacement. A segment may however be fixated in its normal neutral position.

Another medical doyen of spinal manipulation, Lewit, opens his cited chapter quite categorically when he state: '*Without a good understanding of functional anatomy as presented by X-rays, it is impossible to understand impaired function and therefore to interpret correctly what we have felt with our hands during examination ... Basically X-ray diagnosis of the spinal column serves three purposes: (1) diagnosis of changes to structure, (2) assessment of locomotion function (kinematics) and (3) assessment of static function (spinal curvature, position and individual vertebrae) ... Classic X-ray diagnosis is concerned mainly with changes in structure, and this type of diagnosis is essential in order to avoid serious error ...*' (p. 35) Apart from elements pointed out by Kent, Lewit notes that the shape of joints, presumably intervertebral facet, asymmetry of the vertebrae, spinal curvature and how these effect the symmetry of spinal function.

Maigne (1972) stated '*additional clinical and radiological information permit one to make a diagnosis of a minor intervertebral derangement at that level*'. (p. 95) He clarified further that '*If clinical history, radiography, and all possible additional tests are in agreement with a minor mechanical intervertebral derangement, such a diagnosis becomes probable.*' (p. 105) He also noted an additional reason for a radiological examination formally opined that '*one should avoid manipulation without a preliminary radiological examination in cases of suspected platybasia for instance*'. (p. 79)

With the advent of magnetic resonance imaging and further with functional MRI, the diagnosis of vertebral subluxations becomes even clearer. (Cramer et al, 2000; 2002; Kulig et al, 2004; Smith & Dworkin, 2015; Fletcher, 2023; Kent, 1998; 2021; 2023; Kwon, 2020)

Extended reference compilation

Regarding radiological analysis and vertebral subluxation

Barton J W, Margolis MT. Rotational obstruction of the vertebral artery at the atlantoaxial joint. Neuroradiology. 1975;9:117-20.

Biedermann H. The how-to of making radiographs of newborns and children. In: Manual therapy in children. Edinburgh: Churchill Livingstone. 2004;235.

Cramer GD, Tuck NR Jr, Knudsen JT, et al. Effects of side-posture positioning and side-posture adjusting on the lumbar zygapophysial joints as evaluated by magnetic resonance imaging: a before and after study with randomization. J Manipulative Physiol Ther. 2000;23(6):380-94.

Cramer GD, Gregerson DM, Knudsen JT, et al. The effects of side-posture positioning and spinal adjusting on the lumbar Z joints: a randomized controlled trial with sixty-four subjects. Spine (Phila Pa 1976). 2002;27(22):2459-66. DOI 10.1097/00007632-200211150-00008.

Epstein BS. The spine: a radiological text and atlas. 4e. Philadelphia: Lea & Febiger. 1976;540, 549, 551, 557.

Eran A, Yousem DM, Izbudak I. Asymmetry of the odontoid lateral mass interval in pediatric trauma CT: Do we need to investigate further? AJNR Am J Neuroradiol. 2016;37(1):176-9. DOI 10.3174/ajnr.A4492.

Fechtel SG. Pseudosubluxation of the cervical spine in adolescents: a case report. J Manipulative Physiol Ther. 1983;6(2):81-3.

Fletcher D. Functional magnetic resonance imaging and vertebral subluxation. https://insightcla.com/functional-magnetic-resonance-imaging-and-vertebral-subluxation/.

Gay C W, Robinson M E, George SZ, et al. Immediate changes after manual therapy in resting-state functional connectivity as measured by functional magnetic resonance imaging in participants with induced low back pain. J Manipulative Physiol Ther. 2014;37(9):614-27.

Hadley LA. In: Anatomico-roentgenographic studies of the spine. Springfield: Charles C Thomas.1976;114-57, 172-94,422-77.

Jin TY. Atlanto-axial subluxation. Radiopaedia. https://radiopaedia.org/articles/atlanto-axial-subluxation

Keats TE, Anderson MW. The neck. Chapter 3. In: Atlas of normal roentgen variants that may simulate disease. 7e. St Louis: Mosby Inc. 2001:66, 222-3.

Kendrick JI, Lamb RH. Subluxation of the cervical spine. Cleveland Clinic. 1951;18(3):159-64.

Kent C, Vernon LF. Vertebral subluxation. In: case series in chiropractic MRI. Arlington: International Chiropractic Assoc. 1998;11-26.

Kent C. Ed. New research shows widespread prevalence of subluxation components on MRI. Chronicle of Chiropr. 2021;58:10. http://chiropractic.prosepoint.net/175992.

Kent C. MRI and vertebral subluxation. 2023. https://insightcla.com/mri-and-vertebral-subluxation.

Knackstedt H, Kråkenes J, Bansevicius D, et al. Magnetic resonance imaging of craniovertebral structures: clinical significance in cervicogenic headaches. J Headache Pain. 2012;13(1):39-44. DOI 10.1007/s10194-011-0387-4.

Kulig K, Landel R, Powers CM. Assessment of lumbar spine kinematics using dynamic MRI: a proposed mechanism of sagittal plane motion induced by manual posterior-to-anterior mobilization. J Orthop Sports Phys Ther. 2004;34:57-64. https://www.jospt.org/doi/abs/10.2519/jospt.2004.34.2.57.

Kwon C. Secondary analysis of a dataset to estimate the prevalence of vertebral subluxation and its implications for health promotion and prevention. Emory University. Emory Thesis and Dissertation. 2020. Embargo until August 19, 2023. https://etd.library.emory.edu/concern/etds/9019s370x?locale=en. (Reviewed by Kent 2021)

Leung, S. The value of cineradiographic motion studies in the diagnosis of dysfunctions of the cervical spine. Bull Eur Chiro Union 1977;25(2):28-43.

Lewit K. Functional anatomy and radiography of the spinal column. Chapter 3. In: Manipulative therapy in rehabilitation of the locomotor system. Oxford. Butterworth Heinemann. 1999;35-82.

Maigne R. Orthopedic Medicine. A new approach to vertebral manipulations. Springfield: Charles C Thomas. 1972:79, 95, 105.

Sillevis R, Shamus E, Regalado P, et al. Correlation and reliability of the atlas position on x-ray in subjects with and without cervicogenic Headache: A retrospective study. Annals Med Surg Case Reports. 2021;3(1):1-7.

Smith FW, Dworkin JS. The craniocervical syndrome and MRI. Basel: Karger. 2015.

Trager RJ, Anderson BR, Casselberry RM, et al. Guideline-concordant utilization of magnetic resonance imaging in adults receiving chiropractic manipulative therapy vs other care for radicular low back pain: a retrospective cohort study. BMC Musculoskelet Disord. 2022 ;23(1):554.

Xiong XH, Bean A, Anthony A, et al. Manipulation for cervical spinal dislocation under general anaesthesia: serial review for 4 years. Spinal Cord. 1998 Jan;36(1):21-4. DOI 10.1038/sj.sc.3100515.

Manipulative techniques

Articular Correction: The Vertebral Adjustment, Manipulation, Manual Therapies Mobilisation, Manipulative Medicine/Physical Medicine/Physiatry, Massage.

We maintain that because of the marked differences in rationale, goals, philosophies, and efficacies in techniques, it is critical to differentiate the various forms of manipulation. (Rome &Waterhouse, 2021). Similarly, it is important to maintain the identifying titles of each profession as well as a profession's nomenclature. (Repka et al, 2007)

Studies which state that spinal manipulation has either a particular or indefinite outcome can hardly be compared unless the particular technique that is implemented is known, particularly as techniques seem to be distinct to a particular profession and subject to practitioner preferences. In a similar vein, Coulter et al (2019) noted that a one-off manipulation was of questionable value when they stated that '*The studies comparing to no treatment or sham were mostly testing the effect of a single dose, which may or may not be helpful to inform practice.*'

The science behind the techniques is only significant if the technique is specified. As there are so many manipulative techniques, to claim that manipulation is successful, or unsuccessful, in relation to a certain clinical condition proves very little. Some forms of manipulation are far more effective than others for certain conditions so to generalise is not helpful. One would not claim that all analgesics or antibiotics have similar outcomes in all cases. So to designate and classify all these professions as one is quite inaccurate and most misleading.

The World Health Organisation differentiates the vertebral adjustment from manipulation by providing the following definitions: (World Health Organisation, 2005)

- Adjustment: '*Any chiropractic therapeutic procedure that ultimately uses controlled force, leverage, direction, amplitude and velocity, which is applied to specific joints and adjacent tissues. Chiropractors commonly use such procedures to influence joint and neurophysiological function*.' Recognition of the chiropractic adjustment has also been expressed medically having been defined by the Mayo Clinic as '*a procedure in which trained specialists (chiropractors) use their hands or a small instrument to apply a controlled, sudden force to a spinal joint. The goal of this procedure, also known as spinal manipulation, is to improve spinal motion and improve your body's physical function*.' (Mayo Clinic, undated)

It should be noted here that the adjustment as applied by chiropractors does not take or move a joint beyond the physiological range of motion. (Ebrall, 2020; Evans, 2021; Rome & Waterhouse, 2021)

- Spinal manipulative therapy: '*Includes all procedures where the hands or mechanical devices are used to mobilize, adjust, manipulate, apply traction, massage, stimulate or otherwise influence the spine and paraspinal tissues with the aim of influencing the patient's health.*' (World Health Organisation, 2005) The WHO employs a notably different definition for joint manipulation, which it defines as '*A manual procedure involving directed thrust to move a joint past the physiological range of motion, without exceeding the anatomical limit*.' (World Health Organisation, 2005)

One of the key differences is that some techniques, especially chiropractic techniques, are segment specific whereas others are broad forms of general mobilisation. This may apply especially to the spine, but may also be applicable to other articulations.

Another important difference is the rationale behind certain manual techniques. General mobilisation and general manipulation seem to designed more for mechanical global release of stiff joints. This is in contrast to the more specific techniques which are directed more towards neurological associations at a particular spinal level and aimed at correcting specific disturbed zygapophyseal joints and their articular dysfunction. These would be determined by neurological signs and symptoms associated with the autonomic nervous system.

In 2003 Maigne and Vautravers (2003) considered corrective manipulative processes. In discussing the theories of the aim of the manipulation, they avoided identifying the target of the manoeuvre and exactly what was being addressed. They justified the procedure in a more general sense of conducting it in the opposite direction to the movement that causes pain.

Twenty six years after Mooney and Robertson (1976) named *The Facet Syndrome* as a mechanical disruption causing back pain, allopathic management still appears to be focussed on analgesics, NSAIDS, facet joint blocks, radiofrequency neurolysis, or cryoablation. Those authors recommended local anaesthetic and steroids injection into the facet joint. Such a chemical approach appears to be rather invasive for a mechanical condition, at least as an initial procedure. (Perolat 2018) Onafowokan (2020) and colleagues claim there is a paucity levels I and II evidence for such injections.

Despite the range of terms originating from the various manual professions, their techniques and the nomenclature of the target lesion being addressed vary considerably. In effect, this tacit recognition indicates broad recognition of a clinical finding which when addressed, generally produces positive outcomes. These similarities essentially acknowledge a degree of common ground noted by Bordoni et al when they stated '*complete evaluation of the diaphragm is mandatory for several professional subjects, such as physiotherapists, osteopaths, and chiropractors not only to elaborate a treatment strategy but also to obtain information on the validity of the training performed on the patient*'. (Bordoni et al, 2016)

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

Interest is noted in the differentiation of a thoracic chiropractic manipulation, a rather unique if not misleading term when the procedure was conducted by physiotherapists. Chiropractors would generally utilise the term a thoracic segmental adjustment. These findings by Cakir et al were supported by a later physiotherapy finding by Sener et al in 2021. (Interestingly, 10 of the 18 references cites chiropractic journals) (Sener et al, 2021)

Extended reference compilation

Spinal manipulation

Cramer G, Henderson C, Khalsa P, et al. Animal models. In: Basic science research related to chiropractic spinal adjusting: the state of the art and recommendations. J Manipulative Physiol Ther 2006;29(9):726-61.

Anderst WJ, Gale T, LeVasseur C, et al. Intervertebral kinematics of the cervical spine before, during, and after high-velocity low-amplitude manipulation. Spine J. 2018;18(12):2333-42.

Bialosky J, Bishop M, Price D, et al. The mechanisms of manual therapy in the treatment of musculoskeletal pain: A comprehensive model. Manual Therapy. 2009;14(5):531-8.

Bialosky JE, Simon CB, Bishop MD,et al. Basis for spinal manipulative therapy: a physical therapist perspective. J Electromyogr Kinesiol. 2012:643-7. DOI 10.1016/j.jelekin.2011.11.014.

Bialosky JE, Simon CB, Bishop MD, et al. Basis for spinal manipulative therapy: a physical therapist perspective. J Electromyogr Kinesiol. 2012:643-7. DOI 10.1016/j.jelekin.2011.11.014.

Biedermann H (Ed). Manual therapy in children. Edinburgh: Churchill Livingstone. 2004.

Bordoni B, Marelli F, Morabito B, et al. Manual evaluation of the diaphragm muscle. Int J Chron Obstruct Pulmon Dis. 2016;11:1949-56.

Cakir AG, Ozden AV, Kerem AH, et al. Immediate effects of chiropractic thoracic manipulations on the autonomic nervous system. J Orthop Trauma Surg Relat Res. 2019;14(3):7-11. https://www.jotsrr.org/articles/immediate-effects-of-chiropractic-thoracic-manipulations-on-the-autonomic-nervous-system.pdf.

Collings JS. Techniques of manipulation. Med J Aust. 1960;July 9:55-60.

Coulter ID, Crawford C, Vernon H, et al. Manipulation and mobilization for treating chronic nonspecific neck pain: a systematic review and meta-analysis for an appropriateness panel. Pain Physician. 2019;22(2):E55-E70.

Dunning JR, Cleland JA, Waldrop MA, et al. Upper cervical and upper thoracic thrust manipulation versus nonthrust mobilization in patients with mechanical neck pain: a multicenter randomized clinical trial. J Orthop Sports Phys Ther. 2012;42(1):5-18.

Ebrall PS. The paraphysiological space and manipulation: A pragmatist's appraisal. J Phil Princip Practice Chiropr. 2020:8-17.

Evans DW. Why is the prevailing model of joint manipulation (still) incorrect? Chiropr Man Ther. 2022;30:51. https://doi.org/10.1186/s12998-022-00460-2.

Francis RS. Manipulation under anaesthesia: Historical considerations. International MUA Academy of physicians. 2005. www.muaphysicians.com/historical.html.

Fritz JM, Koppenhaver SL, Kawchuk GN, et al. Preliminary investigation of the mechanisms underlying the effects of manipulation: exploration of a multivariate model including spinal stiffness, multifidus recruitment, and clinical findings. Spine (Phila Pa 1976). 2011;36(21):1772-81.

Fritz JM, Whitman JM, Childs JD. Lumbar spine segmental mobility assessment: an examination of validity for determining intervention strategies in patients with low back pain. Arch Phys Med Rehabil. 2005;86(9):1745-52.

Gay C W, Robinson M E, George SZ, et al. Immediate changes after manual therapy in resting-state functional connectivity as measured by functional magnetic resonance imaging in participants with induced low back pain. J Manipulative Physiol Ther. 2014;37(9):614-27.

George SZ, Bishop MD, Bialosky JE, et al. Immediate effects of spinal manipulation on thermal pain sensitivity: an experimental study. BMC Musculoskeletal Disorders. 2006;7(68):1-10.

Gordon R, Cremata E, Hawk C. Guidelines for the practice and performance of manipulation under anesthesia. Chiropr Man Ther. 2014;22(1):7. DOI 10.1186/2045-709X-22-7.

Haavik H, Kumari N, Holt K, et al. The contemporary model of vertebral column joint dysfunction and impact of high-velocity, low amplitude controlled thrusts on neuromuscular function. Europ J Applied Physiol. 2021;121:2675-2720. https://doi.org/10.1007/s00421-021-04727-z.

Haldeman S. Spinal manipulative therapy. A status report. Clin Orthop Relat Res. 1983;(179):62-70.

Harvey D, Byfield D. Preliminary studies with a mechanical model for the evaluation of spinal motion palpation. Clinical Biomechanics 1991;6(2):79-82.

Henderson CNR. The basis for spinal manipulation: chiropractic perspective of indications and theory. J Electromyogr Kinesiol. 2012;22(5):632-642. DOI 10.1016/j.jelekin.2012.03.008.

Holt K, Niazi IK, Amjad I, et al The effects of 4 weeks of chiropractic spinal adjustments on motor function in people with stroke: a randomized controlled trial. Brain Sci. 2021;11(6):676. https://doi.org/10.3390/brainsci11060676.

Kingston L, Claydon, L,Tumilty S. The effects of spinal mobilizations on the sympathetic nervous system: A systematic review. Man Ther. 2014;19(4):281-87.

Langenfeld A, Humphreys BK, de Bie RA, et al. Effect of manual versus mechanically assisted manipulations of the thoracic spine in neck pain patients: study protocol of a randomized controlled trial. Trials. 2015;16:233.

Lewit K. Manipulative therapy of rehabilitation of the locomotion system. 3e. Oxford: Butterworth Heinemann.1999.

Macario-Gioia B, Rivaro R. [Validity of manipulation medicine in minor intervertebral pathology of the cervical spine.] Ann Osp Maria Vittoria Torino 1984;27(1-6):93-99. [English abstract].

Maigne JY, Vautravers P. Mechanism of action of spinal manipulative therapy. Joint Bone Spine. 2003;70(5):336-41. https://sofmmoo.org/documents/mechanism-action-smt.pdf

Maigne R. Orthopedic Medicine. A new approach to vertebral manipulations. Springfield: Charles C Thomas. 1972.

Marario-Gioia B, Rivaro R. [Validity of manipulation medicine in minor intervertebral pathology of the cervical spine.] Ann Osp Maria Vittoria Torino. 19184;27(1-6):93-9.

Mayo Clinic. Chiropractic adjustment. https://www.mayoclinic.org/tests-procedures/chiropractic-adjustment/about/pac-20393513.

Mohammadian P, Gonsalves A, Tsai C, et al. Areas of capsaicin-induced secondary hyperalgesia and allodynia are reduced by a single chiropractic adjustment: A preliminary study. J Manipulative Physiol Ther. 2004 27(6):381-87.

Mooney V, Robertson J. The facet syndrome. Clin Orthop Related Research. 1976;115:149-56.

Onafowokan OO. Fine NF, Brooks F, et al. Multiple injections for low back pain: What's the future? Eur Spine J. 2020;29(3):564-78.

Paris SV. Spinal manipulative therapy. Clin Orthop Relat Res. 1983 Oct;(179):55-61.

Perolat R, Kasler A, Nicot B, et al. Facet joint syndrome: from diagnosis to interventional management. Insights Imag. 2018;9(5):773-89.

