

Literature highlights: chiropractic manipulative therapy and cervical artery dissection

Author	Title	Year	Journal	Highlights
Cassidy, et al	Risk of carotid stroke after chiropractic care: a population-based case-crossover study	2017	J of Stroke and Cerebrovascular Disorders	Followed 12 to 13 million adults in Ontario, Canada for a nine year period. 15,523 carotid artery stroke cases were recorded. There was no significant difference between chiropractic and primary care provider risk.
Church, et al	Systematic review and metatarsal head-analysis of chiropractic care and cervical artery dissection: No evidence for causation.	2016	Cureus	Literature review yielded 253 articles relevant to the topic. The quality of the literature was described as “very low”. “There is no convincing evidence to support a causal link between chiropractic manipulation and CAD. Belief in a causal link may have significant negative consequences such as numerous episodes of litigation.”
Kosloff, et al	Chiropractic care and the risk of a case-control study in US commercial and Medicare Advantage populations	2015	Chiropractic and Manual Therapies	Case-control study of 35.7 million commercially insured and 3.1 million Medicare Advantage insured over a three year period, comparable to ~ 5% of the US population. “Conclusions: We found no significant association between exposure to chiropractic care and the risk of VBA stroke. We conclude that manipulation is an unlikely cause of VBA stroke. The positive association between PCP visits and VBA stroke is most likely due to patient decisions to seek care for the symptoms (headache and neck pain) of arterial dissection. We further conclude that using chiropractic visits as a measure of exposure to manipulation may result in unreliable estimates of the strength of association with the occurrence of VBA stroke.”
Whedon, et al	Risk of stroke after CMT in Medicare B beneficiaries 66-99 years with neck pain..	2015	JMPT	1,157,475 Medicare patients age 66-99 Incidence of VBA stroke was extremely low
Todd, et al	Adverse events due to chiropractic and other manual therapies for infants and children: a review of the literature.	2014	JMPT	Published cases of serious adverse events in infants and children receiving chiropractic, osteopathic, physiotherapy, or manual medical therapy are rare. The 3 deaths that have been reported were associated with various manual therapists; however, no deaths associated with chiropractic care were found in the literature to date. Because underlying preexisting pathology was associated in a majority of reported cases, performing a thorough history and examination to exclude anatomical or neurologic anomalies before applying any manual therapy may further reduce adverse events across all manual therapy professions.
Billar , et al	Cervical arterial dissections and association with cervical manipulative therapy: a statement for healthcare professionals from the American Heart Association/American Stroke Association	2014	Stroke	Members were assigned topics relevant to their areas of expertise and reviewed appropriate literature, references to published clinical and epidemiology studies, morbidity and mortality reports, clinical and public health guidelines, authoritative statements, personal files, and expert opinion to summarize existing evidence and to indicate gaps in current knowledge. CD is an important cause of ischemic stroke in young and middle-aged patients. CD is most prevalent in the upper cervical spine and can involve the internal carotid artery or vertebral artery. Although current biomechanical evidence is insufficient to establish the claim that CMT causes CD, clinical reports suggest that mechanical forces play a role in a considerable number of CDs and most population controlled studies have found an association between CMT and

				VAD stroke in young patients. Although the incidence of CMT-associated CD in patients who have previously received CMT is not well established, and probably low, practitioners should strongly consider the possibility of CD as a presenting symptom, and patients should be informed of the statistical association between CD and CMT prior to undergoing manipulation of the cervical spine.
Mattox, et al	Recognition of spontaneous VAD preempting spinal manipulative therapy: A patient presenting with neck pain and headache for chiropractic care	2014	J Chiro Med	This case highlights the potential for patients with vertebral artery dissection to present with nonspecific musculoskeletal complaints. Neurological symptoms may not manifest initially, but their sudden onset indicates the possibility of an ischemic cerebrovascular event. We suggest that early recognition and emergent referral for this patient avoided potential exacerbation of an evolving pre-existing condition and resulted in timely anticoagulation treatment.
