Clinical Practice Guideline: **Spinal Manipulation for Treatment of Thoracic Spine Pain**

Date of Implementation: **September 18, 2008**

Product: **Specialty**

POLICY

American Specialty Health – Specialty (ASH) clinical committees have determined that support for the use of spinal manipulation for treatment of acute, sub-acute, and chronic thoracic spine pain may be inferred from the evidence supporting the use of spinal manipulation for acute, sub-acute and chronic low back pain [see the *Spinal Manipulation for Treatment of Acute, Sub-Acute, and Chronic Low Back Pain (CPG 115 – S)*] policy. Therefore, spinal manipulation for treatment of acute, sub-acute, and chronic thoracic spine pain is considered established as clinically effective, is professionally recognized, and has a favorable benefit:risk profile**.**

PROCESS AND DEFINITIONS

When developing, reviewing, and approving clinical policy, ASH peer-review committees consider whether the technique/procedure:

- Is established as clinically effective by:
  - Scientific information published in an acceptable peer-reviewed clinical science resource, and
  - The consensus opinion of the Evidence Evaluation Committee (EEC) when available;
- Is professionally recognized by:
  - Inclusion in the educational standards accepted by the majority of the professions' educational institutions,
  - Wide acceptance and use of the practice, and
  - Recommendations for use made by healthcare practitioners practicing in the relevant clinical area;
- Poses a health and safety risk; and
- Is plausible or implausible
  - A belief, theory, or mechanism of health and disease that can be explained within the existing framework of scientific methods, reasoning, and available knowledge is considered plausible.
  - A treatment intervention or diagnostic procedure that requires the existence of forces, mechanisms, or biological processes that are not known to exist within the current framework of scientific methods, reasoning, and available knowledge is considered implausible.

Substitution harm (indirect harm): Compromised clinical outcomes caused by:

- Utilizing a specific diagnostic or therapeutic procedure when the safety, clinical effectiveness, or diagnostic utility is either unknown or is known to be unsafe, ineffective, or of no diagnostic utility, *instead of* a diagnostic or therapeutic procedure known to be safe, be clinically effective, or to have diagnostic utility; or
- The utilization of a diagnostic or therapeutic procedure that is substantially less effective or safe than another procedure with established safety, and clinical effectiveness or utility.

Labeling effects (non-specific harm): The harm that results from identifying in a patient a condition or a finding that is not clinically valid.

Safe: The terms "safe" and "safety," are used only with specific reference to the absence of direct harm. Direct harm would include any injury to a patient caused by the mechanical, thermal, biological, chemical, pharmacological, electrical, electromagnetic, or psycho-dynamic properties of a diagnostic or therapeutic procedure, and as such, the procedure would be considered unsafe.

Direct harm: Any injury to a patient caused by the mechanical, thermal, biological, chemical, pharmacological, electrical, electromagnetic, or psycho-dynamic properties of a diagnostic or therapeutic procedure.

Benefit versus risk profile: The relative effectiveness or utility of a therapeutic intervention or diagnostic procedure versus its potential for direct harm.

- Positive (benefits outweigh risks),
- Negative (risks outweigh benefits), or
- Equivocal (available information is inconclusive).

Description/Background

Spinal manipulation is practiced by a variety of health care providers including, but not limited to: chiropractors, osteopaths, physical therapists, and naturopaths. Health care practitioners may differ with respect to the specific spinal manipulation techniques they use, reflecting the diversities in their education, training, and philosophical foundations. Manipulative therapy uses a number of techniques that can be classified as either manipulations or mobilizations. Mobilization techniques include grades I-IV, as well as grade V manipulation which is similar to the HVLA thrust manipulations (Peterson & Bergmann, 2002). The primary objectives of spinal manipulation in the treatment of spine pain are to alleviate musculoskeletal pain, muscle spasm, and functional impairment of the spine. This form of manipulation is a therapeutic procedure characterized by controlled force, leverage, direction, amplitude, and velocity (directional, high velocity, low amplitude thrust) (Peterson & Bergmann, 2002).