Pickar JG. Neurophysiological effects of spinal manipulation. Spine J. 2002;2(5):357-71.

Reed WR, Long CR, Kawchuk GN, et al Neural responses to the mechanical characteristics of high velocity, low amplitude spinal manipulation: Effect of specific contact site. Man Ther. 2015;20(6):797-804.

Reed WR, Pickar JG, Sozio RS, et al. Effect of spinal manipulation thrust magnitude on trunk mechanical activation thresholds of lateral thalamic neurons. J Manipulative Physiol Ther. 2014;37(5),277-86.

Repka A, Ebrall P, Draper B. Failure to use 'vertebral subluxation' complex as a diagnostic term: a flaw of reductionist diagnosis with resultant compromise of student and patient outcomes in chiropractic teaching clinics. Chiropr J Aust. 2007;37(3):84-91. https://search.informit.org/doi/abs/10.3316/informit.234603036535882

Rome P. Waterhouse JD. The specific chiropractic adjustment is conducted within an articulation's physiological range of motion: Part 4 of a series. Asia-Pacific Chiropr J. 2021;1.3.www.apcj.net/rome-and-waterhouse-adjustment-is-within-rom/.

Rome P. Waterhouse JD. Differentiating chiropractic articular adjustments from manipulation: Part 2 of a series. Asia Pacific Chiropr J. 2021;1.3. www.apcj.net/rome-and-waterhouse-differentiating-the-adjustment/

Sener B, Hatik SH, Ozden AV, et al. Instant effect of chiropractic upper and middle thoracic zone manipulation on autonomic nervous system. Internat J Trad Complement Med Res. 2021;2(3):137-45.

Shivachev Y, Dimitrov A. Chiropractic as a system of manual techniques. Varna Medical Forum. 2021;10(2):133-136. DOI: http://dx.doi.org/10.14748/vmf.v10i2.7890 and https://journals.mu-varna.bg/index.php/vmf/article/view/7890. (English abstract).

Sillevis R, Cleland J, Hellman M, et al. Immediate effects of a thoracic spine thrust manipulation on the autonomic nervous system: a randomized clinical trial. J Manual Manip Ther. 2010;18(4):181-90.

Studin M, Owens WJ. How does the chiropractic adjustment work? A literature review of pain mechanisms and brain function alteration. Am Chiropr. 2015;37(8):30.32-34,36-38,40,42-43. https://theamericanchiropractor.com/index.php/article/2015/8/1/how-does-the-chiropractic-adjustment-work.

Studin M, Owens WJ. The mechanism of the chiropractic spinal adjustment/manipulation: Osseous mechanisms. Part 1 of 5-part series. Am J Chiropr, 2017;30-38. https://theamericanchiropractor.com/article/2017/5/1/the-mechanism-of-the-chiropractic-spinal-adjustmentmanipulation-osseous-mechanisms.

Wright A. Hypoalgesia post-manipulative therapy: a review of a potential neurophysiological mechanism. Man Ther. 1995;1(1):11-6.

World Health Organization. WHO guidelines on basic training and safety in chiropractic. World Health Organization. 2005:3. https://apps.who.int/iris/handle/10665/43352.

Vertebral adjustment

On the Chiropractic subluxation concept and its correction

The term *chiropractic adjustment* for the more specific manipulative procedure has been recognised by both the Mayo Clinic and the Cleveland Clinic. It has also been recognised in the medical journals *Brain Science* and *Frontiers of Neurology*. (Holt et al, 2021; Navid et al, 2022)

Authoritative texts about the subluxation have been published. (Gatterman, 2005; Leach, 1994; Haldeman, 1992; Redwood & Cleveland, 2003; King et al, 2011) While it is acknowledged that further evidence has evolved since these were published, they provided a comprehensive foundation and discussion to the evolving theories.

Eriksen (2004) published extracts of subluxation-related papers across various professions and a range of conditions. The many books and refereed papers reporting positive symptomatic outcomes available and patient demand would explain the uptake by manual therapists, physiotherapists, and medical manipulators. This observation makes it difficult to ignore the popular theoretical element, be it referred to as a subluxation, somatic dysfunction or some other term. The fact remains that it is a targeted condition, identified and addressed by manual therapists and in doing so, it demonstrably produces a reasonable percentage of positive outcomes as indicated by the material presented in this discourse.

While the adjustment, or chiropractic adjustment has been the term long used by the profession as a specialised and deliberately specific form of manipulation, osteopaths use the term *osteopathic manipulative therapy* or OMT. Other methods of manipulation are usually more general in nature and lack specificity.

In further confirmation of the weight and volume of recognition of the clinical role and significance of disturbed vertebral mechanics, there are numerous textbooks by all four professions on the topic of the subluxation (or other term) and the manipulative means of addressing their correction. With the proliferation of medical, chiropractic, and osteopathic textbooks as well as the readily accessible papers published on electronic indices, a claim of no supporting evidence is simply false.

In addition, the fundamental neurophysiology upon which the concept of an activated noxious somatoautonomic and somatovisceral reflexes are based on sound medical evidence as noted in this presentation and more recent publications.

Extended reference compilation

Chiropractic papers and texts on spinal manipulation

Bergman TF, Peterson DH. Chiropractic technique: principles and procedures. St Louis: Elsevier Health. 2010.

Budgell BS, Polus B. The effects of thoracic manipulation on heart rate variability: A controlled crossover trial. J Manipulative Physiol Ther. 2006;29(8):603-10.

Cassidy JD, Quon JA, LaFrance LJ, et al. The effect of manipulation on pain and range of motion in the cervical spine: a pilot study. J Manipulative Physiol Ther. 1992 Oct;15(8):495-500. Erratum in: J Manipulative Physiol Ther 1992 Nov-Dec;15(9).

Coulter ID, Crawford C, Hurwitz EL, et al. Manipulation and mobilization for treating chronic low back pain: a systematic review and meta-analysis. Spine J. 2018;18(5):866-79. DOI 10.1016/j.spinee.2018.01.013.

Coulter ID, Crawford C, Vernon H, et al. Manipulation and mobilization for treating chronic nonspecific neck pain: a systematic review and meta-analysis for an appropriateness panel. Pain Physician. 2019;22(2):E55-E70.

Cramer CNR. The basis for spinal manipulation: chiropractic perspective of indications and theory. J Electromyog Kenesiol. 2012;22(5):632-42.

Cramer G, Budgell B, Henderson C, et al. Basic science research related to chiropractic spinal adjusting: the state of the art and recommendations revisited. J Manipulative Physiol Ther. 2006;29(9):726-61. DOI 10.1016/j.jmpt.2006.09.003.

Cramer G, Gregerson DM, Knudsen JT, et al. Effects of side-posture positioning and side-posture adjusting on the lumbar zygapophyseal joints as evaluated by magnetic resonance imaging: A before and after study with randomization. J Manipulative Physiol Ther. 2002;23(6), 380-394. https://www.ncbi.nlm.nih.gov/pubmed/12435975\.

Cramer GD, Cambron J, Cantu JA, et al. Magnetic resonance imaging zygapophyseal joint space changes (gapping) in low back pain patients following spinal manipulation and side-posture positioning: a randomized controlled mechanisms trial with blinding. J Manipulative Physiol Ther. 2013;36(4):203-17. DOI 10.1016/j.jmpt.2013.04.003. https://www.jmptonline.org/article/S0161-4754(13)00055-9/fulltext

Giles LGF. Mechanical lumbosacral spine pain. Anatomy, histology and imaging. Boca Raton: Taylor & Francis, CRC Press. 2022. ebook 9781003315964 https://doi.org/10.1201/9781003315964.

Daligadu J, Haavik H, Yielder PC, et al. Alterations in cortical and cerebellar motor processing in subclinical neck pain patients following spinal manipulation. J Manipulative Physiol Ther. 2013;36(8):527-37.

Dishman JD, Ball KA, Burke J. Central motor excitability changes after spinal manipulation: A transcranial magnetic stimulation. J Manipulative Physiol Ther. 2002;25(1):1-9.

Dishman JD, Bulbulian R. Comparison of effects of spinal manipulation and massage on motoneuron excitability. Electromyogr Clin Neurophysiol. 2001;41(2):97-106.

Dishman JD, Bulbulian R. Spinal reflex attenuation associated with spinal manipulation. Spine 2000;25(19):2519-24.

Driscoll MD, Hall MJ. Effects of spinal manipulative therapy on autonomic activity and the cardiovascular system: A case study using the electrocardiogram and arterial tonometry. J Manipulative Physiol Ther. 2000;23(8):545-50.

Ebrall P. Chiropractic adjustment of the spine. London: Churchill Livingstone. 2010.

Eriksen K. Subluxation and pathophysiology. In: Upper cervical subluxation complex. A review of the chiropractic literature. Philadelphia: Lippincott Williams & Wilkins.2004:

Gatterman MI. Foundations of chiropractic subluxation. St Louis, Elsevier Mosby. 2e 2005.

Grimm D, Cunningham B, Burke J. Autonomic nervous system function among individuals with acute musculoskeletal injury. J Manipulative Physiol Ther. 2005;28(1):44-51.

Haldeman S. Principles and practice of chiropractic.2e. Norwalk: Appleton & Lange. 1992.

Haneline MT. Evidence-based chiropractic. Sudbury US: Jones & Bartlett Publishers. 2006.

Harris W, Wagnon RJ. The effects of chiropractic adjustments on distal skin temperature. J Manipulative Physiol Ther. 1987;10(2):57-60.

Kleynhans AM, Chiropractic identity building: Approaches to better patient care. ITM Press Institute of Therapeutic Manipulation. 2019.

Kleynhans AM. A chiropractic conceptual framework:- An anthology of reflections on philosophy, science, and chiropractic. ITM Press Institute of Therapeutic Manipulation. 2019.

Leach RA. The chiropractic theories: Principles and clinical application. 3e. Baltimore; Williams and Wilkins. 1994;373-94.

Liebenson C. Rehabilitation of the spine. 3e. Philadelphia: Lippincott Williams & Wilkins. 2019.

Masarsky CS, Todres-Masarsky M. Somatovisceral aspects of chiropractic: An evidence-based approach. New York: Churchill Livingstone. 2001.

Mootz RD. Chiropractic techniques. Philadelphia: Aspen Publishers. 1999.

Murphy DR. Clinical reasoning in spine pain. Primary management of cervical disorders using the CRISP protocols. Vol 11. 2016.

Redwood D, Cleveland CS, Fundamentals of chiropractic. St Louis: Mosby. 2003.

Rome P. Waterhouse JD. Differentiating chiropractic articular adjustments from manipulation: Part 2 of a series. Asia Pacific Chiropr J. 2021;1.3. www.apcj.net/rome-and-waterhouse-differentiating-the-adjustment/.

Schafer RC. Basic principles of chiropractic neuroscience. The foundation of clinical practice. 2e. La Grange: ACA Press. 1996;498-500.

Seaman DR, Faye LJ. The vertebral subluxation complex. In: Gatterman MI. Foundations of chiropractic subluxation. St Louis: Elsevier Mosby. 2e. 2005:195-226.

Manual medicine

A number of medical authors have adopted the principles of spinal manipulation apparently following the demand from patients and the positive outcomes recorded under the manipulative professions. More recent textbooks and papers in medical journals further denote recognition and accord.

Beyer L, Vinzelberg S, Loudovici-Krug, D. Evidence (-based medicine) in manual medicine/manual therapy—a summary review. Manuelle Medizin. 2022;Oct:1-20 https://doi.org/10.1007/s00337-022-00913-y.

Bordoni B, Escher AR. Palpation of the respiratory system in osteopathic manual medicine: from the trachea to the lungs. Cureus. 2021;13(9):e18059.

Bourdillon JF, Day EA. Spinal manipulation. 4e. Oxford: Heinemann Medical Books. 1988.

Collings JS. Techniques of manipulation. Med J Aust. 1960;:55-60.

Cyriax J. Orthopaedic medicine: Treatment by manipulation and massage. Vol 2. 7e. Bailliere Tindall. 2011.

Dvorak JV, Dvorak V, Schneider W. Manual Medicine. New York: Thieme Medical Publishers. 2005.

Dvořák J, Dvořák V, Gillar W, et al. Musculoskeletal Manual Medicine. Stuttgart: Thieme Publishing Group. 2008.

Dvorak MF, Fisher CG, Aarabi B, et al. Clinical outcomes of 90 isolated unilateral facet fractures, subluxations, and dislocations treated surgically and nonoperatively. Spine (Phila Pa 1976). 2007;32(26):3007-13.

Egan TS, Meltzer KR, Standley PR. Importance of strain direction in regulating human fibroblast proliferation and cytokine secretion: a useful in vitro model for soft tissue injury and manual medicine treatments. J Manipulative Physiol Ther. 2007;30(8):584–92.

Ernst A, Seidl RO, Todt I. Wirkmechanismen manueller Medizin an der Halswirbelsäule [Mode-of-action of manual medicine in the cervical spine]. HNO. 2003;51(9):759-68; quiz 769. German. PMID: 14521153.

Franz B, Altidis P, Altidis B, Collis-Brown G. The cervicogenic otoocular syndrome: a suspected forerunner of Ménière's disease. Internat Tinnitis J. 1999;5(2):125-30.

Hobbs SF, Chandler MJ, Bolser DC, et al. Segmental organisation of visceral and somatic input onto C3-T6 spinothalamic tract cells of the monkey. J Neurophysiol. 1992;68(5):1574-88.

Hülse M, Hölzl M. Effektivität der manuellen Medizin in der HNO. Eine retrospektive Langzeituntersuchung [The efficiency of spinal manipulation in otorhinolaryngology. A retrospective long-term study]. HNO. 2004;52(3):227-34. German.

Kang YM, Choi WS, Pickar JG. Electrophysiologic evidence for an intersegmental reflex pathway between lumbar paraspinal tissues. Spine (Phila Pa 1976). 2002;27(3):E56-63.

Kondziella W, [The vertebrogenic factor and thoracalgia.] Schmerz. 1995;9(1):34-8.

Macario-Gioia B, Rivaro R. [Validity of manipulation medicine in minor intervertebral pathology of the cervical spine.] Ann Osp Maria Vittoria Torino. 1984;27(1-6):93-99.

Németh E. Manuelna medicina u dijagnostici i lecenju funkcionalnih poremećaja kicmenog stuba [Physical medicine in the diagnosis and treatment of functional disorders of the spinal column]. Med Pregl. 1999;52(6-8):233-6. Croatian. PMID: 10518378.

Niazi IK, Turker KS, Flavel S, Kinget M, Duehr J, Haavik H. Changes in H reflex and V waves following spinal manipulation. Exp Brain Res. 2015, Jan 13. DOI 10.1007/s00221-014-4193-5.

Oser A, Steinhäuser J. Manualmedizinische Behandlung der Halswirbelsäule bei akutem Tinnitus nach Hörsturz - ein Fallbericht [Manual treatment of the cervical spinal column for tinnitus after acute hearing loss - a case report]. Forsch Komplementmed. 2010;17(3):147-8. German.

Paterson JK, Burn L. An introduction to medical manipulation. Dordrecht: Springer. 2012.

Paterson JK. Vertebral manipulation: a part of orthodox medicine. Kluwer Academic Publishers: 1985.

Pickar JG. Neurophysiological effects of spinal manipulation. Spine J. 2002;2(5):357-71.

Schnell H, Wagner FM, Locher H. Die segmentale und somatische Dysfunktion : Wie funktioniert Manuelle Medizin? [Segmental and somatic dysfunction: How does manual medicine work?]. Orthopade. 2022;51(4):253-262. German.

Shaballot N, Aloumar A, Manual J, et al. Lateralisation and bodily patterns of segmental signs and spontaneous pain in acute visceral disease: observational study. J Med Internet Res. 2021;23(8): e27247. DOI 10.2196/27247.

Seifert K. Manuelle Medizin in der Hals-Nasen-Ohrenheilkunde. Theoretische Grundlagen--klinische Systematik--Grundsätze der Therapie und Prophylaxe [Manual medicine in otorhinolaryngology. Theoretical principles, clinical practice, principles of therapy and prevention]. Laryngorhinootologie. 1995;74(10):583-90. German.

Sillevis R, Shamus E, Regalado P, Lehigh A. Correlation and reliability of the atlas position on x-ray in subjects with and without cervicogenic headache: A retrospective study. Annals Med Surg Case Reports. 2021;3(1):1-7.

Smith ML, Clark KG, Shi X. Manual medicine and the autonomic nervous system: assessing autonomic function in humans. In: King HH, Jänig W, Patterson MM. The science and clinical application of manual therapy. Edinburgh: Churchill Livingstone. 2011;85-92.

Storaci R, Manelli A, Schiavone N. Whiplash injury and oculomotor dysfunction: clinical posturographic correlations. Europ Spine J 2006;15(12):1811-16.

Sung PS, Kang YM, Pickar JG. Effect of spinal manipulation duration on low threshold mechanoreceptors in lumbar paraspinal muscles: a preliminary report. Spine (Phila Pa 1976). 2005 ;30(1):115-22.

Vanaskova E, Dolina J, Hep A. Swallowing disorders related to vertebrogenic dysfunctions. New advances in the basic and clinical gastroenterology In Brzozowski T. The basic and clinical gastroenterology. In Tech. 2012.175-84. https://cdn.intechopen.com/pdfs/35448/InTech-Swallowing_disorders_related_to_vertebrogenic_dysfunctions.pdf.

Vaňásková E, Hep A, Lewit K, et al. Cervical dysfunction with disturbed oesophageal motility – scintigraphic assessment. J Orthop Med 2001;23(1):9-11.

Wagner, U., Fend, J. Treatment of sudden deafness by manipulation of the cervical spine. Manuelle Medizin. 36, 269–271 (1998). https://doi.org/10.1007/s003370050086.

Wagner FM. Die somatische Dysfunktion der Halswirbelsäule und ihr komplexes klinisches Bild : Grundlagen der manualmedizinischen Diagnostik von Zervikobrachialgie und zervikozephalem Syndrom [Somatic dysfunction of the cervical spine and its complex clinical picture : The fundamentals of diagnostics of cervicobrachialgia and cervicocephalic syndrome through manual medicine]. Orthopade. 2022;51(4):263-73. (English abstract)

Walther EK. [Vertebrogenic dysphagia in diffuse idiopathic skeletal hyperostosis (Forestier's disease). Laryngorhinootologie. 1991;70(11):604-8.

Physiatry

Physical Medicine

Annaswamy TM, Rizzo JR, Schnappinger A, et al. Evidence-based medicine training in united states-based physiatry residency programs. Am J Phys Med Rehabil. 2022;101(7 Suppl 1):S40-S44. DOI 10.1097/PHM.0000000000001752.

Dawson PU. A new discipline in medicine, physiatry: physical medicine and rehabilitation. West Indian Med J. 2009;58(6):497-8.