Herbert , et al	Serious adverse events and spinal manipulative therapy of the low back region: a systematic review of cases	2013	JMPT	This systematic review describes case details from published articles that describe serious adverse events that have been reported to occur following SMT of the lumbopelvic region. The anecdotal nature of these cases does not allow for causal inferences between SMT and the events identified in this review.
Quesnele, et al	Changes in VA blood flow following various head positions and cervical spine manipulation	2013	JMPT	The objective of the study was to investigate the cerebrovascular hemodynamic response of cervical spine positions including rotation and cervical spine manipulation in vivo using magnetic resonance imaging technology on the vertebral artery (VA). There were no significant changes in blood flow or velocity in the vertebral arteries of healthy young male adults after various head positions and cervical spine manipulations.
Chung, et al	The association between cervical spine manipulation and CAD: a systematic review of the literature	2013	JMPT	The incidence of ICA dissection after cervical spine manipulation is unknown. The relative risk of ICA dissection after cervical spine manipulation compared with other health care interventions for neck pain, back pain, or headache is also unknown. Although several case reports and case series raise the hypothesis of an association, we found no epidemiologic studies that validate this hypothesis.
Tuchin	Chiropractic and stroke: association or causation	2013	Intl J Clin Prac	There is lack of compelling evidence that SMT is causally associated with stroke.
Herzog, et al	ICA strains during high speed, low amplitude spinal manipulations of the neck	2012	JMPT	This study showed that maximal ICA strains imparted by cervical spinal manipulative treatments were well within the normal ROM. Chiropractic manipulation of the neck did not cause strains to the ICA in excess of those experienced during normal everyday movements. Therefore, cervical spinal manipulative therapy as performed by the trained clinicians in this study, did not appear to place undue strain on the ICA and thus does not seem to be a factor in ICA injuries.

Tuchin	A replication of the study 'Adverse effects of spinal manipulation: a systemic review'	2012	Chiro Man Ther	<p>It is unwise to make conclusions regarding causality from any case study or multiple case studies.</p> <p>In 21 of the cases reported by Ernst to be chiropractic treatment, 11 were from countries where chiropractic is not legislated.</p> <p>Conclusion: The number of errors or omissions in the 2007 Ernst paper, reduce the validity of the study and the reported conclusions. The omissions of potential risk factors and the timeline between the adverse event and SMT could be significant confounding factors. Greater care is also needed to distinguish between chiropractors and other health practitioners when reviewing the application of SMT and related adverse effects.</p>
Haynes, et al	Assessing the risk of stroke from neck manipulation: a systematic review	2012	Intl J Clin Practice	<p>Reviewed 5 studies with controls. Conclusive evidence is lacking for a strong association between neck manipulation and stroke, but is also absent for no association. Cassidy and Deitrich appear to be the most robust studies.</p>
Herbert, et al	Serious adverse events and SMT of the low back region: a systematic review of cases	2012	JMPT	<p>The anecdotal nature of these cases does not allow for causal inferences between SMT and the events identified in this review.</p>
Choi, et al	A population-based case-series of Ontario patients who develop a VBA stroke after seeing a chiropractor.			<p>Purpose: The current evidence suggests that association between chiropractic care and vertebrobasilar artery (VBA) stroke is not causal. Rather, recent epidemiological studies suggest that it is coincidental and reflects the natural history of the disorder. Because neck pain and headaches are symptoms that commonly precede the onset of a VBA stroke, these patients might seek chiropractic care while their stroke is in evolution.</p> <p>The objective of our study is to describe the characteristics of Ontario VBA stroke patients who consulted a chiropractor within the year before their stroke.</p> <p>Methods: We conducted a population-based case series all Ontario residents hospitalized with VBA stroke between April 1, 1993, and March 31, 2002.</p> <p>Results: Ninety-three VBA stroke cases consulted a chiropractor during the year before their stroke. The mean age was 57.6 years and 50% were female. Most cases had consulted a medical doctor during the year before their stroke, and 75.3% of patients had at least one cerebrovascular comorbidity. The 3 most common\ comorbidities were neck pain and headache, diseases of the circulatory system, and diseases of the nervous system and sense organs</p> <p>Conclusions: Our population-based analysis suggests that VBA stroke patients who consulted a chiropractor the year before their stroke are older than previously documented in clinical case series. We did not find that women were more commonly affected than men. Moreover, we found that most patients had at least one cardio or cerebrovascular comorbidity. Our analysis suggests that relying on case series or surveys of health care professionals may provide a biased view of who develops a VBA stroke.</p>

Herzog, et al	Vertebral artery strains during high-speed, low amplitude cervical spinal manipulation	2012	J Electomyo Kinesiology	VA strains obtained during SMT are significantly smaller than those obtained during diagnostic and range of motion testing, and are much smaller than failure strains. We conclude from this work that cervical SMT performed by trained clinicians does not appear to place undue strain on VA, and thus does not seem to be a factor in vertebro-basilar injuries.
