Spine

Bilag 5

SPINE Volume 38, Number 3, pp E158–E177

COCHRANE COLLABORATION

Spinal Manipulative Therapy for Acute Low Back Pain

An Update of the Cochrane Review

Sidney M. Rubinstein, PhD,* Caroline B. Terwee, PhD,* Willem J. J. Assendelft, MD, PhD,†‡ Michiel R. de Boer, PhD,§ and Maurits W. van Tulder, PhD*§

Study Design. Systematic review of interventions.

Objective. To assess the effects of spinal manipulative therapy (SMT) for acute low back pain.

Summary of Background Data. SMT is one of many therapies for the treatment of low back pain, which is a worldwide, extensively practiced intervention.

Methods. An experienced librarian searched for randomized controlled trials (RCTs) in multiple databases up to March 13, 2011. RCTs that examined manipulation or mobilization in adults with acute low back pain (<6-week duration) were included. The primary outcomes were pain, functional status and perceived recovery. Secondary outcomes were return-to-work and quality of life. Two authors independently conducted the study selection, risk of bias assessment and data extraction. GRADE (*grading* of recommendations assessment, development, and *evaluation)* was used to assess the quality of the evidence. The effects were examined for SMT *versus* (1) inert interventions, (2) sham SMT, (3) other interventions, and (4) SMT as adjunct therapy.

Results. We identified 20 RCTs (total participants = 2674), 12 (60%) of which were not included in the previous review. In total, 6 trials (30% of all included studies) had a low risk of bias. In general, for the outcomes of pain and functional status, there is low- to very low-quality evidence suggesting no difference in effect for SMT when compared with inert interventions, sham SMT or as adjunct therapy. There was varying quality of evidence (from very low to moderate) suggesting no difference in effect for SMT when compared with other interventions. Data were particularly sparse for recovery, return-to-work, quality of life, and costs of care. No serious complications were observed with SMT.

Conclusion. SMT is no more effective for acute low back pain than inert interventions, sham SMT or as adjunct therapy. SMT also seems to be no better than other recommended therapies. Our evaluation is limited by the few numbers of studies; therefore, future research is likely to have an important impact on these estimates. Future RCTs should examine specific subgroups and include an economic evaluation.

Key words: spinal manipulative therapy, spinal manipulation, acute low back pain, low back pain, aspecific low back pain, Cochrane review, systematic review, meta-analysis. **Spine 2013;38:E158–E177**

From the *Department of Epidemiology and Biostatistics, EMGO Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands; †Department of Public Health and Primary Care, Leiden University Medical Center, Leiden, the Netherlands; ‡Department of Primary and Community Care, Radboud University Medical Centre, Nijmegen, the Netherlands; and §Department of Health Sciences, Faculty of Earth and Life Sciences, VU University, Amsterdam, the Netherlands.

Acknowledgement date: October 7, 2012. Acceptance date: October 7, 2012.

This article is based on Rubinstein SM, Terwee CB, Assendelft WJJ, de Boer MR, van TulderMW. Spinal manipulative therapy for acute low back pain. *Cochrane Database of Systematic Reviews* 2012, Issue 9. Art. No. CD008880. DOI: 10.1002/14651858.CD008880.pub2.

This Cochrane review was published in *The Cochrane Library 2012, Issue 9* (see www.thecochranelibrary.com for more information).

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work.

Relevant financial activities outside the submitted work: board membership, grants, payment for lecture.

Address correspondence and reprint requests to Sidney M. Rubinstein, PhD, Department of Epidemiology and Biostatistics, EMGO+ Institute for Health and Care Research, VU University Medical Center, PO Box 7057, 1007 MB Amsterdam, the Netherlands; E-mail: sm.rubinstein@vumc.nl

DOI: 10.1097/BRS.0b013e31827dd89d

Low back pain is a common and disabling disorder in Western society, which represents a great societal and financial burden.[1] Therefore, adequate treatment of low back pain is an important issue for patients, clinicians, and healthcare policy makers. One widely used intervention for low back pain is spinal manipulative therapy (SMT), which has been examined in numerous randomized controlled trials (RCTs). These trials have been summarized in recent systematic reviews,[2–4] which have formed the basis for recommendations in clinical guidelines.[5,6] However, these recommendations are largely based on an earlier version of this Cochrane review, which reported that SMT was superior only to sham therapy or therapies judged to be ineffective or even harmful, and concluded that there was no evidence that SMT is superior to other standard treatments for patients with acute low back pain.[7] The effect sizes, however, were small and arguably not clinically relevant. Furthermore, these estimates

were based mainly on small studies with a high risk of bias (RoB).

SMT is administered by various professional groups, including chiropractors, manual therapists, and osteopaths, and is included in many national guidelines for the management of acute low back pain.[8,9] However, these recommendations vary. In most guidelines, SMT is considered to be a therapeutic option in the acute phase of a low back pain episode. The US, UK, New Zealand, and Danish guidelines consider SMT a useful treatment, whereas the Dutch, Australian, and Israeli guidelines do not recommend SMT for the acute phase.[6]

This report is an update of the previous Cochrane review and follows the most recent guidelines developed by The Cochrane Collaboration in general[10] and by the Cochrane Back Review Group in particular.[11] The current review was split into 2 parts according to duration of the complaint, namely acute and chronic low back pain. The review on chronic low back pain has since been published.[12] This review focuses on the effectiveness of SMT for acute low back pain[13] and follows the same methodology as the review for chronic low back pain.

DESCRIPTION OF THE CONDITION

Low back pain is defined as pain and discomfort that is localized below the costal margin and above the inferior gluteal folds, with or without referred leg pain. Acute low back pain is defined as the duration of an episode persisting for no longer than 6 weeks. This condition is considered to be typically self-limiting, with a recovery rate of 90% within 6 weeks of the initial episode, whereas 2% to 7% develop chronic low back pain.[6] Nonspecific low back pain is operationally defined as low back pain not attributed to a recognizable, specific pathology (*e.g.*, infection, tumor, or fracture).

DESCRIPTION OF THE INTERVENTION

In this review, SMT is considered to be any hands-on treatment that includes manipulation, mobilization, or both, directed toward the spine. Mobilizations use low-grade velocity, small- or large-amplitude passive movement techniques within the patient's joint range of motion and control. Manipulation, on the contrary, uses a high velocity impulse or thrust applied to a synovial joint over a short amplitude at or near the end of the passive or physiological range of motion, which is often accompanied by an audible "'crack."[14] The cracking sound is caused by cavitation of the joint, which is a term used to describe the formation and activity of bubbles within the fluid.[15,16] Various practitioners, including chiropractors, manual therapists (physiotherapists trained in manipulative techniques), orthomanual therapists (medical doctors trained in manipulation), or osteopaths use this intervention. However, the focus of the treatment, education, diagnostic procedures used, treatment objectives, techniques, as well as the philosophy of the various professions differ, often considerably. For example, the focus of orthomanual therapy is on correcting abnormal positions of the skeleton and establishing symmetry in the spine through mobilization. Manual therapy focuses on correcting functional disorders of the musculoskeletal system through predominantly passive mobilization and sometimes using high-velocity low-amplitude techniques. Chiropractors, on the other hand, focus on correcting disorders of the neuromusculoskeletal system by using predominantly high-velocity low-amplitude manipulative techniques.[17]

HOW THE INTERVENTION MIGHT WORK

Many hypotheses exist regarding the mechanism of action for spinal manipulation and mobilization, which to some extent is due to the difference in opinions between the various professional groups.[18–20] Some have postulated that mobilization and manipulation should be assessed as separate entities, given their theoretically different mechanisms of action.[15] The modes of action might be roughly divided into mechanical and neurophysiological. The mechanistic approach suggests that SMT acts on a manipulable lesion (often called the functional spinal lesion or subluxation) and proposes that forces to reduce internal mechanical stresses result in reduced symptoms.[21] The neurophysiological approach suggests that SMT impacts the primary afferent neurons from paraspinal tissues, the motor control system, and pain processing.[20] In conclusion, it would seem that the actual mechanism remains debatable.[15,19]

WHY IT IS IMPORTANT TO DO THIS REVIEW

SMT is a worldwide, extensively practiced intervention; however, its effectiveness for acute low back pain is not without dispute. Although numerous systematic reviews have examined the effectiveness of SMT for low back pain, very few have conducted a meta-analysis, especially for acute low back pain.[5,22] The previous Cochrane review last searched for studies up to January 2000.[7] Numerous RCTs have been identified since then. In addition, the methodology for conducting systematic reviews, including the criteria for evaluating the RoB and the GRADE (grading of recommendations assessment, development and evaluation) system for evaluating the strength of the evidence, have been substantially revised; therefore, this update is thought to shed a more reliable overview on this issue.[10]

OBJECTIVE

The objective of this review was to examine the effectiveness of SMT on primary (*i.e.*, pain, functional status, and recovery) and secondary outcomes (*i.e.*, return-to-work, quality of life) as compared with inert interventions, sham, and all other treatments for adults with acute low back pain. The effects were examined for short-term (closest to 1 mo), intermediate (closest to 3–6 mo) and long-term follow-up (closest to 12 mo).

MATERIALS AND METHODS

Criteria for Considering Studies for This Review

Types of Studies

All RCTs were included with the exception of those that used inappropriate randomization procedures (*e.g.*, alternate allocation, birth dates). In addition, studies with follow-up of less than 1 day were excluded.

Types of Participants

Inclusion Criteria

- Adult participants (≥18 yr of age) with a mean duration of low back pain for 6 weeks or less.
- Participants with or without radiating pain.

No limits were placed on the setting (*i.e.*, whether from primary, secondary, or tertiary care).

Exclusion Criteria

Participants with

- postpartum low back pain or pelvic pain due to pregnancy;
- pain not related to the low back, for example, coccydynia;
- postoperative studies or participants with "failed-back syndrome";

or studies which

- examined "maintenance care" or prevention;
- exclusively examined specific pathologies, including sciatica.

Note: Studies of sciatica were excluded because it is a prognostic factor associated with worse pain, disability or both,[23,24] especially with SMT.[25,26] It is thought to represent a pathology different than nonspecific low back pain.

Types of Interventions

Experimental Intervention

The experimental interventions examined in this review included both spinal manipulation and mobilization of the spine. Unless otherwise indicated, SMT refers to both modes of "hands-on" treatments of the spine.

Types of Comparisons

Studies were included for consideration if the study design used indicated that the observed differences were due to the unique contribution of SMT. This excludes studies with a multimodal treatment as one of the interventions (*e.g.*, standard physician care + spinal manipulation + exercise therapy) and either a different type of intervention or only one intervention from the multimodal therapy as the comparison (*e.g.*, standard physician care alone) because it would make it impossible to decipher the actual effect of SMT.

Comparison therapies were combined into the following main clusters:

(1) SMT *versus* inert interventions;
(2) SMT *versus* sham SMT;
(3) SMT *versus* all other therapies;
(4) SMT plus any intervention *versus* that same intervention alone (*e.g.*, SMT as an adjunct therapy);
(5) SMT *versus* another SMT technique (*e.g.*, side-lying thrust SMT *vs.* nonthrust side-lying technique, supine thrust SMT *vs.* side-lying thrust SMT).

Inert interventions include detuned diathermy and detuned ultrasound. Sham SMT was defined as any manipulation or mobilization technique that was ostensibly indistinguishable for the patient from the true technique, meaning the patient did not know if he or she was receiving the "real" (or active component) or the placebo ("fake" therapy). Sham SMT was considered acceptable if this was queried among the participants post-treatment and the blinding seemed to be successful.

Types of Outcome Measures

Only patient-reported outcome measures were evaluated. Physiological measures, such as spinal flexibility or degrees achieved with a straight leg raise test (*i.e.*, Lasegue) were not considered clinically relevant outcomes and were not included in the analyses.

