

# Some extra spinal considerations

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# CERVICAL SPINE

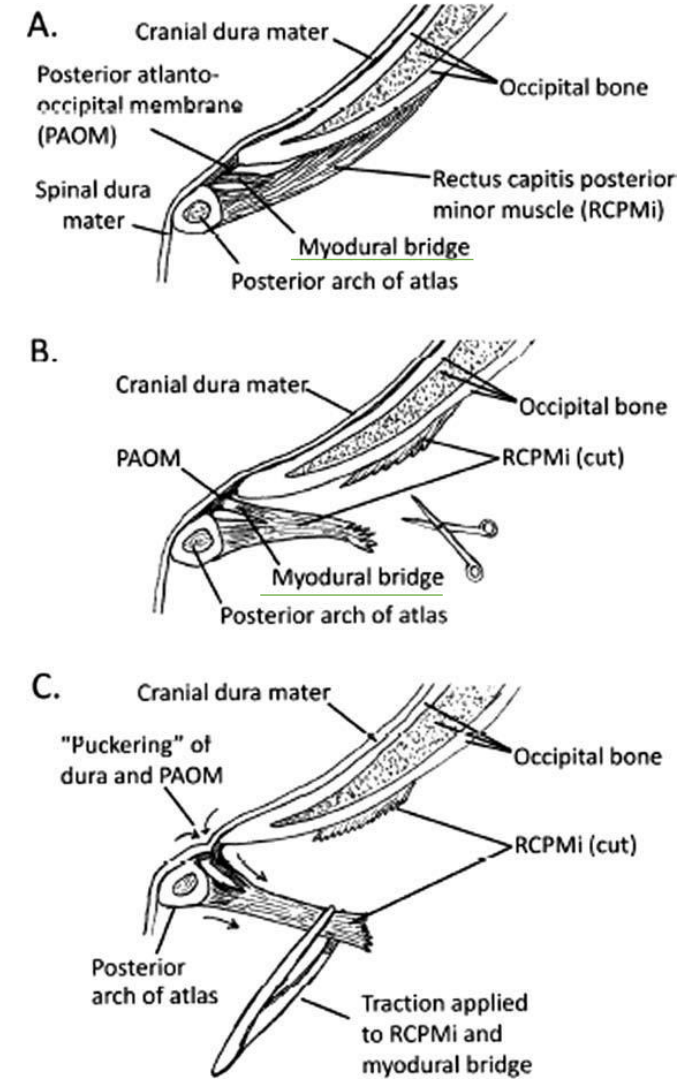
UPDATES?

# MYODURAL BRIDGE

## Connection Between the Spinal Dura Mater and Suboccipital Musculature: Evidence for the Myodural Bridge and a Route for Its Dissection —A Review

CLINICAL ANATOMY 2012

- A connective tissue link between the rectus capitis posterior minor (RCPMi) muscle and the cervical dura mater, hereafter referred to as the “myodural bridge”
- Originally described by Hack et al. (1995)
- The presence of a direct bridge linking the musculoskeletal system to the dura mater provides a **potential mechanical explanation for the efficacy of cervical massage and manipulative treatment on headache.**
- Hypothesis: fatty infiltration, hypertrophy, de-innervation of RCPMi