Smith, Cramer	Spinal Manipulation is Not an Emerging Risk Factor for Stroke Nor is it Major Head/Neck Trauma. Don't Just Read the Abstract!	2011	Open Neurology	We would like to address two points in this letter: 1)the current best-evidence indicates no causal relationship between spinal manipulation ('chiropractic maneuver' in the paper) and vertebrobasilar artery (VBA) stroke, and 2) spinal manipulation or 'chiropractic maneuvers' are not major head/neck trauma as suggested in abstract of this article.
Mosby, et al	VAD in a patient practicing self manipulation of the neck	2011	J Chiro Med	Case study: 42 yo female with "worst headache of her life" for 12 days.
Wuest, et al	Preliminary report: biomechanics of VA segments C1-6 during SMT	2010	JMPT	The engineering strains during cervical spinal manipulations were lower than those obtained during range of motion testing, suggesting that neck manipulations impart stretches on the VA that are well within the normal physiologic range of neck motion
Gardner	Cauda equina syndrome:a review of the current clinical and medico-legal position.	2010	Eur Spine J	CES- R: 50-70% complete urinary retention CES-I: 30-50% incomplete urinary retention. Rare with a disproportionately high medico-legal profile Severe low back pain (LBP) Sciatica: often bilateral but sometimes absent, especially at L5/S1 with an inferior sequestration Saddle and/or genital sensory disturbance Bladder, bowel and sexual dysfunction
Murphy	Current understanding of the relationship between cervical manipulation and stroke: what does it mean for the chiropractic profession?	2010	Chiropr Osteopat	The understanding of the relationship between CMT and VAD and stroke [VADS] has evolved considerably over the years. In the beginning the relationship was seen as simple cause-effect, in which CMT was seen to cause VADS in certain susceptible individuals. This was perceived as extremely rare by chiropractic physicians, but as for more common by neurologists and others. Recent evidence has clarified the relationship considerably, and suggests that the relationship is not causal, but that patients with VADS often have initial symptoms which cause them to seek care from a chiropractic physician and have a stroke some time after, independent of the chiropractic visit.

Cassidy, Boyle, et al	Risk of VBA stroke and chiropractic care	2009	JMPT	Conclusion: VBA stroke is a very rare event in the population. The increased risks of VBS stroke associated with chiropractic and PCP visits is likely due to patients with headache and neck pain from VBA dissection seeking care before their stroke. We found no evidence of VBA stroke associated chiropractor care compared to primary care.
Rubenstein, et al	The benefits outweigh the risks for patients undergoing chiropractor care for neck pain	2007	JMPT	“Therefore, the benefits of chiropractor care for neck pain seem to outweigh the potential risks.”
Langworthy	Consent: its practices and implications in the UK and US.	2007	JMPT	Poor compliance with consent. “Difficulties and omissions in the implementation of valid consent processes appear common, particularly in relation to risk. Practitioners felt that a serious adverse event occurred so infrequently that this, coupled with a lack of convincing evidence regarding the risk associated with certain treatment, rendered the routine discussion of major risk unnecessary.”