Primary Outcomes

- Pain, measured by a visual analogue or other pain scale (*e.g.*, visual analogue scale [VAS], numerical rating scale [NRS], McGill pain score).
- Back-pain specific functional status, measured by a back-pain specific scale (*e.g.*, Roland-Morris disability questionnaire, Oswestry Disability Index).
- Global improvement or perceived recovery, measured by an ordinal or dichotomous scale (defined as the number of patients reported to have recovered or nearly recovered).

Secondary Outcomes

- Perceived health status or quality of life (*e.g.*, subscale from the SF-36, the EuroQol thermometer).
- Return-to-work.

Search Methods for Identification of Studies

Electronic Searches

RCTs and systematic reviews were identified by electronically searching the following databases (search date: March 31,

2011): The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, CINAHL, PEDro and Index to Chiropractic Literature (Note: The search strategy is available upon request from the primary author). The search was limited to studies published since 2000. Studies published prior to this date were included in the previous Cochrane review and were also considered for inclusion in this updated review.

The search strategy developed by the Cochrane Back Group was followed using free text words and medical subject headings. The search was conducted by a clinical librarian with experience in searching for articles for systematic reviews.

Searching Other Resources

We also screened the reference lists of all included studies and (systematic) reviews pertinent to this topic. We reviewed gray literature that is available electronically from clinical trials registers and the websites recommended by the Chiropractic Library Collaboration. We searched for registered trials in the US Clinical Trials database and the World Health Organization International Clinical Trials Registry Platform. Selected researchers familiar with this literature were also approached to confirm whether our selection of studies was complete.

Data Collection and Analysis

Two review authors (S.M.R, C.B.T.) independently conducted the selection of studies and performed the RoB assessment. Both qualitative and quantitative data were extracted by one review author and checked for accuracy against the original article by the second review author. All disagreements were resolved through consensus, and it was not necessary to consult a third review author (M.W.v.T.).

Selection of Studies

We screened titles and abstracts from the search results. Potentially relevant studies were obtained in full text and independently assessed for inclusion. Disagreements were resolved through discussion. Only full articles were evaluated. Abstracts and proceedings from congresses or any other "gray literature" were excluded. No language restrictions were imposed.

Data Extraction and Management

A standardized form was used to extract the qualitative data. The following were extracted: study characteristics (*e.g.*, country where the study was conducted, recruitment modality, source of funding, RoB), patient characteristics (*e.g.*, number of participants, age, sex), description of the experimental and control interventions, duration of follow-up, types of outcomes assessed, and the authors' results and conclusions. Data relating to the primary outcomes were assessed for inclusion in the meta-analyses. Data were not extracted from those studies thought to have a fatal flaw, which was defined as: (1) a drop-out rate greater than 50% at the first and subsequent follow-up measurements; or (2) statistically and clinically relevant important baseline differences for one or more primary outcomes (*i.e.*, pain, functional status) indicating unsuccessful randomization. Final value scores were used for the meta-analyses only, meaning data were estimated when change scores were presented. Outcomes were assessed at 1 week as well as at 1, 3, and 12 months and were categorized according to the time closest to these intervals. In some cases, outcome data were not available for the 3-month interval but were available for 6 months, in which case these data were extracted and labeled as such (*i.e.*, 3–6 mo).

Assessment of Risk of Bias in Included Studies

The RoB assessment for RCTs was conducted using the 12 criteria recommended by the Cochrane Back Review Group. These criteria are standard for evaluating effectiveness of interventions for low back pain and include blinding of the patient, treatment provider, and outcomes assessor (available upon request from the primary author). For the purpose of this review, any attempt to blind the outcome assessor was considered irrelevant because the patient is viewed to be the outcome assessor when evaluating subjective, self-report measures such as pain, functional status, or recovery. Therefore, if the patient was not blinded, the outcome assessor was also considered not blinded. The criteria were scored as "high" or "low" RoB and were reported in the "risk of bias" table. A study with a low RoB was defined as fulfilling 6 or more of the criteria, which is supported by empirical evidence.[17] In all cases and where possible, an attempt was made to contact authors for clarification on methodological issues, if necessary, or for unpublished data. In addition, we attempted to contact all authors from the previous decade with our RoB assessment, and they were given the opportunity to provide feedback. Where necessary, this was discussed among the research team members. No attempt was made to contact authors for publications earlier than 2000. The review authors were not blinded to the authors of the individual studies, institution, or journal.

Measures of Treatment Effect

Pain was examined as a mean difference, whereas functional status was examined as a standardized mean difference (SMD) because different instruments were used to assess functional status. For the mean difference, results were assessed on a 0 to 10 point scale and converted when necessary. A negative effect size indicates that SMT is more beneficial than the comparison therapy, meaning participants have less pain and better functional status. For dichotomous outcomes (*i.e.*, recovery, return-to-work), a risk ratio (RR) was calculated and the event defined as the number of participants recovered or returned-to-work. A RR more than 1 indicates that SMT leads to a greater chance of recovery or return-to-work. A random-effects model was used because there was a substantial amount of clinical and unexplained heterogeneity across studies. Funnel plots were constructed using all data from the outcomes pain and functional status to evaluate possible publication bias, thus regardless of the type of comparison or follow-up interval. For each treatment

comparison, an effect size and a 95% confidence interval (CI) were calculated. All analyses were conducted in Review Manager 5.1.

Assessment of Clinical Relevance

Clinical relevance, as measured by the pooled effect size, was defined as follows[10,28]:

- *Small*: MD less than 10% of the scale (*e.g.*, <1 mm on a 10 mm VAS); SMD less than 0.4; RR less than 1.25.
- *Medium*: MD equal to 10 to 20% of the scale; SMD equal to 0.41 to 0.7; RR equal to 1.25 to 2.0.
- *Large*: MD greater than 20% of the scale; SMD greater than 0.7; RR greater than 2.0.

For the interpretation of minimal important change (MIC), from the patient's perspective, the following absolute cut-offs were considered: 2 points for 0 to 10 on the NRS, 5 points for the Roland-Morris disability questionnaire, and 10 points for the Oswestry Disability Index.[29]

Unit of Analysis Issues

The numbers of participants were accordingly reduced for those studies where multiple comparisons were examined and included in the same comparison in the meta-analysis. This was conducted to prevent overestimating the number of participants for the "shared" intervention (*i.e.*, SMT).

Dealing With Missing Data

When data were reported in a graph only, we estimated the means and standard deviations. We attempted to contact authors when standard deviations were not reported. If the standard deviations for follow-up measurements were missing, the baseline measure was used for the subsequent follow-ups. Finally, if no measure of variation was reported anywhere we estimated the standard deviation based upon other studies with a similar population and RoB.

Assessment of Heterogeneity

Heterogeneity was explored in two manners, by subjective interpretation ("eye ball test") and by formally testing using the Q test ($\chi 2$) and I^2 statistic; however, the decision regarding heterogeneity was dependent upon the I^2, and we used a cut-off of 40%.[10] Results were described in the text when the results were thought to be too heterogeneous to meaningfully report a pooled value.

Assessment of Reporting Biases

We searched for protocols of the studies in ClinicalTrials.org and ISRCTN.org, particularly when studies did not reference their protocol and when we were not able to contact the original authors.

Data Synthesis

The overall quality of the evidence and strength of the recommendations were evaluated using GRADE and discussed by 3 principal members of the group (S.M.R, C.B.T., M.W.v.T.).[30] Quality of the evidence is defined as follows:

High quality: further research is very unlikely to change the level of evidence. There are sufficient data with narrow confidence intervals. There are no known or suspected reporting biases.

Moderate quality: further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate; one of the domains is not met.

Low quality: further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change it; 2 of the domains are not met.

Very low quality: great uncertainty about the estimate; 3 of the domains are not met.

No evidence: no evidence from RCTs.

The quality of the evidence for a specific outcome was based upon 5 domains and subsequently downgraded from high quality to moderate, low, or very low quality, depending upon how many of the domains were fulfilled. For each domain that was not met quality was reduced by one level. The domains are as follows: (1) limitations in design (downgraded if >25% of the participants were from studies with a high RoB); (2) inconsistency of results (downgraded in the presence of significant heterogeneity [I^2 > 40%] or inconsistent findings [in the presence of widely differing estimates of the treatment effect, that is individual studies favoring the intervention or control group]); (3) indirectness (*i.e.*, generalizability of the findings; downgraded if >50% of the participants were outside the target group, for example, studies which exclusively examined older participants or included inexperienced treating physicians); (4) imprecision (downgraded if <400 subjects for continuous data and less than 300 events for dichotomous data);[31] and (5) other (*e.g.*, publication bias). Comparisons that included only a single study (N < 400 for continuous outcomes, N < 300 for dichotomous outcomes) were considered inconsistent and imprecise and thought to provide "low-quality evidence," which could be further downgraded to "very-low quality evidence" if limitations in design or indirectness were also present. "Summary of finding" tables were generated for the primary analyses and for the primary outcome measures only, regardless of statistical heterogeneity.

Subgroup Analysis and Investigation of Heterogeneity

Regardless of possible heterogeneity, stratified analyses were conducted by the control groups as defined in "types of interventions," and by the duration of follow-up.

RESULTS

Description of Studies

Characteristics of the included and excluded studies as well as ongoing studies and studies awaiting assessment are available upon request.

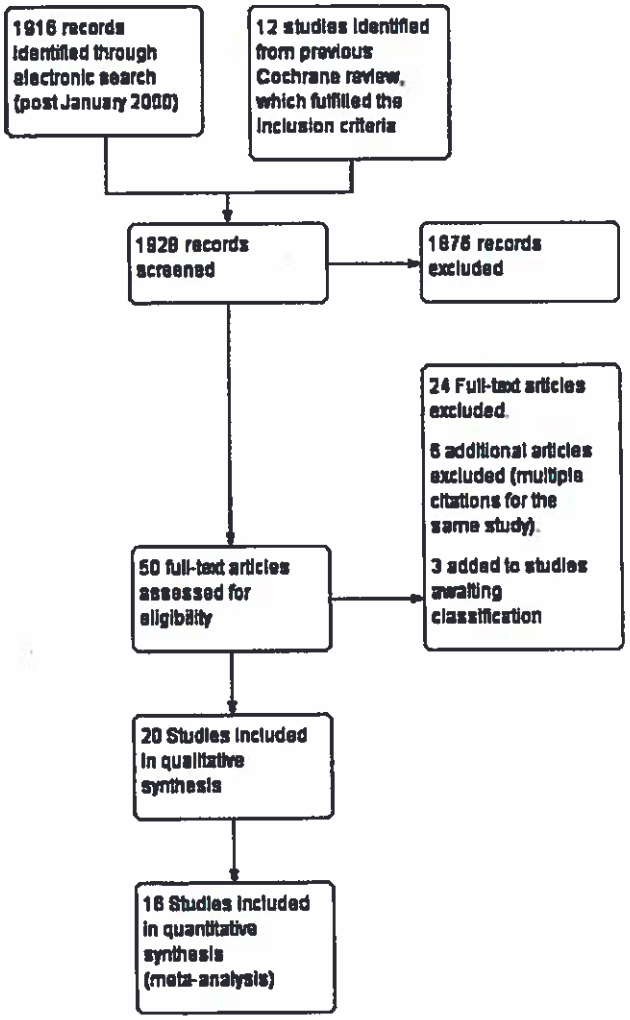


Figure 1. Study flow diagram. Summary of selection process.

