

Spinal manipulation in the treatment of musculoskeletal pain

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INTRODUCTION

Spinal manipulation is a technique used by

chiropractors, physical therapists, and osteopathic clinicians, primarily to provide relief for musculoskeletal pain related to the back and neck. This topic will focus on a description of spinal manipulation, a discussion of its effectiveness, and the risks associated with manipulation.

SPINAL MANIPULATION

Spinal manipulation is a form of manual therapy that involves the deliberate high-velocity, passive movement of a joint, typically near the end of the clinical range of motion. This movement of the joint is frequently accompanied by an audible cracking or popping sound. Spinal manipulation may also be referred to as thrust mobilization, grade V mobilization, or spinal adjustment.

Like all forms of manual therapy, spinal manipulation involves assessment of and attention to vectors, force (depth of technique), velocity, duration, tissues and structures directly involved, and adjacent tissues and structures. Although spinal manipulation is considered a type of mobilization (a grade V mobilization), it is distinguished from the other, lower grades of mobilization by its velocity. In manipulation, a single, typically low-amplitude, high-velocity thrust is applied at or

near the end of passive joint movement, while the other mobilization techniques are comprised of repeated oscillatory low-velocity, non-thrust passive joint movements of varying amplitude.

Types of manipulation — Spinal manipulation is classified into one of two forms, depending upon the lever arm used to help the practitioner apply the load necessary for the manipulation:

- The first type involves long- or short-lever, low- to high-velocity, nonspecific manipulations. These techniques are typically vectored axially and lead to the separation of several adjacent joint surfaces. A common example uses one of the long bones of the limbs (frequently the femur) to amplify the load applied by the clinician's hands to one or several spinal joints. This technique is not used in cervical spinal manipulation.
- The second type involves short-lever, high-velocity manipulation, specific spinal adjustments. This form involves a short, deliberate thrust on a specific vertebra; although intending to move a specific joint, adjacent and contralateral joints are also affected [1,2]. These manipulative techniques usually require coupling of spinal motions across planes to leverage anatomy while also utilizing the least amount of force necessary.

Postulated mechanisms of benefit — Several hypotheses have been proposed to explain the benefits of manipulation [3,4]:

- Neurophysiologic cascade of the central and peripheral nervous system leading to local and remote pain inhibition [5,6]
- Relaxation of hypertonic muscle by sudden stretching
- Disruption of articular or periarticular adhesions
- Unblocking of motion segments that have undergone disproportionate displacements
- Alteration of pain-related reflexes by proprioceptive bombardment
- Changes in central pain pathways, particularly in the spinal and supraspinal mediated mechanisms [6]
- Reflexive muscle activation due to increased afferent output

Although there is some research supporting each of these hypotheses, there is no convincing evidence proving a specific pathophysiologic mechanism underlying the benefit of spinal manipulation [4].

SPECIFIC PAIN CONDITIONS

Spinal manipulation may be appropriate therapy for the management of a variety of musculoskeletal pain syndromes, including non-radicular neck and back pain, headache syndromes, and shoulder pain. However, advice regarding the use of spinal manipulation in the treatment of neck pain and headache is based upon limited, low-quality evidence, and the potential benefits of spinal manipulation must be considered with respect to the rare but potentially serious adverse effects associated with cervical manipulation. (See ['Serious adverse events'](#) below.)

Low back pain — Spinal manipulation is used in the treatment of acute, subacute, and chronic non-radicular low back pain; this is reviewed elsewhere.

(See ["Treatment of acute low back pain", section on 'Spinal manipulation'](#) and ["Subacute and chronic low back pain: Nonpharmacologic and pharmacologic treatment", section on 'Spinal manipulation'.](#))

Neck pain and headache — After low back pain, neck pain and headache are the next most common symptoms for which spinal manipulative therapy is offered. Together, these symptoms account for about 20 percent of all visits to chiropractors. It is estimated that between 18 and 38 million cervical spine manipulations are performed annually in the United States [7,8].

