

THE CHIROPRACTIC REPORT

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PROFESSIONAL NOTES

Whiplash Injuries – Role of the Facets

A significant number of whiplash victims develop chronic symptoms. As imaging generally fails to reveal any structural damage or pathology in the cervical spine, many of these victims are accused of exaggerating their symptoms or compensation neurosis.

A new systematic review of the literature on cervical injuries following traffic accidents causing fatality, from Danish chiropractic researchers Uhrenholt, Grunnet-Nilsson and Hartvigsen and published in the leading journal *Spine*, provides important findings on two matters:

a) That present imaging methods, including MRI and CT scanning, are very insensitive in this context and do not visualize subtle pathoanatomical lesions of the cervical spine. In the various studies reviewed 93.5% of the minor lesions later found at autopsy were missed by conventional radiologic examination. Because of common traumatology and injury mechanisms, it is reasonable to assume, say Uhrenholt et al., that many non-fatal cases may result in similar lesions. “Negative clinical and radio-

continued on page 4

MANIPULATION AS SAFE AS NORMAL NECK MOVEMENTS

Dramatic New Biomechanical Evidence from Canada

THINGS HAVE REACHED the point at which noisy critics of neck manipulation, many of them neurologists who should know better, put one in mind of the Flat Earth Society. Anecdote, rumor, and herd instinct prevail, science and reason have been abandoned.

We are encouraged to be so outspoken by two important recent developments:

a) The testimony of Professor David Sackett at the Lewis Inquest in Toronto on November 18-20, 2002. This is the inquest, still proceeding, which is determining the cause of death for Lana Lewis, whose left vertebral artery was completely blocked by end-stage atherosclerosis when she suffered a stroke and died, but who had also received cervical manipulation one week prior to her stroke. Sackett, a foremost epidemiologist and the founding chair of the Clinic in Epidemiology at Oxford University, England, who is known worldwide as the father of evidence-based medicine, was called as an expert on the scientific study of human health.

He gave severe criticism of the neurologists in the Canadian Stroke Consortium and their much publicised SPONTADS study.¹ This study, quoted by neurologists worldwide during the past year and said by Consortium leader Dr. John Norris, Professor of Neurology, University of Toronto, to demonstrate a new and higher risk rate of vertebral artery injury and stroke from neck manipulation, was rejected by Sackett as a weakly designed retrospective case series that was of no scientific value whatsoever on the subject of manipulation and stroke.

Dr. Norris had been “scientifically irresponsible” in making any claims on causation in the media based on this study, and had demonstrated that he was “incompetent as a scientist in the study of causation.”² (As we reported in the July 2002 issue of this Report, Dr. Nor-

ris acknowledged in his testimony at the inquest that the SPONTADS study had not in fact produced a single case documenting stroke caused by manipulation, and that his comments in the media on the risk of stroke following manipulation had been pure guesswork and wrong.)

b) Far more importantly, publication of the first study to measure actual forces reaching the vertebral arteries as a result of manipulation. This watershed study from Symons, Leonard and Herzog at the University of Calgary in Canada, and now published in the *Journal of Manipulative and Physiological Therapeutics (JMPT)*, is of major clinical, legal, and professional significance to the chiropractic profession in reporting that:

i) The maximum forces/strains on a vertebral artery (VA) from chiropractic manipulation are no greater than those recorded during common diagnostic range of motion (ROM) tests regularly performed by chiropractors, medical doctors and physical therapists.

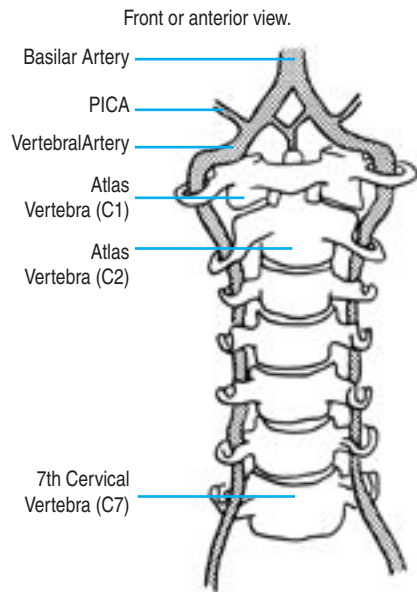
ii) The forces are “within the range of strains produced during normal, physiologic motion of the cervical spine.”

iii) Maximum strains during chiropractic manipulation provide only “approximately one ninth of the strain” required to produce first mechanical failure in the tissues of a VA.