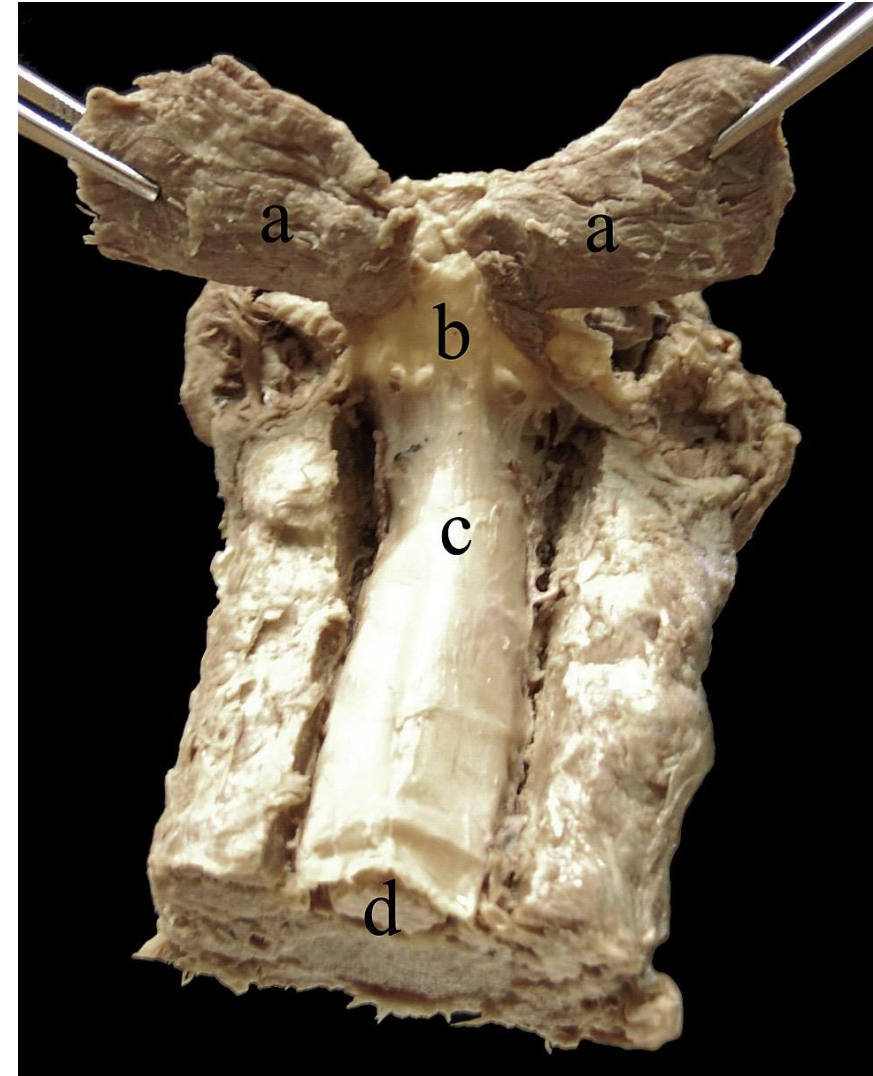


# MYODURAL BRIDGE

Histological analysis of the  
rectus capitis posterior  
major's myodural bridge

THE SPINE JOURNAL 2013

- Existence of proprioceptive fibers within this communication establishes biofeedback of dural tension during ranges of motion of the head and neck.
- During these movements, adaptation of dural tension may rely on forces produced by the suboccipital muscles that communicate with the cervical dura.
- Myodural biofeedback may play a role in maintaining the integrity of the subarachnoid space and, subsequently, cerebrospinal fluid pressure.
- **Its failure may result** in a variety of clinical manifestations including those arising from increasing dural tension, namely **cervicogenic headaches**



*‘A degenerated disc  
can be  
source of pain’*

*‘Inflammation leads  
to nerve and  
vascular ingrowth’*

- Intervertebral disc innervation in the cervical spine is analogous to that in the lumbar spine, with **cervical discs receiving innervation posteriorly from the sinuvertebral nerves, laterally from the vertebral nerve, and anteriorly from the sympathetic trunks.**
- Bogduk et al, using a cholinesterase stain, showed the presence of nerve fibers and free nerve endings as deeply as the outer third of the annulus fibrosus in human cervical discs obtained at operation.
- Release of chemokines from degenerative discs promote infiltration and activation of T- and B-cells, macrophages, and mast cells, further amplifying the inflammatory cascade and release of neurotrophins (NTs), in particular NGF.
- **The onset of the inflammatory condition inside the degenerated disc is a trigger to induce kinds of pathogenic responses, such as cell senescence and apoptosis, as well as nerve and vascular ingrowth.**
- In addition, the increased levels of NGF in the disc and the breakdown of the aggrecans will lead to the **ingrowth of nociceptive nerve fibers**

‘A degenerative cervical disc is likely to be a same source of neck pain and dizziness’

Disturbed cervical proprioceptive input has been suggested as a cause of cervical vertigo. **Cervical vertigo** now is defined as:

**“a non-specific sensation of altered orientation in space and disequilibrium originating from abnormal afferent activity from the neck”**

Because this vertigo is not caused by vestibular pathology, it rarely leads to true vertigo. Thus, the term “cervicogenic dizziness” is more appropriate than the term “cervical vertigo.”