Geiringer SR, deLateur BJ. Physiatric therapeutics. 3. Traction, manipulation, and massage. Arch Phys Med Rehabil. 1990;71(4-S):S264-6.

Greiss C, Yonclas PP, Jasey N,et al. Presence of a dedicated trauma center physiatrist improves functional outcomes following traumatic brain injury. J Trauma Acute Care Surg. 2016;80(1):70-5. DOI 10.1097/TA.0000000000000890.

Hitzig SL, Gotlib Conn L, Guilcher SJT, et al. Understanding the role of the physiatrist and how to improve the continuum of care for trauma patients: a qualitative study. Disabil Rehabil. 2021 Oct;43(20):2846-2853. DOI 10.1080/09638288.2020.1719215.

van Duijn J, van Duijn AJ, Nitsch W. Orthopaedic manual physical therapy including thrust manipulation and exercise in the management of a patient with cervicogenic headache: a case report. J Man Manip Ther. 2007;15(1):10-24. DOI 10.1179/106698107791090114.

Extended reference compilation

Spinal manipulation

Bourdillon JF, Day EA. Spinal manipulation. 4e. Oxford: Heinemann Medical Books.1988.

Clark BC, Russ DW, Nakazawa M, et al. A randomized control trial to determine the effectiveness and physiological effects of spinal manipulation and spinal mobilization compared to each other and a sham condition in patients with chronic low back pain: Study protocol for The RELIEF Study. Contemp Clin Trials. 2018;70:41-52. DOI 10.1016/j.cct.2018.05.012.

Collings JS. Techniques of manipulation. Med J Aust. 1960;July 9:55-60.

Cross KM, Kuenze C, Grindstaff TL, et al. Thoracic spine thrust manipulation improves pain, range of motion, and self-reported function in patients with mechanical neck pain: a systematic review. J Orthop Sports Phys Ther. 2011;41(9):633-42.

Cyriax J. Orthopaedic medicine: Treatment by manipulation and massage. Vol 2. 7e. London: Bailliere Tindall. 2011.

Dvorak J, Dvorak v, Schneider W, Manual Medicine, Springer-Verlag, 1988.

Gyer G, Michael J, Inklebarger J, et al Effects of biomechanical parameters of spinal manipulation: A critical literature review. J Integr Med. 2022;20(1):4-12. DOI 10.1016/j.joim.2021.10.002.

Holt K, Niazi IK, Amjad I, et al The effects of 4 weeks of chiropractic spinal adjustments on motor function in people with stroke: a randomized controlled trial. Brain Sci. 2021;11(6):676. https://doi.org/10.3390/brainsci11060676.

King HH, Jänig W, Patterson MM. The science and clinical application of manual therapy. Edinburgh: Churchill Livingstone. 2011.

Langenfeld A, Humphreys BK, de Bie RA, Swanenburg J. Effect of manual versus mechanically assisted manipulations of the thoracic spine in neck pain patients: study protocol of a randomized controlled trial. Trials. 2015;16:233.

Maigne JY, Vautravers P. Mechanism of action of spinal manipulative therapy. Joint Bone Spine. 2003;70(5):336-41. https://sofmmoo.org/documents/mechanism-action-smt.pdf.

Masaracchio M, Cleland JA, Hellman M, et al. Short-term combined effects of thoracic spine thrust manipulation and cervical spine nonthrust manipulation in individuals with mechanical neck pain: a randomized clinical trial. J Orthop Sports Phys Ther. 2013;43(3):118-27.

Mayo Clinic. Chiropractic adjustment. https://www.mayoclinic.org/tests-procedures/chiropractic-adjustment/about/pac-20393513.

McFadden KD, Taylor J. Axial rotation in the lumbar spine and gapping of the zygapophyseal joints. Spine 1990;15(4):295-9.

Navid MS, Niazi IK, Lelic D, et al. Chiropractic spinal adjustment increases the cortical drive to the lower limb muscle in chronic stroke patients. Front Neurol. 2022;12:747261. DOI 10.3389/fneur.2021.

Potter L, McCarthy C, Oldham J. Physiological effects of spinal manipulation: a review of proposed theories. Physical Ther Rev. 2005;10(3):163-79.

Schmörl G, Junghanns H. The human spine in health and disease. New York" Grune & Stratton. 2USe. 1971:221-27.

Schnell H, Wagner FM, Locher H. Die segmentale und somatische Dysfunktion : Wie funktioniert Manuelle Medizin? [Segmental and somatic dysfunction: How does manual medicine work?]. Orthopade. 2022 Apr;51(4):253-262. German.

Win N, Jorgensen A, Chen Y, et al. Effects of upper and lower cervical spinal manipulative therapy on blood pressure and heart rate variability in volunteers and patients with neck pain: A randomized controlled, cross-over, preliminary study. J Chiropr Med. 2015;14(1):1-9.

Zhang J, Dean D, Nosco D, et al. Effect of chiropractic care on heart rate variability and pain in a multisite clinical study. J Manipulative Physiol Ther. 2006;29(4):267-74.

Xie R, Liang L, Li K, et al. Effects of seated lumbar rotation manipulation in treating degenerative lumbar instability: a protocol for a randomized controlled trial. Trials. 2021;22, 398. https://doi.org/10.1186/s13063-021-05350-1.

Mobilisation

It is suggested that there is a significant difference in technique, efficacy between general manipulation, mobilisation with chiropractic adjustments. To ignore the differences, particularly under a single term of manipulation or manual therapy would be most misleading. Such differentiation in comparative outcome studies must be clarified.

Bolton PS, Budgell BS. Spinal manipulation and spinal mobilization influence different axial sensory beds. Med Hypotheses 2006:66(2):258-62.

Cho J, Lee E, Lee S. Upper thoracic spine mobilization and mobility exercise versus upper cervical spine mobilization and stabilization exercise in individuals with forward head posture: a randomized clinical trial. BMC Musculoskelet Disord. 2017;18(1):525. DOI 10.1186/s12891-017-1889-2.

Cleland JA, Glynn P, Whitman JM, et al. Short-term effects of thrust versus nonthrust mobilization/manipulation directed at the thoracic spine in patients with neck pain: a randomized clinical trial. Phys Ther. 2007;87(4):431-40. DOI 10.2522/ptj.20060217.

Coulter ID, Crawford C, Hurwitz EL, et al. Manipulation and mobilization for treating chronic low back pain: a systematic review and meta-analysis. Spine J. 2018 May;18(5):866-879. DOI 10.1016/j.spinee.2018.01.013.

Coulter ID, Crawford C, Vernon H, et al. Manipulation and mobilization for treating chronic nonspecific neck pain: a systematic review and meta-analysis for an appropriateness panel. Pain Physician. 2019;22(2):E55-E70.

Dunning JR, Butts R, Mourad F. Upper cervical and upper thoracic manipulation versus mobilization and exercise in patients with cervicogenic headache: a multi-center randomized clinical trial. BMC Musculoskelet Disord. 2016;17:64. DOI 10.1186/s12891-016-0912-3.

Finneson BE. Low back pain. 2e. Philadelphia. JB Lippincott 1980:252.

Garcia JD, Arnold S, Tetley K, et al. Mobilisation and manipulation of the cervical spine in patients with cervicogenic headache: any scientific evidence? Front Neurol. 2016;7:40. DOI 10.3389/fneur.2016.00040. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4800981/

Hamilton RI, Garden CLP, Brown SJ. Immediate effect of a spinal mobilisation intervention on muscle stiffness, tone and elasticity in subjects with lower back pain - A randomized cross-over trial. J Bodyw Mov Ther. 2022;29:60-67. DOI 10.1016/j.jbmt.2021.09.032.

Hegedus EJ, Goode A, Butler RJ, et al. The neurophysiological effects of a single session of spinal joint mobilization: does the effect last? J Man Manip Ther. 2011;19(3):143-51. DOI 10.1179/2042618611Y.0000000003.

Hurwitz EL, Aker PD, Adams AH, et al. Manipulation and mobilization of the cervical spine. A systematic review of the literature. Spine (Phila Pa 1976). 1996;21(15):1746-59; discussion 1759-60.

Kulig K, Landel R, Powers CM. Assessment of lumbar spine kinematics using dynamic MRI: a proposed mechanism of sagittal plane motion induced by manual posterior-to-anterior mobilisation. J Orthop Sports Phys Ther. 2004;34:57-64 https://www.jospt.org/doi/abs/10.2519/jospt.2004.34.2.57.

Lascurain-Aguirrebeña I, Newham DJ, Galindez-Ibarbengoetxea X, et al. Association between sympathoexcitatory changes and symptomatic improvement following cervical mobilisations in participants with neck pain. A double-blind placebo controlled trial. Musculoskelet Sci Pract. 2019;42:90-7.

Lerner-Lentz A, O'Halloran B, Donaldson M, et al. Pragmatic application of manipulation versus mobilization to the upper segments of the cervical spine plus exercise for treatment of cervicogenic headache: a randomized clinical trial. J Man Manip Ther. 2021;29(5):267-275. DOI 10.1080/10669817.2020.1834322.

Piekarz V, Perry J. An investigation into the effects of applying a lumbar Maitland mobilisation at different frequencies on sympathetic nervous system activity levels in the lower limb. Man Ther. 2016;23:83-9. DOI 10.1016/j.math.2016.01.001.

Schmid A, Brunner F, Wright A, et al. Paradigm shift in manual therapy? Evidence for a central nervous system component in the response to passive cervical joint mobilisation. Man Ther. 2008;13(5):387-96. DOI 10.1016/j.math.2007.12.007.

Sterling M, Jull G, Wright A. Cervical mobilisation: concurrent effects on pain, sympathetic nervous system activity and motor activity. Man Ther, 2001;6(2):72-81.

Massage

Along with an influence on circulation, massage is noted to have a somato-autonomic stimulatory effect on other than solely musculoskeletal structures, massage has been shown to influence the brain, the immune system and health status in general.

Massage has been regarded as a manual therapy and as a form of manipulation, a trend which may be misinterpreted. Massage is the therapeutic manipulation of soft tissues of the body. At times it may be used in conjunction with adjustments or with articular manipulation. (Wieting et al, 2020) As with manipulation, manual therapy and articular adjustments, there are quite a range of massage techniques. (Espí-López et al, 2016)

The term massage also covers a variety of techniques and manual contact techniques.

Massage has also been reported as having a positive influence on certain visceral conditions including gastric motility and reflux, immune function through vagal activity and autism. (Vickers et al, 2001; Field, 2016) One website uses the term deep tissue manipulation, another muscle manipulative therapy. (Curtiss, 2018)

Curtiss T. Deep tissue manipulation: getting to the root of an injury. https://hhs.edu/2018/03/13/deep-tissue-manipulation-getting-root-injury/.

Darmstadt GL, Khan NZ, Rosenstock S, et al. Impact of emollient therapy for preterm infants in the neonatal period on child neurodevelopment in Bangladesh: an observational cohort study. J Health Popul Nutr. 2021;40(1):24.

Espí-López GV, Zurriaga-Llorens R, Monzani L, et al. The effect of manipulation plus massage therapy versus massage therapy alone in people with tension-type headache. A randomized controlled clinical trial. Eur J Phys Rehabil Med. 2016;52(5):606-617.

Field T. Massage therapy research review. Complement Ther Clin Pract. 2016;24:19-31. DOI 10.1016/j.ctcp.2016.04.005.

Guzzetta A, Baldini S, Bancale A, et al. Massage accelerates brain development and the maturation of visual function. J Neurosci. 2009;29:6042–51.

Guzzetta A, D'Acunto MG, Carotenuto M, et al. The effects of preterm infant massage on brain electrical activity. Dev Med Child Neurol. 2011;53:46–51.

Li X, Zhong Q, Tang L. A meta-analysis of the efficacy and safety of using oil massage to promote infant growth. J Pediatr Nurs. 2016 Sep-Oct;31(5):e313-22. DOI 10.1016/j.pedn.2016.04.003.

Muscle manipulation therapy. (Undated) http://musclemanipulation.com/gpage.html (Extracted Jan 1st 2023)

Vickers A, Zollman C, Reinish JT. Massage therapies. West J Med. 2001;175(3):202–4.

Wang L, He JL, Zhang XH. The efficacy of massage on preterm infants: a meta-analysis. Am J Perinatol. 2013 Oct;30(9):731-8. DOI 10.1055/s-0032-1332801.

Waters-Banker C, Dupont-Versteegden EE, Kitzman PH, et al. Investigating the mechanisms of massage efficacy: the role of mechanical immunomodulation. J Athl Train. 2014;49:266-73.

Wieting JM, Hommer DH, Silberman SO, et al. Massage, traction, and manipulation. Medscape. 2020; https://emedicine.medscape.com/article/324694-overview#a11

Manual therapy

'Based on the current systematic reviews, a general evidence-based medicine level III is available, with individual studies reaching level II or Ib. This allows manual medicine treatment or manual therapy to be used in a valid manner.' (Beyer et al, 2022)

Arumugam A, Milosavljevic S, Woodley S, et al. Effects of external pelvic compression on form closure, force closure, and neuromotor control of the lumbopelvic spine - a systematic review. Man Ther. 2012;17(4):275-84.

Barassi G, Bellomo RG, Porreca A, et al. Somato-Visceral effects in the treatment of dysmenorrhea: neuromuscular manual therapy and standard pharmacological treatment. J Altern Complement Med. 2018;24(3):291-299. DOI 10.1089/acm.2017.0182.

Beck RW. Functional neurology for the practitioners of manual therapy. Edinburgh: Churchill Livingstone. 2008. Subluxation dysfunction p 9 chapter 1, ch 3 p65.

Beyer L, Vinzelberg S, Loudovici-Krug, D. Evidence (-based medicine) in manual medicine/manual therapy—a summary review. Manuelle Medizin. 2022:1-20 https://doi.org/10.1007/s00337-022-00913-y.

Bialosky JE, Beneciuk JM, Bishop MD, et al. Unravelling the mechanisms of manual therapy: modelling an approach. JOSPT. 2018;48(1):8-18. https://www.jospt.org/doi/10.2519/jospt.2018.7476.

Biedermann H. Ed. Manual therapy in children. Edinburgh: Churchill Livingstone. 2004

Borrella-Andrés S, Marqués-García I, Lucha-López MO, et al. Manual therapy as a management of cervical radiculopathy: a systematic review. Biomed Res Int. 2021;2021:9936981. DOI 10.1155/2021/9936981.

Carnes D, Plunkett A, Ellwood J, et al. Manual therapy for unsettled, distressed and excessively crying infants: a systematic review and metanalyses. BMJ Open. 2018;8(1):e019040.

Chang WC, Livneh H, Yen CT,et al. Decreased risk of low back pain during pregnancy associated with the use of orthopedic manual therapy: a nested case-control study. Front Med (Lausanne). 2022;9:887877. DOI 10.3389/fmed.2022.887877.

Chu J, Allen DD, Pawlowsky S, et al. Peripheral response to cervical or thoracic spinal manual therapy: an evidence-based review with meta-analysis. J Man Manip Ther. 2014;22(4):220-9.

Cirak Yb, Yilmaz Yelvar GD, Durustkan Elbasi N. Effectiveness of 12-week inspiratory muscle training with manual therapy in patients with COPD: A randomized controlled study. Clin Respir J. 2022;16(4):317-328. DOI 10.1111/crj.13486.

Delgado de la Serna P, Plaza-Manzano G, Cleland J, et al. Effects of cervico-mandibular manual therapy in patients with temporomandibular pain disorders and associated somatic tinnitus: A randomized clinical trial. Pain Med. 2020;21(3):613-24.

dos Santos CB, Artioli DP, Bertolini GRF. Manual therapy as a management approach for gastroesophageal reflux disease: A systematic review. Internat J Osteop Med. 2022; *In press.*

Engel R, Grace S, Broadbent S. The effect of manual therapy and exercise on age-related lung function: study protocol for a randomised controlled trial. Trials. 2019;20(1):163. DOI 10.1186/s13063-019-3257-z.

Fernández-de-las-Peñas C, Courtney CA. Clinical reasoning for manual therapy management of tension type and cervicogenic headache. J Man Manip Ther. 2014;22(1):44-50.

Fernández-López I, Peña-Otero D, Atín-Arratibel MLÁ, et al. Effects of manual therapy on the diaphragm in the musculoskeletal system: A systematic review. Arch Phys Med Rehabil. 2021;102(12):2402-2415.

Fırat T, Sağlam M, Vardar Yağlı N, et al. Acute effects of manual therapy on respiratory parameters in thoracic outlet syndrome. Turk Gogus Kalp Damar Cerrahisi Derg. 2019;27(1):101-6.

Gay CW, Robinson ME, George SZ, et al. Immediate changes after manual therapy in resting-state functional connectivity as measured by functional magnetic resonance imaging in participants with induced low back pain. J Manipulative Physiol Ther. 2014;37(9):614-27. DOI 10.1016/j.jmpt.2014.09.001.

Harrison W. Manual therapy and exercise to improve outcomes in patients with muscle tension dysphonia. https://www.physiospot.com/2014/10/28/manual-therapy-and-exercise-to-improve-outcomes-in-patients-with-muscle-tension-dysphonia/

Heneghan NR, Adab P, Balanos GM, et al Manual therapy for chronic obstructive airways disease: a systematic review of current evidence. Man Ther. 2012;17(6):507-18. DOI 10.1016/j.math.2012.05.004.

Höfler L. Manuelle Halswirbelsäulentherapie in der HNO [Manual therapy of the cervical vertebrae in otorhinolaryngology]. Monatsschr Ohrenheilkd Laryngorhinol. 1966;100(10):433-8. German. PMID: 16114437.

Hu C, Ye M, Huang Q. Effects of manual therapy on bowel function of patients with spinal cord injury. J Phys Ther Sci. 2013 Jun;25(6):687-8. DOI 10.1589/jpts.25.687.

King HH, Janig W, Patterson MM. The science and clinical application of manual therapy. Churchill Livingstone: Edinburgh. 2011;301-12.

King HH. Manual therapy and OMT may be of benefit in the management of somatosensory tinnitus. J Am Osteopath Assoc. 2016;116(10):684-5. DOI 10.7556/jaoa.2016.134.

Kingston L, Claydon, L, Tumilty S. The effects of spinal mobilizations on the sympathetic nervous system: A systematic review. Manual Therapy. 2014;19(4):281-7.

Kramp ME. Combined manual therapy techniques for the treatment of women with infertility: a case series. J Am Osteopath Assoc. 2012;112(10):680-4.

Likhachev SA, Borisenko AV. Dinamika vertebrogennoĭ vestibuliarnoĭ disfunktsii pod vliianiem manual'noĭ terapii [The dynamics of vertebrogenic vestibular dysfunction under the influence of manual therapy]. Lik Sprava. 1994 Jul-Aug;(7-8):84-8. Russian. PMID: 7900365.

Mein EA, Richards DG, McMillin D, et al. Physiologic regulation through manual therapy. Phys Med Rehab: State of the Art Reviews 2000;14(1):27-42.