(See ["Management of non-radicular neck pain in adults", section on 'Manipulation techniques'.](#))

- **Neck pain** – For patients with non-radicular neck pain that persists beyond seven days, who are interested in manipulative therapy, and who have no identifiable risk factors for serious adverse events from spinal manipulation, treatment may include spinal manipulation along with education and a home exercise program (see ['Serious adverse events'](#) below). Although there is limited high-quality evidence available supporting the efficacy of spinal manipulation (cervical or thoracic) in the treatment of neck pain, some patients with non-radicular neck pain may benefit from such treatment when provided with exercise or other movement-based therapy.

In a systematic review including 51 randomized trials of patients with neck pain [9], only three small trials compared a single cervical manipulation with inactive control in patients with subacute and chronic neck pain [10-12]; in these patients, there was only immediate, but not short-term, improvement in pain. In addition, in patients with acute and subacute neck pain, multiple cervical manipulation sessions were more effective than medications (nonsteroidal antiinflammatory drugs [NSAIDs], opioids, and muscle relaxants) but were not more effective than home exercise with advice for improvement in neck pain at one year [13]. Further, patients with neck pain of varying duration may do as well with cervical spine manipulation as with non-thrust mobilization techniques [14].

In the same systematic review described above, three trials compared a single thoracic manipulation with inactive control for treatment of neck pain of varying duration; there was modest short- and intermediate-term improvement in neck pain and function with thoracic manipulation [13,15,16]. In another randomized trial not included in the systemic review, the addition of thoracic manipulation to exercise for the treatment of neck pain resulted in moderate short-term improvement in pain and long-term disability compared with exercise alone [17].

•**Headache** – Although spinal manipulation may have moderate efficacy in the management of some headache syndromes, including migraine and cervicogenic headaches [18-20], manipulation is not the preferred treatment for these syndromes. Other treatments may have superior efficacy without the same degree of potential risk of rare but serious adverse effects. Nevertheless, for select patients (eg, those who wish to avoid pharmacotherapy, who have previously responded to spinal manipulation therapy, and who have no risk factors for adverse events), spinal manipulation may be a reasonable treatment choice. (See '[Serious adverse events](#)' below.)

In a systematic review comparing noninvasive techniques for headache management, spinal manipulation treatment was as effective

as [amitriptyline](#) therapy migraine headache prophylaxis in short-term follow-up [21]. For the management of cervicogenic headache, spinal manipulation was more effective than no treatment but no more effective than exercise. There was inadequate evidence to evaluate the efficacy of manipulation in the management of tension-type headache.

Other conditions — Spinal manipulation may be used in the treatment of other musculoskeletal pain conditions. As an example, in a randomized trial including 150 patients with shoulder girdle pain and dysfunction, manipulation (of the cervical and upper thoracic spine, as well as adjacent ribs) improved pain and disability at 12 weeks compared with usual care [22].

RISKS OF SPINAL MANIPULATION

In general, spinal manipulation is a relatively safe procedure. However, it may rarely be associated with serious adverse effects and, more commonly, minor complaints.

Serious adverse events — A number of serious adverse events have been reported to be associated with spinal manipulation, including disc herniation, the cauda equina syndrome, vertebrobasilar occlusion or dissection, and carotid dissection [23,24]. However, no causal relationship between these rare events and prior spinal manipulative therapy has been conclusively proven or disproven [25-27].

Nevertheless, vascular dissection may have significant consequences, and patients with risk factors for dissection (eg, a prior history of cervical artery dissection, recent neck trauma [28], stroke or transient ischemic attack [TIA] symptoms, Ehlers-Danlos syndrome type IV) should avoid cervical spinal manipulation. Other risk factors for potential serious adverse events associated with spinal manipulation include a bleeding disorder, inflammatory spondyloarthropathy, osteoporosis, Down syndrome, upper cervical instability, aortic aneurysm and dissection, and chronic anticoagulation (not including chronic [aspirin](#) treatment)

[29]. (See "[Cerebral and cervical artery dissection: Clinical features and diagnosis](#)", section on 'Etiology' and "[Clinical manifestations and diagnosis of Ehlers-Danlos syndromes](#)", section on 'Vascular EDS' and "[Down syndrome: Clinical features and diagnosis](#)", section on 'Atlantoaxial instability'.)