Evidence and Research

There has been little research regarding the effectiveness and safety of spinal manipulation for the treatment of acute, sub-acute, and chronic thoracic spine pain. The support for the use of spinal manipulation in the treatment of thoracic spine pain may be inferred from the evidence supporting the use of spinal manipulation for chronic non-specific low back pain and neck pain. With regards to thoracic spinal manipulation for conditions of associated areas, Walser et al. (2009) completed a systematic review on thoracic spine manipulation (TSM) and treatment of various musculoskeletal conditions. Evidence was limited to determine effectiveness of TSM for shoulder conditions, but authors suggested that evidence is strong enough to encourage the pursuit of additional research in this area. One high quality study looked at lower trapezius strength and TSM. Increased strength was noted but the study was not generalizable.

There is sufficient evidence to support the use of TSM in the management of neck pain in the short term. Several studies have supported thoracic spinal manipulation as effective for acute/sub-acute neck pain (González-Iglesias et al., 2009; Bronfort et al., 2010; Cross et al., 2011; Puenttedura et al., 2011; Lau et al., 2011; Massaracchio et al., 2013; Huisman et al., 2013; Casanova-Méndez et al., 2014). Thoracic spine manipulation has a therapeutic benefit for some patients with neck pain. Thoracic spine manipulation alone, or in combination with, other interventions is a suitable intervention to try in the treatment of non-specific neck pain.

References

Aker PD, Gross AR, Goldsmith CH, Peloso P. Conservative management of mechanical neck pain: systematic overview and meta-analysis. BMJ 1996;313:1291-6.

Anderson R, Meeker W, Wirick B, Mootz R, Kirk D, Adams A. A meta-analysis of clinical trials of spinal manipulation. J Manipulative Physiol Ther 1992;15:181-94.

Andersson GBJ. Epidemiological features of chronic low-back pain. Lancet 1999;354:581-5.

Arkuszewski J. Joint blockage: a disease, a syndrome, or a sign. Man Med 1988;3:132-4.

Assendelft WJJ, Koes BW, Knipschild PG, Bouter LM. The relationship between methodological quality and conclusions in reviews of spinal manipulation. JAMA 1995;274:1942-8.

Assendelft WJJ, Koes BW, van der Heijden G, Bouter LM. The effectiveness of chiropractic for treatment of low back pain. An update and attempt at statistical pooling. J Manipulative Physiol Ther 1996;19:499-507.

Assendelft WJJ, Morton SC, Yu EI, Suttorp MJ, Shekelle PG. Spinal manipulative therapy for low back pain. A meta-analysis of effectiveness relative to other therapies. Ann Intern Med 2003;138:871-81.

Astin JA. Why patients use alternative medicine. JAMA 1998;279:1548-53.

Black N. Why we need observational studies to evaluate the effectiveness of health care. BMJ 1996;312:1215-8.

Boal RW, Gillette RG. Central neuronal plasticity, low back pain and spinal manipulative therapy. J Manipulative Physiol Ther 2004;27:314-26.

Bogduk N, Jull G. The theoretical pathology of acute locked back: a basis for manipulative therapy. Man Med 1985;23:77-81.

Bogduk N. The anatomical basis for cervicogenic headache. J Manipulative Physiol Ther 1992;15:67-9.

Bolton PS. Reflex effects of vertebral subluxations: the peripheral nervous system. an update. J Manipulative Physiol Ther 2000;23:101-3.

Bombardier C, Laine L, Reicin A, Shapiro D, Burgos-Vargas R, Davis B, Day RFMB, Hawkey CJ, Hochber MC, Kvien TK, Schnitzer TJ. Comparison of upper gastrointestinal toxicity of rofecoxib and naproxen in patients with rheumatoid arthritis. VIGOR Study Group. N Engl J Med 2000;343:1520-8.

Brennan PC, Triano JJ, McGregor M, Kokjohn K, Hondras MA, Brennan DC. Enhanced neutrophil respiratory burst as a biological marker for manipulation forces: duration of the effect and association with substance P and tumor necrosis factor. J Manipulative Physiol Ther 1992;15:83-9.

Bronfort G, Haas M, Evans R, Kawchuk G, Dagenais S. Evidence-informed management of chronic low back pain with spinal manipulation and mobilization. Spine J 2008;8:213-225.

Bronfort G, Haas M, Evans R. The clinical effectiveness of spinal manipulation for musculoskeletal conditions. In Haldeman S, Dagenais S, editors. Principles and practice of chiropractic. 3rd ed. New York: McGraw-Hill; 2005. p. 147-66.