Accordingly forces are not remotely close to causing physical harm to a normal artery, and this dramatic new study sweeps away the hypothesized injury mechanism most commonly given to link manipulation to stroke.

This Report reviews the Calgary study and then addresses related issues of importance to clinicians, such as what elements of patient history and examination are most important, is there a continuing role for diagnostic vertebral insufficiency (VBI) tests, and when should cervical adjustment be modified,

Figure 1. Relationship of the Vertebral Arteries to the Cervical Spine



Adapted from Terrett A and Kleyhans A (1992).

delayed or avoided. Firstly, however, here are summary background comments on the safety, effectiveness and appropriateness of neck manipulation.

2. Independent expert reviews of the scientific evidence, most recently from the Evidence-Based Practice Center at Duke University in the US,³ accept that chiropractic neck manipulation is a safe, effective and appropriate treatment for many patients with common forms of disabling neck pain and headache.^{3,4,5} This appropriateness, and the relief from constant dependence on medication that physical treatments can give, are further confirmed by the new physiotherapy trial of manipulative therapy for cervicogenic headache from Jull et al.⁶ discussed on page 4.

3. Very rarely, following neck manipulation by a chiropractor, medical doctor, or other health professional, a patient suffers a vertebrobasilar stroke (VBS). In some instances this leads to permanent injury. Responsible estimates of the risk rate of VBS vary between 1 in 400,000 and 1 in 5.85 million.^{7,8,9} The figure most frequently given by experts is 1 incident in every 1 to 2 million treatments.

This risk rate can probably be better understood by most people, as Terrett explains, if it described as one incident in a group of 25 chiropractors all of whom have practised for 40 years.⁸

4. This is such a low risk rate, in absolute

terms and in comparison with medications and surgery given for the complaints typically treated with manipulation that chiropractic and medical doctors and others using neck manipulation have traditionally not even mentioned it to patients. In recent years the new emphasis on patient rights and the law of informed consent have led to increased disclosure of this risk.

5. However, as Rome has just pointed out in an article giving Australian statistics¹⁰, this means that the risk of experiencing VBS after manipulation is no higher than the risk of VBS in the community generally. This, particularly given the new information from the University of Calgary study, suggests that the rare cases of stroke following manipulation may be coincidence rather than related. On this consider the following:

a) The argument that neck manipulation may be a cause of VBS depends upon two things – a biologically rational and plausible explanation, and a close association in time between the treatment and the symptoms of stroke. The postulated biological mechanism or explanation is injury to one of the two vertebral arteries in the upper cervical spine because of forces generated by the manipulation. Vasospasm or injury to the artery wall leads to interruption of blood supply to the brain and thus stroke.

b) But if manipulation can generate such forces and damage why is injury so rare? If there was a true causative relationship one would expect, as Herzog suggests, 100 VBSs a week in Canada alone.¹¹

c) There are reported cases of VBS following many normal daily activities involving neck movement as listed in Table 1, such as turning the head to back a car, sneezing, painting the ceiling and engaging in dancing or sports. These also are very rare.

d) Even more interestingly there are many reported cases of “spontaneous” vertebral artery injury and stroke – cases similar to those above but in which, upon close questioning, the patient cannot recall any neck movement that precipitated the sudden symptoms of VA dissection and stroke (e.g. severe neck pain, dizziness, nausea).

e) Next, there is growing evidence that those few individuals who prove vulnerable to stroke from VA injury have rare forms of underlying pathology that make the artery wall fragile and susceptible to

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injury (e.g. genetic collagen and other connective tissue disorders).

If this is so, what triggers spontaneous injury/dissection of the artery after normal neck movements? Recent work suggests that such patients become especially vulnerable after a complicating factor such as an upper respiratory tract infection and that this, therefore, is a multifactorial problem. McDermaid in Canada¹² and Terrett in Australia¹³ discuss much of this new evidence in greater detail in excellent new reviews.

6. All of the above considerations have now led researchers to question whether neck manipulation can ever be the cause of vertebral artery injury and stroke, or whether these events merely represent a coincidence. The dicey role of chance is well illustrated in the near-miss case reports given in Table 2, cases that may well have ended up as chiropractic statistics.