**Dizziness usually implies a mismatch between the vestibular, visual, or cervical proprioception.** Abnormal neck proprioceptive input integrated from the signals of Ruffini corpuscles in degenerative cervical discs and muscle spindles in tense neck muscles sends incorrect afferent information to higher centers and will lead to a **sensory mismatch**

In clinical practice, **dizziness often happens in patients with chronic neck pain with only cervical disc degeneration** without cervical spondylotic radiculopathy or myelopathy on magnetic resonance imaging (MRI)

**Cervical intervertebral disc degeneration contributes to dizziness:  
a clinical and immunohistochemical study**

World neurosurgery journal 2018

# 'Cervicogenic dizziness is a diagnosis of exclusion'

- If a patient does not report both dizziness and cervical involvement, cervicogenic dizziness ( CGD ) is unlikely. CGD is also less likely if the patient reports tinnitus, hearing loss or migraines.
- It is sometimes necessary to **screen for neck instability and CAD** involvement before moving on to clinical tests.
- **Vestibular testing**, such as the head-neck differentiation test and Dix-Hallpike maneuver, can then be used to determine if the vestibular system is causing the dizziness.
- Examine the **cervical spine**, followed by the cervical neck torsion test and cervical relocation test to help confirm or exclude the diagnosis of CGD.

**How to diagnose cervicogenic dizziness**

# SHARP PURSER TEST



First, the patient's head is semi-flexed to 20-30° in a seated position (WHITE ARROW). The clinician assesses for any numbness and/or tingling in the arms or legs.

If the transverse ligament is compromised the dens of C2 may compress the tracts of the spinal cord with upper cervical flexion, thereby producing myelopathic symptoms such as numbness and/or tingling in the arms and/or legs.

Secondly, the clinician will stabilize the C2 spinous process with a pincer grip of one hand and apply an anterior to posterior force through the forehead of the patient with the clinician's other hand (BLACK ARROW).

The test is considered positive if the myelopathic symptoms that were produced with upper cervical flexion resolve, or a sliding motion of the head occurs posteriorly, sometimes resulting in an audible 'clunk' with the approximation of the dens on the posterior aspect of the anterior ring of the atlas.



# LUMBAR SPINE

UPDATES ?

# Dura mater AND POSTURE

A significant posture-dependent difference of the dural sac cross-sectional area at the level of the intervertebral disc in asymptomatic volunteers has been demonstrated.

**When the posture changed from supine to standing, lumbar dural sac volume expanded by the increased pressure of CSF (cerebro-spinal-fluid ) and the dural sac cross-sectional area increased.**

The smallest values were found in the supine position.

The most important factor leading to an increase of dural sac cross-sectional area in asymptomatic individuals was the gravity-related hydrostatic CSF pressure.

**Postural Changes of the Dural Sac in the Lumbar Spines of Asymptomatic Individuals Using Positional Stand-Up  
Magnetic Resonance Imaging**

**SPINE 2007**

# STRAIGHT LEG RAISE OR LASEGUE..OR LAZAREVIC TEST?

- In 1881, one year after the full and clear description of the test by Lazarevic, J.J. Forst described the straight leg raising test in his thesis, published in French. Forst gives full credit to his teacher Lasègue. Numerous authors admit that Lasègue never published the description of the straight leg raising test and instead credit its discovery to Dr. Lazarevic.
- Forst wrote, “We suppose that the sharp pain experienced by the patient can be ascribed to the compression of the nerve by the muscle bulk; this is also opinion of our teacher professor Lasègue.”
- Lazarevic concluded:  
“I diagnosed sciatica, in this way, immediately upon examining my patients, and I wasn’t mistaken. Similarly, once or twice before, I excluded sciatica applying the same principle and I was correct.”

Lazar K. Lazarevic, the author who first described the straight leg raising test

AMERICAN ACADEMY OF NEUROLOGY 2015

# CLINICAL EXAMINATION OF THE LUMBAR SPINE: MOTOR CONDUCTION

- L4-S4 nerve roots of the uninjured side were stimulated during operation. Motor innervation was determined by stimulating the spinal nerves with supramaximal intensity

“Based on common wisdom, the anterior tibia and the peroneus longus muscle are primarily innervated by L5, but there are also contributions from L4 to S1.