Bronfort G, Haas M, Evans RL, Bouter LM. Efficacy of spinal manipulative therapy for low back and neck pain: a systematic review and best evidence synthesis. Spine J 2004;4:335-56.

Bronfort G, Haas M, Moher D, Bouter LM, Van Tulder MW, Triano J, Assendelft WJ, Evans RL, Dagenais S, Rosner A. Review conclusions by Ernst and Canter regarding spinal manipulation refuted. Chiropr Osteopat 2006;14:14.

Bronfort G. Spinal manipulation: current state of research and its indications. Neurologic Clinics of North America 1999;17:91-111.

Bronfort G, Haas M, Evans R, Leininger B, Triano J. Effectiveness of manual therapies: the UK evidence report. Chiropr Osteopat. 2010 Feb 25;18:3.

Budgell BS. Reflex effects of subluxation: the autonomic nervous system. J Manipulative Physiol Ther 2000;23:104-6.

Campbell BD, Snodgrass SJ. The effects of thoracic manipulation on posteroanterior spinal stiffness. J Orthop Sports Phys Ther. 2010;40(11):685-93.

Carroll LJ, Hogg-Johnson S, van der Velde G, Haldeman S, Holm LW, Carragee EJ, Hurwitz EL, Cote P, Nordin M, Peloso PM, Guzman J, Cassidy JD. Course and prognostic factors for neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine 2008;33:S75-S82.

Carson JL, Willett LR. Toxicity of nonsteroidal anti-inflammatory drugs: An overview of the epidemiological evidence. Drugs 1993;46(Suppl 1):243-8.

Casanova-Méndez A, Oliva-Pascual-Vaca A, Rodriguez-Blanco C, Heredia-Rizo AM, Gogorza-Arroitaonandia K, Almazán-Campos G. Comparative short-term effects of two thoracic spinal manipulation techniques in subjects with chronic mechanical neck pain: a randomized controlled trial. Man Ther. 2014 Aug;19(4):331-7.

Cassidy JD, Boyle E, Cote P, He Y, Hogg-Johnson S, Silver FL, Bondy SJ. Risk of vertebrobasilar stroke and chiropractic care: results of a population-based case-control and case-crossover study. Spine 2008;33:S176-S183.

Cherkin DC, Deyo RA, Street JH, Barlow W. Predicting poor outcomes for back pain seen in primary care using patients' own criteria. Spine 1996;21:2900-7.

Cherkin DC, Sherman KJ, Deyo RA, Shekelle PG. A review of the evidence for the effectiveness, safety, and cost of acupuncture, massage therapy, and spinal manipulation for back pain. Ann Intern Med 2003;138:898-906.

Cherry DK, Woodwell DA, Rechtsteiner EA. National Ambulatory Medical Care Survey:

2005 summary. Adv Data 2007;1-39.

Chou R, Huffman LH. Nonpharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians Clinical Practice Guideline. Ann Intern Med 2007;147:492-504.

Chou R, Qaseem A, Snow V, Casey D, Cross JT, Jr., Shekelle P, Owens DK. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. Ann Intern Med 2007;147:478-91.

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

Clark W, Haldeman S. The development of guideline factors for the evaluation of disability in neck and back injuries. Spine 1993;18 (13):1736-45.

Colle F, Rannou F, Revel M, Fermanian J, Poiraudeau S. Impact of quality scales on levels of evidence inferred from a systematic review of exercise therapy for low back pain. Arch Phys Med Rehabil 2002;83:1745-52.

Conlin A, Bhogal S, Sequeira K, Teasell R. Treatment of whiplash-associated disorders--part I: Non-invasive interventions. Pain Res Manag 2005;10:21-32.

Cote P, Cassidy JD, Carroll L. The Saskatchewan health and back pain survey. Spine 1998;23:1689-98.

Cote P, Kristman V, Vidmar M, Van Eerd D, Hogg-Johnson S, Beaton D, Smith PM. The prevalence and incidence of work absenteeism involving neck pain: a cohort of Ontario lost-time claimants. Spine 2008;33:S192-S198.