Results of the Search

In total, 20 trials were identified which fulfilled the inclusion criteria: 8 (40%) of the trials were published since the previous review (Figure 1).[32–39] One of the trials was awaiting assessment at the time of publication of the previous review and was therefore not included in the previous assessment.[40]

A search of ongoing trials in ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform Search Portal revealed 3 trials examining acute or subacute low back pain. A preliminary report of one of the studies revealed that the majority of participants recruited thus far have subacute pain (NCT01211613). Another study was identified, which according to the trial registry was completed in 2007; however, a search in PubMed and contact with a colleague of the principal investigator suggests that it has not (yet) been submitted for publication (NCT00497861). A third study was identified as a feasibility study that is in the final stages of manuscript preparation (NCT00632060) and examined participants with acute low back pain in a military setting.

The countries in which the studies were conducted varied, but were largely limited to North America and Europe: 9 were conducted in the United States,[32–34,37,39,41–44] 3 in Sweden,[40,45,46] 2 in Australia[36,47] and the United Kingdom,[48,49] and 1 in each of the following countries: Denmark,[50] Italy,[51] the Netherlands,[35] and Switzerland.[38] All trials were published in English.

Included Studies

In total, 2674 participants were examined in the trials. Study sample sizes ranged from 36 to 323 (median [IQR] = 108 [61, 189]). A sample size calculation was performed in 8 (40%) of the studies based upon determining a minimally clinically relevant difference for one or more of the primary outcome measures.[32–36,38,39,41]

Types of Studies.

Slightly less than half of the studies examined multiple comparisons: 3 arms,[32,34,37,40,41,45] 4 arms,[36] and 6 arms.[51]

The following comparisons were identified:

(1) Seven studies compared SMT with inert interventions (*i.e.*, educational booklet,[41] detuned ultrasound and cold packs,[42] detuned ultrasound,[36] detuned short-wave diathermy,[48] antioedema gel spread over the lumbar region,[51] bed rest,[51] and short-wave diathermy).[45,50] No studies were identified that compared SMT with no intervention or a waiting list control.
(2) One study compared SMT with sham SMT.[37]
(3) Eight studies compared SMT with any other intervention (*i.e.*, exercise,[32,40] physical therapy,[41,45–47,51] massage,[44] standard GP care consisting primarily of prescription [diclofenac or codeine] and/or nonprescription medication [paracetamol],[40,51] and back school.[45,51]).
(4) Four studies examined the additional benefit of SMT to another intervention (*i.e.*, consisting of GP visits where advice was given on posture, exercise and avoidance of occupational distress,[49] medication as necessary,[38] exercise,[33] and physiotherapy).[35]
(5) Three studies compared different SMT techniques with one another.[34,39,43]

Study Population.

Most participants were middle-aged, recruited from primary or secondary care. In one study, the vast majority were male (because this was a study conducted in an industrial setting),[48] and another study included exclusively male participants.[50] Two studies were conducted in an occupational setting.[45,48] Virtually all studies included participants with or without radiating pain and most were clear that participants with nerve root signs or compressive neuropathy were excluded.[33–39,41,42,46–50] Other studies allowed those with sciatica or radiculopathy ("some had signs of radiculopathy")[43]; (78% had low back pain only[40]) and others did not specify if participants with radiating pain were included or not.[44] Virtually all studies

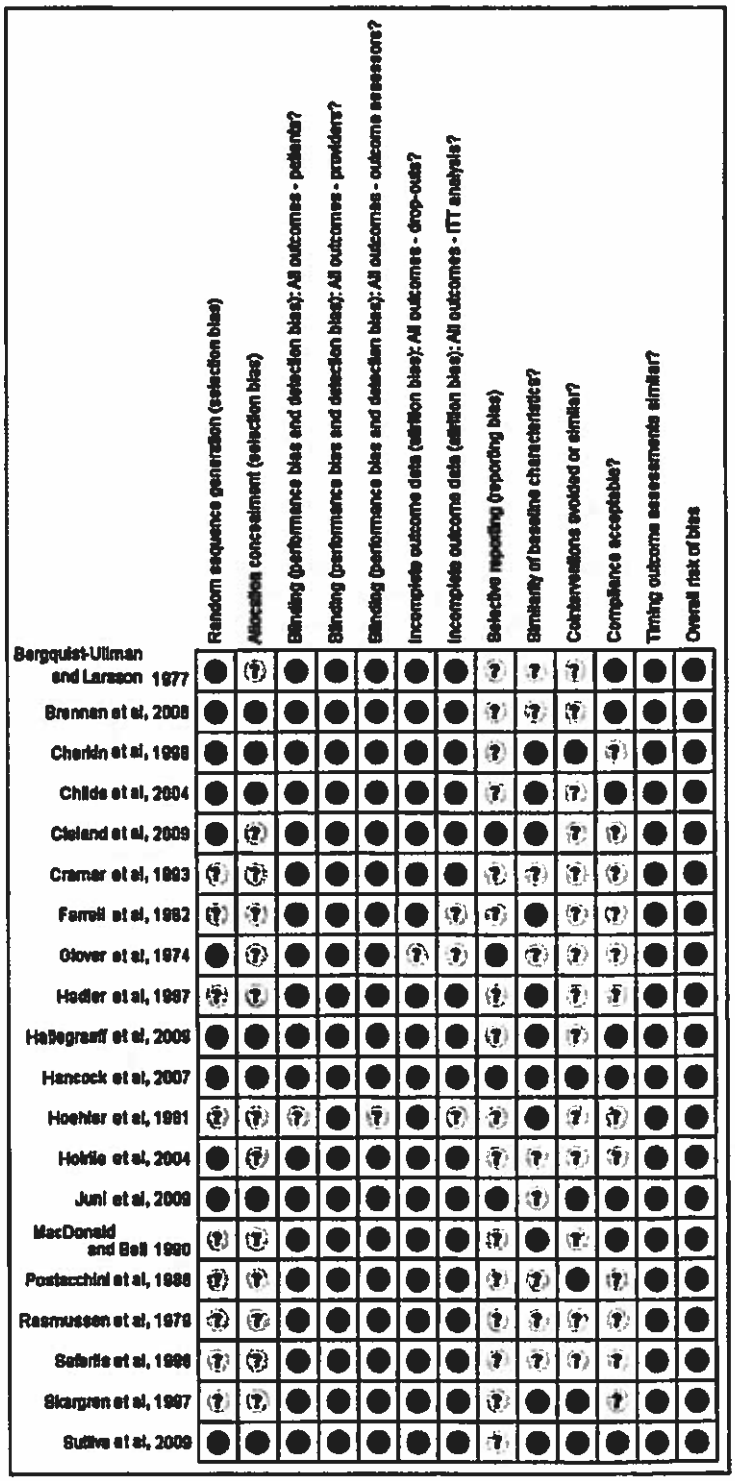


Figure 2. Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

included participants with less than 4 weeks of low back pain. Approximately half of the studies included participants with exclusively acute (<6 wk) low back pain,[35-38,40,42,43,47,50] whereas others included a mixed population (*i.e.*, acute and subacute),[32,34,39,45] or acute, subacute, and chronic.[33,41,44,46,49,51] In one study, it was unclear what proportion of participants had acute low back pain; however, data were stratified by duration (less than 7 d and more than 7 d) and therefore, we used the data for less than 7 days only.[48] Another study also included participants

with neck pain, but the vast majority (78%, n = 253/323) had low back pain.[46]

Technique: Type, Practitioner, Number, and Duration of Treatment.
The studies were rather diverse with regards to the type of manipulator/practitioner and manipulation and the number and duration of treatments administered. Most treatments were administered either by physiotherapists[32–36,39,40,45,47] or chiropractors,[37,41,42,46,51] whereas in other cases, either an osteopathic physician,[43,44] combination physiotherapist or medical manipulator,[50] medical manipulator or osteopath administered care.[38,48] In 3 studies, care was administered by a relatively large number of practitioners (n = 14;[33] n = 17;[34] n = 15[36]), whereas in other cases care was administered either by one or a few select practitioners[38,48,50]; in all other cases the practitioner was unspecified or unclear. In most cases, a high-velocity thrust was administered,[33–35,37–39,41–44,46,49,51] whereas in other cases it was unclear if a high-velocity thrust was used or not[40,48,50] or a combination of manipulation and/or mobilization techniques were used.[32,36,45,47] The mean (or median) number of treatments administered in the SMT group was reported by slightly more than half of the studies and ranged from one[39,48] to 10.[40]

Outcome Measures: Type, Timing.

Primary outcomes: pain. All but one study measured pain.[43] In most cases it was measured *via* a VAS or NRS scale; in other cases it was not specified,[50] was measured using a 4- or 5-point ordinal scale, respectively,[44,51] or was measured by a 0 to 70 (or 75) point scale,[45,49] making it unclear how this relates to the more common VAS or NRS. In addition, in only a minority of studies was it clear what time-contingent aspect of pain was being measured, which in all cases where it was stated was current pain or pain in the previous 24 hours.[32–36,38,40,41]

Functional status. Functional status was measured by most studies using a validated instrument, such as the Oswestry Disability Index[32–35,37,39,40,42,46] or the Roland–Morris disability questionnaire,[36,38,41,43] whereas other older studies assessed this construct by questioning participants about their ability to perform a number of specific back-related activities, such as the ability to walk across a room or to sit up or get up out of a low chair.[44,45,47,49,51] Two studies did not assess functional status.[48,50]

Recovery. Although most assessed this construct, few assessed it *via* the global improvement or similar (3-, 5-, or 7-point Likert scale) scale.[41,43,46,48] Other studies used, for example, a composite score consisting of various instruments or measures to determine whether their participants were recovered or not,[37,47,50] examined number of days to recovery and plotted *via* a Kaplan–Meier curve,[36,38] based recovery on 50% improvement as measured by the ODI,[33,34] asked participants whether they were recovered or not[35,49] or whether they thought the treatment was effective.[44] Six studies did not measure recovery.[32,39,40,42,45,51]

Secondary outcomes. Seven studies measured return-to-work,[33,40,41,45,46,49,50] and 2 studies measured general functional status.[36,46]

Other outcomes. Two studies conducted cost-effectiveness analyses.[40,46] Five studies examined medication usage.[33,37,38,40,46]

Follow-up. More than half of the studies limited follow-up to short-term measurements only (*i.e.*, <3 mo),[35–37,42–44,47–50] including in particular one study that measured the effect 2 days post-treatment only.[39] Five studies measured the long-term (*i.e.*, >12 mo) effects of the treatments.[32,40,41,45,46]

Safety. Six studies, with a total of 1195 participants, reported on adverse events.[34,36,38,41,46,49] One study reported 4 serious adverse events occurring equally in both the experimental and control groups; however, "neither of the events seemed to be related to the allocated treatment strategies."[38] In another study, 25% of the participants reported at least 1 side effect of treatment; however, there were no differences between the groups and all symptoms resolved within 48 hours of onset.[34] None of the other studies reported serious adverse events.

Excluded Studies
Many studies were excluded because the proportion of participants with acute low back pain was unclear or unspecified,[52–62] the contribution of SMT to the overall treatment effect could not be determined,[63–69] participants had predominantly subacute or chronic low back pain[70–72] or exclusively sciatica.[73,74] Other reasons for exclusion were the study was a pseudo-RCT (*e.g.*, alternate inclusion),[75,76] the authors did not evaluate their participants beyond 1 day,[77,78] no relevant outcome was measured,[79] or asymptomatic participants were included.[80]

Risk of Bias in Included Studies

The results from the RoB analysis for the individual studies are summarized in Figure 2. In total, approximately one-third of the studies were considered to have a low RoB,[34–36,38,39,41] representing 34% of all participants. Overall RoB scores ranged from 0 to 9 (median [IQR] 3 [2, 6]). It should be noted that personal contact with Hallegraeff *et al*[35] resulted in this study being given an overall low RoB, although the original evaluation resulted in a high RoB. Only 2 other trial authors responded to our assessment of the RoB for their study, which did not result in any other modifications.