7. One such researcher interested in these questions has been the Swiss biomechanics expert Prof. Walter Herzog, one of the

principal investigators for the new study from the University of Calgary. He heard the claim that manipulation could cause stress and injury to the VA, wondered if this was actually possible as a matter of biomechanics given the depth and location of the VAs, noted the fact that there was not “a shred of scientific evidence” to support the injury hypothesis, and decided to investigate.¹⁴ We now look in more detail at Herzog and his study.

B. THE CALGARY STUDY

8. Background. This new research was done at the Human Performance Laboratory, Faculty of Kinesiology, University of Calgary, Canada. Principal investigators were Bruce Symons DC MSc, working on this project as a PhD student, Tim Leonard a research technologist, and Walter Herzog PhD, Professor and Associate Dean of Research. Herzog, originally from Zurich and with a PhD in biomechanics from the University of Iowa in the US, has 17 years postdoctoral research experience in Calgary, where he has adjunct appointments in the Faculties of Medicine and Engineering.

He has devoted a significant part of his research to spinal manipulation since 1989. His current research interests are joint injury and disease (e.g. osteoarthritis 40%), muscle mechanics (40%), chiropractic clinical biomechanics (10%) and other human movement (10%). He is editor of the text *Clinical Biomechanics of Spinal Manipulation* (Churchill Livingstone, 2000) and author of the chapters *Basic Mechanics* and *The Mechan-*

cal, Neuromuscular and Physiologic Effects Produced by Spinal Manipulation in that work.

9. Goals. Previously Herzog’s research team has measured the forces delivered by clinicians during spinal manipulative therapy (SMT) to the cervical spine, the thoracic spine and the sacroiliac joint – but all these measurements were performed on the body surface. Neither they nor anyone else has studied how these external forces are transmitted through the various soft-tissue layers and bones to the deeper anatomic structures.

The purpose of this new study was to quantify “the strains and elongations of the VA during SMT and then to compare these values against the ultimate failure loading strain of the VA.” This was to test the hypothesis that SMT may place strains on the VA capable of causing injury.

10. Terminology. Chiropractic adjustment techniques may involve rapid movement of the joint (chiropractic manipulation) or slow movements over a smaller range of motion (mobilization). It is often assumed, incorrectly as this new study shows, that high-velocity movements involve more potential force and strain on the VA and thus risk.

In their paper Symons et al. use the term spinal manipulative therapy (SMT), defining this as “a high-velocity low-amplitude thrust delivered to a specific landmark on the spine in a specific direction.” In this discussion we use the terms manipulation and mobilization, to identify respectively thrust and non-thrust

techniques, and not the broader terms adjustment and SMT. This is consistent with current, general scientific usage.

11. Study Details. Major relevant details are:

- a) The study was performed on six VAs from five fresh, unembalmed, postrigor patients who had died within the past 72 hours.
 - b) Minimal dissection was performed to preserve true mechanical behaviour of the relevant structures. Without damaging muscles and ligaments, the VAs were exposed at two sections or lengths, between the atlas and axis (C0-C1) where it is hypothesized that most dissections to the VA artery wall occur after manipulation, and from the origin of the VA at the subclavian artery to C6 (C6-SA).
 - c) Two pairs of piezoelectric ultrasonographic crystals were attached to the sections of each VA and served as transmitters and receivers for ultrasound signals that measured the relevant times/distances as each VA was at neutral position or subjected to various movements. This allowed calculation of various forces as explained in the paper.
 - d) Movements/forces measured in this way included:
 - i) Range-of-motion (ROM) testing in flexion, extension, rotation and lateral bending – passive movement of the joints and cervical spine to the end-range point.
 - ii) Vertebrobasilar insufficiency (VBI) testing – Houle’s Test, with the head and neck held in extension and rotation).
 - iii) Various techniques of chiropractic manipulation – pure lateral and pure rotatory adjustments, and lateral/rotatory break adjustments, at C1/C2, C3/C4, and C6/C7.
- For all of these movements average and peak strains were determined.
- e) The VAs were then harvested, taking care in the described manner to retain their normal consistency and optimal ultrasound signal conduction, and were tested in a vertical materials testing machine to determine mechanical failure point. This was the first point at which the elongation of the VA produced a decrease in force, which was evidence of first tissue damage or failure.
 - f) One must read the paper for the many detailed results, but findings of particular interest include:

Table 1. Normal Neck Movements and Trivial Trauma Associated with Vertebrobasilar Artery Dissection/Occlusion and Stroke (VBS)

| Type of Trial Trauma | Examples | Number of Cases |
|---------------------------------------|---|-----------------|
| Sporting activities | Basketball, tennis, softball, swimming, calisthenics | 18 |
| Leisure activities | Walking, kneeling at prayer, household chores, sexual intercourse | 8 |
| Sustained rotation and/or extension | Wall papering, washing walls and ceilings, archery, yoga | 10 |
| Short-lived rotation and/or extension | Turning head while driving, backing out of driveway, looking up | 7 |
| Sudden head movements | Sneezing, fair ride, violent coughing, sudden head flexion | 7 |
| Miscellaneous minor trauma | Minor fall, “banging” head | 2 |
| Miscellaneous | Atlantoaxial instability, postpartum, post-gastrectomy | 6 |
| Total | | 58 |

Adapted from Haldeman et al, Spine 1999.¹

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Recent Research Highlights

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graphic examinations do not prove the absence of pathoanatomical lesions.”

b) Secondly, that studies using a control group and optimal autopsy technique have consistently found the same pattern of lesions in whiplash fatalities. These lesions were not found in non-traumatized control group patients and are not consistent with normal changes caused by ageing. They include injuries to the cervical intervertebral disc, cartilaginous endplates, and the zygapophysial or facet joints.

As noted by Bogduk, providing *Spine's* Point of View and commentary on Uhrenholt et al.'s work, various completely different lines of investigation point to the facet joints as the “main culprit” in whiplash injuries. These include post-mortem studies demonstrating the lesions, biomechanics studies showing how the facet joints can be injured to produce the lesions, and clinical studies which have shown that facet joint pain is common in patients with chronic neck pain after whiplash. (Uhrenholt L, Grunnet-Nilsson N et al. (2002) *Cervical Spine Lesions after Road Traffic Accidents: A Systematic Review*, *Spine* 27(17): 1934-1941).

2. Australia – PT Mobilization/Manipulation for Cervicogenic Headache. Research has demonstrated that chiropractic manipulation is effective for patients with cervicogenic headache, headache arising from musculoskeletal disorders of the cervical spine. *Spine* has just published the first trial of physiotherapy manual therapy for the same condition, from Gwendolyn Jull, PT PhD et al. in Australia. This also reports good results.

The trial was a multicenter study by PT leaders from six universities in five states in Australia. They acknowledge the chiropractic research in this field, and note that cervicogenic headache is a common form of chronic and recurrent headache “for which physical treatments are recommended as a first line of management”. One important aspect of this trial was its strong findings against the effectiveness of standard medication – see below. Points are:

1. The goal of the trial was to assess the short and long-term effectiveness of two conservative approaches to manage cervicogenic headache, manual therapy and low-load exercise to re-educate muscle control of the cervico-scapular region.

Inclusion criteria included age 18-60 years, signs of cervicogenic headache according to Sjaastad et al. (unilateral headache associated with neck pain and aggravated by neck movement), joint tenderness on palpation of the upper cervical spine, and a headache frequency of at least one per week for a period of 2 months or more. Patients who had had physiotherapy or chiropractic treatment for headache in the past 12 months were excluded.

2. There were 200 subjects and treatment was delivered by 25 “experienced physiotherapists” in the several trial centers. Treatment, over a period of 6 weeks, included a minimum of 8 and a maximum of 12 treatments each within a period of 30 minutes per visit. Patients were randomly allocated to 1 of 4 groups:

- Manual therapy – a combination of low and high-velocity

techniques as thought clinically appropriate according to the regimen of Australian physiotherapist Maitland.

- Exercise – a program of low-load endurance exercises to train muscle control of the cervico-scapular region, not strength training.

- A combination of both treatments above.

- The control group – receiving no physical therapy interventions at all.

Medication was not withheld from any of the participants, but use was monitored in headache diaries.

3. Outcome measures were change in headache frequency (primary outcome), changes in headache intensity and duration and in neck pain (secondary), and various physical assessments. Measurements were taken at baseline (i.e. prior to treatment), in the week immediately after treatment (week 7) and then at 3, 6 and 12 months after the intervention.

4. Results included:

a) In all three active treatment groups there was significant reduction in headache frequency and intensity and in neck pain immediately after treatment as compared with the control group, and these differences were still evident at 12 months follow-up.

b) The combined therapy was not significantly superior to either therapy alone, but 10% more patients gained relief and this, together with the individual effectiveness of each therapy, argues in favour of use of both of manipulative therapy and exercise say Jull et al. Asked by *Spine* to provide his commentary on the trial in a Point of View, leading US chiropractic researcher Dr. John Triano agrees with this.

c) Finally, use of medication decreased almost completely in the three active treatment groups (by 100% in the manual therapy group and the exercise therapy group, by 93% in the combined group) but increased by 33% in the control group. This is an important finding that should influence health policy and clinical management – but will not thrill the pharmaceutical industry.