Rubenstein, Haldeman, et al	An etiologic model to help explain the pathogenesis of cervical artery dissection: implications for cervical manipulation	2006	JMPT	“Although the notion of an underlying arteriopathy and a trigger are universally accepted concepts, we propose in our model that dissection is a product of an underlying [genetic] predisposition, triggered specifically by risk factors associated with environmental exposure, with or without trivial trauma. Given the widespread daily occurrence of neck movements and sporting activities, it seems unlikely that trivial trauma, in the absence of other triggers and an underlying arteriopathy, is sufficient to cause a dissection.”
Brontfort, et al	Review conclusions by Ernst and Canter regarding spinal manipulation refuted	2006	Chiro Osteop	Based on a critical appraisal of their review, the authors of this commentary seriously challenge the conclusions by Ernst and Canter, who did not adhere to standard systematic review methodology, thus threatening the validity of their conclusions. There was no systematic assessment of the literature pertaining to the hazards of manipulation, including comparison to other therapies. Hence, their claim that the risks of manipulation outweigh the benefits, and thus spinal manipulation cannot be recommended as treatment for any condition, was not supported by the data analyzed. Their conclusions are misleading and not based on evidence that allow discrediting of a large body of professionals using spinal manipulation.
Rubenstein, et al	An etiologic model to help explain the pathogenesis of CAD and implications for CMT.	2006	JMPT	We propose that dissection is a product of an underlying (genetic) predisposition, triggered specifically by risk factors associated with environmental exposure, with or without trivial trauma. Given the widespread daily occurrence of neck movements and sporting activities, it seems unlikely that trivial trauma, in the absence of other triggers and an underlying arteriopathy, is sufficient to cause dissection. This concept has significant implications for

				practitioners of spinal manipulation. This may represent a paradigm shift because the model suggests that stroke following manipulation is unlikely in otherwise healthy individuals.
Rosner	Adverse reactions to chiropractic care in the UCLA Neck Pain Study: A Response	2006	JMPT	Detailed rebuttal of the UCLA Neck Pain Study. Regarding the adverse reactions attributed to cervical manipulation in the UCLA Neck Pain Study, several anomalies appear which require further explanation. These anomalies pertain to both the design of the study as well as the properties of the adverse events described. In certain instances, the risks of manipulation appear to be equal to or actually less than other interventions (eg, heat and EMS). Lacking details about the specific manipulative technique used, the number of adjustments, and the cervical regions adjusted, the study does not provide important details.
Goldstein, et al	Is this patient having a stroke?	2005	JAMA	The prior probability of a stroke among patients with neurologically relevant symptoms is 10%. Based on studies using modern neuroimaging, the presence of acute facial paresis, arm drift, or abnormal speech increases the likelihood of stroke while the absence of all 3 decreases the odds. The accurate determination of stroke subtype requires neuroimaging to distinguish ischemic from hemorrhagic stroke. Early mortality increases among those with any combination of impaired consciousness, hemiplegia, and conjugate gaze palsy. Symptoms associated with high agreement for the diagnosis of stroke or transient ischemic attack vs no vascular event are a sudden change in speech, visual loss, diplopia, numbness or tingling, paralysis or weakness, and non-orthostatic dizziness.
Haneline, Triano	Cervical artery dissection. A comparison of dynamic mechanisms: manipulation v. motor vehicle collision.	2005	JMPT	“The direct evidence suggests that the healthy vertebral artery is not at risk from properly performed chiropractic manipulative procedures.”
Triano, et al	Current Concepts: spinal manipulation and cervical arterial incidents 2005	2005	NCMIC	“In summary, the incidence of CAD or CVA following spinal manipulation to the neck is very small and at the same magnitude that occurs in the general population.”
Oliphant	Safety of spinal manipulation in the treatment of lumbar disk herniations: a systematic review and risk assessment	2004	JMPT	Results: An estimate of the risk of spinal manipulation causing a clinically worsened disk herniation or CES in a patient presenting with LDH is calculated from published data to be less than 1 in 3.7 million.

				Conclusion: The apparent safety of spinal manipulation, especially when compared with other accepted treatments for LDH, should stimulate its increased use in the conservative treatment plan of LDH
Chestnut	The stroke issue: Paucity of valid data, plethora of unsubstantiated conjecture	2004	JMPT	Considering that more than 98% of VBA dissections and occlusions are associated with events other than chiropractic cervical adjustment, it becomes obvious that studies to identify these factors warrant much more attention and resources.