According to this finding, weakness of the dorsiflexion at the ankle joint does not necessarily indicate lumbar disc herniation between L4 and L5.

L5 and S1 are two major nerves innervating the gluteus medius and the gluteus maximus.

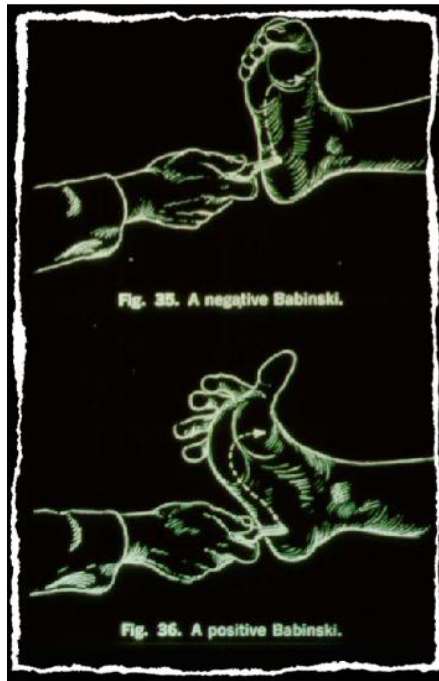
The biceps femoris and the medial gastrocnemius are mainly innervated by S1.

The nerve fibres that innervate the extensor digitorum brevis, the abductor hallucis and the flexor digitorum brevis are mainly from S2 to S3.”

# CLINICAL EXAMINATION OF THE LUMBAR SPINE

## ➤ BABINSKY REFLEX

CORTICO SPINAL TRACT INTEGRITY



‘The Babinski sign was confirmed to have a **very high specificity for pyramidal tract dysfunction (PTD)**. When present, it was a highly accurate “rule-in” finding, justifying its value in the clinical examination.

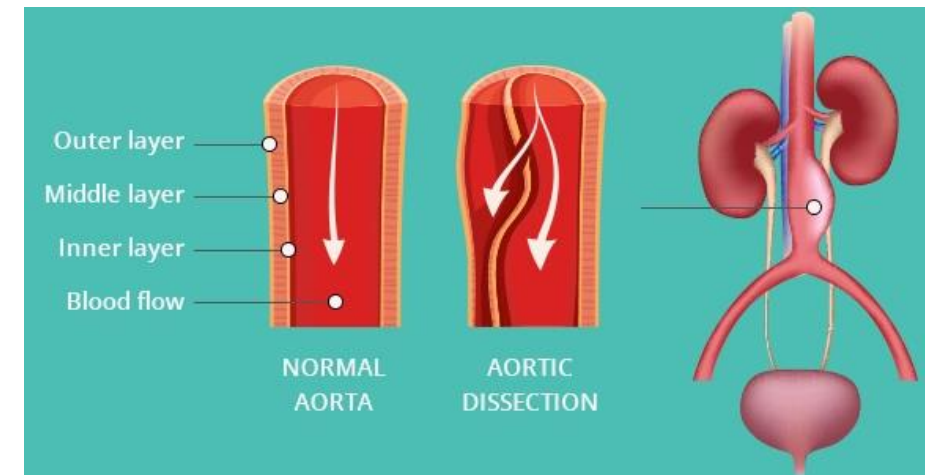
By contrast, **its sensitivity was modest indicating that its absence did not rule out PTD and where suspected, further assessment is indicated.**’

# ABDOMINAL AORTA DISSECTION

- FREQUENTLY ASYMPTOMATIC
- ACUTE BACK PAIN ( 'FORBIDDEN AREA'? ), BUT ALSO ABDOMINAL OR CHEST PAIN
- MAINLY MEN ( ABOUT 70 %), MEAN AGE 63 YEARS
- 'PULSATING PAIN', ABDOMINAL TENDERNESS, CLAUDICATION, PULSE DEFICIT ( 'BRUIT' AT AUSCULTATION )

A systematic review and meta-analysis of isolated abdominal aortic dissection  
JOURNAL OF VASCULAR SURGERY 2019