Allocation (Selection Bias)
In 7 studies (35%), both the sequence generation and allocation procedure were conducted properly.[32,33,35,36,38,39,41] In an additional 4 studies (20%), the sequence generation was conducted properly, but they were questionable regarding the allocation because this was inadequately

described.[34,37,45,48] In the remaining studies it was unclear whether the sequence generation and allocation were properly conducted.

Blinding (Performance Bias and Detection Bias)

One study attempted to blind participants to treatment type[37]; however, the results suggest that the participants were able to decipher their group allocation.

Incomplete Outcome Data (Attrition Bias)

In 1 study, loss to follow-up exceeded 50% of the population at the second follow-up measurement (3 wk),[45] representing a fatal flaw. In various other studies, the loss to follow-up exceeded the 30% cut-off for long-term data, representing potentially biased results.

Selective Reporting (Reporting Bias)

Eight studies (40%) were published in the 21st century. It was, therefore, expected that few studies would fulfill this criterion because it has only been relatively recently (*i.e.*, since July 2005) that trial protocols are required to be registered.[34,36,38] It is noteworthy that one older study indicated that recovery had been recorded at 1 month but did not report this, nor other secondary outcomes,[48] whereas in other studies return-to-work was measured but not reported[50] and similarly for recovery in another study.[35]

Other Potential Sources of Bias

Publication Bias

No firm conclusions could be drawn from the funnel plots that were suggestive of publication bias (available upon request).

Source of Funding

Most studies were funded by nonprofit organizations,[32–34,37,42–44,47,48,51] or governmental sources,[36,41,46] whereas in other cases a combination of funding sources were used including industry.[38,45,49] In other cases it was unclear or unspecified.[35,39,40,50]

Effects of Interventions

Data were not extracted from one study beyond the 1-week follow-up excessive drop-outs (*i.e.*, >50%)[45] and not extracted from a second study thought to have a fatal flaw as it demonstrated a significant difference between groups for baseline pain.[35] In addition, data could not be extracted from 3 studies and these are described below.[40,48,51] The quality of the evidence is summarized in the "Summary of Findings" tables (Tables 1–4). The data and analyses for all comparisons are available upon request.

Effect of SMT Versus Inert Interventions

Data were available for extraction from 2 studies with a low RoB[36,41] and 3 studies with a high RoB.[42,45,50] For the outcome of pain, there was low-quality evidence (high RoB, imprecision) from 3 studies[41,42,45] that SMT was not significantly better than inert interventions at 1-week follow-up (MD 0.14; 95% CI −0.69 to 0.96) and low-quality evidence (inconsistency, imprecision) from one study[41] that SMT was significantly better at 1- and 3-month follow-up (MD −1.20; 95% CI −2.01 to −0.39 and MD −1.20; 95% CI −2.11 to −0.29, respectively). Data from one small study with a high RoB[48] (n = 44) could not be extracted, but the results suggested a significant immediate effect on pain relief when SMT was compared with detuned diathermy; however, there were no significant differences between the groups thereafter, including 1-week follow-up (Table 3).

For the outcome of functional status, there was moderate-quality evidence (imprecision) from 2 studies[41,42] that SMT was not significantly better than inert interventions at 1-week follow-up (SMD −0.08; 95% CI −0.37 to 0.21) and low-quality evidence (inconsistency, imprecision) from one study[41] that SMT was not significantly better at 1 and 3 months (SMD −0.27; 95% CI −0.58 to 0.04 and SMD −0.28; 95% CI −0.59 to 0.02, respectively).

In a separate analysis, one study with a low RoB[36] examined the effect of SMT *versus* detuned ultrasound in those who received either diclofenac or placebo. For the outcomes of pain and functional status, there were no significant differences at 1-, 2-, 4-, or 12-week follow-up, with the exclusion of the 2-week follow-up for functional status, which favored SMT (MD −1.4; 95% CI −2.7 to −0.1). These data were not presented in the pooled analyses because they were not available from the publication.

For the outcome of recovery, evidence was available from 2 studies[36,50] at 1-week follow-up. They demonstrated non-significant, but conflicting results. One relatively large study (n = 239) with a low RoB[36] suggested benefit in favor of inert interventions (RR 0.74; 95% CI 0.50–1.09), whereas the other relatively small study[50] (n = 24) suggested benefit in favor of SMT (RR 3.50; 95% CI 0.91–13.53). Furthermore, there was low-quality evidence (inconsistency, imprecision) from one study[36] that SMT was not significantly better at 1 and 3 months (RR 0.98; 95% CI 0.86–1.11 and RR 1.00; 95% CI 0.98–1.02).

No data were available for quality of life, return-to-work or cost-effectiveness.

Effect of SMT Versus Sham SMT

One study was identified.[37] For the outcomes of pain and functional status, there was very low-quality evidence (high RoB, inconsistency, imprecision) from 1 study[37] that SMT was not significantly better than sham SMT at 1-month follow-up (MD −0.50; 95% CI −1.39 to 0.39 and SMD −0.35; 95% CI −0.76 to 0.06, respectively). No data were available for recovery, quality of life, return-to-work, or cost-effectiveness (Table 4).

Effect of SMT Versus All Other Interventions

Data were available for extraction from one study with a low RoB[41] and 6 studies with a high RoB.[32,44–47,50] For

Table 1. Spinal Manipulative Therapy Compared With Other Interventions for Acute Low Back Pain

Outcomes	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)	Comments
	Assumed Risk	Corresponding Risk				
	Other Interventions	Spinal Manipulative Therapy				
Pain at 1 wk, 0 (no pain)–10 (worse pain)	The mean pain at 1 wk ranged across control groups from 2.6 to 3.5 points	The mean pain at 1 wk in the intervention groups was 0.1 higher (0.5 lower–0.7 higher)		383 (3 studies)	⊕⊕⊖⊖ Low*†	Small, not clinically relevant effect.
Pain at 1 mo, 0 (no pain)–10 (worse pain)	The mean pain at 1 mo ranged across control groups from 0.5 to 2.3 points	The mean pain at 1 mo in the intervention groups was 0.2 lower (0.5 lower–0.2 higher)		606 (3 studies)	⊕⊕⊕⊖ Moderate*	Small, not clinically relevant effect.
Functional status at 1 wk, RMDQ. Scale from 0 (no dysfunction) to 24 (worse function)	The mean functional status at 1 wk in the control groups was 7.2 points	The mean functional status at 1 wk in the intervention groups was 0.1 standard deviations higher (0.2 lower–0.3 higher)		241 (1 study)	⊕⊕⊖⊖ Low†‡	Small, not clinically relevant effect.
Functional status at 1-mo, RMDQ. Scale from 0 (no dysfunction) to 24 (worse function)	The mean functional status at 1 mo in the control groups was 4.1 points	The mean functional status at 1 mo in the intervention groups was 0.5 points lower (1.2 lower–0.2 higher)		681 (3 studies)	⊕⊕⊕⊖ Moderate*	Small, not clinically relevant effect. Based on pooled SMD: −0.11 (−0.26 to 0.05).§
Recovery at 1 mo	Study population		RR 1.06 (0.94–1.21)	117 (2 studies)	⊕⊕⊖⊖ Low*¶	Small, not clinically relevant effect.
	87 per 100	92 per 100 (81–100)				
Serious adverse events	Study population		Not estimable	2 studies		Total 578 participants. No serious adverse events were observed in the SMT group.

*High risk of bias.

†$N < 400$ subjects.

‡Only 1 study reported the outcome; therefore, data are inconsistent and imprecise.

§RMDQ based upon Cherkin et al.[11]

¶$N < 300$ events.

The symbols ⊕⊕⊖⊖ indicate how many of the items were fulfilled (for each ⊕, 1 item was fulfilled and corresponds to the different levels of evidence).

CI indicates confidence interval; RR, risk ratio; RMDQ, Roland-Morris disability questionnaire.

GRADE denotes working group grades of evidence; High quality, further research is very unlikely to change our confidence in the estimate of effect; Moderate quality, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low quality, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; Very-low quality, we are very uncertain about the estimate.

TABLE 2. Spinal Manipulative Therapy Plus Another Intervention Compared With the Intervention Alone for Acute Low Back Pain

Outcomes	Illustrative Comparative Risks* (95% CI)			Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)	Comments
	Assumed Risk	Corresponding Risk					
	The Intervention Alone	Spinal Manipulative Therapy Plus Another Intervention					
Pain at 1 wk, scale from: 0 (no pain) to 10 (worse pain)	The mean pain at 1 wk in the control groups was 1.9 points	The mean pain at 1 wk in the intervention groups was 0.8 points higher (0.04 lower–1.7 higher)			102 (1 study)	⊕⊕⊖⊖ Low†	Small, not clinically relevant effect.
Pain at 3 to 6 mo, scale from 0 (no pain) to 10 (worse pain)	The mean pain at 3 to 6 mo in the control groups was 1.5 points	The mean pain at 3 to 6 mo in the intervention groups was 0.7 points higher (0.3 lower–1.6 higher)			104 (1 study)	⊕⊕⊖⊖ Low†	Small, not clinically relevant effect.
Functional status at 1 wk, ODI. Scale from 0 (no dysfunction) to 100 (worse function)	The mean functional status at 1 wk in the control groups was 33 points	The mean functional status at 1 wk in the intervention groups was 5.7 points lower (10.1–1.4 lower)			225 (2 studies)	⊕⊕⊖⊖ Low†‡	Moderately clinically relevant effect. Based on pooled SMD: −0.41 (−0.73 to −0.10).§
Functional status at 3 to 6 mo, ODI. Scale from 0 (no dysfunction) to 100 (worse function)	The mean functional status at 3 to 6 mo in the control groups was 24.4 points	The mean functional status at 3 to 6 mo in the intervention groups was 3.8 points lower (10.6 lower–2.8 higher)			225 (2 studies)	⊕⊕⊖⊖ Low†‡	Small, not clinically relevant effect. Based on pooled SMD: −0.22 (−0.61 to 0.16).§
Recovery at 1 wk	Study population			RR 0.89 (0.32–2.47)	196 (2 studies)	⊕⊖⊖⊖ Very low†¶‖	Small, not clinically relevant effect. Based on pooled RR: 0.88 (0.36 to 2.19).
	16 per 100	14 per 100 (5–40)					
Recovery at 3 to 6 mo	Study population			RR 0.75 (0.51–1.1)	195 (2 studies)	⊕⊖⊖⊖ Very low†‖	Small, not clinically relevant effect. Based on pooled RR: 0.96 (0.71–1.31). I^2 = 57%.
	64 per 100	48 per 100 (33–70)					
Serious adverse events	Study population			Not estimable	2 studies		Total 199 participants. In 1 of the studies, 2 serious adverse events were observed in the SMT group; however, they "seemed not to be related to the treatment." An equal number of adverse events were seen in the control group (Juni et al[28]).

*Only 1 study reported the outcome; therefore, the data are inconsistent and imprecise.
†High risk of bias.
‡N < 400 subjects.
§ODI based upon Childs et al.[11]
¶Widely varying estimates of effect.
‖N < 300 events.
The symbols ⊕⊕⊖⊖ indicate how many of the items were fulfilled (for each ⊕, 1 item was fulfilled and corresponds to the different levels of evidence).
CI indicates confidence interval; RR, risk ratio; ODI, Oswestry Disability Index.
GRADE denotes working group grades of evidence; High quality, further research is very unlikely to change our confidence in the estimate of effect; Moderate quality, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low quality, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; Very-low quality, we are very uncertain about the estimate.