Cote P, van der Velde G, Cassidy JD, Carroll LJ, Hogg-Johnson S, Holm LW, Carragee EJ, Haldeman S, Nordin M, Hurwitz EL, Guzman J, Peloso PM. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine 2008;33:S60-S74.

Coulter ID, Hurwitz EL, Adams AA, Genovese BJ, Hays R, Shekelle PG. Patients using chiropractors in North America. Spine 2002;27:291-8.

Croft PR, Macfarlane GJ, Papageorgiou AC, Thomas E, Silman AJ. Outcome of low back pain in general practice: a prospective study. BMJ 1998;316:1356-9.

Cross KM, Kuenze C, Grindstaff TL, Hertel J. 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 Sep;41(9):633-42.

Dabbs V, Lauretti WJ. A risk assessment of cervical manipulation vs NSAIDS for the treatment of neck pain. J Manipulative Physiol Ther 1995;18:530-6.

Descarreaux M, Blouin JS, Drolet M, Papadimitriou S, Teasdale N. Efficacy of preventive spinal manipulation for chronic low-back pain and related disabilities: a preliminary study. J Manipulative Physiol Ther 2004;27:509-14.

DeVocht JW, Pickar JG, Wilder DG. Spinal manipulation alters electromyographic activity of paraspinal muscles: a descriptive study. J Manipulative Physiol Ther 2005;28:465-71.

Di Fabio RP. Efficacy of manual therapy. Phys Ther 1992;72:853-64.

Dishman JD, Ball KA, Burke J. Central Motor Excitability Changes After Spinal Manipulation: A transcranial magnetic stimulation study. J Manipulative Physiol Ther 2002;25:January1-9.

Eisenberg DM, Davis RB, Ettner SL, Appel S, Wilkey S, Van Rompay M, Kessler RC. Trends in alternative medicine use in the United States, 1990-1997. JAMA 1998;280:1569-75.

Eisenberg DM, Kessler RC, Van Rompay M, Kaptchuk TJ, Wilkey S, Appel S, Davis RB. Perceptions about complementary therapies relative to conventional therapies among adults who use both: results from a national survey. Ann Intern Med 2001;135:344-51.

Ernst E, Canter PH. A systematic review of systematic reviews of spinal manipulation. J R Soc Med 2006;99:189-93.

Ernst E, Harkness E. Spinal manipulation: a systematic review of sham-controlled, double-blind, randomized clinical trials. J Pain Symptom Manage 2001;22:879-89. [Abstract]

Ernst E. Manual therapies for pain control: chiropractic and massage. Clin J Pain 2004;20:8-12.

Evans DW. Mechanisms and effects of spinal high velocity, low amplitude thrust

manipulation: previous theories. J Manipulative Physiol Ther 2002;25:251-62.

Eysenck HJ. Meta-analysis and its problems. BMJ 1994;309:789-92.

Feinstein AR. Meta-analysis: statistical alchemy for the 21st century. J Clin Epidemiol 1995;48:71-9.

Ferreira ML, Ferreira PH, Latimer J, Herbert R, Maher CG. Does spinal manipulative therapy help people with chronic low back pain? Aust J Physiother 2002;48:277-84.

Fishbain DA, Cutler R, Cole B, Rosomoff HL, Rosomoff RS. International Headache Society headache diagnostic patterns in pain facility patients. Clin J Pain 2001;17:78-93.

Gillette RG. A speculative argument for the coactivation of diverse somatic receptor populations by forceful chiropractic adjustments. Man Med 1987;3:1-14.

González-Iglesias J, Fernández-de-las-Peñas C, Cleland JA, Alburquerque-Sendín F, Palomeque-del-Cerro L, Méndez-Sánchez R. Inclusion of thoracic spine thrust manipulation into an electro-therapy/thermal program for the management of patients with acute mechanical neck pain: a randomized clinical trial. Man Ther. 2009 Jun;14(3):306-13.

Gross AR, Goldsmith C, Hoving JL, Haines T, Peloso P, Aker P, Santaguida P, Myers C. Conservative management of mechanical neck disorders: a systematic review. J Rheumatol 2007;34:1083-102.

Gross AR, Hoving JL, Haines TA, Goldsmith CH, Kay T, Aker P, Bronfort G. A Cochrane review of manipulation and mobilization for mechanical neck disorders. Spine 2004;29:1541-8.