In addition, in individuals in whom a herniated intervertebral disc is documented or suspected, spinal manipulation in the area of concern should be avoided due to the risk of worsening the disc displacement and the possibility of neurologic impairment. If offered, however, only low-velocity, non-thrust passive mobilization should be performed, cautiously, and with close monitoring of neurologic symptoms.

Although screening for risk factors prior to manipulation may assist the clinician in decision-making about the safety of proceeding, serious adverse events may still occur; some patients who develop serious adverse events after spinal manipulation, particularly vascular dissection, have no identifiable risk factors [[30-32](#)].

Estimates of the incidence of serious adverse events vary, ranging from no increased risk to 1 per 100,000 to 1 per 6 million manipulations [[24,33,34](#)]. These estimates are primarily derived from retrospective studies and case reports and series; no serious adverse event has been reported in any published clinical trial of cervical spinal manipulation [[35](#)]. In addition, some observational studies have suggested a possible association between cervical spinal manipulation and stroke among younger adult patients, although results of studies are mixed. As examples:

- In a six-week prospective study of cervical spine manipulations including 377 British chiropractors and over 19,000 patients and 50,000 cervical manipulations, no serious adverse events were reported by clinicians or patients [[36](#)]. However, study bias was possible due to potential underreporting bias (due to loss to follow-up and self-reporting) and clinician participation bias.
- In a case-control study including patients younger than age 60 years with ischemic stroke or transient ischemic attack, spinal manipulation within the preceding month was associated with vertebral arterial dissection (odds ratio [OR] 6.62, 95% CI 1.4-30) [[37](#)].

- In a case-control study including commercially insured United States patients, among 1159 patients admitted to hospital with vertebrobasilar artery (VBA) strokes over three years, there was no association between a recent (ie, within 30 days) chiropractic visit and stroke [26].
- In a population-based, case-control study including patients younger than age 45 with vertebrobasilar stroke (due to dissection or occlusion), patients were approximately five times more likely than the control group to have had a cervical chiropractic visit within the preceding week and three or more cervical chiropractic visits within the previous month (OR 5.52, 95% CI 1.54-19.76; and OR 4.98, 95% CI 1.34-18.57, respectively) [38]. There was no such association for patients \geq 45 years.
- In another case-control study including 818 patients admitted to Ontario, CA, hospitals with VBA strokes over nine years, there was an association between a chiropractic visit within the prior 30 days and subsequent stroke for patients <45 years (OR 3.13, 95% CI 1.34-7.21). However, there was also an association with a recent primary care visit (OR 3.57, 95% CI 2.17-5.86). The authors suggested that the association with any prior health care visit may be due to the symptoms associated with impending VBA, not as a result of the visit [25].

In addition, in positional and dynamic hemodynamic studies of the vertebral arteries, spinal manipulations do not induce vascular strain exceeding published failure strain measurements [39]. In fact, peak strain during cervical manipulations (which typically reduce rotational motions by combining movements) is lower than the strain measured during passive end-range axial rotational assessment [40].

Minor complaints — Minor complaints following spinal manipulation are common, with rates that may vary according to type of manipulation and patient age [41]. Rates of minor side effects vary and generally range between 25 to 60 percent in prospective studies and randomized trials [33,41].