Miller JE, Newell D, Bolton JE. Efficacy of chiropractic manual therapy on infant colic: a pragmatic single-blind, randomized controlled trial. J Manip Physiol Ther. 2012;35(8):600-7.

Murphy DR, Gay CW. Manual therapy and ear pain: a report of four cases. J Can Chiropr Assoc. 2011;55(1):40-6.

Niethamer LN, Myers R, Manual therapy and exercise for a patient with Neck-Tongue Syndrome: a case report. J Orthop Sports Phys Ther 2016;46(3):217-24.

Oswald C, Higgins CC, Assimakopoulos D. Optimizing pain relief during pregnancy using manual therapy. Can Fam Physician. 2013;59(8):841-2.

Park S-G, Song S-H, Jung J-H, et al. The effect of sacroiliac joint manual therapy on heart rate varability in women with primary dysmenorrhea. Phys Ther Rehab Sci 2020;9:252-60.

Rabal Conesa C, Cao Avellaneda E, López Cubillana P, et al. Manual therapy intervention in men with chronic pelvic pain syndrome or chronic prostatitis: An exploratory prospective case-series. Cureus. 2022;14(4):e24481. DOI 10.7759/cureus.24481.

Reid SA, Callister R, Katekar MG, et al. Effects of cervical spine manual therapy on range of motion, head repositioning, and balance in participants with cervicogenic dizziness: a randomized controlled trial. Arch Phys Med Rehabil. 2014;95(9):1603-12. DOI 10.1016/j.apmr.

Reid SA, Rivett DA, Katekar MG, et al. Efficacy of manual therapy treatments for people with cervicogenic dizziness and pain: protocol of a randomised controlled trial. BMC Musculoskelet Disord. 2012;13,201. https://doi.org/10.1186/1471-2474-13-201.

Roh JA, Kim KI, Jung HJ. The efficacy of manual therapy for chronic obstructive pulmonary disease: A systematic review. PLOS ONE 2021;16(5): e0251291. https://doi.org/10.1371/journal.pone.0251291.

Satpute K, Bedekar N, Hall T. Headache symptom modification: the relevance of appropriate manual therapy assessment and management of a patient with features of migraine and cervicogenic headache - a case report. J Man Manip Ther. 2020;28(3):181-8. DOI 10.1080/10669817.2019.1662637.

Sidorenko LV, Koval' DE. IK-termografiia v otsenke éffektivnosti lecheniia bol'nykh s sheĭnom osteokhondrozom metodom manual'noĭ terapii [IR thermography in the evaluation of the effectiveness of treating patients with cervical osteochondrosis by manual therapy]. Ortop Travmatol Protez. 1989;(12):28-31. Russian. PMID: 2628825.

Spain V. Efficacy of manual therapy on frequency and intensity of pain, anxiety, and depression in patients with tension-type headache. A randomized controlled clinical trial. Int J Osteopath Med. 2016;22:11–20.

Svatko LG, Ivanichev GA, Sobol' IL. Manual'naia terapiia nekotorykh form narusheniĭ slukhovoĭ funktsii, obuslovlennykh patologieĭ sheĭnogo otdela pozvonochnika [Manual therapy of various forms of auditory function disorders caused by pathology of the cervical spine]. Vestn Otorinolaringol. 1987;(2):28-31. Russian.

Tatsios PI, Grammatopoulou E, Dimitriadis Z, et al. The effectiveness of spinal, diaphragmatic, and specific stabilization exercise manual therapy and respiratory-related interventions in patients with chronic nonspecific neck pain: systematic review and meta-analysis. Diagnostics (Basel). 2022 ;12(7):1598.

Theiler R. Attention deficit disorder and the upper cervical spine. In: Biedermann H. Ed. Manual therapy in children. Edinburgh: Churchill Livingstone. 2004;135-42, 267-69, 317-8.

Voĭtanik SA. Manual'naia terapiia torakalgiĭ s vegetovistseral'nymi proiavleniiami [Manual therapy of thoracalgia with autonomic-visceral manifestations]. Vopr Kurortol Fizioter Lech Fiz Kult. 1986;(5):35-8. Russian. PMID: 3811262.

Yao C, Cheng Y, Zhu Q, et al. Clinical evidence for the effects of manual therapy on cancer pain: a systematic review and meta-analysis. Evid Based Complement Alternat Med. 2021;2021:6678184. DOI 10.1155/2021/6678184.

Zunke P, Auffarth A, Hitzl W, et al. The effect of manual therapy to the thoracic spine on pain-free grip and sympathetic activity in patients with lateral epicondylalgia humeri. A randomized, sample sized planned, placebo-controlled, patient-blinded monocentric trial. BMC Musculoskelet Disord. 2020;21(1):186. DOI 10.1186/s12891-020-3175-y.

Naprapathy

Skillgate E, Vingård E, Alfredsson L. Naprapathic manual therapy or evidence-based care for back and neck pain: a randomized, controlled trial. Clin J Pain. 2007;23(5):431-9.

Paanalahti K, Holm LW, Nordin M, Höijer J, Lyander J, Asker M, Skillgate E. Three combinations of manual therapy techniques within naprapathy in the treatment of neck and/or back pain: a randomized controlled trial. BMC Musculoskelet Disord. 2016;17:176. DOI 10.1186/s12891-016-1030-y.

Care

Restoration, maintenance, preventive, supportive, long-term

'*Physiotherapy extends from health promotion to injury prevention, acute care, rehabilitation, maintenance of functional mobility, chronic disease management, patient and carer education and occupational health*'. (Australian Physiotherapy Association) Such a definition may apply to the range of manual therapies.

It is suggested here that a normal spine should be mobile, flexible, supple to enable uninhibited movement within its normal range of motion. That is with each vertebral segment moving freely and independently without noxious sensory input and with physiological autonomic reflexes.

To restore that segmental integrity by adjustment, we endorse '*The physical application of a highly developed and finely tuned form of manual or instrument assisted intervention directed to restore joint and neural physiology in order to ameliorate associated signs and symptoms.*' (Rome, Waterhouse, 2021)

Given the range of conditions and the plethora of other factors, certain conditions are correctible, some require ongoing management, while others may benefit from supportive maintenance or preventive care in order to minimise exacerbations. (Taylor, 2011)

Depending on the severity of the patients' presentation, their age, duration of condition, and the possibility of pre-existing vulnerability they may require ongoing management and support to contain their symptoms to the optimum therapeutic level possible. The intervals of care would be

dependent on practitioner experience and patient preference along with clinical need based on outcome measures. These patterns of care would seem consistent with most forms of health care as in medications or exercises. (Sacket et al, 1996)

Extended reference compilation

Care

Axén I, Hestbaek L, Leboeuf-Yde C. Chiropractic maintenance care - what's new? A systematic review of the literature. Chiropr Man Therap. 2-19;.27, 63. https://doi.org/10.1186/s12998-019-0283-6.

Chu EC. Reducing cervical retrolisthesis with long-term monthly chiropractic maintenance care: a case report. J Med Cases. 2022;13(7):359-64. DOI 10.14740/jmc3960.

Chu ECP. Alleviating cervical radiculopathy by manipulative correction of reversed cervical lordosis: 4 years follow-up. J Family Med Prim Care. 2021;10(11):4303-6. DOI 10.4103/jfmpc.jfmpc_648_21.

Eklund A, Axen I, Kongsted A, et al. Prevention of low back pain: effect, cost-effectiveness, and cost-utility of maintenance care - study protocol for a randomized clinical trial. Trials. 2014;15:102. DOI 10.1186/1745-6215-15-102.

Eklund A, Hagberg J, Jensen I, et al. The Nordic maintenance care program: maintenance care reduces the number of days with pain in acute episodes and increases the length of pain free periods for dysfunctional patients with recurrent and persistent low back pain - a secondary analysis of a pragmatic randomized controlled trial. Chiropr Man Therap. 2020;28, 19. https://doi.org/10.1186/s12998-020-00309-6.

Eklund A, Palmgren PJ, Jakobsson U, Axen I. Development and evaluation of the MAINTAIN instrument, selecting patients suitable for secondary or tertiary preventive manual care: the Nordic maintenance care program. Chiropr Man Therap. 2022;30(1):15. DOI 10.1186/s12998-022-00424-6.

Flanagan T, Green S. The concept of maintenance physiotherapy. Aust J Physiother. 2000;46(4):271-8. DOI 10.1016/s0004-9514(14)60288-9.

Hancock M. Approach to low back pain. Physiotherapy. Aust Fam Physic. 2014;43(3). https://www.racgp.org.au/afp/2014/march/physiotherapy.

Hoving JL, de Vet HC, Koes BW,et al. Manual therapy, physical therapy, or continued care by the general practitioner for patients with neck pain: long-term results from a pragmatic randomized clinical trial. Clin J Pain. 2006;22(4):370-7.

Leaver A. On maintenance physiotherapy. Aust J Physioth. 2001;47(2):146-7.

Monash Health. What is physiotherapy. (Citing Australian Physiotherapy Association. https://www.youtube.com/watch?v=ormYpdXMJRE and https://monashhealth.org/services/allied-health/physiotherapy/. Undated.

Rome P. Waterhouse JD. Neurodynamics of vertebrogenic somatosensory activation and Autonomic Reflexes - a review: The introduction to a clinical series. Asia-Pacific Chiropr J. 2021;1.4. apcj.net/papers-issue-2-4/#RomeWaterhouseIntroduction.

Sackett DL, Rosenberg WM, Gray JA, et al. Evidence based medicine: what it is and what it isn't. BMJ. 1996;312(7023):71-2. DOI 10.1136/bmj.312.7023.71.

Sahrmann S, Azevedo DC, Dillen LV. Diagnosis and treatment of movement system impairment syndromes. Braz J Phys Ther. 2017;21(6):391-399. DOI 10.1016/j.bjpt.2017.08.001.

Sahrmann S. Movement system impairment syndromes of the extremities, cervical and thoracic spines: considerations for acute and long-term management. St Louis: Elsevier. 2010.

Senna MK, Machaly SA. Does maintained spinal manipulation therapy for chronic nonspecific low back pain result in better long-term outcome? Spine (Phila Pa 1976). 2011;36(18):1427-37. DOI 10.1097/BRS.0b013e3181f5dfe0.

Skillgate E, Bohman T, Holm LW, et al. The long-term effects of naprapathic manual therapy on back and neck pain - results from a pragmatic randomized controlled trial. BMC Musculoskelet Disord. 2010;11:26. DOI 10.1186/1471-2474-11-26.

Taylor DN. A theoretical basis for maintenance spinal manipulative therapy for the chiropractic profession. J Chiropr Humanit. 2011;18(1):74-85. DOI 10.1016/j.echu.2011.07.001.

Paediatric care

The 2004 textbook *Manual Therapy in Children* edited by Biedermann is perhaps the authoritative text for the medical profession. The other professions in the manual manipulative

science have produced a number of textbooks over the decades. Consequently, evidential material has been readily available.

Keats noted vertebral displacement and noted lines of mensuration in the cervical spine in paediatric studies. He stated that physiological subluxations can occur on children's X-rays, simulating dislocations, particularly of C2 on C3 and C3 on C4 on forward flexion. In such circumstances there may be steps in lines 1 and 2 but line 3 will remain intact. All three lines are out of alignment with a real subluxation. Keats and Anderson also coined the term '*Physiological subluxations*'. (Keats, 2001)

Theiler notes that with kinematic imbalances due to sub-occipital strain (KISS), associated symptoms may include clumsiness of both fine and gross motor function, ability to concentrate and behavioural difficulties. The main result following successful manipulation therapy for KISS was an improvement in intake concentration span especially in verbal and visual perception…… Some of the children recovered 2 or more years' performance deficit in the course of a few weeks or months. (Theiler, 2004. p/136-7)

We are aware of some notable positive outcomes under paediatric care where interprofessional collaboration successfully prevailed. (Quigley, 1983; Vallone et al, 2007; Hynes, 2008; Vallone, 2010; Bakkum & Nolan, 2010) '*Children with physical or neurologic disabilities may also require more extensive treatment. Often, as demonstrated anecdotally in the academic clinical setting or over the years at facilities like the Kentuckiana Children's Center in Louisville, Kentucky, United States, when chiropractic treatment is provided in collaboration with other healthcare professionals (nutritionists, occupational therapists, physical therapists, art and recreational therapists, etc.), many children demonstrate improved development or a more consistent maintenance of their quality of life*.' (Barnes, 1997)

The following extract from an osteopathic website (blog) lists a range of paediatric conditions addressed under osteopathic manipulation.

Conditions Treated using Osteopathic Manipulative Treatment (OMT)

Infants and children (Tortu, 2006)

- ADD/ADHD
- Allergies
- Asthma
- Behavior Problems
- Birth Trauma
- Bronchitis
- Cerebral Palsy
- Colic
- Developmental Delay
- Down Syndrome
- Ear Infections
- Frequent Colds
- Generalized Body Ache/Pain
- Head Trauma
- Learning Disorders

- Neurologic Syndromes
- Odd-Shaped Head
- Recurrent Sore Throats
- Seizures
- Sucking Difficulty
- Vomiting

Extended reference compilation

Paediatric spinal manipulation

'Somatic dysfunction of the cranial, cervical, lumbar, and sacral regions was common in healthy newborns, and the total somatic dysfunction (SDSS) was related to the length of labor.' (Waddington et al, 2015)

The need and demand for such optional care is apparent with interprofessional collaboration recommended. (Spigelblatt, 2002)

Adeolu AA, Ukachukwu AK, Adeolu JO, et al. Clinical outcome of closed reduction of cervical spine injuries in a cohort of Nigerians. Spinal Cord Ser Cases. 2019;5:17. DOI 10.1038/s41394-019-0158-z.

Alcantara J, Davis J. The chiropractic care of children with "growing pains": A case series and systematic review of the literature. Complement Ther Clin Pract. 2011;17(1):28-32.

Bakkum BW, Nolan DB. The Fountain Head Chiropractic Hospital: the dream that almost came true. J Chiropr Humanit. 2010;17(1):47-54.

Barnes T. Kentuckiana children's centre: a 40-year history. J Chiropr Humanit. 1997;7:18-22.

Bato-Tallón V, Esquirol-Caussa J, Palao-Vidal DJ et al. Effectiveness of a manual therapy program as adjuvant treatment for school-age children with attention-deficit/hyperactivity disorder: a randomized pilot study. SAGE Open. 2020;10(4). https://journals.sagepub.com/doi/epub/10.1177/2158244020983023.

Bendixen K, Beinlich A, Beck B, et al. Pilot study assessing the effect of osteopathic manipulative treatment (OMT) on length of stay in neonates after therapeutic hypothermia. J Osteopath Med. 2021;121(1):97-104. DOI 10.1515/jom-2020-0005.

Biedermann H. Ed. Manual therapy in children. Edinburgh: Churchill Livingstone. 2004.

Biedermann H. Manual therapy in children: proposals for an etiologic model. J Manipulative Physiol Ther. 2005;28(3):e1-15. DOI 10.1016/j.jmpt.2005.02.011.

Bier AD, Vachhrajani S, Bayeri SH, et al. Rotatory subluxation: experience from the hospital for sick children. J Neurosurg Pediatrics. 2012;9:144–8.

Brurberg KG, Dahm KT, Kirkehei I. Manipulation techniques for infant torticollis. Tidsskr Nor Laegeforen. 2018 Dec 19;138(1). English, Norwegian. DOI 10.4045/tidsskr.17.1031.

Cade A, Jones K, Holt K, Penkar AM, Haavik H. The effects of spinal manipulation on oculomotor control in children with Attention Deficit Disorder: a pilot and feasibility study. Brain Sciences. 2021;11(8):1047. https://doi.org/10.3390/brainsci11081047

Fielding JW, Hawkins RJ. Atlanto-axial rotatory fixation. (Fixed rotatory subluxation of the atlanto-axial joint). J Bone Joint Surg Am. 1977;59(1):37-44.

Filippkin MA, Akberov RF, Vasenin BN. Funktsional'nye rasstroĭstva pishchevaritel'nogo trakta u deteĭ, obuslovlennye vertebrogennymi zabolevaniiami [Functional disorders of the digestive tract in children with vertebrogenic diseases]. Vestn Rentgenol Radiol. 1995; (6):19-22. Russian. PMID: 8629340.

Gomex J. Acute atlantoaxial rotary subluxation (AARS). Pediatric Orthopaedic Society of North America. (Study Guide). (Undated) https://posna.org/Physician-Education/Study-Guide/Acute-Atlantoaxial-Rotary-Subluxation(AARS).

Greenberg MR, Forgeon JL, Kurth LM, et al. Atlantoaxial rotatory subluxation presenting as acute torticollis after mild trauma. Radiol Case Rep. 2020;15(11):2112-5. DOI 10.1016/j.radcr.2020.08.028.

Gutmann G. Schulkopfschmerz und Kopfhaltung. Ein Beitrag zur Pathogenese des Anteflexions-Kopfschmerzes und zur Mechanik der Kopfgelenke [School headache and head posture. A contribution to the pathogenesis of anteflexion headache and the mechanics of the atlas]. Z Orthop Ihre Grenzgeb. 1969;105(4):497-515. German. PMID: 4241022.

Harreby M, Neergaard K, Hesselsøe G, Kjer J. Are radiologic changes in the thoracic and lumbar spine of adolescents' risk factors for low back pain in adults? A 25-year prospective cohort study of 640 school children. Spine (Phila Pa 1976). 1995;20(21):2298-302. DOI 10.1097/00007632-199511000-00007.

Hill CS, Borg A, Tahir MZ, et al. Atlantoaxial rotatory fixation in childhood: a staged management strategy incorporating manipulation under anaesthesia. Childs Nerv Syst. 2021;37(1):167-175. DOI 10.1007/s00381-020-04727-y.

Kaiser G, Degenhardt BF, Menke MJ,et al. Characteristics and treatment of pediatric patients in an osteopathic manipulative medicine clinic. J Am Osteopath Assoc. 2020 ;120(3):153-163. DOI 10.7556/jaoa.2020.028.

Karch D, Boltshauser E, Grob-Selbeck G, et al. Manualmedizinische behandlung des KISS syndroms und atlas therapie nach arlen. [Manual medical treatment of KISS syndrome.] Manuelle Medizin. 2005;43(2):100-5.

Keats TE, Anderson MW. The neck. Chapter 3. In: Atlas of normal roentgen variants that may simulate disease. 7e. St Louis: Mosby Inc. 2001:66, 222-3.

Koch LE. The influence of the high cervical region on the autonomic regulatory system in infants. In: Biedermann H. Ed. Manual therapy in children. Edinburgh: Churchill Livingstone. 2004:125-31.

Langkau J, Miller J. An investigation of musuculoskeletal dysfunction in infants includes a case series of KISS diagnosed children. J Clin Chiro. 2012;13(1):958–67.