Haas M, Bronfort G, Evans RL. Chiropractic clinical research: progress and recommendations. J Manipulative Physiol Ther 2006;29:695-706.

Haas M, Goldberg B, Aickin M, Ganger B, Attwood M. A practice-based study of patients with acute and chronic low back pain attending primary care and chiropractic physicians: two-week to 48-month follow-up. J Manipulative Physiol Ther 2004;27:160-9.

Haas M, Groupp E, Aickin M, Fairweather A, Ganger B, Attwood M, Cummins C, Baffes L. Dose-response for chiropractic care of chronic cervicogenic headache and associated neck pain: a randomized pilot study. J Manipulative Physiol Ther 2004;27:547-53.

Haas M, Groupp E, Kraemer DF. Dose-response for chiropractic care of chronic low back pain. Spine J 2004;4:574-83.

Haas M, Sharma M, Stano M. Cost-effectiveness of medical and chiropractic care for acute and chronic low back pain. J Manipulative Physiol Ther 2005;28:555-63.

Haldeman S, Dagenais S. Cervicogenic headaches: a critical review. Spine J 2001;1:31-46.

Haldeman S, Rubinstein SM. Cauda equina syndrome in patients undergoing manipulation of the lumbar spine. Spine 1992;17:1469-73.

Haldeman S. Neurological effects of of the adjustment. J Manipulative Physiol Ther 2000;23:112-4.

Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain. Spine 1995;20:11-9.

Heikkila H, Johansson M, Wenngren BI. Effects of acupuncture, cervical manipulation and NSAID therapy on dizziness and impaired head repositioning of suspected cervical origin. Manual Therapy 2000;5:151-7.

Herzog W, ed. Clinical biomechanics of spinal manipulation. New York: Churchill Livingstone; 2000.

Herzog W. Mechanical, physiologic, and neuromuscular considerations of chiropractic treatments. In Lawrence DJ, Cassidy JD, McGregor M, Meeker WC, Vernon HT, editors. Advances in Chiropractic. Volume 3 ed. St. Louis: Mosby-Year Book; 1995. p. 269-85.

Hestbaek L, Leboeuf-Yde C, Manniche C. Low back pain: what is the long-term course? A review of studies of general patient populations. Eur Spine J 2003;12:149-65.

Hettinga DM, Hurley DA, Jackson A, May S, Mercer C, Roberts L. Assessing the effect of sample size, methodological quality and statistical rigour on outcomes of randomised controlled trials on mobilisation, manipulation and massage for low back pain of at least 6 weeks duration. Physiotherapy 2008;94:97-104.

Hogg-Johnson S, van der Velde G, Carroll LJ, Holm LW, Cassidy JD, Guzman J, Cote P, Haldeman S, Ammendolia C, Carragee E, Hurwitz E, Nordin M, Peloso P. The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders.

Spine 2008;33:S39-S51.

Hoving JL, Gross AR, Gasner D, Kay T, Kennedy C, Hondras MA, Haines T, Bouter LM. A critical appraisal of review articles on the effectiveness of conservative treatment for neck pain. Spine 2001;26:196-205.

Huisman PA, Speksnijder CM, de Wijer A. The effect of thoracic spine manipulation on pain and disability in patients with non-specific neck pain: a systematic review. Disabil Rehabil. 2013 Sep;35(20):1677-85.

Hurwitz E, Morgenstern H, Vassilaki M, Chiang LM. Frequency and clinical predictors of adverse reactions to chiropractic care in the UCLA neck pain study. Spine 2005;30:1477-84.

Hurwitz EL, Aker PD, Adams AH, Meeker WC, Shekelle PG. Manipulation and mobilization of the cervical spine. Spine 1996;21:1746-60.

Hurwitz EL, Carragee EJ, van der Velde G, Carroll LJ, Nordin M, Guzman J, Peloso PM, Holm LW, Cote P, Hogg-Johnson S, Cassidy JD, Haldeman S. Treatment of neck pain: noninvasive interventions: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine 2008;33:S123-S152.

Hurwitz EL, Coulter ID, Adams AH, Genovese BJ, Shekelle PG. Use of chiropractic services from 1985 through 1991 in the United States and Canada. Am J Public Health 1998;88:771-6.