In one systematic review including five prospective studies, mild to moderate transient adverse reactions (eg, dizziness, light headedness, headache, numbness) occurred in one-half of all patients undergoing spinal manipulation [42]. In a subsequent prospective study including almost 20,000 patients undergoing cervical spine manipulation, there were no serious adverse events, but minor

adverse effects (eg, dizziness, light headedness, numbness, paresthesia) were more common, occurring immediately and up to one week following treatment (16 per 1000 visits and 13 per 1000 visits, respectively) [36]. In a randomized trial of manipulation for neck pain comparing low- with high-velocity manipulations, those undergoing high-velocity manipulation were somewhat more likely to experience a minor adverse reaction (increased neck pain or stiffness), although the difference between the groups did not reach significance (approximately 30 percent in both groups) [41]. In another randomized trial including 180 patients, there was no difference in minor side effects (muscle pain and stiffness) between the spinal manipulation and the sham treatment group [43].

Other — There can be complications of manipulation therapy due to provider misdiagnosis, such as failing to correctly diagnose spinal tumors (primary or metastatic disease). Before performing spinal manipulation, appropriate clinical evaluation should be done by the practitioner to ensure the patient is an appropriate candidate.

SOCIETY GUIDELINE LINKS

Links to society and government-

sponsored guidelines from selected countries and regions around the world are provided separately. (See "[Society guideline links: Lower spine disorders](#)".)

SUMMARY AND RECOMMENDATIONS

- Spinal manipulation is a form of manual therapy that involves the deliberate high-velocity, passive movement of a joint, typically near the end of the clinical range of motion. Spinal manipulation is a type of mobilization (grade V mobilization), which differs from the other mobilization techniques; in manipulation, a single, typically low-amplitude, high-velocity thrust is applied at or near the end of passive joint movement, while the other mobilization techniques are comprised of repeated oscillatory low-velocity, non-thrust passive joint movements of varying amplitude. (See '[Spinal manipulation](#)' above.)

- Spinal manipulation may be appropriate therapy for the management of a variety of musculoskeletal pain syndromes, including non-radicular neck and back pain, certain headache syndromes, and shoulder pain. However, advice regarding the use of spinal manipulation in the treatment of neck pain and headache is based upon limited, low-quality evidence, and the potential benefits of spinal manipulation must be considered with respect to the rare but potentially serious adverse effects associated with cervical manipulation. (See '[Specific pain conditions](#)' above and '[Serious adverse events](#)' above.

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- For patients with non-radicular neck pain that persists beyond seven days, who are interested in manipulative therapy, and who have no identifiable risk factors for serious adverse events from spinal manipulation, treatment may include spinal manipulation along with education and a home exercise program. (See '[Neck pain and headache](#)' above.)

- Although spinal manipulation may have moderate efficacy in the management of some headache syndromes, including migraine and cervicogenic headaches, manipulation is not the preferred treatment for these syndromes; other treatments may have superior efficacy without the same degree of potential risk of rare but serious adverse effects. (See '[Neck pain and headache](#)' above.)

- A number of serious adverse events have been reported to be associated with spinal manipulation, including disc herniation, the cauda equina syndrome, vertebralbasilar occlusion or dissection, and carotid dissection. Patients with risk factors for dissection (eg, a prior history of cervical artery dissection, recent neck trauma, stroke or transient ischemic attack [TIA] symptoms, Ehlers-Danlos syndrome type IV) should avoid cervical spinal manipulation. Other risk factors for potential serious adverse events associated with spinal manipulation include a bleeding disorder, inflammatory spondyloarthropathy, osteoporosis, Down syndrome, upper cervical instability, aortic aneurysm and dissection, and chronic anticoagulation (not including chronic [aspirin](#) treatment).

In addition, in individuals in whom a herniated intervertebral disc is documented or suspected, spinal manipulation in the area of concern should be avoided.

Although screening for risk factors prior to manipulation may assist the clinician in decision-making about the safety of proceeding, serious adverse events may still occur; some patients who develop serious adverse events after spinal manipulation have no identifiable risk factors. (See '[Serious adverse events](#)' above.)

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