- WHEN ACUTE BACK PAIN:
  - NOT INFLUENCED BY POSTURE OR MOVEMENTS
  - NO DURAL S/S



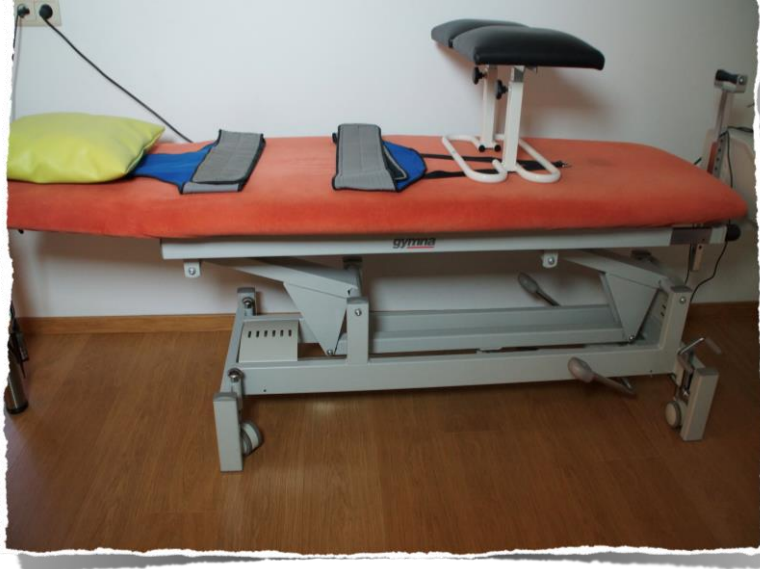
# MECHANICAL TRACTION

Mechanical traction can effectively relieve lumbar and leg pain and improve ODI in patients with lumbar disc herniation but has no significant effect on spinal motion.

The therapeutic effect of mechanical traction was significantly better than that of conventional physical therapy. Lumbar traction can be used in conjunction with other traditional physical therapy.

**Clinical Efficacy of Mechanical Traction as Physical Therapy for Lumbar Disc Herniation: A Meta-Analysis**

Computational and Mathematical Methods in Medicine  
2022



# THORACIC SPINE

UPDATES?



# The Herniated Thoracic Disc: A Review of Literature

Linda Resnik Mellion & Carlos Ladeira

Pages 154-163 | Published online: 18 Jul 2013

Download citation <https://doi.org/10.1179/jmt.2001.9.3.154>

- Posterocentral protrusions compress the dura resulting in extrasegmental referral of pain.
- Posterolateral protrusions may irritate the dural sleeve around the nerve root and result in motor or sensory disturbance with referred pain into the corresponding dermatome.
- Intradural penetration by a protruded thoracic disc has been reported in 12% of thoracic disc patients: can be caused by large calcified discs.
- Cases with intradural penetration have been accompanied by unilateral or bilateral spastic paraparesis, with increased muscle tone and increased reflexes, weakness and decreased sensation, and urinary incontinence

## NATURAL HISTORY OF THORACIC DISC DISEASE: INCIDENCE

- The incidence of thoracic disc herniation is estimated to be from 0.25 to 1% of all disc herniations.
- There is approximately a 1:1 male/female ratio in presentation.
- The majority of thoracic herniations have been noted to be central or centrolateral, with a minority of herniations truly lateral.
- Many herniated thoracic discs are shown to be calcified at presentation, the cause of this phenomenon remains unclear.
- Calcification is an important consideration, however, because approximately 5 to 10% of calcified discs are associated with intradural extension.



The pathophysiology of thoracic disc disease  
NEUROSURGERY FOCUS 2000

## NATURAL HISTORY OF THORACIC DISC DISEASE: INCIDENCE

- The majority of thoracic herniations are seen during the **third to fifth decades**
- The vast majority of herniated thoracic discs are found **below the level of T-7.**
- The greater degree of flexion allowable at each level should, predict a higher incidence of nucleus pulposus herniations.
- The increase in incidence of herniated discs demonstrated at the more mobile (lower) thoracic vertebral levels lends further support to the theory of a common pathophysiology for disc herniations at all levels