Lewit K, Janda V. [Development of functional disorders of the spine in children and the basis of preventing vertebrogenic disorders]. Cesk Neurol. 1963 Mar;26:73-80. Czech. PMID: 13930340.

Lewit K, Janda V. [Development of functional disorders of the spine in children and the basis of preventing vertebrogenic disorders]. Cesk Neurol. 1963;26:73-80. Czech. PMID: 13930340.

Lewit K, Janda V. [The development of articulation disorders of the spine in childhood and the principles of preventing vertebrogenic disorders]. Hippokrates. 1963;34:308-16. German. PMID: 13930339.

Luceño-Mardones A, Luceño-Rodríguez I, Rodríguez-López ES, et al. Effects of osteopathic T9-T10 vertebral manipulation in tonsillitis: a randomized clinical trial. Healthcare (Basel). 2021 Apr 1;9(4):394. DOI 10.3390/healthcare9040394.

Maheshwaran S, Sgouros S, Jeyapalan K, et al. Imaging of childhood torticollis due to atlanto-axial rotatory fixation. Childs Nerv Syst. 1995;11(12):667-71. DOI 10.1007/BF00262228.

Margolius FR. Compared with dimethicone, 2 weeks of spinal manipulation reduced infantile colic behaviour at 4–11 days after initial treatment. Evidence Based Nursing. 2000;3(2):42; DOI: 10.1136/ebn.3.2.42. https://ebn.bmj.com/search/Margolius%20jcode%3Aebnurs.

Milne N, Longeri L, Patel A, et al. Spinal manipulation and mobilisation in the treatment of infants, children, and adolescents: a systematic scoping review. BMC Pediatr. 2022;22(1):721. DOI 10.1186/s12887-022-03781-6.

Muniz AE, Belfer RA. Atlantoaxial rotary subluxation in children. Pediatric Emergency Care. 1999;15:25–9.

Ndetan H, Evans MW Jr, Hawk C,et al. Chiropractic or osteopathic manipulation for children in the United States: an analysis of data from the 2007 National Health Interview Survey. J Altern Complement Med. 2012;18(4):347-53. DOI 10.1089/acm.2011.0268.

Partha Sarathi CI, Swords C, Bewick J. Torticollis in a child with otalgia. BMJ. 2022;378:e070608. DOI 10.1136/bmj-2022-070608.

Pastor-Pons I, Lucha-López MO, Barrau-Lalmolda M, et al Efficacy of pediatric integrative manual therapy in positional plagiocephaly: a randomized controlled trial. Ital J Pediatr. 2021;47(1):132. DOI 10.1186/s13052-021-01079-4.

Pilge H, Prodinger PM, Bürklein D, et al. Nontraumatic subluxation of the atlanto-axial joint as rare form of acquired torticollis: diagnosis and clinical features of the Grisel's syndrome. Spine (Phila Pa 1976). 2011;36(11):E747-51. DOI 10.1097/BRS.0b013e3181fab0e4.

Pizzolorusso G, Turi P, Barlafante G, et al. Effect of osteopathic manipulation treatment on gastrointestinal dysfunction and length of stay in preterm infants: an exploratory study. Chiropr Man Ther. 2011;19(1):15.

Powell EC, Leonard JR, Olsen CS, et al. Atlantoaxial rotatory subluxation in children. Pediatr Emerg Care. 2017;33(2):86-91.

Quigley WH. Pioneering mental health institutional psychiatric care in chiropractic. Chiropr Hist. 1983;3(1):69-75.

Ressel O, Rudy R. Vertebral subluxation correlated with somatic, visceral and immune complaints: an analysis of 650 children under chiropractic care. J Vertebral Subluxation Research. 2004;:1-23. https://livingvitallife.com/wp-content/uploads/2018/06/1022_Ressel_Pelvic-Distortion-Master-20041017-FINAL3.pmd_.pdf.

Rzewnicki I, Janica JR. Nieprawidłowości odcinka szyjnego kregosłupa jako mozliwa przyczyna zawrotów głowy u młodych osób [Pathologies of the cervical spine anatomy as a possible cause of young patients' vertigo]. Przegl Lek. 2008;65(3):122-5. Polish. PMID: 18624119. (Abstract)

Sferopoulos NK. Atlantoaxial rotatory subluxation in children: A review. J Radiol Med Imaging.2018;2:1009.

Şimşek TT, Bol H, Şimşek IE, et al. The effects of osteopathic treatment on constipation in children with cerebral palsy: a pilot study. J Manipulative Physiol Ther. 2009;32(8):648-53.

Spigelblatt L. (Prin au) Chiropractic care for children: Controversies and issues. Paediatr Child Health. 2002 Feb;7(2):85-104. DOI 10.1093/pch/7.2.85.

Spicer A. Colic. In: Loo M, (Ed) Integrative medicine for children. Chapter 23. London. Elsevier Health.2002;248-58. [Chiropractic 250-1.]

Steele KM, Carreiro JE, Viola JH, et al. Effect of osteopathic manipulative treatment on middle ear effusion following acute otitis media in young children: a pilot study. J Am Osteopath Assoc. 2014;114(6):436-47. DOI 10.7556/jaoa.2014.094.

Subach BR, McLaughlin MR, Albright LA, et al. Current management of pediatric atlantoaxial rotatory subluxation. Spine. 1998;23:2174-9.

Swischuk LE. Anterior displacement of C2 in children: physiologic or pathologic. Radiology. 1977;122(3):759-63. DOI 10.1148/122.3.759.

Tarsuslu T, Bol H, Simşek IE, et al. The effects of osteopathic treatment on constipation in children with cerebral palsy: a pilot study. J Manipulative Physiol Ther. 2009;32(8):648-53. DOI 10.1016/j.jmpt.2009.08.016.

Theiler R. Attention deficit disorder and the upper cervical spine. IN: Biedermann H. Ed. Manual therapy in children. Edinburgh: Churchill Livingstone. 2004;133-43, 267-69, 317-8.

Tortu JP. Conditions treated using osteopathic manipulative treatment (OMT) https://www.studentdoctor.net/blogs/omtguru/2006/03/conditions-treated-using-osteopathic.html (Extracted Jan 4th 2023) [Source: http://drtortu.com/Description%20of%20Techniques.htm' March 4, 2006]

Tsapok AA. [Autonomous and vertebral dysfunction in children]. Lik Sprava. 2015;(1-2):161-2. (Ukranian).

Vallone SA, Barnes TA, Whittman R, et al. Dr Lorraine M Goldman – leading an eloquent life at Kentuckiana Children's Centre. Chiropr Hist. 2007;27(2):21-33.

Vallone SA, Miller J, Larsdotter A, Barham-Floreani J. Chiropractic approach to the management of children. Chiropr Man Ther. 2010;18(16): https://doi.org/10.1186/1746-1340-18-16.

Waddington EL, Snider KT, Lockwood MD, et al. Incidence of somatic dysfunction in healthy newborns. J Am Osteopath Assoc. 2015;115(11):654-65. DOI 10.7556/jaoa.2015.136.

Watson KD, Papageorgiou AC, Jones GT, et al. Low back pain in schoolchildren: the role of mechanical and psychosocial factors. Arch Dis Child. 2003;88(1):12-7. DOI 10.1136/adc.88.1.12.

Weber Hellstenius SA. Recurrent neck pain and headaches in preadolescents associated with mechanical dysfunction of the cervical spine: a cross-sectional observational study with 131 students. J Manipulative Physiol Ther. 2009;32(8):625-34. DOI 10.1016/j.jmpt.2009.08.025.

Wenger KJ, Hattingen E, Porto L. Magnetic Resonance Imaging as the Primary Imaging Modality in Children Presenting with Inflammatory Nontraumatic Atlantoaxial Rotatory Subluxation. Children (Basel). 2021;8(5):329. DOI 10.3390/children8050329.

Wiberg JM, Nordsteen J, Nilsson N. The short-term effect of spinal manipulation in the treatment of infantile colic: a randomized controlled clinical trial with a blinded observer. J Manipulative Physiol Ther. 1999;22(8):517-22. DOI 10.1016/s0161-4754(99)70003-5.

Wiberg KR, Wiberg JM. A retrospective study of chiropractic treatment of 276 Danish infants with infantile colic. J Manipulative Physiol Ther. 2010;33(7):536-41. DOI 10.1016/j.jmpt.2010.08.004.

Grisel's syndrome

Medicine's apparent interest in displacements of the upper cervical segments apart from traumatic injuries to the region, seems focused on children. These have been regarded primarily as idiopathic, or related to upper respiratory infection as in *Grisel's Syndrome*.

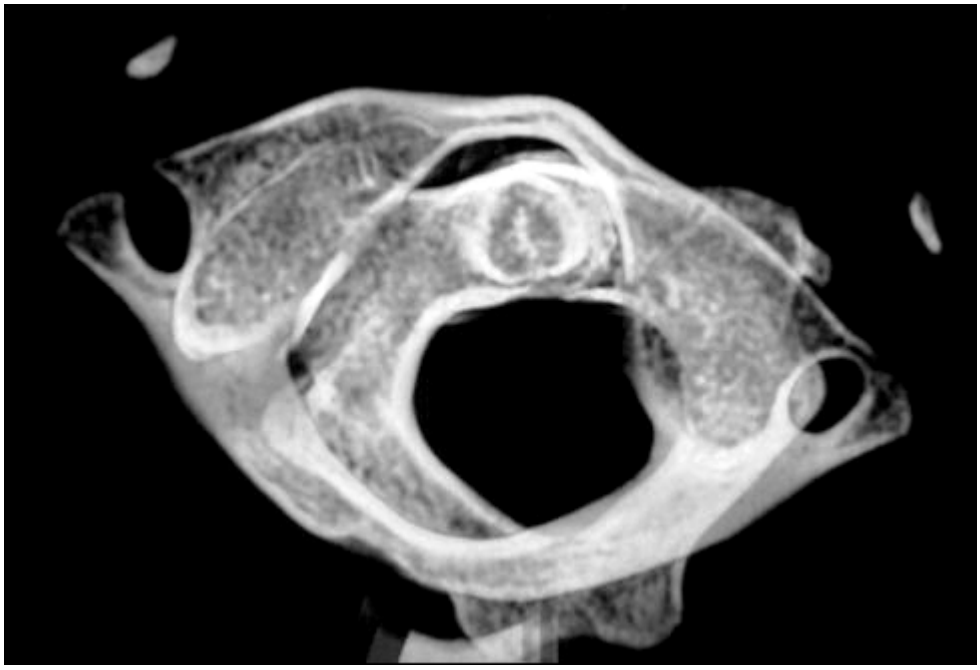
The frequency in younger children might suggest a relationship with birth injuries although the head comprises some 33% of body length and about 25% of body weight in infants making it somewhat vulnerable to this type of strain or injury. (Clark et al, 1988; Holcomb et al, 2001; Uğur et al, 2003; Babu, 2010; Miller et al, 2018; Iaccarino et al, 2019; Barker et al, 2022)

The papers on *Grisel's Syndrome* appear as a focus on the biomechanical aspect while not apparently considering the dysfunction or neurological sensory disturbances which may occur with the displacement.

The suboccipital subluxation of *Grisel's Syndrome* has been treated by manipulation under anaesthetic for some years. It may be called manipulation reduction (Shetty et al, 2013) or reposition. (Pilge et al, 2013) While subluxation of the C1 (Atlas) vertebra in *Grisel's Syndrome* has been recognised, most manipulation of it appears to be conducted under anaesthetic (MUA). An extended period of traction is another method. (Sia et al, (2012)

Medical management of upper cervical subluxations logically depend on the severity of a particular case. Possible interventions may include rest, analgesics, cervical collar, halter traction, halo traction, halo vest, operative fusion, through to decompression and fusion. Naturally, particularly severe cases would not be considered candidates for manipulative care.

This syndrome is primarily a paediatric condition which is often associated with normally routine upper respiratory surgical procedures or infection. (Battiata & Pazox, 2004; Galer et al, 2005)



CT scan showing rotatory atlanto-axial subluxation with anterior displacement of atlas relative to axis corresponding to Fielding Type II subluxation. (Bocciolini et al, 2005)

Extended reference compilation

Grisel's syndrome

Babu, A., Knipe, H. Grisel syndrome. Reference article, Radiopaedia.org. 2010. https://radiopaedia.org/articles/grisel-syndrome-2.

Barker S, Mujallid R, Bayanzay K. Atlantoaxial subluxation secondary to Sars-Cov-2 infection: a rare orthopedic complication from COVID-19. Am J Case Rep. 2022;19;23:e936128.

Battiata AP, Pazos G. Grisel's syndrome: the two-hit hypothesis--a case report and literature review. Ear Nose Throat J. 2004;83(8):553-5.

Bocciolini C, Dall'Olio D, Cunsolo E, et al. Grisel's syndrome: a rare complication following adenoidectomy. Acta Otorhinolaryngol Ital. 2005;25(4):245-9.

Cekinmez M, Tufan K, Sen O, et al. Non-traumatic atlanto-axial subluxation: Grisel's syndrome. Two case reports. Neurol Med Chir (Tokyo). 2009;49(4):172-4. DOI 10.2176/nmc.49.172.

Clark WC, Coscia M, Acker JD, et al. Infection-related spontaneous atlantoaxial dislocation in an adult: case report. J Neurosurg. 1988;69(3):455-58 10.

Deichmueller CM, Welkoborsky HJ. Grisel's syndrome's syndrome, a rare complication following "small" operations and infections in the ENT region. Eur Arch Otorhinolaryngol. 2010;267(9):1467-73. DOI 10.1007/s00405-010-1241-z.

Deniz V, Kelle B, Hidalgo B, Özkan C. Orthopedic physical therapy treatment for chronic nontraumatic atlantoaxial rotation subluxation (Grisel Syndrome): A 6-year-old female case report. JOSPT Cases 2022;2(4):196-203.

Durst F, Staudenmaier R, Pilge H,et al. Grisel-Syndrom nach Anthelixplastik [Grisel's syndrome after otoplasty]. HNO. 2012;60(2):135-40. German. DOI 10.1007/s00106-011-2315-y.

Fath L, Cebula H, Santin MN, et al. The Grisel's syndrome: A non-traumatic subluxation of the atlantoaxial joint. Neurochirurgie. 2018;64(4):327-330. DOI 10.1016/j.neuchi.2018.02.001.

Fernández Cornejo VJ, Martínez-Lage JF, Piqueras C, et al. Inflammatory atlanto-axial subluxation (Grisel's syndrome) in children: clinical diagnosis and management. Childs Nerv Syst. 2003;19(5-6):342-7.

Galer C, Holbrook E, Treves J, et al. Grisel's syndrome: a case report and review of the literature. Int J Pediatr Otorhinolaryngol. 2005;69(12):1689-92. DOI 10.1016/j.ijporl.2005.03.046.

Hirth K, Welkoborsky HJ. Das Grisel-Syndrom: Eine seltene Komplikation HNO-ärztlicher Eingriffe [Grisel's syndrome following ENT-surgery: report of two cases]. Laryngorhinootologie. 2003 Nov;82(11):794-8. German. DOI 10.1055/s-2003-44547.

Holcomb JD, Jaffe DM, Greinwald JH Jr, et al. Nontraumatic atlantoaxial rotary subluxation in the pediatric otolaryngology patient. A report of four cases. Ann Otol Rhinol Laryngol. 2001;110(12):1137-40.

Hussain K, Abdo MM, AlNajjar FJ, et al. Not your typical torticollis: a case of atlantoaxial rotatory subluxation. BMJ Case Rep. 2014;25;2014:bcr2013201023. DOI 10.1136/bcr-2013-201023.

Iaccarino C, Francesca O, Piero S, et al. Grisel's Syndrome: Non-traumatic atlantoaxial rotatory subluxation-report of five cases and review of the literature. Acta Neurochir Suppl. 2019;125:279-288. DOI 10.1007/978-3-319-62515-7_40.

Karkos PD, Benton J, Leong SC, et al. Grisel's syndrome in otolaryngology: A systematic review. Int J Pediatr Otorhinolaryngol. 2007;71(12):1823-27.

Kawabe N, Hirotani H, Tanaka O. Pathomechanism of atlanto-axial rotary fixation in children. J Pediatr Orthop. 1989;9:569–74.

Miller BJ, Lakhani R, Rashid A, et al. Painful torticollis following adenotonsillectomy: a cardinal sign of atlantoaxial subluxation. BMJ Case Rep. 2018;2018:bcr2017223567. DOI 10.1136/bcr-2017-223567.

Muniz AE, Belfer RA. Atlantoaxial rotary subluxation in children. Pediatric Emergency Care. 1999;15:25-9.

Neal KM, Mohamed AS. Atlantoaxial subluxation in children. JAAOS. American Academy Orthopaedic Surgeon. 2015;23(6):382-92.

NORD (National Organization for Rare Disorders). Cervical dystonia. 'In children with slippage of the vertebrae in the neck (atlanto-axial subluxation). https://rarediseases.org/rare-diseases/cervical-dystonia/.

Ortiz GL, Pratts I, Ramos E. Grisel's syndrome: an unusual cause of torticollis. J Pediatr Rehabil Med. 2013;6(3):175-80. DOI 10.3233/PRM-130253.

Phillips WA, Hensinger RN. The management of rotatory atlanto-axial subluxation in children. J Bone Joint Surg Am. 1989;71(5):664-8.

Pilge H, Holzapfel BM, Lampe R, et al. A novel technique to treat Grisel's syndrome: results of a simplified, therapeutical algorithm. Int Orthop. 2013;37(7):1307-13. DOI 10.1007/s00264-013-1895-4.

Powell EC, Leonard JR, Olsen CS, et al. Atlantoaxial rotatory subluxation in children. Pediatr Emerg Care. 2017;33(2):86-91.

Sakaida H, Akeda K, Sudo A, et al. Atlantoaxial rotatory fixation as a rare complication from head positioning in otologic surgery: Report of two cases in young children. Patient Saf Surg. 2017;11:5. DOI 10.1186/s13037-016-0116-7.

Sferopoulos NK. Atlantoaxial rotatory subluxation in children: A review. J Radiol Med Imaging.2018;2:1009.

Shen Y, Yang L, Liu X, et al. Grisel's syndrome associated with mumps: A case report. Front Pediatr. 2022 Sep 29;10:916538.

Shetty A, Kumar A, Chacko A, et al. Reduction techniques in the management of atlantoaxial subluxation. Indian J Orthop. 2013;47(4):333-9. DOI 10.4103/0019-5413.114908.

Sia KJ, Tang IP, Kong CK, et al Grisel's syndrome: a rare complication of tonsillectomy. J Laryngol Otol. 2012;126(5):529-31. DOI 10.1017/S0022215112000175.

Sobolewski BA, Mittiga MR, Reed JL. Atlantoaxial rotary subluxation after minor trauma. Pediatric Emergency Care. 2008;24:852-6.