Haneline, Lewkovich	An analysis of the etiology of cervical artery dissections	2004	JMPT	Conclusions: The case series that were reviewed in this article indicated that most CADs reported in the previous decade were spontaneous but that some were associated with trauma/trivial trauma, and a minority with cervical spine manipulation. This etiologic breakdown of CAD does not differ significantly from what has been portrayed by most other authors. (J Manipulative Physiol Ther 2005;28:617-622) 61% spontaneous; 30% trivial trauma; 6-9% SMT
Gross, et al	A Cochrane review of manipulation and mobilization for mechanical neck disorders	2004	Spine	Mobilization and/or manipulation when used with exercise are beneficial for persistent mechanical neck disorders with or without headache. Done alone, manipulation and/or mobilization were not beneficial; when compared to one another, neither was superior.
Haneline, Lewkovich	Identification of ICAD in chiropractic practice	2004	J Can Chiropractic Assn.	“The problem any chiropractic physician faces in identifying ICAD patients is that the condition may present without any symptoms or the symptoms may appear benign [eg headache, neck pain or cervicogenic dizziness]. Consequently, it may be impossible to identify some ICAD patients, especially in the early stages of the pathology. AS the ICAD progresses and neural blood flow is compromised, the symptom picture typically manifests more completely.”
Smith, et al	SMT is an independent risk factor for VAD	2003	Neurologist	This case-controlled study of the influence of SMT and cervical arterial dissection shows that SMT is independently associated with vertebral arterial dissection, even after controlling for neck pain. Patients undergoing SMT should be consented for risk of stroke or vascular injury from the procedure. A significant increase in neck pain following spinal manipulative therapy warrants immediate medical evaluation.
Hurwitz	Adverse reactions to chiropractic treatment	2003	JMPT	Nausea and dizziness each comprise 5% of less of reported symptoms. The majority of reactions have been reported to begin within 24 hours of the treatment and to resolve in less than 24 hours.
Jensen	Vertebrobasilar Ischemia and Spinal manipulation	2003	JMPT	Spinal manipulative therapy may have a normalizing effect on the sympathetic nervous system; allowing for a [positive] change in vasospastic cerebral vascular arteries.
Nadgir	Simultaneous bilateral internal carotid and vertebral artery dissection	2003	Neuroradiology	Although the pathogenesis of multivessel dissection is unclear, it is thought to be a consequence of underlying collagen disease.

	following chiropractic manipulation: case report and review of the literature			
Suzuki	Nontraumatic acute complete paraplegia resulting from cervical disc herniation	2003	Spine	Four reported cases
Licht	Is cervical spinal manipulation dangerous?	2003	JMPT	"..the risk involved is acceptably low and that the fear of serious complications is greatly exaggerated."
Haneline, Croft.	Association of ICAD and CMT	2003	The Neurologist	"None of the cases ..suggested a clear causal relationship between ICAD and CMT" Odds of ICAD > 1: 600,000,000
Brandt	Spontaneous CAD	2002	Stroke	The pathogenesis of a cervical artery dissection (CAD) remains unknown in most cases. ^{1,2} Dissections are usually classified as either traumatic or spontaneous. ³ However, mechanical trauma did not appear to be an important and frequent cause for the development of CAD, neither in clinical nor in histopathological studies.
Young	Sudden onset of cervical spondylitic myelopathy during sleep: a case report	2002	Arch Phys Med Rehabil	Cervical spondylitic myelopathy should be included in the differential diagnosis for patients with acute neurologic deterioration.
Licht	Carotid artery blood flow during premanipulative testing	2002	JMPT	...we believe that premanipulative testing is of little clinical value.