TABLE 3. Spinal Manipulative Therapy Compared With Inert Interventions for Acute Low Back Pain

Outcomes	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)	Comments
	Assumed Risk	Corresponding Risk				
	Inert Interventions	Spinal Manipulative Therapy				
Pain at 1 wk, scale from 0 (no pain) to 10 (worse pain)	The mean pain at 1 wk ranged across control groups from 2 to 4.2 points	The mean pain at 1 wk in the intervention groups was 0.1 points higher (0.7 lower–1 higher)		311 (3 studies)	⊕⊕⊖⊖ low*†	Small, not clinically relevant effect.
Pain at 1 mo, scale from 0 (no pain) to 10 (worse pain)	The mean pain at 1 mo in the control groups was 3.1 points	The mean pain at 1 mo in the intervention groups was 1.2 points lower (2–0.4 lower)		178 (1 study)	⊕⊕⊖⊖ low‡	Moderately clinically relevant effect.
Functional status at 1 wk, RMDQ. Scale from 0 (no dysfunction) to 24 (worse function)	The mean functional status at 1 wk in the control groups was 7.8 points	The mean functional status at 1 wk in the intervention groups was 0.3 points lower (1.5 lower–0.8 higher)		205 (2 studies)	⊕⊕⊕⊖ moderate†	Small, not clinically relevant effect. Based on pooled SMD: −0.08 (−0.37 to 0.21).§
Functional status at 1 mo, RMDQ. Scale from 0 (no dysfunction) to 24 (worse function)	The mean functional status at 1 mo in the control groups was 4.9 points	The mean functional status at 1 mo in the intervention groups was 0.3 standard deviations lower (0.6 lower–0.04 higher)		178 (1 study)	⊕⊕⊖⊖ low‡	Small, not clinically relevant effect.
Recovery at 1 wk	Study population		RR 0.96 (0.5–1.85)	263 (2 studies)	⊕⊕⊖⊖ low¶‖	Small, not clinically relevant effect.
	33 per 100	31 per 100 (16–60)				
Serious adverse events	Study population		Not estimable	2 studies		Total 427 participants. No serious adverse events were observed in the SMT group.

*High risk of bias.

†N < 400 subjects.

‡Only 1 study reported the outcome; therefore, the data are inconsistent and imprecise.

§RMDQ based upon Cherkin et al.[41]

¶I² = 58%

‖N < 300 events

The symbols ⊕⊕⊖⊖ indicate how many of the items were fulfilled (for each ⊕, 1 item was fulfilled and corresponds to the different levels of evidence).

CI indicates confidence interval; RR, risk ratio; RMDQ, Roland-Morris disability questionnaire.

GRADE denotes working group grades of evidence; High quality, further research is very unlikely to change our confidence in the estimate of effect; Moderate quality, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low quality, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; Very-low quality, we are very uncertain about the estimate.

Table 6. Spinal Manipulative Therapy (SMT) Compared With Sham SMT for Acute Low Back Pain

Outcomes	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)	Comments
	Assumed Risk	Corresponding Risk				
	Sham SMT	Spinal Manipulative Therapy				
Pain at 1 mo, 0 (no pain) to 10 (worse pain)	The mean pain at 1 mo in the control groups was 2.2 points	The mean pain at 1 mo in the intervention groups was 0.5 lower (1.4 lower–0.4 higher)		74 (1 study)	⊕⊖⊖⊖ Very low*†	Small, not clinically relevant effect.
Functional status at 1 mo, ODI. Scale from 0 (no dysfunction) to 100 (worse function)	The mean functional status at 1 mo in the control groups was 16.3 points	The mean functional status at 1 mo in the intervention groups was 0.4 standard deviations lower (0.8 lower–0.1 higher)		94 (1 study)	⊕⊖⊖⊖ Very low*†	Small, not clinically relevant effect.
Recovery at 1 mo	Study population		Not estimable	0 studies		No data were available.
Serious adverse events	Study population		Not estimable	0 studies		No data were available.

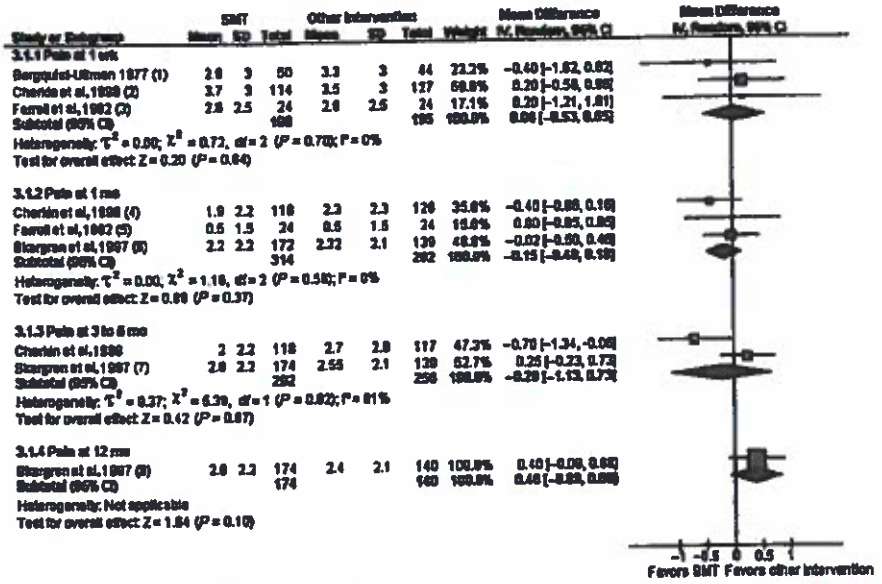
**High risk of bias.*

†Only 1 study reported the outcome; therefore, the data are inconsistent and imprecise.

The symbols ⊕⊕⊖⊖ indicate how many of the items were fulfilled (for each ⊕, 1 item was fulfilled and corresponds to the different levels of evidence).

CI indicates confidence interval; RR, risk ratio; ODI, Oswestry Disability Index.

GRADE denotes working group grades of evidence; High quality, further research is very unlikely to change our confidence in the estimate of effect; Moderate quality, further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low quality, further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; Very low quality, we are very uncertain about the estimate.



(1) vs. back school; Table 20; data presented as median and converted to a 10-point scale; SDs estimated from a similar population.
(2) vs. physiotherapy; "Bothersomeness of symptoms" (incl. back, leg or numbness or tingling in the preceding 24h - data for worse symptom)
(3) vs. exercise; Fig.4
(4) vs. physiotherapy; "Bothersomeness of symptoms" (incl. back, leg or numbness or tingling in the preceding 24h - data for worse symptom)
(5) vs. exercise; Fig. 4, SD ext. from other studies
(6) vs. PT; Based upon Fig.1 and Table 5, SD used from baseline values.
(7) Data based upon Fig.1 and Table 5.
(8) Data based upon Fig.1 and T. 5 from 1987 publication and T.2 from the 1998 publication.

Figure 3. Forest plot of comparison: spinal manipulative therapy *versus* all other therapies, outcome "pain."

the outcome of pain, there was low-quality evidence (high RoB, imprecision) from 3 studies[41,45,47] that SMT was not significantly better than other interventions at 1-week follow-up (MD 0.06; 95% CI −0.53 to 0.65); moderate-quality evidence (high RoB) from 3 studies[41,46,47] that SMT was not significantly better at 1-month follow-up (MD −0.15; 95% CI −0.49 to 0.18); low-quality evidence (high RoB, inconsistency (I^2 = 81%)) from 2 studies[41,46] that SMT was not significantly better (MD −0.20; 95% CI −1.13 to 0.73) at 3- to 6-month follow-up; and very low-quality evidence (high RoB, inconsistency, imprecision) from one study[46] that SMT was not significantly better (MD 0.40; 95% CI −0.08 to 0.88) (Figure 3; Table 1).

For the outcome of functional status, there was low-quality evidence (inconsistency, imprecision) from one study[41] that SMT was not significantly better than other interventions at 1-week follow-up (SMD 0.07; 95% CI −0.18 to 0.33); moderate-quality evidence (high RoB) from 3 studies[32,41,46] that SMT was not significantly better at 1-month follow-up (SMD −0.11; 95% CI −0.26 to 0.05); low-quality evidence (high RoB, inconsistency [I^2 = 51%]) that SMT was not significantly better at 3- to 6-month follow-up (SMD −0.09; 95% CI −0.33 to 0.15); and low-quality evidence (high RoB, imprecision) that SMT was not significantly better at 12-month follow-up (SMD 0.06; 95% CI −0.14 to 0.25) (Figure 4).

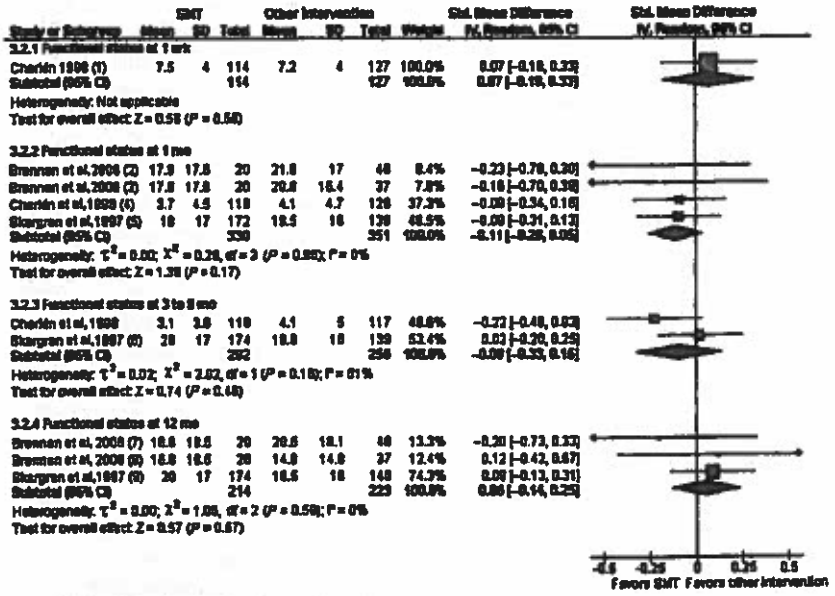
For the outcome of recovery, there was low-quality evidence (high RoB, imprecision) from 2 studies[44,47] that there was no significant difference at 1 month (RR 1.06; 95% CI 0.94–1.21) and very low-quality evidence (high RoB, inconsistency, imprecision) from one study[44] that SMT did not result in significantly better recovery at 3 months (RR 1.29; 95% CI 0.96–1.74).

For return-to-work, data were available from one study with a high RoB.[46] This study demonstrated similar proportions of participants during the treatment phase and at 6 months who were no longer on sick leave.

Data not able to be extracted from one study[40] examined the effects of SMT to exercise and standard GP care. At 1-month follow-up, there were no significant differences between the interventions for the outcomes of pain, functional status, or socioeconomic disability (including sick leave, low back pain recurrence, and change of job because of low back pain).

Two studies conducted cost-effectiveness analyses. One study conducted a cost-minimization analysis, which demonstrated that the differences in cost during 1-year follow-up for SMT compared with GP care alone or an exercise program were small; however, no formal statistical comparison was conducted.[40] Furthermore, cost data were not entirely complete (*i.e.*, only the costs of treatment, the investigations [*i.e.*, imaging] and operations were collected as direct costs). In addition, cost-minimization analyses may have limited application because it assumes that the outcomes are equivalent; therefore, these results should be viewed with some caution. Another study examined differences in costs at 1 year between those receiving chiropractic care and physiotherapy. The study demonstrated small, nonsignificant differences in costs.[46]

No data were available for quality of life.