Spiegel D, Shrestha S, Sitoula P, et al Atlantoaxial rotatory displacement in children. World J Orthopaedics. 2017;8(11):836-45.

Spinnato P, Zarantonello P, Guerri S, et al. Atlantoaxial rotatory subluxation/fixation and Grisel's syndrome in children: clinical and radiological prognostic factors. Eur J Pediatr. 2021;180(2):441-7. DOI 10.1007/s00431-020-03836-9.

Subach BR, McLaughlin MR, Albright AL, et al. Current management of pediatric atlantoaxial rotatory subluxation. Spine (Phila Pa 1976). 1998;23(20):2174-9. DOI 10.1097/00007632-199810150-00006.

Uğur HC, Cağlar S, Unlu A, Erdem A, et al. Infection-related atlantoaxial subluxation in two adults: Grisel syndrome or not? Acta Neurochir (Wien). 2003;145(1):69-72 9.

Infants

Alcantara J, Anderson R. Chiropractic care of a pediatric patient with symptoms associated with gastroesophageal reflux disease, fuss-cry-irritability with sleep disorder syndrome and irritable infant syndrome of musculoskeletal origin. J Can Chiropr Assoc. 2008;52(4):248-55.

Biedermann H. Resolution of infantile ERB's palsy utilizing chiropractic treatment. J Manipulative Physiol Ther. 1994;17(2):129-31.

Bradley E, Finlay F. Towards evidence-based medicine for paediatricians. Is cranio-sacral therapy useful in the management of crying babies? Arch Dis Child. 2009;94(7):555-6. DOI 10.1136/adc.2008.153569.

Castejón-Castejón M, Murcia-González MA, Todri J, et al. Treatment of infant colic with craniosacral therapy. A randomized controlled trial. Complement Ther Med. 2022;71:102885. DOI 10.1016/j.ctim.2022.102885.

Cerritelli F, Pizzolorusso G, Ciardelli F, et al. Effect of osteopathic manipulative treatment on length of stay in a population of preterm infants: a randomized controlled trial. BMC Pediatr. 2013;13:65. DOI 10.1186/1471-2431-13-65.

Colli R, Biagiotti I, Sterpa A. Osteopatia in neonatologia [Osteopathy in neonatology]. Pediatr Med Chir. 2003;25(2):101-5. Italian.

Driehuis F, Hoogeboom TJ, Nijhuis-van der Sanden MWG, et al. Spinal manual therapy in infants, children and adolescents: A systematic review and meta-analysis on treatment indication, technique and outcomes. PLoS One. 2019;5;14(6):e0218940. DOI 10.1371/journal.pone.0218940.

Gutmann G. Das atlas-blockierungs-syndrom des sauglings und des kleinkindes (The blocked atlas nerve syndrome in babies and infants.) Man. Med 1987;25:5-10 [Also translated and published in ICA International Review of Chiropractic July/Aug 1990;46(4):37-43]

Holm LV, Jarbøl DE, Christensen HW, et al. The effect of chiropractic care on infantile colic: results from a single-blind randomised controlled trial. Chiropr Man Therap. 2021;29(1):15. DOI 10.1186/s12998-021-00371-8.

Koch L.E, Koch H, Graumann-Brunt S. Heart rate changes in response to mild mechanical irritation of the high cervical spinal cord region in infants. Forensic Sci Int. 2002;128(3):168-76.

Lanhkau J, Miller J. An investigation of musculoskeletal dysfunction in infants including a case series of KISS diagnosed children. J Clin Chiropr Pediatr, 2012;13(1):958-67.

Lanaro D, Ruffini N, Manzotti A, et al. Osteopathic manipulative treatment showed reduction of length of stay and costs in preterm infants: A systematic review and meta-analysis. Medicine (Baltimore). 2017;96(12):e6408.

Lund GC, Edwards G, Medlin B, et al. Osteopathic manipulative treatment for the treatment of hospitalized premature infants with nipple feeding dysfunction. J Am Osteopath Assoc. 2011;111(1):44-8.

Miller J, Newell D. Prognostic significance of subgroup classification for infant patients with crying disorders: A prospective cohort study. J Can Chiropr Assoc. 2012;56(1):40-8.

Miller JE, Newell D, Bolton JE. Efficacy of chiropractic manual therapy on infant colic: a pragmatic single-blind, randomized controlled trial. J Manipulative Physiol Ther. 2012;35(8):600-7. DOI 10.1016/j.jmpt.2012.09.010.

Pastor-Pons I, Hidalgo-García C, Lucha-López MO, et al. Effectiveness of pediatric integrative manual therapy in cervical movement limitation in infants with positional plagiocephaly: a randomized controlled trial. Ital J Pediatr. 2021;47(1):41.

Sacher R, Wuttke M, Göhmann U, et al Effects of single manual medicine treatment for infants with postural and movement asymmetries and positional preference: A multicentre randomised controlled trial - SMMT for IPMA. 2022. Physikalische Medizin Rehabilitationsmedizin Kurortmedizin. DOI: 10.1055/a-1704-3494

Sacher, R., Knüdeler, M., Wuttke, M. et al. Manual therapy of infants with postural and movement asymmetries and positional preference. Manuelle Medizin. 2021;59:117–27 https://doi.org/10.1007/s00337-020-00760-9

Schwerla F, Daake B, Moeckel E, et al. Most common infant health concerns in osteopathic practices in Germany. A survey. J Bodyw Mov Ther. 2021;Oct 28:114-20. DOI 10.1016/j.jbmt.2021.07.038.

Schwerla F, Daake B, Moeckel E, et al. Osteopathic treatment of infants in their first year of life: A prospective multicenter observational study (OSTINF Study). Complement Med Res. 2021;28(5):395-406. English. DOI 10.1159/000514413.

Vismara L, Manzotti A, Tarantino AG, et al. Timing of oral feeding changes in premature infants who underwent osteopathic manipulative treatment. Complement Ther Med. 2019;43:49-52. DOI 10.1016/j.ctim.2019.01.003.

Preterm, neonates, newborn

Bendixen K, Beinlich A, Beck B, Het al. Pilot study assessing the effect of osteopathic manipulative treatment (OMT) on length of stay in neonates after therapeutic hypothermia. J Osteopath Med. 2021;121(1):97-104. DOI 10.1515/jom-2020-0005.

Biedermann H. Manual'naia terapiia u novorozhdennykh i deteĭ mladshego vozrasta [The manual therapy of newborn infants and young children]. Vopr Kurortol Fizioter Lech Fiz Kult. 1995;(4):48-9. Russian.

Biedermann H. Colic in newborn and the functional pathology of the cervical spine: A catamnestic study of 150 cases. 1-15. Colic_in_Newborn_and_the_Functional_Path.pdf

Cerritelli F, Cicchitti L, Martelli M et al. Osteopathic manipulative treatment and pain in preterms: study protocol for a randomised controlled trial. Trials. 20158;16:84. DOI 10.1186/s13063-015-0615-3.

Cerritelli F, Pizzolorusso G, Renzetti C, et al. A multicenter, randomized, controlled trial of osteopathic manipulative treatment on preterms. PLOS One. 2015;10(5):e0127370. DOI 10.1371/journal.pone.0127370.

Chaturvedi A, Chaturvedi A, Stanescu AL, et al Mechanical birth-related trauma to the neonate: An imaging perspective. Insights Imaging. 2018;9(1):103-18. DOI 10.1007/s13244-017-0586-x.

Huisman TAGM, Phelps T, Bosemani T, et al. Parturitional injury of the head and neck. J Neuroimaging. 2015;25(2):151-166. DOI 10.1111/jon.12144.

Miller KA. Bronchopulmonary. Chiropractic care of a pre-term infant with bronchopulmonary dysplasia and vertebral subluxation (case report). J Vertebral Subluxation Research. 2008;Feb.14.

Paravicini I. Manipulation under anaesthesia in infants with arthrogenic newborn torticollis: a retrospective case series. J Chiropr Med. 2018;17(4):289-97.

Pizzolorusso G, Cerritelli F, D'orazio M, et al. Osteopathic evaluation of somatic dysfunction and craniosacral strain pattern among preterm and term newborns. J Am Osteopath Assoc. 2013;113(6):462-7.

Pizzolorusso G, Turi P, Barlafante G, et al. Effect of osteopathic manipulation treatment on gastrointestinal dysfunction and length of stay in preterm infants: an exploratory study. Chiropr Man Ther. 2011;19(1):15.

Tekes A, Pinto PS, Huisman TA. Birth-related injury to the head and cervical spine in neonates. Magn Reson Imaging Clin N Am. 2011 Nov;19(4):777-90; viii. DOI 10.1016/j.mric.2011.08.004.

Waddington EL, Snider KT, Lockwood MD, Pazdernik VK. Incidence of somatic dysfunction in healthy newborns. J Am Osteopath Assoc. 2015;115(11):654-65. DOI 10.7556/jaoa.2015.136.

Plagiocephaly

Apart from more than a dozen chiropractic sites, there are also relevant references for manual therapy and OMT papers on this topic.

Antares JB, Jones MA, King JM, et al. Non-surgical and non-pharmacological interventions for congenital muscular torticollis in the 0-5 year age group. Cochrane Database of Systematic Reviews 2018, Issue 3. Art. No. CD012987. DOI 10.1002/14651858.CD012987.

Bagagiolo D, Priolo CG, Favre EM, et al. A Randomized controlled trial of osteopathic manipulative therapy to reduce cranial asymmetries in young infants with nonsynostotic plagiocephaly. Am J Perinatol. 2022;39(S 01):S52-S62. DOI 10.1055/s-0042-1758723.

Billi M, Greco A, Colonneli P, et al. The functional manual therapy intervention in infants with non-synostotic plagiocephaly: a pilot study. Minerva Pediatr (Torino). 2022;74(3):294-300. DOI 10.23736/S2724-5276.17.04838-1.

Cabrera-Martos I, Valenza MC, Valenza-Demet G, et al. Effects of manual therapy on treatment duration and motor development in infants with severe nonsynostotic plagiocephaly: a randomised controlled pilot study. Childs Nerv Syst. 2016;32(11):2211-7. DOI 10.1007/s00381-016-3200-5.

Di Chiara A, La Rosa E, Ramieri V, et al. Treatment of deformational plagiocephaly with physiotherapy. J Craniofac Surg. 2019;30(7):2008-13.

Lessard S, Gagnon I, Trottier N. Exploring the impact of osteopathic treatment on cranial asymmetries associated with nonsynostotic plagiocephaly in infants. Complement Ther Clin Pract. 2011;17(4):193-8. DOI 10.1016/j.ctcp.2011.02.001.

Pastor-Pons I, Lucha-López MO, Barrau-Lalmolda M, et al Efficacy of pediatric integrative manual therapy in positional plagiocephaly: a randomized controlled trial. Ital J Pediatr. 2021;47(1):132. DOI 10.1186/s13052-021-01079-4.

Chiropractic reference base of plagiocephaly

Collins K, Alcantara J, Holt K. Resolution of breastfeeding and gastrointestinal complaints in infant twins with plagiocephaly and scaphocephaly following birth trauma: A case series [case report]. J Pediatr Matern & Fam Health 2015;1:34-41.

Davies NJ. Chiropractic management of deformational plagiocephaly in infants: An alternative to device-dependent therapy. Chiropr J Aust: 2002;32(2):52-5.

Hash JL. Deformational plagiocephaly and chiropractic care: A narrative review and case report [review]. J Clin Chiropr Pediatr. 2014;14(2):1131-8.

Humphris TJ, Askin ASMM, Glucina-Russell TT. Resolution of non-synostotic plagiocephaly following chiropractic care: A case report Clin Chiropr Pediatr: 2014;14(3):1176-8.

Ellwood J, Draper-Rodi J, Carnes D. The effectiveness and safety of conservative interventions for positional plagiocephaly and congenital muscular torticollis: a synthesis of systematic reviews and guidance. Chiropr Man Therap. 2020;28(1):31. DOI 10.1186/s12998-020-00321-w.

Leighton JM. Non-synostotic deformational plagiocephaly: An evidence-based case report. Clin Chiropr: Dec 2008;11(4):211-8.

O'Neil C,Stewart A. The recognition of craniosynostosis when managing patients with plagiocephaly: Two case reports of lambdoid craniosynostosis [case report]. Chiropr J Aust. 2013;43(4):124-30.

Quezada D. Chiropractic care of an infant with plagiocephaly [case report]. J Clin Chiropr Pediatr. 2004;6(1):342-8.

Rubin D,Istok M. Resolution of infantile colic, torticollis, plagiocephaly and feeding difficulties following subluxation-based chiropractic: A case report [case report]. J Pediatr Matern & Fam Health. 2013;2:24-7.

Siegenthaler MH. Methods to diagnose, classify, and monitor infantile deformational plagiocephaly and brachycephaly: A narrative review. J Chiropr Med. 2015;14(3):191-204.

Swaminathan R,Hanson L. Improvement in a child with gastroesophageal reflux disease, constipation, and deformational plagiocephaly undergoing chiropractic care [case report]. J Pediatr Matern & Fam Health - Chiropr. 2011;1:9-13.

Tutt GM,Mesidor RG. Resolution of torticollis, plagiocephaly and breastfeeding difficulties in an infant following subluxation-based chiropractic care [case report]. J Pediatr Matern & Fam Health - Chiropr. 2014;2:14-20.

Williams S. Improvement of congenital torticollis, plagiocephaly and breastfeeding issues in an infant following subluxation-based chiropractic care: A case study [case report]. J Pediatr Matern & Fam Health – Chiropr. 2014;4:87-94.

Williams S,Blum CL,Billings S. [Proceedings of the European Chiropractors' Union Convention, London, 13-15 May 2010 Part II: Accepted Papers] Part 3: Case studies. Plagiocephaly: The oblique skull a method of chiropractic correction [case report; meeting abstract]. Clin Chiropr: Jun 2010;13(2):195-6.

Health and well-being

Quality of Life

'Living with persistent back pain may also lead to mood issues, such as anxiety, irritability, frustration and depression.' (Dept of Health, Victoria, 2021)

'Findings from this pre-planned secondary analysis demonstrate that chiropractic care impacts health-related quality of life beyond pain and pain-related disability.' (Hays et al, 2022)

Consideration of the removal or amelioration of chronic pain would indicate an improved quality of life. Apart from that, the list of positive outcomes of conditions and symptoms noted under somato-visceral disorders would also indicate an improved quality of life. In addition, some patients may have conditions that can only be managed on a symptom basis, or management directed at symptoms associated with a severe pathological condition.

It would seem natural for the relief of even just pain to lead to a higher and healthier quality of life, a finding noted by Hays et al. It is also reflected in the title of certain textbooks.

A correlation between spinal pain and spinal conditions has been addressed earlier in this treatise. Naturally the relief from these condition, signs, and symptoms leads to a sensation of well-being. Perhaps more fundamentally though, is the relief from pain conditions and the consequences which may be associated with pain, and particularly chronic pain. These factors are considered in just the titles of certain medical publications. These would include

- Essentials of body mechanics in health and disease (Goldthwait et al, 1952)
- The human spine in health and disease (Schmörl & Junghanns, 1971)

- The articular polymodal nociceptor in health and disease (Schmidt, 1996)

Tomic et al (2014) noted some of the effects of neck pain with the implication indicating that removal of that noxious symptom may positively influence the patient's health and other benefits. '*Pain influenced some aspects of ...physical function, and physical and mental disability. Being associated with disability and pain, cervical dystonia decreases the quality of life in many aspects. Disability also influenced depression and anxiety, which were present in half of study patients.*' (Tomic et al, 2016)

Extended reference compilation

Health and Well-Being

Barnes T. Kentuckiana children's centre: a 40-year history. J Chiropr Humanit. 1997;7:18-22.

Chang L. Review article: epidemiology and quality of life in functional gastrointestinal disorders. Aliment Pharmacol Ther. 2004;20 Suppl 7:31-9.

Christensen ST, Hartvigsen J. Spinal curves and health: a systematic critical review of the epidemiological literature dealing with associations between sagittal spinal curves and health. J Manipulative Physiol Ther. 2008;31(9):690-714. DOI 10.1016/j.jmpt.2008.10.004.

Department of Health. Back pain. Better Health. State Government of Victoria. 2021. https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/back-pain.

Desaulniers AMJ: Effect of subluxation-based chiropractic care on quality of life in a patient with major depression. J Vertebral Sublux Res. April 23, 2008.16.

Fanuele JC, Birkmeyer NJ, Abdu WA, et al The impact of spinal problems on the health status of patients: have we underestimated the effect? Spine (Phila Pa 1976). 2000;25(12):1509-14. DOI 10.1097/00007632-200006150-00009.

Goldthwait JE, Brown LT, Swaim LT, et al Essentials of body mechanics in health and disease. Philadelphia: JB Lippencott Co. 1952. 181, 192.

Hannon S. Objective physiologic changes and associated health benefits of chiropractic adjustments in asymptomatic subjects: a review of the literature. Journal of Vertebral Subluxation Research, 2004;April:1-9. https://liberationchiropractic.com/wp-content/uploads/research/AsymptomaticChiropracticBenefits.pdf.

Hays RD, Shannon ZK, Long CR, et al. Health-related quality of life among United States service members with low back pain receiving usual care plus chiropractic care vs usual care alone: secondary outcomes of a pragmatic clinical trial. Pain Medicine, 2022; pnac009, https://doi.org/10.1093/pm/pnac009.

Karran EL, Grant AR, Moseley GL. Low back pain and the social determinants of health: a systematic review and narrative synthesis. Pain. 2020;161(11):2476-93. DOI 10.1097/j.pain.0000000000001944.

Lennon RP, Dong H, Zgierska AE, et al. Adjunctive osteopathic therapy for hospitalized COVID-19 patients: A feasibility-oriented chart review study with matched controls. Int J Osteopath Med. 2022;44:3-8. DOI 10.1016/j.ijosm.2022.05.004.

McAllister W, Boone WR: Changes in physical state and self-perceptions in domains of health-related quality of life among public safety personnel undergoing chiropractic care. Journal of Vertebral Subluxation Research. August 6, 2007.21.

Noy M. Macedo L, Cartesso L. Biomedical origins of the term 'osteopathic lesion' and its impact on people in pain. Inter J Osteop Med. 2020: impact on people in pain/ Inter J Osteop Med. 2020. https://www.journalofosteopathicmedicine.com/article/S1746-0689(19)30135-X/fulltext.

Pellisé F, Balagué F, Rajmil L, et al. Prevalence of low back pain and its effect on health-related quality of life in adolescents. Arch Pediatr Adolesc Med. 2009;163(1):65-71. DOI 10.1001/archpediatrics.2008.512.

Raciborski F, Gasik R, Kłak A. Disorders of the spine. A major health and social problem. Reumatologia. 2016;54(4):196-200. DOI 10.5114/reum.2016.62474.