Symons	Internal forces sustained by the VA during CMT	2002	JMPT	"...a single typical SMT thrust is very unlikely to mechanically disrupt the VA." "...our results suggest that the VA is elongated during neck SMT but not stretched, and that neck SMT does not put any stress on the VA"
Siivola	MRI changes of cervical spine in asymptomatic and symptomatic young adults.	2002	Eur Spine J	...abnormal MRI findings were present in both groups Disc herniation was the only MRI finding that was significantly associated with neck pain.
Schievink	Spontaneous Dissections of the Carotid and Vertebral Arteries	2001	NEJM	Spontaneous CAD 2.5 to 3 per 100,000 population US and France Spontaneous VAD 1 to 1.5 per 100,000 population US and France Spontaneous dissections are only ~2% of all ischemic strokes.
Haldeman	Arterial dissections following chiropractic manipulative therapy; the chiropractic experience	2001	CMAJ	1:5.85 million cervical adjustments 1:48 practice careers
Rothwell, et al	Chiropractic manipulation and stroke: a population based case study	2001	Stroke	582 VBA cases , matched with controls only for age and sex [<i>not for head/neck symptoms</i>]. Results for those aged <45 years showed VBA cases to be 5 times more likely than controls to have visited a chiropractor within 1 week of the VBA. Additionally, in the younger age group, cases were 5 times as likely to have had 3 visits with a cervical diagnosis in the month before the case's VBA date . No significant associations were found for those aged > 45 years.

				Conclusions —While our analysis is consistent with a positive association in young adults, potential sources of bias are also discussed. The rarity of VBAs makes this association difficult to study despite high volumes of chiropractic treatment.
Roniger	Stroke study renews scrutiny of cervical manipulation	2001	Biomechanics	
Saeed	Vertebral artery dissection: warning signs, clinical features and prognosis in 26 patients	2000	Can J Neurol Sci.	The most common clinical features included vertigo, unilateral facial paralysis, cerebellar signs, lateral medullary signs, visual field defects.
Haldeman	Risk Factors and Precipitating Neck Movements Causing VAD after Cervical Trauma and CMT	1999	Spine	<p>“...the current understanding of the exact mechanism and risk factors for vertebrobasilar artery dissection must be considered no more than speculation”</p> <p>“...vertebrobasilar artery dissection after neck movement, trauma or manipulation should be considered a rare, random, unpredictable complication associated with these activities”.</p> <p>“The literature does not assist in the identification of the offending mechanical trauma, neck movement, or type of manipulation precipitating vertebral artery dissection or the identification of the patient at risk. Thus, given the current status of the literature, it is impossible to advise patients or physicians about how to avoid vertebral artery dissection when considering cervical manipulation ...”</p>
Licht	Vertebral artery volume flow in human beings	1999	JMPT	Volume blood flow through the vertebral artery does not change with cervical rotation or after spinal manipulative therapy
Rivett	Effect of premanipulative tests on vertebral artery and internal carotid artery flood	1999	JMPT	The reliability of premanipulative testing was supported.
Lauretti	What are the risks of chiropractic neck adjustments?	1999	JACA	<p>A reasonable estimate of the risks of stroke following cervical manipulation is one-half to two incidents per one million treatments.</p> <ul style="list-style-type: none"> . About one-third of these cases of stroke will resolve with mild or no residuals (probably more, due to reporting bias) . About one-fourth of these cases will prove fatal (probably less, due to reporting bias) . Therefore, there are about 40 to 50 manipulation-caused strokes in the United States per year, and perhaps a dozen deaths. <p>To place this in perspective, if we agree that the risk of .dying from a stroke after a neck adjustment is one in four million, there may be as much as 100 times greater risk of dying from an ulcer due to taking a prescription NSAID like Motrin.</p>

				If you drive about eight miles each way to get to your chiropractic appointment, you have a statistically greater risk of being killed or seriously injured in a car accident while travelling to the office than of having a serious complication from a neck adjustment.
Hufnagel	Stroke following chiropractic manipulation of the spine	1999	J Neurol	Thus, patients at risk for stroke after chiropractic manipulation may not be identified a priori. Note: most “adjustments” were performed by non-chiropractors.