(Jull G, Trott P et al. (2002) *A Randomized Controlled Trial of Exercise and Manipulative Therapy for Cervicogenic Headache*, *Spine* 27(17):1835-1843).

3. Czech Republic – Structure, Function and Infertility. In a recent editorial in the UK-based *Journal of Orthopaedic Medicine*, the prominent Czech neurologist and manual medicine specialist, Prof. Karel Lewit, a widely acknowledged leader in the orthopedic medicine world, summarizes his views on the influence of function on structure after what he calls “almost half a century of preoccupation by Czech neurologists”. Points are:

1. Lewit goes back to evolution and the bipedal human posture to explain that changes of function occur before changes of structure, that functional pathology is at least as important as structural pathology, but that it is regrettable that this has not yet been understood or accepted in the medical world.

2. His examples of structure following function include the fact that “fast muscle fibers are transformed into slow fibers after

transplantation depending on the neurons supplying the transplanted muscle,” and “asymmetry in vertebrae develops during growth as a consequence of asymmetrical muscular pull.”

3. Lewit argues, however, that in understanding function you need to put more emphasis on muscle function, which is under the direct control of the nervous system, rather than passive structures such as bones, joints and ligaments, important though these are also.

4. This approach means that members of the Czech school manage many disorders from a functional perspective, like chiropractors. Lewit’s editorial is accompanied by a trial in which his colleague Volejniková studied the treatment of female infertility as a functional disturbance. Details are:

a) The study group was 166 women who had been treated unsuccessfully for infertility for an average of four years. Inclusion criteria included age between 22 and 30 years, potency of fallopian tubes, and normal sperm count of partner. Women were randomly allocated to five groups:

- **Group A:** (Number = 50). In this group women received a physical treatment regime from a female physiotherapist which included stretching and relaxation of lumbar and pelvic musculature, internal rectal massage, and mobilization of hypomobile sacroiliac and lumbar joints as more fully described in the paper.

- **Group B:** (N 50). Here women received a set of active and passive exercises that did not affect the lumbar spine and pelvis, were designated by the researchers as non-genuine, but under circumstances where the women were blinded to the fact that they were receiving exercises thought to be non-effective.

- **Group C:** (N 50). These women received the same initial talk and gynecological examination as those in Groups A and B, but commencement of the exercise program was delayed six months.

- **Group D:** (N 16). These women received general active home exercises which were not monitored by the medical rehabilitation unit.

- **Group E:** (N 76). This group comprised women who did not become pregnant in Groups B, C and D – in other words after performing ‘wrong’ exercises or not exercising at all. They then received the study treatment as earlier delivered to the women in Group A.

c) Pregnancy success rate and therefore results were significantly higher in those women receiving the study treatment in Groups A (34.3% pregnant) and E (27.4%) than those in the control groups – B (8.8%), C (8.1%) and D (8.3%).

(Lewit K (2001) Relationship of Structure and Function in the Motor System, *J Orthop Med* 23(2):45-46, and Volejniková H (2001) Female Infertility: A Study of Physical Treatment by the Method of L. Mojzisořová for Functional Disturbances of the Pelvic Region, *J Orthop Med* 23(2):47-49).

4. **Denmark – Simulated Angina Pectoris.** The *Journal of Orthopaedic Medicine*, like chiropractic journals, commonly has case reports of functional disturbances mimicking other disorders. Hawran, Pedersen et al. report on a case from Frederiks-

berg Hospital, Copenhagen, of a patient with thoracic facet joint syndrome simulating angina pectoris.

A 70 year old man suffered recurrent attacks of pain over five years that had him repeatedly hospitalized under a diagnosis of unstable angina pectoris. He was treated with the standard prophylactic drugs even though no clear cardiac disorder was ever documented.

A rheumatologist finally found a thoracic facet joint syndrome, first tried mobilization and exercise therapy without effect, but then treated the patient successfully over 1 to 2 months with manipulation and cortisone injections. It is concluded that such patients should be referred to a specialist in musculoskeletal medicine.