Russell DG, Kimura MN, Cowie HR, et al. Changes in Quality of Life in 7 Older Adult Patients Receiving Activator Methods Chiropractic Technique. J Chiropr Med. 2016;15(1):59-66. DOI 10.1016/j.jcm.2016.02.008.

Sarker KK, Sethi J, Mohanty U. Effect of spinal manipulation on specific changes in segmental instability, pain sensitivity and health-related quality of life among patients with chronic non-specific low back pain, a randomized clinical trial. Ann Res Rev Biol. 2017;18(2):1-10.

Schmidt RF. The articular polymodal nociceptor in health and disease. Prog Brain Res 1996;113:53-81.

Schmörl G, Junghanns H. Inefficient motor segment (Intervertebral insufficiency). In: The human spine in health and disease. New York. Grune & Stratton. 2USe. 1971:213-29.

Tomic S, Petkovic I, Pucic T, et al. Cervical dystonia and quality of life. Acta Neurol Belg. 2016;116(4):589-92. DOI 10.1007/s13760-016-0634-1.

Textbook sources

Considerable detail on the vertebral subluxation has been published by Schafer et al. Their volume ponders such topics as microneuropathology, neuronal electrophysiology, the sensory system, the visceral system, the vascular system, the reticular activating system, the supratentortial, the posterior fossa, and the spinal and neuroconceptual levels in chiropractic. These are then linked to clinical disorders of the autonomic nervous system, and other associations. (Schafer et al, 2008)

Apart from the volume of published journal papers, the considerable number of available textbooks by all the manipulative professions tends to contradict any claims that there is a dearth of evidence. Indeed, we suggest that it is formal evidence to the contrary, that is lacking.

Chiropractic

Anrig CA, Plaugher G. Pediatric chiropractic. Philadelphia: Wolters Kluwer Health. 3e. 2022

Beck R.W. Functional Neurology for the Practitioners of Manual Therapy. Edinburgh: Churchill Livingstone. 2008.

Bergman TF, Peterson DH. Chiropractic technique: principles and procedures. St Louis: Elsevier Health. 2010.

Cramer GD, Darby SA. Basic clinical anatomy of the spine, spinal cord, and ANS; St Louis: Mosby. 1995.

Davies N, Fallon J. Chiropractic pediatrics. London: Elsevier Health. 2010.

Ebrall P. Assessment of the spine. London: Churchill Livingstone. 2004.

Erikson KL. Upper cervical subluxation complex: a review of the chiropractic and medical literature. Baltimore: Williams and Wilkins. 2004.

Foreman SM, Croft AC. Whiplash injuries: the cervical acceleration/deceleration syndrome. 3e. Philadelphia: Lippincott Williams & Wilkins. 2001.

Gatterman MI. Foundations of the chiropractic subluxation. 2e. St Louis: Elsevier Mosby. 2005.

Gatterman MI. Whiplash. A patient-centered approach to management. St Louis: Elsevier. 2012.

Gatterman MI. Chiropractic management of spine related disorders. Baltimore: Williams and Wilkins. 1990.

Giles LGF, Singer KP. The clinical anatomy and management of back pain series. Vol 1: Clinical anatomy and management of low back pain. Edinburgh: Butterworth Heinemann. 1997.

Giles LGF, Singer KP. The clinical anatomy and management of back pain series. Vol 2: Clinical anatomy and management of thoracic spine pain. Edinburgh: Butterworth Heinemann. 2000.

Giles LGF, Singer KP. The clinical anatomy and management of back pain series. Vol 3: Clinical anatomy and management of cervical spine pain. Edinburgh: Butterworth Heinemann. 2005.

Giles LGF. 100 challenging spinal pain syndrome cases. St Louis: Elsevier. 2009.

Haavik H. The reality check: A quest to understand chiropractic from the inside out. Auckland Haavik Research. 2019.

Haldeman S. Principles and practice of chiropractic.2e. Norwalk: Appleton & Lange. 1992.

Haneline MT. Evidence-based chiropractic. Sudbury: Jones & Bartlett Publishers. 2006.

Kleynhans AM, Chiropractic identity building: Approaches to better patient care. ITM Press Institute of Therapeutic Manipulation. 2019.

Kleynhans AM. A chiropractic conceptual framework:- An anthology of reflections on philosophy, science, and chiropractic. ITM Press Institute of Therapeutic Manipulation. 2019

Leach RA. The chiropractic theories/ Principles and application. 3e. Baltimore: Williams and Wilkins. 1995

Liebenson C. Rehabilitation of the spine. 3e. Philadelphia: Lippincott Williams & Wilkins. 2019.

Masarsky CS, Todres-Masarsky M. Somatovisceral aspects of chiropractic: An evidence-based approach. New York: Churchill Livingstone. 2001.

Miller J. Evidence-based chiropractic care for infants. Amarillo. Praeclarus Press. 2019.

Mootz RD. Chiropractic techniques. Philadelphia. Aspen Publishers. 1999.

Műller RO. Autonomics in chiropractic. Toronto. The Chiro Publishing Co. 1954.

Murphy DR. Clinical reasoning in spine pain. Primary management of low back pain disorders using the CRISP protocols. Vol I. 2013

Murphy DR. Clinical reasoning in spine pain. Primary management of cervical disorders using the CRISP protocols. Vol II. 2016.

Nordholf LS. Motor vehicle collision injuries. Biomechanics, diagnosis, and management. Boston: Jones & Bartlett. 2005.

Perri VL. Conjugate gaze adjustive technique. An introduction to innovative chiropractic theory and practice. Irvine: Universal Publishers. 2001.

Redwood D, Cleveland CS. Fundamentals of chiropractic. St Louis: Mosby. 2003.

Schafer RC. Basic principles of chiropractic neuroscience. The foundation of clinical practice. 2e. La Grange: ACA Press. 1996;498-500.

Schafer RC, Johnson GC, Zolli F. Basic principles of chiropractic neuroscience. 2e. La Grange: ACA Press. 2008.

Souza TA. Differential diagnosis and management for the chiropractor. 5e. Sunbury: Jones & Bartlett Publishers. 2018.

Vernon H. The cranio-cervical syndrome. London: Elsevier Health Sciences. 2001.

Wessely MA, Young MF, Essential musculoskeletal MRI: a primer for the clinician. London: Churchill Livingstone. 2011.

Yockum TR, Rowe LJ. Essentials of skeletal radiology. 2e. Vol I.Baltimore: Williams & Wilkins.1996.

Yockum TR, Rowe LJ. Essentials of skeletal radiology. 2e. Vol II.Baltimore: Williams & Wilkins.1996.

Osteopathic

Burns LM, Chandler LC, Rice RW. Eds. Pathogenesis of visceral disease following vertebral lesions. Chicago: American Osteopathic Association. 1948.

Carreiro JE. Pediatric manual medicine: an osteopathic approach. London: Churchill Livingstone. 2009.

Carreiro JE. An osteopathic approach to children. 2e. London: Elsevier Health. 2009.

Cook CE. Orthopedic manual therapy. 2e. Upper Saddle River: Pearson Education. 2011.

DeStefano LA. Greenman's principles of manual medicine. 5e. Philadelphia: Lippincott Williams & Wilkins. 2016.

DiGiovanna EL, Amen CJ, Burns CK. An osteopathic approach to diagnosis and treatment. Wolters Kluwer Health. 2020.

Gibbons P, Tehan P. Manipulation of the spine, thorax and pelvis with videos: an osteopathic perspective. 4e. 2016.

King HH, Jänig W, Patterson MM. The science and clinical application of manual therapy. Edinburgh: Churchill Livingstone. 2011.

Lederman E. The science and practice of manual therapy. London: Elsevier. 2005.

Lunghi C, Fusco G. The five osteopathic models: rationale, application, integration – from an evidence-based to a person-centered osteopathy. Jessica Kingsley Publishers. 2017.

Moeckel ER. Textbook of pediatric osteopathy. London: Elsevier Health. 2008.

Nelson KE, Glonek T. Somatic dysfunction in osteopathic family medicine. Philadelphia: Lippincott Williams & Wilkins. 2014.

Nicholas AS, Nicholas EA. Atlas of osteopathic techniques. Philadelphia: Lippincott Williams & Wilkins. 2015.

Parsons J. Osteopathy. London: Elsevier Health. 2005.

Patterson HH, Howell JN. Eds. The central connection: somatovisceral/viscerosomatic interaction. Athens University Classics: American Academy of Osteopathy. 1989.

Schomacher J. Orthopedic manual therapy. Stuttgart, New York: Thieme Publishing. 2014.

Seffinger MA. Foundations of osteopathic medicine. Philadelphia: Lippincott Williams & Wilkins. 2019.

Sergueef N. Cranial osteopathy for infants, children and adolescents. London: Elsevier Health. 2007.

Stone C. Visceral and obstetric osteopathy. Elsevier Health. 2006

Medical

Biedermann H (Ed). Manual therapy in children. Edinburgh: Churchill Livingstone. 2004.

Bourdillon JF, Day EA. Spinal manipulation. 4e. Oxford: Heinemann Medical Books. 1988.

Breig A, Dvořák J, Dvořák V, et al. The vertebral subluxation complex. Colorado Springs: Renaissance. 1989.

Culbert T, Olness K. Integrative pediatrics. New York: Oxford University Press. 2009. (See chapter on chiropractic)

Cyriax J. Orthopaedic medicine: Treatment by manipulation and massage. Vol 2. 7e. London: Bailliere Tindall. 2011:53-5.

Dvořák J, Dvořák V, Schneider W. Manual Medicine. Springer-Verlag. 1988.

Dvořák J. Dvořák V, Gillar W, et al. Musculoskeletal Manual Medicine. Stuttgart: Thieme Publishing Group. 2008.

Epstein BS. The spine. A radiological text and atlas. 4e. Philadelphia: Lea & Febiger. 1976.

Goldthwait JE, Brown LT, Swaim LT, et al. Essentials of body mechanics in health and disease. 5e. Philadelphia: JB Lippincott Co. 1952.

Gorman RF. The scientific basis of spinal manipulation therapy for constitutional illnesses. North Charleston: Createspace. 2011.

Hing W, Hall T, Mulligan B. The mulligan concept of manual therapy. London: Elsevier. 2019.

Jackson R. The cervical syndrome. Springfield: Charles C Thomas. 3e. 1966:284.

Jänig W. The integrative action of the autonomic nervous system: neurobiology of homeostasis. Cambridge: Cambridge University Press. 2006.

Kattan KR. Ed. "Trauma" and "No-trauma" of the cervical spine. Springfield: Charles C Thomas.1975.

Lewit K. Manipulative therapy of rehabilitation of the locomotion system. 3e. Oxford: Butterworth Heinemann.1999:89.

Maigne R. Orthopedic Medicine. A new approach to vertebral manipulations. Springfield: Charles C Thomas. 1972.

Murtagh JE, Kenna JE. Back pain and spinal manipulation. 2e. London: Butterworth-Heinemann. 1997.

Paterson JK, Burn L. An introduction to medical manipulation. Dordrecht: Springer. 2012.

Paterson JK. Vertebral manipulation: a part of orthodox medicine. Kluwer Academic Publishers. 1985.

Patterson JK, Burn L. An introduction to medical manipulation. Lancaster: MTP Press. 1985.

Schneider W, Dvořák J, Dvořák V. Manual medicine: therapy. New York: Thieme Medical Publishers Inc. 2005.

Schmörl G, Junghanns H. The human spine in health and disease. 2USe. New York: Grune & Stratton. 1971.

Interprofessional collaboration

Cassidy JD, Kirkaldy-Willis WH. Manipulation in managing back pain. In: Kirkaldy-Willis WH. Ed. New York: Churchill Livingstone. 1988:287-96.

Giles LGF, Singer KP. Clinical anatomy and management of low back pain. Vol 1.Oxford: Butterworth Heinemann. 1997.

Glasgow EF, Twomey LT, Scull ER, et l. Aspects of manipulative therapy. Melbourne: Churchill Livingstone. 1985.

King HH, Jänig W, Patterson MM. The science and clinical application of manual therapy. Edinburgh: Churchill Livingstone. 2011.

Patterson MM, Howell JN. The central connection: somatovisceral/viscerosomatic interaction. Proceedings of the 1989 American Academy of Osteopathy International Symposium. Athens OH: University Classics Ltd. 1992.

Physiotherapy

Boyling JD, Palastanga RN. Grieve's modern manual therapy: the vertebral column. 2e. London: Churchill Livingstone. 1994

Buelna C. Manipulation techniques in physiotherapy. Independently published. 2021.

Fernandez de las Penas C, Cleland JA, Dommerholt J. Manual therapy of musculoskeletal pain syndromes. London: Elsevier. 2015.

Hengeveld E, Banks K. Maitland's vertebral manipulation.

Jull G, Moore A, Falla D. Grieve's modern musculoskeletal physiotherapy. 4e. Elsevier: London. 2015.

Maitland G, Hengeveld E. Maitland's Vertebral Manipulation.

Neumann DA. Kinesiology of the Musculoskeletal System.

Olson KA. Manual physical therapy of the spine.3e. 2021.

Animal research

A synopsis of quotations is provided here in order to demonstrate the broader adoption of the principles of the subluxation complex into veterinary science. Also noted is the animal research that has been conducted on animal subjects. Rosner summarised a range of chiropractic research using animal subjects, (Rosner, 2015) while Keifer and Summers (2016) point out the advantages of animal subjects in research in neurobiology for the '*development of therapeutic treatments for neurological disorders*.'

'*There is a strong analogy between the above data collected on humans and those obtained in animal experiments of this investigation, during direct stimulation of the Cervical Sympathetic Nerve*.' (Passatore et al, 1996)

'*In agreement with the results obtained in mammalian species, the present findings suggest that the vestibulotrigeminal relationship is quite complex and uses multiple pathways to connect the vestibular apparatus with the motor and sensory nuclei of the trigeminal nerve in the anurans as well*.' (Matesz et al, 2008)

'*Colitis significantly altered responses to mechanical and thermal stimulation of both hind paws on day 7 but not day 14. We conclude that cross talk between afferent visceral and somatic pathways may contribute to the coexistence of pain syndromes*.' (Lanb et al, 2006)

'*In experimental animals, both noxious and innocuous stimulation of somatic afferents have been shown to evoke reflex changes in sympathetic efferent activity and, thereby, effector organ function. These phenomena have been demonstrated in such sites as the gastrointestinal tract, urinary bladder, adrenal medulla, lymphatic tissues, heart and vessels of the brain and peripheral nerves.*' (Sato 1995)

Extended reference compilation

Subluxation and manipulation animal subjects

Bolton PS, Tracey DJ. The medullary relay from neck receptors to somatosensory thalamus in the rat. A neuroanatomical study. Exp Brain Res. 1992;88(3):473-84.

Budgell B, Sato A, editors. Modulations of autonomic functions by somatic nociceptive inputs. Prog Brain Res. 1996;113:525-39.

Colloca CJ, Gunzburg R, Freeman BJ, et al. Biomechanical quantification of pathologic manipulable spinal lesions: an in vivo ovine model of spondylolysis and intervertebral disc degeneration. J Manipulative Physiol Ther. 2012;35(5):354-66.

Colloca CJ, Keller TS, Moore RJ, et al. Validation of a noninvasive dynamic spinal stiffness assessment methodology in an animal model of intervertebral disc degeneration. Spine (Phila Pa 1976). 2009;34(18):1900-5. DOI 10.1097/BRS.0b013e3181afea9d.

Colloca CJ, Keller TS, Gunzburg R. Neuromechanical characterization of in vivo lumbar spinal manipulation. Part II. Neurophysiological response. J Manipulative Physiol Ther. 2003;26(9):579-91. DOI 10.1016/j.jmpt.2003.08.004.

Colloca CJ, Keller TS, Gunzburg R, et al. Neurophysiologic response to intraoperative lumbosacral spinal manipulation. J Manipulative Physiol Ther. 2000;23(7):447-57. DOI 10.1067/mmt.2000.108822.

Cramer G, Henderson C, Khalsa P, et al. Animal models. In: Basic science research related to chiropractic spinal adjusting: the state of the art and recommendations. J Manipulative Physiol Ther. 2006;29(9):726-61.

Cramer GD, Fournier JT, Henderson CNR, et al. Degenerative changes following spinal fixation in a small animal model. J Manipulative Physiol Therapeutics. 2004;27(3):141-54.

Gomez Alvarez CB, L'ami JJ, Moffat D, Back W, van Weeren PR. Effect of chiropractic manipulations on the kinematics of back and limbs in horses with clinically diagnosed back problems. Equine Vet J. 2008;40(2):153-9. DOI 10.2746/042516408X250292.

Henderson CNR. Animal models in the study of subluxation and manipulation. 1964-2004, Chapter 4, 47-103. In: Gatterman MI. Foundations of Chiropractic. 2e. St Louis: Elsevier Mosby. 2005.

Keifer J, Summers CH. Putting the "biology" back into "neurobiology": the strength of diversity in animal model systems for neuroscience research. Front Syst Neurosci. 2016;10:69. DOI 10.3389/fnsys.2016.00069.

Kimura A, Sato A. Somatic regulation of autonomic functions in anesthetized animals--neural mechanisms of physical therapy including acupuncture. Jpn J Vet Res. 1997;45(3):137-45.

Lamb K, Zhong F, Gebhart GF, et al. Experimental colitis in mice and sensitization of converging visceral and somatic afferent pathways. Am J Physiol Gastrointest Liver Physiol. 2006;290(3):G451-7.

Lima CR, Martins DF, Reed WR. Physiological responses induced by manual therapy in animal models: A scoping review. Front Neurosci. 2020;14:430. DOI 10.3389/fnins.2020.00430.

Matesz C, Kovalecz G, Veress G, et al. Vestibulotrigeminal pathways in the frog, Rana esculenta. Brain Res Bull. 2008;75(2-4):371-4. DOI 10.1016/j.brainresbull.2007.10.049.

Onifer SM, Reed WR, Sozio RS, et al. Antinociceptive effects of spinal manipulative therapy on nociceptive behaviour of adult rats during the formalin test. Evid Based Complement Alternat Med. 26 Nov 2015, 2015:520454. DOI 10.1155/2015/520454.

Passatore M, Deriu F, Roatta S, et al. Effects of cervical sympathetic nerve stimulation on the cerebral microcirculation: possible clinical implications. Acta Neurobiol Exp (Wars). 1996;56(1):117-27.

Pickar JG, Bolton PS. Spinal manipulative therapy and somatosensory activation. J Electromyogr Kinesiol. 2012;22(5):785-94. DOI 10.1016/j.jelekin.2012.01.015.

Reed WR, Liebschner MA, Sozio RS, et al. Neural response during a mechanically assisted spinal manipulation in an animal model: A pilot study. J Nov Physiother Phys Rehabil. 2015;2(2):20-27. DOI 10.17352/2455-5487.