# NATURAL HISTORY OF THORACIC DISC DISEASE: PRESENTATION

- **Traumatic injury** is associated with approximately **25% of cases** of such herniations.
- Nearly **25%** did not present **with any symptomatic pain**.
- In a 1998 paper in which they discussed surgery-related outcomes, Stillerman, et al., divided the presentation of thoracic disc herniations into three distinct symptom complexes:
  - **localized thoracolumbar pain,**
  - **radicular pain,**
  - **myelopathy.**
- Associated symptoms can include bladder dysfunction (24%), sensory impairment (61%), and motor deficits (61%).
- The most common characterization of bladder dysfunction was **urgency**. Sensory disturbances usually consisted of paresthesias, dysesthesias, or complete sensory loss

# SPONTANEOUS RESORPTION

- It is generally accepted that **a soft hernia can be reversed**
- In this particular case, the analysis of the disc and hernia volumes suggests that the appearance of a calcified herniation is not so much the result of an expulsion of disc material but rather the accumulation of calcium deposit.
- There are two types of **disc calcification**: **chronic**, possibly symptomatic or not, and **acute** with inflammatory symptoms.
- **The evolution of the acute forms is documented by numerous case reports, which often indicate a spontaneous resolution with disappearance of the symptomatology in a few weeks.**
- **For the chronic forms, the spontaneous evolution is much less documented.** It seems clear that certain metabolic disorders favor disc calcifications.

What are the possibilities of spontaneous resorption of a thoracic disc herniation occupying more than 20% of the spinal canal in the asymptomatic subject? Comparative study  
JOURNAL OF CLINICAL NEUROSCIENCE 2017

## NATURAL HISTORY OF THORACIC DISC DISEASE: LONG TERM OUTCOME

- Thoracic discs may herniate without causing any symptomatology at all.
- Similarly, thoracic disc herniations may respond to conservative measures and never require any surgical intervention.

The pathophysiology of thoracic disc disease  
NEUROSURGERY FOCUS 2000

- Asymptomatic thoracic disc herniation is a condition that can disappear spontaneously, even in the case of a large lesion. To date, there are no clinical or radiological data that can predict such an evolution.

What are the possibilities of spontaneous resorption of a thoracic disc herniation occupying more than 20% of the spinal canal in the asymptomatic subject? Comparative study

JOURNAL OF CLINICAL NEUROSCIENCE 2017

The current **systematic review** failed to find any measurable difference in clinical outcome measurements based on whether the SMT was applied at a vertebral level based on clinical assessment (e.g., motion palpation) or not.

This may run counter to the expectations and clinical experiences of those engaged in SMT. However, on reflection, this finding should not be surprising for several reasons:

- *The candidate site is a subjective concept.*
- *The manipulation is not specific.*
- *A neuromuscular or biomechanical mechanism might explain the positive results of SMT.*
- *Contextual contribution might explain the positive results of SMT.*

**The importance of selecting the correct site to apply spinal manipulation when treating spinal pain: Myth or reality? A systematic review**

**The candidate site is a subjective concept.**

- There are many lines of thinking regarding what tests to use to detect these presumed clinically relevant candidate sites to apply SMT.
- No studies have succeeded in showing that such tests are reliable and reproducible.
- Motion palpation cannot reliably distinguish between individuals from the general population with or without low back pain.
- The detection method applied will depend on the profession, school of training, the fashion at the time of training, and own experience and preference.
- The application site is not important for clinical outcomes despite attempting to target objectively determined clinically relevant sites, either in relation to stiffness or pain sensitivity.

**The importance of selecting the correct site to apply spinal manipulation when treating spinal pain: Myth or reality? A systematic review**

**SCIENTIFIC REPORT- NATURE 2021**



**The manipulation is not specific.**

- It has been shown that SMT has a wider effect on multiple vertebral joints, both in proximity and further away from the application site.
- Studies in which accelerometers or microphones have been used to record the location of the “crack”-sound associated with SMT have found that it does not necessarily stem from the SMT application site.
- It is not obvious how to interpret such findings, but they certainly do not suggest that the mechanical effects of SMT are restricted to the application site.