Interestingly, in their background to the case Hawran, Pedersen et al. reference a German study finding that 13% of 1,097 patients hospitalized in a cardiology ward because of chest pain had features of thoracic facet joint syndrome. Accordingly we are discussing a quite common problem. (Hawran S, Pedersen PB, Bliddal H (2000) *Thoracic Facet Joint Syndrome Simulating Angina Pectoris: A Case Report.* *J Orthop Med* 22(3):96-97).



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i) In diagnostic movements, the distal part of the VA (C0-C1) is typically subjected to more strain than the proximal part (C6-SA), and the contralateral artery has more strain than the ipsilateral one. No surprises there.

ii) During ROM testing greatest strains were for rotation, followed by lateral bending. Extension caused very little stretching of the VA.

iii) VBI testing, with the spine in rotation and extension, resulted in VA strains at C0-C1 “comparable to those experienced in extreme rotation.”

iv) In manipulation, interestingly, greatest strain to the VA at C0-C1 was not from upper cervical adjustment but from the C6/C7 break adjustment. Symons et al. suggest that this was probably due to the pre-manipulative flexion and rotation necessary to lock the joint out.

Table 2. Near Miss Cases

Case 1

A 40-yr-old man had experienced neck pain with some diffuse dizziness, nausea and a stiff, painful neck. A CT scan of the head, ordered by his medical doctor, showed no positive findings. The man kept on working but the stiffness of the neck remained. Two weeks after the onset of symptoms and 20 minutes before his first appointment with the chiropractor, he died from a massive stroke while still at work.¹

Case 2

A chiropractor worked for a couple of weeks as a locum in a busy practice. Because he was unused to the patients and the clinic procedures, he was running late. Patients waited in cubicles to be called in for treatment. As the chiropractor was treating a patient, he heard a loud thump on the cubicle wall. It was a middle-aged man who was the patient next in line for treatment. He had died from a stroke.¹

Case 3

A 44-year-old male first developed problems while bowling during a cricket match. As the left neck and shoulder pain persisted, he saw a chiropractor, who manipulated his neck using rotational manipulation, with some apparent benefit. About five days later, he suddenly developed vertigo that lasted for about four days before resolving spontaneously. The vertigo recurred the following day, became more severe, and was associated with double vision, tinnitus, left orbital headache, vomiting and weakness of the left arm. He returned to the chiropractor, who immediately referred him to the local hospital. The patient died before investigations could be completed. This was 15 days after the neck manipulation and 18 days since the game of cricket. Post mortem examination revealed cystic mucoid degeneration (medial cystic necrosis), which is an accepted predisposing cause of arterial dissection.²

1. Leboeuf-Yde C, Rasmussen LR et al. (1996) *The Risk of Over-reporting Spinal Manipulative Therapy-Induced Injuries: A Description of Some Cases that Failed to Burden the Statistics*, J Manipulative Physiol Ther 19:536-38.

2. Johnson CP, Lawler W, Burns J. (1993) *Use Of Histomorphometry In The Assessment Of Fatal Vertebral Artery Dissection*. J Clin Pathol 46:1000-3.

Overall the contralateral VA strain at C0-C1 during chiropractic manipulation was 6.2% (plus or minus 1.3%) – meaning the C0-C1 portion of the VA “stretched an average of 6.2% of its resting (neutral) length.”

This represents “approximately 10% of the ultimate failure strain of the VA” – the point at which strain causes first tissue damage. At first failure point the VA at C0-C1 has stretched 53% over its resting length.

v) Maximum ROM testing strain was 12%, maximum VBI testing strain 13%, and maximum chiropractic manipulation strain 11%.

vi) These estimates are felt by Symons et al. to be very conservative (i.e. over emphasizing the relative strains from the above maneuvers) because cadavers were from elderly people most of whom had died from cardiovascular disease.

g) The researchers discuss the limitations of the study, meaning potential sources of bias and inaccuracy. These are few, the major one being the use of cadaveric spinal specimens which, it might be said, may perform differently from living tissue. However Symons et al. reference substantial previous research reporting that the biomechanical properties of cadaveric spinal specimens do not alter significantly after weeks or months of properly controlled storage. Their specimens were under three days old.

12. Symons et al. conclude that chiropractic manipulation “results in strains (to the VA) that are within the range of strains produced during normal physiologic motion of the cervical spine” – i.e. less strain than during normal daily neck movements – and that typical manipulation “is very unlikely to mechanically disrupt the VA.”