(1) vs. physiotherapy; RMDQ; adjusted data presented in Fig.1
(2) vs. stabilization exercise; ODI; data based upon randomized tx. group, and not subgroup classification
(3) vs. specific exercise; ODI; data based upon randomized tx. group and not subgroup classification
(4) vs. physiotherapy; RMDQ; data presented as mean (95% CI)
(5) vs. PT; ODI; Data est. from Fig.1 & Table 5; SD used from baseline values.
(6) Data est. from Fig.1 & Table 5
(7) vs. stabilization exercise; ODI
(8) vs. specific exercise; ODI
(9) Data est. from Fig.1 & Table 5

Figure 4. Forest plot of comparison: spinal manipulative therapy *versus* all other therapies, outcome "functional status."

Effect of SMT Plus Another Intervention Versus the Intervention Alone

Data were available for extraction from one study with a low RoB[38] and 2 studies with a high RoB.[33,49] For the outcome of pain, there was low-quality evidence (inconsistency, imprecision) from one study[38] that SMT plus another intervention was not significantly better than the intervention alone at 1 week or 3- to 6-month follow-up, respectively (MD 0.84; 95% CI −0.04 to 1.72 and MD 0.65; 95% CI −0.32 to 1.62) (Table 2).

For the outcome of functional status, there was low-quality evidence (high RoB, imprecision) from 2 studies[33,49] that SMT plus another intervention was significantly better at 1-week follow-up (SMD −0.41; 95% CI −0.73 to −0.10); low-quality evidence (high RoB, imprecision) from 3 studies[33,38,49] that SMT was not significantly better at 1 month (SMD −0.09; 95% CI −0.39 to 0.21) and low-quality evidence (high RoB, imprecision) from 2 studies[33,49] that SMT was not significantly better at 3 months (SMD −0.22; 95% CI −0.61 to 0.16). The study reported in Childs *et al*[33] demonstrated a strong, clinically relevant short-term effect (SMD −0.65; 95% CI −1.00 to −0.30).

For the outcome of recovery, there were conflicting results from one study with a low RoB[38] and 2 studies with a high RoB.[33,49] There was low-quality evidence (inconsistency, imprecision) from the one study with a low RoB,[38] which demonstrated no significant effect on recovery at 1 week or 3 to 6 months, respectively (RR 0.89; 95% CI 0.32–2.47 and RR 0.75; 95% CI 0.51–1.10). One relatively large study[33] (n = 131) with a high RoB demonstrated a weak, significant effect (RR 1.74; 95% CI 1.19–2.55) in favor of SMT at 1 month. The remaining study[49] that had a high RoB, examined various subgroups that were defined by duration of the baseline pain. The results were conflicting and by and large, they were nonsignificant. One of the subgroup comparisons from MacDonald and Bell represented a moderate, significant effect on recovery at 3 to 6 months (RR 2.06; 95% CI 1.07–3.97).[49]

For the outcome of return-to-work, there were data from one study with a high RoB.[33] There was very low-quality evidence (high RoB, inconsistency, imprecision) that there was no significant effect on return-to-work (RR 1.21; 95% CI 0.99–1.47).

No data were available for quality of life or cost-effectiveness.

Effect of SMT Versus Another SMT Technique

Data were not pooled for this comparison because it was thought that a pooled estimate would not represent a clinically meaningful assessment because various different techniques were being compared with one another; therefore, the individual estimates are described here. In general, side-lying and supine thrust SMT techniques demonstrated a short-term statistically significant difference compared with nonthrust SMT techniques for the outcomes of pain, functional status and recovery, and a significant difference at 6 months for the outcome of functional status but not pain or recovery.[34]

No significant difference was identified between the different thrust techniques for any outcome or time interval.

In a second study, no short-term effect on functional status was observed for high-velocity SMT *versus* mobilization. In a third study, the short-term effect (48 hr post-treatment) of 2 different side-lying SMT techniques were compared with one another (lumbar pelvic *vs.* neutral-gap SMT).[39] No statistically significant difference was observed between the 2 techniques for pain or functional status.

In a third study, the effects of high-velocity SMT were compared with mobilization. No significant differences were found for short-term functional status.

No data were available for quality of life or cost-effectiveness.

Other Clinical Variables and Sensitivity Analyses

Data were insufficient per comparison, outcome, and follow-up measurement to allow us to assess the effect of SMT for any of the planned sensitivity analyses (*e.g.*, by RoB, success of randomization, specific type of SMT technique used). Nevertheless, only 2 studies demonstrated a strong clinically relevant effect: a small study (n = 24) with a high RoB[50] and to a lesser extent the study by Childs *et al*[33] (also with a high RoB).

DISCUSSION

Summary of Main Results

In general, for the primary outcomes there is low- to very low-quality evidence of no difference in effect of SMT compared with inert interventions, sham SMT, or when added to another intervention, and varying quality of evidence (from very low to moderate) of no significant difference in effect of SMT compared with other interventions. There are 2 minor exceptions. There is a statistically significant short-term but not clinically relevant effect of SMT on pain relief compared with inert interventions (1 RCT; MD −1.20; 95% CI −2.01 to −0.39) and a moderate short-term effect of SMT on functional status when added to another intervention (2 RCTs; SMD −0.41; 95% CI −0.73 to −0.10). Furthermore, 2 studies demonstrated a positive, in some cases clinically relevant effect of SMT as an adjuvant therapy for functional status (1-week change in Oswestry of 9.2; 95% CI 4.4–14.1) and recovery (RR 2.06; 95% CI 1.07–3.97) (Childs *et al*[33] MacDonald and Bell,[49] respectively); although these were isolated effects in studies with a high RoB.

To some extent, these results seem inconsistent because one would expect the effect of SMT compared with sham treatment or inert interventions to be greater than that of other (effective) interventions, such as exercise or physiotherapy. The observation that there is no difference across the various control groups is confusing. In part, these results might be explained by the low-quality level of evidence, which is a result of the small numbers of studies identified per comparison, outcome, and time interval, and typically investigated by studies with a high RoB. More importantly, the 6 RCTs with a low RoB demonstrated no clinically relevant effect of SMT across the various comparisons.[34–36,38,39,41] In light of these findings, it is difficult to come to any strong conclusions or make recommendations regarding the use of SMT for acute low back pain.

Two important factors might have influenced these results. First, acute low back pain is known for its favorable natural history[81]; therefore, demonstrating a clinically relevant difference represents a unique challenge. Second, baseline pain and functional status were, on average, at moderate levels for the study populations in most studies. Therefore, so-called floor effects (meaning there is too little room for improvement) cannot be discounted.

It is noteworthy that the majority of studies that are registered and currently being conducted are investigating the effect of SMT for subacute and chronic low back pain. Consequently, the issue of effectiveness of SMT for acute low back pain is not likely to be resolved in the near future. Importantly, there was no evidence of serious adverse events demonstrated in any of the trials, although all RCTs were too small to give any reliable and precise estimate of these types of events; these have been described elsewhere.[82] However, 2 large cohort studies of SMT failed to identify any serious adverse events following more than 6500 SMT treatments to the neck or low back, or both.[83,84]

Overall Completeness and Applicability of Evidence

Virtually all the studies included in this review were conducted in North America or Europe and include a rather broad category of participants (*i.e.*, most were middle-aged, had little to no radiating pain, and were recruited from primary or tertiary care). Furthermore, care was provided by a variety of practitioners, including chiropractors, osteopaths, and manual therapists; therefore, the results of this review might be generalized to various settings. Nevertheless, there are concerns that applying SMT to such a heterogeneous population as aspecific low back pain is likely to inevitably lead to small-to-moderate effects. In contrast, there is evidence from studies evaluated in this review that (perhaps) clinically relevant differences are obtained when clinical prediction rules (CPRs) or forms of subgrouping are applied.[32,33] Although the trial conducted by Brennan *et al*[32] was intended to compare the outcomes of those receiving treatments that were matched (or unmatched) to specific subgroups on the basis of their initial clinical presentation, our analysis did not take this into account; rather, we extracted the data from the unmatched patient assignment. Thus, although SMT might be an effective therapy for specific subgroups, there is too little information at present to draw any strong conclusions. In addition, to our knowledge only 2 studies have examined CPRs for SMT in patients with acute low back pain, namely the CPR of Childs *et al*,[33] which failed to be validated in another trial.[85]

Other factors that might have influenced these results are the specific features of the treatment, namely frequency and duration. However, that is difficult for us to evaluate because only slightly more than half of the studies reported this feature. Future reviews could benefit from studies that provide more insight into the details of the intervention as well as providing details regarding the practitioner.

Quality of the Evidence

Although many questions remain about the effect of SMT, especially given the fact that two-thirds of the included studies demonstrated a high RoB, questions may also be raised regarding the quality of the extracted data. In many cases, particularly for the older studies published before 2000, data were estimated from figures or graphs, which in most cases lacked a measure of variance. Furthermore, we extracted final scores or values rather than change scores or values adjusted for various confounders because the vast majority of studies presented only the former. Therefore, the reader should not place too much emphasis on the precision of the pooled estimates, meaning the pooled point estimates might be compromised. Lastly, relatively few participants were identified for any of the principal outcome measures; therefore, none of the findings should be considered robust.

Potential Biases in the Review Process

The most important and obvious limitation is the large number of studies with a high RoB. Although there is empirical evidence in the field of low back pain that studies with a high RoB tend to yield a larger effect,[27] it is unclear to what extent this might have influenced the overall results. An additional limitation is the low numbers of studies and small sample sizes identified per comparison, outcome, and time interval, which prohibited us from conducting any meaningful sensitivity analyses. Other limitations include potential publication bias. Published trials are generally larger and may show an overall greater treatment effect than studies published in the "gray" literature; therefore, it is important to include these latter studies in systematic reviews.[86] Although we only searched online sources for gray literature, funnel plots did not suggest this was an issue. In addition, the source of funding is an important consideration because of potential financial conflicts and influence from industry-sponsored research[87,88]; however, most of the studies were funded by nonprofit or governmental institutions, and this would not seem to be an important concern. Finally, it must be declared that the principal author of this review (S.M.R.) is a chiropractor and uses SMT in his daily practice; however, any potential bias associated with that authorship must be offset by a team of reviewer authors with impeccable academic reputations and who have no financial gain from the conclusions drawn in this review.

Agreements and Disagreements With Other Studies or Reviews

In principal, the results and conclusions of this updated review are consistent with the previous edition of the review, namely that SMT is no better than standard interventions for acute low back pain. However, one important conclusion from the previous review was that SMT demonstrated a short-term, clinically relevant effect on pain relief compared with sham SMT or other therapies thought to be ineffective or harmful. This is in contrast to the findings of this updated review. Although we found a moderate clinically relevant, short-term effect of SMT compared with inert interventions for pain relief, this was from just one study,[41] albeit a study with a low RoB. Importantly, no significant effect was found for functional improvement. Importantly, some of the studies included in the previous review were excluded from this update for the various reasons listed for the excluded studies. Therefore, we think that this update is a better reflection of the effect of SMT for acute low back pain.

This review is not in agreement with a recent systematic review, which was much more positive.[89] Approximately one-third (n = 5/14) of the studies in that review were not included in this review because they either evaluated patients with sciatica exclusively (n = 2) and therefore were thought to represent a subgroup of patients with low back pain not evaluated here or included studies with subacute (n = 1) or a mix of subacute and chronic pain (n = 1) or included studies in which the contribution of SMT could not be properly determined (n = 1). However, our findings are consistent with other recent systematic reviews.[5,6]

CONCLUSION

Implications for Practice

No high-quality evidence was provided for any comparison, outcome, or time interval; therefore, no strong conclusions or recommendations can be made for the use of SMT for acute low back pain. SMT seems to be no better than other existing therapies for pain reduction and improvement of functional status. The decision to refer for SMT should be based upon costs, preferences of the patient and providers, and relative safety of the various treatment options.