Ianuzzi A, Khalsa PS. Comparison of human lumbar facet joint capsule strains during simulated high-velocity, low-amplitude spinal manipulation versus physiological motions. Spine J 2005;5:277-90.

Keller A, Hayden J, Bombardier C, van TM. Effect sizes of non-surgical treatments of non-specific low-back pain. Eur Spine J 2007; Doc No DOI 10.1007/s00586-007-0379-x.

Keller TS, Colloca CJ. Mechanical force spinal manipulation increases trunk muscle strength assessed by electromyography: a comparative clinical trial. J Manipulative Physiol Ther 2000;23:585-95.

Kessler RC, Davis RB, Foster DF, Van Rompay M, Walters EE, Wilkey S, Kaptchuk TJ, Eisenberg DM. Long-term trends in the use of complementary and alternative medical therapies in the United States. Ann Intern Med 2001;135:262-8.

Khalsa PS, Ge W. Encoding of tensile stress and strain during stretch by muscle mechano-nociceptors. Muscle Nerve 2004;30:216-24.

Kjellman GV, Skargren EI, Oberg BE. A critical analysis of randomised clinical trials on neck pain and treatment efficacy. A review of the literature. Scand J Rehab Med 1999;31:139-52.

Koes BW, Assendelft WJJ, van der Heijden G, Bouter LM. Spinal manipulation for low back pain. An updated systematic review of randomized clinical trials. Spine 1996;21:2860-73.

Lau HM, Wing Chiu TT, Lam TH. The effectiveness of thoracic manipulation on patients with chronic mechanical neck pain - a randomized controlled trial. Man Ther. 2011 Apr;16(2):141-7.

Lawrence RC, Helmick CG, Arnett FC, Deyo RA, Felson DT, Giannini EH, Heyse SP, Hirsch R, Hochberg MC, Hunder GG, Liang MH, Pillemer SR, Steen VD, Wolfe F. Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. Arthritis Rheum 1998;41:778-99.

Lazarou JL, Pomeranz BH, Corey PN. Incidence of adverse drug reactions in hospitalized patients. A meta-analysis of prospective studies. JAMA 1998;279:1200-5.

Leboeuf-Yde C, Hestbaek L. Maintenance care in chiropractic - what do we know? Chiropr Osteopat 2008;16:3.

Leigh JP, Markowitz SB, Fahs M, Shin C, Landrigan PJ. Occupational injury and illness in the United States. Estimates of costs, morbidity, and mortality. Arch Intern Med 1997;157:1557-68.

Licciardone JC, Brimhall AK, King LN. Osteopathic manipulative treatment for low back pain: a systematic review and meta-analysis of randomized controlled trials. BMC Musculoskelet Disord 2005;6:43.

Lisi AJ, Holmes EJ, Ammendolia C. High-velocity low-amplitude spinal manipulation for symptomatic lumbar disk disease: a systematic review of the literature. J Manipulative Physiol Ther 2005;28:429-42.

Luijsterburg PA, Verhagen AP, Ostelo RW, van Os TA, Peul WC, Koes BW. Effectiveness of conservative treatments for the lumbosacral radicular syndrome: a systematic review. Eur Spine J 2007;16:881-99.

Masaracchio M, Cleland JA, Hellman M, Hagins M. 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.

Meeker WC, Haldeman S. Chiropractic: a profession at the crossroads of mainstream and alternative medicine. Ann Intern Med 2002;136:216-27.

Mior S. Manipulation and mobilization in the treatment of chronic pain. Clin J Pain 2001;17 Suppl 4:S70-S76.

Nilsson N. The prevalence of cervicogenic headache in a random population sample of 20-59 year olds. Spine 1995;20(17):1884-8.

Office of Technology Assessment. The impact of randomized clinical trials on health policy and medical practice: background. Washington, DC: U.S. Congress Office of Technology Assessment, OTA-BP-H-22; 1983.

Olesen J. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Copenhagen: The International Headache Society; 1990.

Oliphant D. Safety of spinal manipulation in the treatment of lumbar disk herniations: a systematic review and risk assessment. J Manipulative Physiol Ther 2004;27:197-210.

Ottenbacher KJ, Di Fabio RP. Efficacy of spinal manipulation/mobilization therapy. A meta-analysis. Spine 1985;10:833-7.