Good scientists are cautious in print, and more fulsome when they explain and defend their work in person. Giving testimony at the Lewis Inquest, Herzog explained:

- After this study it was his firm opinion that in normal circumstances a VA could not be damaged by cervical manipulation.
- For the average person the VA is stretched much more by normal daily movements of the head and neck than it is during neck manipulation – often twice as much.¹¹

C. LOGICAL CONCLUSIONS

13. Can manipulation cause vertebrobasilar stroke (VBS)?

There are three logical possibilities:

a) Firstly, cervical manipulation may be a direct cause in normal individuals. If so it would be on one of two models of injury:

i) Trauma to the wall of the artery producing tissue damage (dissection), followed by thrombosis and/or embolisation and thus obstruction of blood flow to the brain. The Calgary study presents clear new evidence against this hypothesis.

ii) Lesser trauma to the artery, but sufficient to cause vasospasm, diminished blood flow and VBS. Reasons this mechanism has been suggested include the known role of vasospasm as a major cause of harm to the vertebral and cerebral arteries in severe trauma, the rapid appearance of symptoms in some cases – which is hard to ascribe to a new injury to the artery wall, and transient ischaemic attacks.

However, as McDermaid says, vasospasm has always been “poorly understood in the context of (VBS)”¹² Studies have now demonstrated no change in vertebral artery blood flow during pre-manipulative extension/rotation tests,^{15, 16} and the Cal-

gary study now shows that manipulation places even less stress on a VA than pre-manipulative tests.

As a result on current evidence this model of injury can also be dismissed, justifying the conclusion that manipulation cannot cause VBS in normal individuals. Such a conclusion is consistent with the extremely rare occurrence of problems – as noted 24 of 25 chiropractors never see a single incident in their careers even though delivering more than 100 cervical adjustments weekly.

b) A second logical possibility, at the other extreme, is that cervical manipulation may never be a causative factor for any patient, and is entirely coincidental. Individuals with rare underlying VA pathology have spontaneous VBS triggered by completely normal activities and neck movements. Some have this mishap before visiting a chiropractor, producing the neck/head pain and other symptoms for which they seek chiropractic care. Some have VBS in the waiting room as in Case 2 in Table 2, some while receiving care, and some from normal neck movements during the hours and days after receiving care.

Clearly some of these rare cases will fall into each of these categories and be coincidence. However, there are some cases where the patient has significant symptoms immediately following the manipulation which strongly suggest that the treatment is at least one of the causative factors, and that not all patients can be dismissed as pure coincidence. Importantly, though, now that we know that manipulation places less force/strain on a VA than common daily rotational neck movements it becomes very hard to argue that VBS with first symptoms experienced several minutes or more after the manipulation was caused by manipulation. The cause may have been any neck movement in the interim – for example turning the head to back the car out of the parking lot at the clinic.

c) The third possibility is that manipulation, as with mobilization or any other normally benign neck movement, may be an aggravating factor that exacerbates pre-existing and undiagnosed pathology. If a patient has severe neck pain before treatment he or she may already have a VA dissection in progress. If there are sudden new symptoms after manipulation or mobilization, the treatment has happened to be the movement that triggers the VBS, the fundamental causes of which are underlying arteriopathies as yet only partially understood and not capable of being diagnosed.

D. CLINICAL SIGNIFICANCE

14. The Calgary study, together with other recent research, has major clinical and legal significance for all health professionals using manual methods to diagnose and treat the cervical spine. Normal range of motion testing, mobilization and manipulation all have remote but similar risk of complications. One illustration of this is Michaeli's survey of physiotherapy complications in South Africa – the one patient experiencing VBS had received mobilization, none of the many patients receiving manipulation had this complication.¹⁷ Important clinical points, many covered by Terrett in his recent article,¹³ are:

a) **History.** For patients presenting with head and neck pain, especially the sudden and severe neck pain consistent with VA dissection, important points to cover and record are:

i) Other neck movements prior to the onset of pain. Terrett cites a case where twisting the neck to remove a motorcycle helmet produced the first sudden pain and signs of VBS.

ii) The severity and location of the pain, and whether it is associated with dizziness and signs of brainstem ischaemia such as nausea and/or vomiting. Both severe pain and dizziness may be due to neuromusculoskeletal dysfunction that responds well to chiropractic management, but the presence of other symptoms of ischaemia suggests the possibility of VA injury or another vascular cause of pain. In these circumstances Terrett suggests a trial of alternative treatment methods (e.g. soft-tissue therapy, accessory joint play, electrotherapies, etc) may be wise. If these relieve pain, suggesting a musculoskeletal cause, adjunctive care is then appropriate.