Implications for Research

It would seem from the continuing "disappointing" results from the trials included in this review (at least from the perspective of the clinician) that either further research on such heterogeneous populations with acute low back pain is a waste of funding or that something more fundamental is lacking in our approach. The small to moderate effects seen in clinical trials covering both pharmacological and nonpharmacological interventions have been a point of contention and discussion by numerous authors,[90,91] while clinicians wonder why the dramatic effects sometimes observed in their clinical practice are not reflected in these trials. At least one lesson should be drawn from this review, continuing in the same vein seems pointless. After all, there are currently more than 100 RCTs of SMT for low back pain.[92] Despite the disappointing quality of the evidence examined here, a more precise estimate of the effect of SMT for acute low back pain, a condition with a rather benign natural history, does not seem to be the way forward. Preventing the onset of chronic low back pain, which is disabling and expensive, may be a much more clinically relevant question. Relatively few of the studies included in this review followed patients long enough to identify chronicity or recurrence as an outcome, although any such studies would have to be sufficiently large and powered to adequately address this. Observational designs might sooner be the design of choice to identify who develops chronic complaints and recurrent symptoms.

There remain various avenues yet to be explored. Examples include better identification of subgroups likely to respond to SMT, such as through the use of clinical prediction rules. Other examples include better definitions and reporting in trials of SMT so that interpretation of the results is more transparent. Various initiatives are underway. For example, our research group is currently conducting a large-scale international survey using a Delphi process designed to reach consensus as to which items should be included in a description of SMT in future trials. This effort is designed to represent an extension of the CONSORT statement.

Other areas to be considered include whether we should abandon the search for a better diagnosis or better identification of the pain generators in favor of a different approach. Apart from identifying those with serious pathology, radicular pain, and psychosocial factors, it would seem that we have not proceeded beyond the aspecific (or "uncomplicated") back pain model.[93] Various examination procedures and tests can be conducted, which include advanced imaging, neuromuscular testing, or diagnostic blocks, all of which remove aspecific low back pain from the primary care arena; however, it is unclear to what extent this might influence clinician behavior and more importantly, whether the patient is likely to benefit.[94] It seems unlikely that the search for a better diagnosis through better identification of pain generators or better identification of pathology will lead in the right direction. Alternative approaches include dropping the aspecific back pain model, which includes a rather heterogeneous group of patients, in favor of better classification of patients through identification of pain through movement, such as directional preference or mechanical diagnosis and therapy (*i.e.*, the McKenzie approach). Other approaches might include use of diagnostic algorithms, such as those that include components of the diagnostic triage and directional preference.

These are but a few examples of the way to proceed, and it seems imperative that these problems be resolved before further research is conducted. Finally, it is imperative that any future studies include an economic evaluation.

➢ Key Points

- ❑ A systematic review assessed the effects of SMT for acute low back pain.
- ❑ Twenty RCTs were identified (N = 2674), 6 (30%) of which had a low RoB.
- ❑ Low- to very low-quality evidence suggests no difference in effect for SMT compared with inert interventions, sham SMT, or as adjunct therapy and very low to moderate evidence, which suggests no difference in effect for SMT when compared with other interventions.
- ❑ Data were particularly sparse for recovery, return-to-work, quality of life, and costs.
- ❑ Our evaluation is limited by the low numbers of studies; therefore, future research is likely to have an important impact on this assessment.
- ❑ Future RCTs should examine specific subgroups and include an economic evaluation.

Acknowledgments

The review authors thank the members of the Editorial Board of the Cochrane Back Review Group for constructive comments on the protocol of this review and Ms. Rachel Couban for her assistance with the development of the search strategies. The authors also thank Dr. Sally Morton, Mrs. Emily Yu, Ms. Marika J. Suttorp, and Dr. Paul Shekelle for their work on the previous version of this review.

References

1. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. *Spine J* 2008;8:8–20.
2. Brown A, Angus D, Chen S, et al. *Costs and Outcomes of Chiropractic Treatment for Low Back Pain [technology report no. 56]*. Ottawa: Canadian Coordinating Office for Health Technology Assessment; 2007.
3. Brønfort G, Haas M, Evans RL, et al. Efficacy of spinal manipulation and mobilization for low back pain and neck pain: a systematic review and best evidence synthesis. *Spine J* 2004;4:335–56.
4. Cherkin DC, Sherman KJ, Deyo RA, et al. 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.
5. 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.
6. van Tulder MW, Becker A, Bekkering T, et al. European Guidelines for the management of acute non-specific low back pain in primary care. *Eur Spine J* 2006;15(Suppl.2):S169–91.
7. Assendelft WJJ, Morton SC, Yu EI, et al. Spinal manipulative therapy for low back pain. *Cochrane Database Syst Rev* 2004. DOI:10.1002/14651858.CD000447.pub2.
8. Koes BW, van Tulder MW, Ostelo R, et al. Clinical guidelines for the management of low back pain in primary care: an international comparison. *Spine* 2001;26:2504–13.
9. van Tulder MW, Tuut M, Pennick V, et al. Quality of primary care guidelines for acute low back pain. *Spine* 2004;29:E357–62.
10. Higgins JPT, Green S. *Cochrane Handbook for Systematic Reviews of Interventions*. The Cochrane Collaboration Version 5.0.0 [updated February 2008]. http://www.cochrane.org/resources/handbook/index.htm. 2011.
11. Furlan AD, Pennick V, Bombardier C, et al. on behalf of the Cochrane Back Review Group Editorial. 2009 Updated method guidelines for systematic reviews in the Cochrane Back Review Group. *Spine* 2009;34:1929–41.
12. Rubinstein SM, van Middelkoop M, Assendelft WJJ, et al. Spinal manipulative therapy for chronic low back pain. *Cochrane Database Syst Rev* 2011;DOI: 10.1002/14651858.CD008112.pub2.
13. Rubinstein SM, Terwee C, Assendelft WJJ, et al. Spinal manipulation for acute low back pain. *Cochrane Database Syst Rev* 2010. DOI:10.1002/14651858.CD008880.
14. Sandoz R. The significance of the manipulative crack and of other articular noises. *Ann Suiss Chiro Assoc* 1969;4:47–68.
15. Evans DW. Mechanisms and effects of spinal high-velocity, low-amplitude thrust manipulation: previous theories. *J Manipulative Physiol Ther* 2002;25:251–62.
16. Unsworth A, Dowson D, Wright V. 'Cracking joints'. A bioengineering study of cavitation in the metacarpophalangeal joint. *Ann Rheum Dis* 1971;30:348–58.

17. van de Veen EA, de Vet HC, Pool JJ, et al. Variance in manual treatment of nonspecific low back pain between orthomanual physicians, manual therapists, and chiropractors. *J Manipulative Physiol Ther* 2005;28:108–16.
18. Brønfort G, Evans R, Kawchuk G, et al. Evidence-informed management of chronic low back pain with spinal manipulation and mobilization. *Spine J* 2008;8:213–25.
19. Khalsa PS, Eberhart A, Cotler A, et al. The 2005 conference on the biology of manual therapies. *J Manipulative Physiol Ther* 2006;29:341–6.
20. Pickar JG. Neurophysiological effects of spinal manipulation. *Spine J* 2002;2:357–71.
21. Triano JJ. Biomechanics of spinal manipulative therapy. *Spine J* 2001;1:121–30.
22. Airaksinen O, Brox JI, Cedraschi C, et al. European guidelines for the management of chronic non-specific low back pain. *Eur Spine J* 2006;15(Suppl 2):S192–298.
23. Bouter LM, van Tulder MW, Koes BW. Methodological issues in low back pain research in primary care. *Spine* 1998;23:2014–20.
24. Brønfort G, Evans RL, Maiers M, et al. Spinal manipulation, epidural injections, and self-care for sciatica: a pilot study for a randomized clinical trial. *J Manipulative Physiol Ther* 2004;27:503–8.
25. Axen I, Jones JJ, Rosenbaum A, et al. The Nordic Back Pain Subpopulation Program: validation and improvement of a predictive model for treatment outcome in patients with low back pain receiving chiropractic treatment. *J Manipulative Physiol Ther* 2005;28:381–5.
26. Malmqvist S, Leboeuf-Yde C, Ahola T, et al. The Nordic back pain subpopulation program: Predicting outcome among chiropractic patients in Finland. *Chiropr Osteopat* 2008;16:13.
27. van Tulder MW, Suttorp M, Morton S, et al. Empirical evidence of an association between internal validity and effect size in randomized controlled trials of low back pain. *Spine* 2009;34:1685–92.
28. Cohen J. *Statistical Power Analysis for the Behavioural Sciences*. 1st ed. New York, San Francisco, London: Academic Press; 1988.
29. Ostelo RW, Deyo RA, Stratford P, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976)* 2008;33:90–4.
30. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008;336:924–6.
31. Mueller PS, Montori VM, Bassler D, et al. Ethical issues in stopping randomized trials early because of apparent benefit. *Ann Intern Med* 2007;146:878–81.
32. Brennan GP, Fritz JM, Hunter SJ, et al. Identifying subgroups of patients with acute/subacute "nonspecific" low back pain: results of a randomized clinical trial. *Spine (Phila Pa 1976)* 2006;31:623–31.
33. Childs JD, Fritz JM, Flynn TW, et al. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: a validation study. *Ann Intern Med* 2004;141:920–8.
34. Cleland JA, Fritz JM, Kulig K, et al. Comparison of the effectiveness of three manual physical therapy techniques in a subgroup of patients with low back pain who satisfy a clinical prediction rule: a randomized clinical trial. *Spine (Phila Pa 1976)* 2009;34:2720–9.
35. Hallegraeff JM, de Greef M, Winters JC, et al. Manipulative therapy and clinical prediction criteria in treatment of acute nonspecific low back pain. *Percept Mot Skills* 2009;108:196–208.
36. Hancock MJ, Maher CG, Latimer J, et al. Assessment of diclofenac or spinal manipulative therapy, or both, in addition to recommended first-line treatment for acute low back pain: a randomised controlled trial. *Lancet* 2007;370:1638–43.
37. Hoiriis KT, Pfleger B, McDuffie FC, et al. A randomized clinical trial comparing chiropractic adjustments to muscle relaxants for subacute low back pain. *J Manipulative Physiol Ther* 2004;27:388–98.
38. Juni P, Battaglia M, Nuesch E, et al. A randomised controlled trial of spinal manipulative therapy in acute low back pain. *Ann Rheum Dis* 2009;68:1420–7.
39. Sutlive TG, Mabry LM, Easterling EJ, et al. Comparison of short-term response to two spinal manipulation techniques for patients with low back pain in a military beneficiary population. *Mil Med* 2009;174:750–6.
40. Seferlis T, Nemeth G, Carlsson AM, et al. Conservative treatment in patients sick-listed for acute low back pain: a prospective randomised study with 12 months' follow-up. *Eur Spine J* 1998;7:461–70.
41. Cherkin DC, Deyo RA, Battie M, et al. A comparison of physical therapy, chiropractic manipulation, and provision of an educational booklet for the treatment of patients with low back pain. *N Engl J Med* 1998;339:1021–9.
42. Cramer GD, Humphreys CR, Hondras MA, et al. The Hmax/Mmax ratio as an outcome measure for acute low back pain. *J Manipulative Physiol Ther* 1993;16:7–13.
43. Hadler NM, Curtis P, Gillings DB, Stinnett S. A benefit of spinal manipulation as adjunctive therapy for acute low back pain: a stratified controlled trial. *Spine (Phila Pa 1976)* 1987;12:702–6.
44. Hoehler FK, Tobis JS, Buerger AA. Spinal manipulation for low back pain. *JAMA* 1981;245:1835–8.
45. Bergquist-Ullman M, Larsson U. Acute low back pain in industry. A controlled prospective study with special reference to therapy and confounding factors. *Acta Orthop Scand* 1977;1–117.
46. Skargren EI, Oberg BE, Carlsson PG, et al. Cost and effectiveness analysis of chiropractic and physiotherapy treatment for low back and neck pain. Six-month follow-up. *Spine* 1997;22:2167–77.
47. Farrell JP, Twomey LT. Acute low back pain. Comparison of two conservative treatment approaches. *Med J Aust* 1982;1:160–4.
48. Glover JR, Morris JG, Khosla T. Back pain: a randomized clinical trial of rotational manipulation of the trunk. *Br J Ind Med* 1974;31:59–64.
49. MacDonald RS, Bell CJM. An open controlled assessment of osteopathic manipulation in non-specific low back pain. *Spine* 1990;15:364–70.
50. Rasmussen GG. Manipulation in the treatment of low back pain: a randomized clinical trial. *Manuelle Medizin* 1979;1:8–10.
51. Postacchini F, Facchini M, Palieri P. Efficacy of various forms of conservative treatment in low back pain: a comparative study. *Neuro-Orthopedics* 1988;6:28–35.
52. Beyerman KL, Palmerino MB, Zohn LE, et al. Efficacy of treating low back pain and dysfunction secondary to osteoarthritis: chiropractic care compared with moist heat alone. *J Manipulative Physiol Ther* 2006;29:107–14.
53. Brønfort G. Chiropractic versus general medical treatment of low back pain: a small scale controlled clinical trial. *Am J Chiropractic Med* 1989;2:145–50.
54. Doran DML, Newell DJ. Manipulation in treatment of low back pain: a multicentre study. *BMJ* 1975;2:161–4.
55. Kinalski R, Kuwik W, Pietrzak D. The comparison of the results of manual therapy versus physiotherapy methods used in treatment of patients with low back pain syndromes. *J Manu Med* 1989;4:44–6.
56. Meade TW, Dyer S, Browne W, et al. Low back pain of mechanical origin: randomised comparison of chiropractic and hospital outpatient treatment. *BMJ* 1990;300:1431–7.
57. Rupert RL, Wagnon R, Thompson P, et al. Chiropractic adjustments: results of a controlled clinical trial in Egypt. *ICA Int Rev Chiropract* 1985;Winter:58–60.
58. Sims-Williams H, Jayson MI, Young SM, et al. Controlled trial of mobilisation and manipulation for patients with low back pain in general practice. *Br Med J* 1978;2:1338–40.
59. Sims-Williams H, Jayson MI, Young SM, et al. Controlled trial of mobilisation and manipulation for low back pain: hospital patients. *Br Med J* 1979;2:1318–20.
60. Williams NH, Wilkinson C, Russell I, et al. Randomized osteopathic manipulation study (ROMANS): pragmatic trial for spinal pain in primary care. *Fam Pract* 2003;20:662–9.
61. Wreje U, Nordgren B, Aberg H. Treatment of pelvic joint dysfunction in primary care: a controlled study. *Scand J Prim Health Care* 1992;10:310–5.
62. Zylbergold RS, Piper MC. Lumbar disc disease: comparative analysis of physical therapy treatments. *Arch Phys Med Rehabil* 1981;62:176–9.
63. Bishop PB, Quon JA, Fisher CG, et al. The Chiropractic Hospital-based Interventions Research Outcomes (CHIRO) study: a