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**A neuromuscular or biomechanical mechanism might explain the positive results of SMT.**

- The positive changes observed after SMT may be unrelated to treatment specificity but an effect of a generalized (systemic) effect or biomechanical interactions, such as functional changes in a “biomechanical chain” and spinal regional interdependence.
- This could explain why thoracic SMT seems to reduce cervical pain in clinical adult populations. Examples of other potential biomechanical effects are:
  - increased disc diffusion
  - decreased posterior-anterior stiffness
  - changes in the functioning of descending anti-nociceptive system
  - a widespread effect on muscle spindle response
  - central mechanisms of pain modulation.
- Possibly, the benefits of SMT might come from mechanisms that have not yet been investigated thoroughly<sup>52</sup> or complex interactions that cannot currently be understood.

**The importance of selecting the correct site to apply spinal manipulation when treating spinal pain: Myth or reality? A systematic review**

**Contextual contributions might explain the positive results of SMT.**

- It is possible that at least some positive effects of SMT may be due to non-specific mechanisms such as contextual contributions (e.g., patient expectations and a response to the therapeutic alliance).
- These systemic and non-specific factors could contribute to an increased improvement following SMT. The same has been observed in acupuncture and exercise, and it is a general finding across multiple interventions.

**The importance of selecting the correct site to apply spinal manipulation when treating spinal pain: Myth or reality? A systematic review**

# MANIPULATION AND SYMPATHETIC NERVOUS SYSTEM

Manual therapy directed to the cervical or thoracic spine produces a peripheral increase in skin conductance and a decrease in skin temperature, and also results in positive clinical outcome measures of decreased subjective pain reports at rest and improved upper extremity ROM during an ULNT.

**These findings are consistent with activation of the SNS in response to SMT.**

These findings may assist clinicians in educating their patients about the effects of SMT, and may also provide clinicians with evidence to guide them in considering SMT as a possible treatment for patients with appropriate upper quarter symptoms.

SYSTEMATIC REVIEW:

Peripheral response to cervical or thoracic spinal manual therapy: an evidence-based review with meta analysis

Journal of Manual and Manipulative Therapy 2014

# ADVERSE EVENTS FOLLOWING TJM

- Serious AE following TJM to the thoracic spine are extremely rare, it is likely that such events are under-reported.
- Most frequent AE reported:
  - injury (mechanical or vascular) to the spinal cord (7 out of the 10 cases).
  - pneumothorax and hemothorax (2 out of 10 cases)
  - cerebrospinal fluid (CSF) leak secondary to dural sleeve injury was reported in 1 case.
- Chiropractors were involved in the majority of injuries following TJM to the thoracic spine with 70% of the cases analysed. An osteopathic physician, physical therapist and a lay person were involved in the remaining 30% of the cases.

**Table 3 The 10 cases of serious adverse events (AEs) reported in seven published articles**

No.	Authors and year	Age (years), sex	Interval to symptom onset	Practitioner	Thoracic level manipulated	AE
1	Ruelle <i>et al.</i> (1999) <sup>35</sup>	64, F	2 hours	Chiropractor	Lumbar and thoracic spine	Acute epidural haematoma T9–11
2	Oppenheim <i>et al.</i> (2005) <sup>39</sup>	60, F	Not known	Chiropractor	Upper thoracic spine	T4–5 collapse; cord compression
3		56, F	Not known	Chiropractor	Upper thoracic spine	T4 pathology; epidural tumour
4		71, F	Not known	Chiropractor	Upper thoracic spine	T4 fracture; lung CA
5		32, M	Not known	Chiropractor	Middle thoracic spine	Thoracic syrinx, swollen cord
6	Lopez-Gonzalez and Peris-Celda (2011) <sup>33</sup>	45, F	2 hours	Chiropractor	Middle thoracic spine	Traumatic T8–T9 disc herniation; complete T6 level paraplegia secondary to spinal cord ischaemia
7	Lee <i>et al.</i> (2011) <sup>34</sup>	38, F	4 hours	Chiropractor	Cervical and upper thoracic spine	Acute epidural haematoma T1–7
8	Struewer <i>et al.</i> (2013) <sup>38</sup>	17, M	2 days	Osteopath	Middle thoracic spine	Large left hemothorax
9	Masneri <i>et al.</i> (2007) <sup>37</sup>	20, F	24 hours	Lay person	Middle thorax	Right pneumothorax
10	Donovan <i>et al.</i> (2007) <sup>36</sup>	32, F	2 weeks	Physical Therapist	Cervical and upper thoracic spine	CSF leak and spontaneous intracranial hypotension from dural sleeve tear C8–T5