Pengel HM, Maher CG, Refshauge KM. Systematic review of conservative interventions for subacute low back pain. Clin Rehabil 2002;16:811-20.

Peterson DH, Bergmann TF. Chiropractic technique: principles and practice. 2nd ed. St. Louis: Mosby; 2002.

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

Pickar JG. Neurophysiologic issues of the subluxation lesion. Top Clin Chiropr 2001;8:9-15.

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

Puentedura EJ, Landers MR, Cleland JA, Mintken PE, Huijbregts P, Fernández-de-Las-Peñas C. Thoracic spine thrust manipulation versus cervical spine thrust manipulation in patients with acute neck pain: a randomized clinical trial. J Orthop Sports Phys Ther. 2011 Apr;41(4):208-20.

Rasmussen BK. Epidemiology of Headache. Cephalalgia 1995;15:45-68.

Rubinstein SM, Leboeuf-Yde C, Knol DL, de Koekkoek TE, Pfeifle CE, Van Tulder MW. The benefits outweigh the risks for patients undergoing chiropractic care for neck pain: a prospective, multicenter, cohort study. J Manipulative Physiol Ther 2007;30:408-18.

Senstad O, Leboeuf-Yde C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. Spine 1997;22:435-41.

Shekelle P, Adams A, Chassin M, Hurwitz E, Brook R. Spinal manipulation for low-back pain. Ann Intern Med 1992;117:590-8.

Sjaastad O, Fredriksson TA, Pfaffenrath V. Cervicogenic headache: diagnostic criteria. Headache 1998;38:442-5.

Slavin RE. Best evidence synthesis: an intelligent alternative to meta-analysis. J Clin Epidemiol 1995;48:9-18.

Summaries for patients: the effectiveness of spinal manipulation relative to other therapies for low back pain. Ann Intern Med 2003;138:I33.

Terrett A, Kleynhans A. Complications from manipulation of the low back. Chiro J Aust 1992;22(4):129-40.

Triano JJ. Biomechanics of spinal manipulative therapy. Spine J 2001;1:121-30.

Van Tulder MW, Koes BW, Bouter LM. Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. Spine 1997;22:2128-56.

Vernon H, Humphreys K, Hagino C. Chronic mechanical neck pain in adults treated by manual therapy: a systematic review of change scores in randomized clinical trials. J Manipulative Physiol Ther 2007;30:215-27.

Vernon H. Cervicogenic dysfunction in muscle contraction headache and migraine: a descriptive study. J Manipulative Physiol Ther 1992;15, No.7:418-29.

Vernon HT, Dhami MS, Howley TP, Annett R. Spinal manipulation and beta-endorphin: a controlled study of the effect of spinal manipulation plasma beta-endorphin levels in normal males. J Manipulative Physiol Ther 1986;9:115-23.

Vernon HT, Humphreys BK, Hagino CA. A systematic review of conservative treatments for acute neck pain not due to whiplash. J Manipulative Physiol Ther 2005;28:443-8.

Von Korff M, Saunders K. The course of back pain in primary care. Spine 1996;21:2833-7.

Vroomen PCAJ, De Krom MCTFM, Slofstra PD, Knottnerus JA. Conservative treatment of sciatica: a systematic review. J of Spinal Dis 2000;13:463-9.

Waddell G. Low back pain: a twentieth century health care enigma. Spine 1996;21:2820-5.

Walser RF, Meserve BB, Boucher TR. The effectiveness of thoracic spine manipulation for the management of musculoskeletal conditions: a systematic review and meta-analysis of randomized clinical trials. J Man Manip Ther. 2009;17(4):237-46.

Weingart SN, Wilson RM, Gebberd RW, Harrison B. Epidemiology of medical error. BMJ 2000;320:774-7.

Whitcomb DC, Block GD. Association of acetaminophen hepatoxicity with fasting and ethanol use. JAMA 1994;272:1845-50.

Wilson PR. Cervicogenic headache. Am Pain Soc J 1992;1:259-64.

Wolfe MM, Lichtenstein DR, Singh G. Gastrointestinal toxicity of non-steroidal anti-inflammatory drugs. N Engl J Med 1999;340:1888-99.

Woodhead T, Clough A. A systematic review of the evidence for manipulation in the treatment of low back pain. J of Orthop Med 2005;27:99-120.