iii) Various risk factors for VBS should be noted when present – for example hypertension, use of oral contraceptives, smoking, migraine headaches and family history. If the patient has one or more of these risk factors and is complaining of severe neck pain and symptoms of ischemia, there are even stronger grounds for a trial of alternative treatment methods. However these risk factors do not represent contra-indications to manual treatments because they are no more common in patients who have experienced VBS after manipulation than they are in the general population.⁷

b) **Pre-manipulative tests.** Previously there was already a strong case against the clinical value and legitimacy of these tests, in which the head and neck are held in sustained extension and rotation.¹⁸ Some clinicians have continued to perform them principally as a matter of legal risk management. Now these tests have no such role and, arguably, increase legal risk. The Calgary study demonstrates that such provocative tests put more stress on the VA – albeit still slight – than chiropractic manipulation.

c) **Examination.** Is it possible through physical examination or testing, to discover those rare patients at risk because of inherited and/or acquired disorders rendering the VAs more fragile to trauma, or to normally benign neck movements including manipulation? The answer, on current knowledge, is no.^{7,12,13}

d) **Treatment.** In the past it has been considered that manipulation might carry higher risk than mobilization, and that manipulative techniques involving significant rotation should be avoided. This was because of presumptions, now proven wrong by the Calgary study, that manipulation placed the VA under more stress than mobilization, and that most stress arose from rotational techniques in the upper cervical spine. Those presumptions were strengthened by the fact that many of the cases of VBS involved manipulation with rotation. However historically this has been the most common form of manual therapy applied to the cervical spine, other patients experienced VBS after manipulation without rotation or mobilization, and in the most thorough paper on the subject, Haldeman et al. conclude that no adjustment technique can be said to have more risk.⁷

e) **Informed Consent.** In the wake of the Calgary study, and all discussed above, clinicians may be tempted to consider that disclosure of the risk of VBS to patients is less important. This is not so. Legally the window has been narrowed considerably. For example it is much harder to attribute first symptoms of VBS to chiropractic treatment unless these occur exactly following that treatment, rather than hours or days later.

However legal risk remains in various ways, including:

i) Even if cervical adjustment, whether manipulation or mobilization, is demonstrated as not being capable of being the primary or sole cause of VBS, a specific judge or jury may not

accept that – faced with competing expert testimony and an injured plaintiff.

ii) It is known that cervical adjustment may be a contributing factor in rare patients with underlying disorders currently incapable of diagnosis. In terms of patient rights, ethics and the law of informed consent in most jurisdictions that means that clinicians using manual methods of treatment have a duty to disclose the risk. In the words of the current US national guidelines for chiropractic practice:

“Patient consent to treatment is always necessary, it is often implied rather than expressed. However, where there is risk of significant harm from the treatment proposed, this risk must be disclosed, understood, and accepted by the patient. Such informed consent is required for ethical and legal reasons. The best record of consent is one that is objectively documented (e.g. a witnessed written consent or videotape).

Recommendation 5.5.1, *Mercy Center Conference Guidelines*¹⁹

Failure to obtain informed consent is highly likely to lead to liability for damages and negligence in the event of a patient experiencing VBS contemporaneous with chiropractic treatment. With consent, however, liability for negligence is extremely unlikely.

E. CONCLUSION

15. Some may argue that the new research from Calgary is only one study, and that more investigation is necessary before reaching conclusions on the forces generated by chiropractic manipulation.

It will be important to have further studies, but there is nothing marginal or equivocal about the Calgary results. They demonstrate that cervical manipulation and mobilization, which are treatments directed towards moving the facet joints and associ-

ated tissues near the surface of the body, have no more impact down at the location of the vertebral arteries than completely normal neck movements. Critics of neck manipulation have been ready to warn through the media that this practice is dangerous and may tear an artery. This has been based on theory and hypothesis, not evidence, and it is now proven as wrong as the theory that a storm at sea is likely to injure the scuba diver swimming 50 feet below the wind and waves.

In the words of US neurologist Prof. Scott Haldeman, chosen by the Toronto coroner at the Lewis Inquest as his foremost independent expert, no patient can reasonably be seen to be at higher risk from spinal manipulative therapy because of specific predisposing factors or specific types of manipulation. VBS must simply be seen and accepted as “a rare, random, unpredictable complication” of all neck movements.⁷ TCR

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