Rosner. Neural responses to external forces in animal models. In: Getting down to brass tacks: the neurophysiology of spinal manipulation. Dynamic Chiropr. 2015;33(17): https://www.dynamicchiropractic.com/mpacms/dc/article.php?id=57469

Sato A. Somatovisceral reflexes. J Manipulative Physiol Ther. 1995 Nov-Dec;18(9):597-602.

Veterinary science research

Subluxation, clinical

Veterinary science appears to have adopted the concepts of the vertebral subluxation complex model as well as the chiropractic terminology involved. There also appears to be considerable integration of the professions as members of the *Australian Veterinary Chiropractic Association* which has become the *Animal Biomechanical Professionals Australia* also including osteopaths. (https://www.abmprof.com.au/) The range of conditions diagnosed and addressed is quite varied. See Australian Veterinary Chiropractic Association, https://www.petpages.com.au/association/australian_veterinary_chiropractic_association.

Cole C, Tully G. Reversal of paraplegia secondary to intervertebral disc disease in 24 canines with vertebral subluxation: A retrospective analysis of outcomes following chiropractic [case report]. Ann Vert Sublux Res. 2018;173-9. https://www.vertebralsubluxationresearch.com/2018/11/27/reversal-of-paraplegia-secondary-to-intervertebral-disc-disease-in-24-canines-with-vertebral-subluxation-a-retrospective-analysis-of-outcomes-following-chiropractic/.

Cronin N, Loukopoulos P, Brown D, et al. Suspected hereditary cervicothoracic vertebral subluxation with cervical myopathy in Poll Merino sheep. Aust Vet J. 2019;97(12):499-504.

Giggleman G, Shiver A. Resolution of orthostatic intention tremors in a 3-week-old male Great Dane following chiropractic: A case report and review of the literature [case report]. Ann Vert Sublux Res. 2018:29-37. https://www.vertebralsubluxationresearch.com/2018/02/05/resolution-of-orthostatic-intention-tremors-in-a-3-week-old-male-great-dane-following-chiropractic-a-case-report-review-of-the-literature/.

Halle KS, Granhus A. Veterinary chiropractic treatment as a measure to prevent the occurrence of spondylosis in boxers. Vet Sci. 2021;8(9):199. DOI 10.3390/vetsci8090199.

Hammons JR. Vertebral subluxation in a guinea pig. Mod Vet Pract. 1979;60(3):231.

Hartley WJ, Stevenson JM, McCarthy PH. Cervicothoracic vertebral subluxation causing ataxia in sheep. Aust Vet J. 1994;71(8):267-8.

Haussler K. Review of manual therapy techniques in equine practice. J Equine Veterinary Sci. 2009;29(12):849-69. DOI:10.1016/j.jevs.2009.10.018

Haussler KK, Hesbach AL, Romano L, et al. A systematic review of musculoskeletal mobilization and manipulation techniques used in veterinary medicine. Animals (Basel). 2021;11(10):2787. DOI 10.3390/ani11102787.

Havik ME, Cornell KK, Hawthorne JC, et al. Evaluation of nonsurgical treatment of atlantoaxial subluxation in dogs: 19 cases (1992-2001). J Am Vet Med Assoc. 2005;227(2):257-62. DOI 10.2460/javma.2005.227.257.

Johnson P, Beltran E, Dennis R, et al. Magnetic resonance imaging characteristics of suspected vertebral instability associated with fracture or subluxation in eleven dogs. Vet Radiol Ultrasound. 2012;53(5):552-9.

Kamen D, The well adjusted dog. Brookline MA: Brookline Books. 1996.

Kamen D. The well adjusted cat. Cambridge MA: Brookline Books. 1997.

Kamen D. The well adjusted horse. BrooklineMA: Brookline Books. 1998

Maler MM. Overview of veterinary chiropractic and its use in pediatric exotic patients. Vet Clin North Am Exot Anim Pract. 2012;15(2):299-310, viii. DOI 10.1016/j.cvex.2012.03.001.

McDonald M. Case study. Conservative manual chiropractic management of a recurrent medial luxating patella in a dog [case report]. Chiropr J Aust. 2009;39(1):27-8.

Nannarone S, Bellezza E, Moens YP, Larenza Menzies P. Vertebral subluxation repair in a pet goat. Vet Surg. 2017;46(1):81-8.

Nelson KM, Scarratt WK, Moon ML, et L. What is your diagnosis? Radiographic diagnosis, dorsal subluxation of cervical vertebrae 2 and 3. J Am Vet Med Assoc. 1994;204(1):47-8.

Rome PL, McKibbin M. A review of chiropractic veterinary science: An emerging profession with somatic and somatovisceral anecdotal histories. Chiropr J Aust. 2011;41(4):127-139. http://animalchiropractic.com/uploads/AnimalChiropracticArticle.pdf.

Rome PL. Animal chiropractic neutralises the claim of placebo effect of spinal manipulation: Historical perspectives [review]. Chiropr J Aust. 2012;42(1):15-20. http://cjaonline.realviewdigital.com/?iid=60759.

Rooney JR, Delaney FM, and Mayo JA. Sacroiliac luxation in the horse. Equine Vet J, 1969;1:287-9.

Sivula NJ. Research: Sympathetic effects of spinal manipulation. Holistic Horse. (Excerp from 2010 American Holistic Veterinary Medical Association Proceedings. https://holistichorse.com/research-sympathetic-effects-of-spinal-manipulation/.

Stalin C, Gutierrez-Quintana R, Faller K, er al. A review of canine atlantoaxial joint subluxation. Vet Comp Orthop Traumatol. 2015;28(1):1-8. DOI 10.3415/VCOT-14-05-0064.

Sullwold P, Lavallie N. Resolution of constipation, polydipsia and generalized weakness in a 14-year-old canine following chiropractic adjustment: A case report and review of the literature [case report; review]. Ann Vert Sublux Res. 2018:135-44. https://www.vertebralsubluxationresearch.com/2018/09/06/resolution-of-constipation-polydipsia-and-generalized-weakness-in-a-14-year-old-canine-following-chiropractic-adjustment-a-case-report-review-of-the-literature/.

Taylor LL, Romano L. Veterinary chiropractic. Can Vet J. 1999;40:732-5.

Watson AG, de Lahunta A. Atlantoaxial subluxation and absence of transverse ligament of the atlas in a dog. J Am Vet Med Assoc. 1989;195(2):235-7.

Watson AG, Wilson JH, Cooley AJ, et al Occipito-atlanto-axial malformation with atlanto-axial subluxation in an ataxic calf. J Am Vet Med Assoc. 1985;187(7):740-2.

Discussion

Apart from conventional radiological findings of the spine, indications of functional spinal disturbance provide additional considerations, particularly under a manipulation model of care. This diagnostic analysis of films also ensures the appropriateness for this model of care and recognition of contraindications and pathologies along with segmental and postural appraisal, the basic spinal condition and signs of prior injury(s). These assessments may be applied to indicate the optimal technique to be implemented, assist in estimating the necessary duration of care, indicate the degree of resolution of a condition, the types of exercises that may be necessary and other post-care advice.

We define a subluxation complex as '*an articular dysfunction with or without minor displacement, typically but not limited to the spine and pelvis and characterised by anatomical and neurophysiological signs and*

Essentially the VSC consists of degrees and combinations of the following considerations:

- A disturbance of facet function – articular pathophysiology or dysfunction. This may present in four basic forms,
  - Excessive motion (hypermobile),
  - Restricted motion (hypomobile),
  - Fixation (no motion – a blocked motion),
  - Aberrant motion (irregular or lurching motion)
- Translation of facet surfaces, marginal facet displacement. However, translation may also be absent if a functional segmental fixation occurs at the articulation's physiologically neutral position.
- Activation of noxious sensory reflexes, pathoneurophysiology. This involves mechanoreceptors particularly nociceptors and proprioceptors. These may be articular, ligamentous, tendinous and both skeletal, and intrinsic spinal muscle tone. This indicates altered (hyper or hypo) normal physiological sensory feedback.
- Activated reflexes involve autonomic stimulation, pathoneurophysiology, and involves both somatosomatic reflexes and somatovisceral reflexes.
- Identifiable signs and symptom. Typical signs and symptoms may be dull or acute localised pain, referred pain, radicular pain, paresthesias, and may include cervicogenic headaches, vertebrogenic angina, vertebrogenic dysphagia, vertebrogenic dyspepsia and altered tendon reflexes as examples.

It seems that some sectors are reluctant to identify, name or appreciate the lesion known as a vertebral subluxation complex, but are willing to use any one of a number of other designations for the same clinical entity. Some seem content to address or treat an enigmatic anatomical feature exhibiting signs or symptoms in a clinical setting, but cannot describe it with a term that has been its label for over 120 plus years. Apart from unsubstantiated opinion, we did not locate any formal evidential studies which contradicted the pathoneurophysiology of somatovisceral or somatoautonomic reflex activation from the disturbed somatic structures.

Regardless of the name, there must be a focus on an entity to justify a restorative procedure; an adjustment, a manipulation or mobilisation, otherwise there is no point in conducting such therapeutic procedures. Indeed, a manipulative procedure would be then conducted on a normal spine.

Apart from the vertebral subluxation, somatic dysfunction or other synonyms or euphemisms, all of which support aspects of the VSC, we could not find any other hypothesis which could explain the clinical ramifications of this entity. There appears to be no other hypothesis that could explain the symptoms and the outcomes that are repeated, repeatable and clinically recorded. Localised spinal pain, cervicogenic headache, sciatica, intercostal neuralgia, functional dysphasia, functional vertebrogenic dyspepsia, and other vertebrogenic conditions appear associated with neural sensitivity from biomechanical alterations. It is suggested that these examples may be indications of neural involvement as a probable factor in a range of other conditions, particularly functional visceral conditions, as presented in this series.

As there is now recognised physiological association with somatosensory, somatovisceral, somatovascular, somatosomatic, and somatoautonomic reflexes, the indications suggest that the complex vertebral interosseous lesion provides a reasonable rationale and is much more complex than segmental dysfunction or displacement of a vertebra.

It may be said that if the published claims about the effects of subluxations and recorded positive outcomes of vertebral manipulation were unfounded, then why has so much been

published about a non-existent biological concept? Additionally, so many patients have sought benefit from, and referred so many others for having their 'non-existent' lesions manually addressed. The upshot is that there is a lesion which chiropractors happen to identify as a vertebral subluxation complex (VSC), osteopaths as a vertebral dysfunction, physiotherapists call a manipulable lesion and medical doctors as a blockage, with a more recent attempt to rename it as a vague non-allopathic lesion. (Get PT, 2023)

The emergence of manipulative interest

A U-turn by some professions

The listed elements of the chiropractic vertebral subluxation and the osteopathic somatic dysfunction are well supported by independent scientific physiological evidence. Despite efforts by other professions to adopt and promote this model of health care in their own form, the practice of allopathy has barely changed. We suggest this is due to intransigent political introspection rather than research-based rationale.

The authors would maintain that without the positive clinical outcomes, the persistence of patient demand and the conviction of members of the profession itself, spinal manipulation may well have not attracted the interest of physiotherapy, manipulative medicine and the reviving interest from osteopathy.

Health authorities and dominant powers seem to lack understanding and willingness to forego pre-conceived notions regarding fair and scientific consideration and even research into the hypotheses regarding the wider positive outcomes of spinal manipulation in any of its forms. They seem to be held under the influence of entrenched introspective allopathic opinion without formal research. This lack of endeavour in conservative allopathic fields seems to have snowballed in recent decades with resistance to the idea regardless of supportive published literature, mostly from medicine's own literature.

The manipulation model offers a limited non-chemical-drug mode of care for a certain range of conditions, at least as a reasonable option as an initial intervention that is much less invasive.

It is acknowledged that while currently research has yet to fully explain the physiology behind the positive patient outcomes under spinal manipulation, those very reports seem to be drivers in all the health sciences including medicine.

However, given the volume and diversity of professional sources, as well as the frequency and depth of evidence, it would appear that the segmental disturbance model may offer a further element for a range of conditions, an element which has yet to be fully explored or exploited.

As there is a recognised physiological association with somatosensory, somatovascular, somatovisceral, somatosomatic, and somatoautonomic reflexes, the indications are that the complex vertebral lesion – the vertebral subluxation or somatic dysfunction, provide a reasonable rationale and would be grounds for ongoing research and possible development in neurophysiology

It is emphasised that the recognition and evidence of the biomechanics, physiology, neuropathophysiology, through to the rationale, clinic procedures, and efficacy as incorporated in the listed citations here, are predominately medical. That political medicine has denigrated and caste unsubstantiated opinion on this model of manipulative care, has led to other professions providing for the patient demand.

Conclusion

It is suggested that in view of the extensive support for the VSC hypothesis, the format of the presented evidential material suggests tacit recognition of the vertebral subluxation complex or

somatic dysfunction. It is not intended as a formal paper series, but more to record exemplars of available material under particular topics.

This series is not intended as a formal literature review. It is a gathering and presentation of readily accessible material relevant to, and suggestive of the somatovisceral aspect of the manipulative sciences. It comprises medical, physiotherapy and manual therapy material with limited chiropractic and osteopathic references bases. These are available through the online index the *ICL*, the *Osteopathic Medicine Digital Repository* and *PubMed*. As there is an abundance of material it was not practical at this time to include extensive chiropractic and osteopathic material.

It is emphasised again, that the sources presented in this series of papers are overwhelmingly not chiropractic and are independent with an emphasis on medical papers. Chiropractic and osteopathic papers have been generally omitted in this exercise although the ones that are listed are available through the internet. Should researchers choose to ignore this material they would disregard a significant volume of referenced literature.

Critics who question the existence of the VSC seem to offer no alternative hypotheses, and appear to suggest that it has no ramifications on other structures apart from osseous dysfunction. This does not explain many apparent signs and symptoms centred on neurosensory awareness such as basic pain. Notwithstanding that pain is a neural response and a protopathic one at that, such a notion overlooks other sensory and inflammatory responses, disturbance of other connective tissue and neural structures. The clinical examples of vertebral dysfunction associated with cervicogenic headaches and vertebrogenic sciatica would suggest otherwise. In addition, these same critics fail to describe the entity that they are dealing with clinically, and have failed to contradict or rebut the material presented here.

The extensive acknowledgements in the literature as identified here and elsewhere, for a clinical observation that is not supposed to exist according to some cynics, is overwhelmingly supportive of the clinical finding.

The evidence presented from medical and osteopathic sources seems to be accepted without critical comment, although acceptance of the same evidence from chiropractic sources is finally gaining more recognised. Even on *PubMed* access and reference to chiropractic papers seems remains limited.

In view of the volume noted in this series, claims of a lack of evidence in the manipulative management of somatovisceral disorders would appear to be voided in blinded professional territorial claims used for political preservation by some critics. It does seem hypocritical, unscientific, and contradictory when an opposite view is offered, even promoted by colleagues from the same allopathic professions.

We would submit that given the volume of independent papers presented, the dubious claim that there is no evidence to validate the chiropractic model of care cannot be supported, therefore such claims should be considered as being unsubstantiated, uninformed, and superficial unfounded opinion. A lack of willingness to fairly research the deeper neurophysiological ramifications cannot lead to a greater understanding of the principles of the VSC, nor further the knowledge base in the interest of the professions and the patients they serve.

The option of a health care model that is chemical-free or drugless for certain conditions at least as an initial measure would seem appropriate. This would be one in which serious medical research is yet to explore and seems to resist while exploring other more tenuous models and theories in order to explain the recorded positive patient outcomes. To some degree this could be viewed as abrogating a responsibility to offer the most appropriate mode of care for the patient's

condition and preference, that is extensively evidence based, paradoxically for the most part by medical research.

After decades of deriding and rejecting chiropractic concepts, one has to wonder why physiotherapy and manipulative medicine has actively taken up these same concepts in more recent years, then claiming themselves as the originators.

The evidence of the literature shows that medicine has been aware of the neurophysiological phenomenon of noxious somatoautonomic reflexes and the potential role of vertebral subluxations, displacement, and dysfunction, but with few exceptions, has ignored their clinical application.

Given the evidence presented, and with so much frequently recorded clinical observations, medicine has been remiss by not taking the concepts, reports, and patient preferences seriously

The biomechanical pathophysiology and the neurological pathophysiological basis of the presented conditions appears to be well recognised in the medical literature. However, there appears to be a degree of hesitancy to a therapeutic model for addressing these other than a pharmaceutical approach

In the study of body homeostasis and environmental adaptation it would seem very important to further analyse the contribution of somatic afferent input to the autonomic nervous and hormonal regulation of visceral organ activity. Also, some immunological functions have been found to be influenced by autonomic nerves or hormones (e.g. adrenal cortical hormone and catecholamines). Finally, we must take into account as we have briefly discussed, that visceral functions can be modulated by somatic afferent input via various degrees of integration of autonomic nerves, hormones, and immunological processes. We trust that such research will be expanded to higher species of mammals, and that ultimately this knowledge of somato-visceral reflexes obtained in the physiological laboratory will become clinically useful in influencing visceral functions. (Sato A, Schmidt RF. The modulation of visceral functions by somatic afferent activity. Japanese J. Physiol 1987;37:1-17)

Last word

This paper concludes the 6-part series by documenting evidence reported to date that a Chiropractor's manual intervention to correct subluxations is associated with changes to dysfunction and neural pathophysiology. These changes are shown to ameliorate symptoms and restore physiology in a range of conditions.

We consider a solid knowledge of these principles and their reported evidence to date is critical to an understanding the *Vertebral Subluxation Complex*.

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See also

Rome PL. Waterhouse JD. The Vertebral Subluxation premise: Part 1: The medical literature regarding nomenclature. Asia-Pacific Chiropr J. 2023;4.1. URL apcj.net/papers-issue-4-1/#RWVSCPremisePart1.

Rome PL. Waterhouse JD. The Vertebral Subluxation premise: Principle 1 continued, The medical literature regarding nomenclature and onset. Asia-Pacific Chiropr J. 2023;4.2. URL apcj.net/papers-issue-4-2/#RWVSCPrinciple1b

Rome PL. Waterhouse JD. The Vertebral Subluxation premise: Principle 2, the somatic vertebrogenic element. Asia-Pacific Chiropr J. 2023;4.2. URL apcj.net/papers-issue-4-2/#RWVSCPrinciple2

Rome PL. Waterhouse JD. The Vertebral Subluxation premise: Principle 3, altered physiological functions. Asia-Pacific Chiropr J. 2023;4.2. URL apcj.net/papers-issue-4-2/#RWVSCPrinciple3

Rome PL. Waterhouse JD. The Vertebral Subluxation premise: Principle 4, Segmental and neural disturbance is associated with clinical signs and symptoms, and a range of conditions. Asia-Pacific Chiropr J. 2023;4.2. URL apcj.net/papers-issue-4-2/#RWVSCPrinciple4