Humphreys	The natural history of the cervical foramen in symptomatic and asymptomatic	1998	Spine	
Miller	Screening procedures prior to cervical manipulation	1998	JACA	
Auyong	ICAD and stroke	1998	JNMS	Unlike vertebral artery dissection, a causal link between ICAD, stroke and chiropractic manipulative therapy has yet to be made
Licht	Vertebral artery flow and spinal manipulation	1998	JMPT	We observed no change in peak flow velocity immediately after spinal manipulative therapy and found no correlation between peak flow velocity and systolic blood pressure.
Budgell	The cervical subluxation and regional cerebral blood flow	1997	JMPT	
Cote.	The Validity of the Extension/Rotation Test as a clinical screening procedure before CMT	1996	JMPT	“The value of this test is questionable”
Klugargt	Safety in chiropractic practice Part I: The occurrence of cerebrovascular accident after manipulation to the neck in Denmark form 1978-1988.	1996	JMPT	A firm policy statement against upper cervical rotation as a technique of first choice.
Klugargt	Safety in chiropractic practice Part II: The occurrence of cerebrovascular accident after manipulation to the neck in Denmark form 1978-1988.	1996	JMPT	
Terrett	Vertebrobasilar stroke following manipulation	1996	NCMIC	“Current testing procedures are not able to predict susceptibility to VBS if SMT is used [except possibly in the most grossly pathological and highly susceptible cases.”
Crom	Etiology of vertebrobasilar stroke temporally related to cervical manipulation	1996	Dynamic Chiropractic	
Dabbs, Lauretti	A risk assissment of cervical manipulation vs. NSAID’s for the treatment of neck pain.	1995	JMPT	The best evidence indicates that cervical manipulation for neck pain is much safer than the use of NSAID’s by as much as a factor of several hundred times.

Peters	Dissection of the internal carotid artery after chiropractic manipulation of the neck	1995	Neurology	“Predisposing factors for spontaneous and traumatic artery dissection include cystic or mucoid medial degeneration, fibromuscular dysplasia, Marfan syndrome, Ehlers-Danos syndrome, and probably migraine, hypertension, oral contraception, arteriosclerosis, and leuic arteritis.
Plaughter	Chiropractic and cerebrovascular accident: dispelling the myths	1994	Dynamic Chiropractic	
Wolf, et al	Probability of stroke: a risk profile from the Framingham Study	1991	Stroke	Stroke risk factors are age, systolic BP, antihypertensive therapy, DM, smoking, prior CV disease, atrial fibrillation, left ventricular hypertrophy by electrocardiogram
Nixdorf	Current Standards of Material risk	1990		In the doctor-patient relationship, full disclosure, as the courts deem it, is seldom occurring.
Ferezy	Neural Ischemia and Cervical Manipulation: An Acceptable Risk	1988	JACA	“...these unfortunate maladies are usually entirely unavoidable”.
Textbooks				
Evans	Illustrated Essentials of Orthopedics			Neuro tests; Georges test
Winkel	Diagnosis and treatment of the spine	1996		Neuro tests; Georges test
Chapman-Smith	Chiropractic Report	2001		Safety and effectiveness of cervical manipulation
Byfield	Chiropractic Manipulative Skills			30-40 deg of head and neck rotation is permitted.
Murphy	Cervical Spine Syndromes			89% of VBS cases show symptoms within 6 hours p 558 Signs of VBS: p 560 Dizziness ,. vertigo, giddiness, lightheadedness Drop attacks , loss of consciousness Diplopia (or other visual symptoms) Dysanhria (speech difficulties) Dysphagia Ataxia of gait (walking difficulties, incoordination of the extremities, ataxia, falling to one side) Nausea (with possible vomiting) Numbness on one side of the face or body Nystagmus
Haldemann	Cerebrovascular complications of manipulation Ch 32			PRESENTING COMPLAINT. A review of the major complaints of patients who subsequently suffered a manipulation-induced vertebrobasilar accident (Table 32-6) reveals little that could alert the astute practitioner as to the impending accident. Most patients presenting with symptoms, such as dizziness, in association with cervical musculoskeletal complaints respond well to SMT . p 589
Various	George’s test			