randomized controlled trial on the effectiveness of clinical practice guidelines in the medical and chiropractic management of patients with acute mechanical low back pain. *Spine J* 2010;10:1055–64.
64. Blomberg S, Hallin G, Grann K, et al. Manual therapy with steroid injections–a new approach to treatment of low back pain. A controlled multicenter trial with an evaluation by orthopedic surgeons. *Spine (Phila Pa 1976)* 1994;19:569–77.
65. Delitto A, Cibulka MT, Erhard RE, et al. Evidence for use of an extension-mobilization category in acute low back syndrome: a prescriptive validation pilot study. *Phys Ther* 1993;73: 216–22.
66. Erhard RE, Delitto A, Cibulka MT. Relative effectiveness of an extension program and a combined program of manipulation and flexion and extension exercises in patients with acute low back syndrome. *Phys Ther* 1994;74:1093–100.
67. Godfrey CM, Morgan PP, Schatzker J. A randomized trial of manipulation for low back pain in a medical setting. *Spine (Phila Pa 1976)* 1984;9:301–4.
68. Grunnesjo MI, Bogefeldt JP, Svardsudd KF, et al. A randomized controlled clinical trial of stay-active care versus manual therapy in addition to stay-active care: functional variables and pain. *J Manipulative Physiol Ther* 2004;27:431–41.
69. Waterworth RF, Hunter IA. An open study of diflunisal, conservative and manipulative therapy in the management of acute mechanical low back pain. *N Z Med J* 1985;98:372–5.
70. Andersson GB, Lucente T, Davis AM, et al. A comparison of osteopathic spinal manipulation with standard care for patients with low back pain. *N Engl J Med* 1999;341:1426–31.
71. Hsieh CY, Adams AH, Tobis J, et al. Effectiveness of four conservative treatments for subacute low back pain: a randomized clinical trial. *Spine* 2002;27:1142–8.
72. Hurley DA, McDonough SM, Dempster M, et al. A randomized clinical trial of manipulative therapy and interferential therapy for acute low back pain. *Spine (Phila Pa 1976)* 2004;29:2207–16.
73. Mathews JA, Mills SB, Jenkins VM, et al. Back pain and sciatica: controlled trials of manipulation, traction, sclerosant and epidural injections. *Br J Rheumatol* 1987;26:416–23.
74. Santilli V, Beghi E, Finucci S. Chiropractic manipulation in the treatment of acute back pain and sciatica with disc protrusion: a randomized double-blind clinical trial of active and simulated spinal manipulations. *Spine J* 2006;6:131–7.
75. Coyer AB, Curwin I. Low back pain treated by manipulation. *Br Med J* 1955;1:705–7.
76. Nwuga VCB. Relative therapeutic efficacy of vertebral manipulation and conventional treatment in back pain management. *Am J Physical Med* 1982;1:160–4.
77. Gemmell HA, Jacobson BH. The immediate effect of activator vs. meric adjustment on acute low back pain: a randomized controlled trial. *J Manipulative Physiol Ther* 1995;18:453–6.
78. Sanders GE, Reinert O, Tepe R, et al. Chiropractic adjustive manipulation on subjects with acute low back pain: visual analog pain scores and plasma beta-endorphin levels. *J Manipulative Physiol Ther* 1990;13:391–5.
79. Helliwell PS, Cunliffe G. Manipulation in low back pain. *The Physician* 1987;187–8.
80. Terrett ACJ, Vernon H. Manipulation and pain tolerance. *Am J Physical Med* 1984;63:217–25.
81. Dunn KM, Croft PR. Epidemiology and natural history of low back pain. *Eura Medicophys* 2004;40:9–13.
82. Assendelft WJ, Bouter LM, Knipschild PG. Complications of spinal manipulation: a comprehensive review of the literature. *J Fam Pract* 1996;42:475–80.
83. Leboeuf-Yde C, Hennius B, Rudberg E, et al. Side effects of chiropractic treatment: a prospective study. *J Manipulative Physiol Ther* 1997;20:511–5.
84. Senstad O, Leboeuf-Yde C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. *Spine* 1997;22:435–40.
85. Hancock MJ, Maher CG, Latimer J, et al. Independent evaluation of a clinical prediction rule for spinal manipulative therapy: a randomised controlled trial. *Eur Spine J* 2008;17:936–43.
86. McAuley L, Pham B, Tugwell P, et al. Does the inclusion of grey literature influence estimates of intervention effectiveness reported in meta-analyses? *Lancet* 2000;356:1228–31.
87. Bekelman JE, Li Y, Gross CP. Scope and impact of financial conflicts of interest in biomedical research: a systematic review. *JAMA* 2003;289:454–65.
88. Okike K, Kocher MS, Mehlman CT, et al. Industry-sponsored research. *Injury* 2008;39:666–80.
89. Dagenais S, Gay RE, Tricco AC, et al. NASS Contemporary Concepts in Spine Care: spinal manipulation therapy for acute low back pain. *Spine J* 2010;10:918–40.
90. Foster NE, Hill JC, Hay EM. Subgrouping patients with low back pain in primary care: are we getting any better at it? *Man Ther* 2011;16:3–8.
91. Lamb SE, Hansen Z, Lall R, et al. Group cognitive behavioural treatment for low back pain in primary care: a randomised controlled trial and cost-effectiveness analysis. *Lancet* 2010;375: 916–23.
92. Rubinstein SM, Terwee CB, de Boer MR, et al. Is the methodological quality of trials on spinal manipulative therapy for low back pain improving? *Int J Osteop Med* 2012;15:37–52.
93. Rubinstein SM, van TM. A best-evidence review of diagnostic procedures for neck and low back pain. *Best Pract Res Clin Rheumatol* 2008;22:471–82.
94. Haldeman S. Is it time to discard the term "diagnosis" when examining a person with uncomplicated axial neck pain? *Spine J* 2011;11:177–9.

Bilag 6

THE INTERNATIONAL JOURNAL OF CLINICAL PRACTICE
Editor's Choice

SYSTEMATIC REVIEW

Assessing the risk of stroke from neck manipulation: a systematic review

M. J. Haynes,[1] K. Vincent,[2] C. Fischhoff,[2] A. P. Bremner,[1] O. Lanlo,[3] G. J. Hankey[4]

[1]The University of Western Australia, Crawley, WA, Australia
[2] Société Franco-Européenne de Chiropratique (SOFEC), Vilemoble, France
[3]Institut Franco-Européen de Chiropratique, Paris, France
[4]Stroke Unit, Department of Neurology, Royal Perth Hospital, Perth Australia; and School of Medicine and Pharmacology, the University of Western Australia, Perth, Australia

Correspondence to:
Michael J. Haynes
School of Population Health, The University of Western Australia, Stirling Hwy, Crawley, Perth, WA, 6009, Australia
Tel.: +69 8 9454 4711
Fax: +61 8 6488 1188
Email: mhaynes@fastmail.fm

Disclosures
Michael J Haynes, Karl Vincent, Cyril Fischhoff, Alexandra P Bremner, Olivier Lanlo, Graeme J Hankey have no conflicts of interest regarding this manuscript.

SUMMARY

Background: Strokes, typically involving vertebral artery dissection, can follow cervical spinal manipulative therapy, and these types of stroke occur rarely. There is disagreement about whether a strong association between neck manipulation and stroke exists. An earlier systematic review found two relevant studies of association that used controls, which also discussed the limitations of the two papers. Our systematic review updates the earlier review, and aims to determine whether conclusive evidence of a strong association exists. **Methods:** PRISMA guidelines for systematic reviews were followed, and the literature was searched using a strategy that included the terms 'neck manipulation' and 'stroke' from the PubMed, Embase, CINAHL Plus and AMED databases. Citations were included if they met criteria such as being case–control studies, and dealt with neck manipulation and/or neck movement/positioning. Papers were scored for their quality, using similar criteria to the earlier review. For individual criteria, each study was assigned a full positive score if the criterion was satisfied completely. **Results:** Four case–control studies and one case–control study, which included a case- crossover design, met the selection criteria, but all of them had at least three items in the quality assessment that failed to be completely positive. Two studies were assessed to be the most robustly designed, one indicating a strong association between stroke and various intensities of neck movement, including manipulation, and the other suggesting a much reduced relative association when using primary care practitioners' visits as controls. However, potential biases and confounders render the results inconclusive. **Conclusion:** Conclusive evidence is lacking for a strong association between neck manipulation and stroke, but is also absent for no association. Future studies of association will need to minimise potential biases and confounders, and ideally have sufficient numbers of cases to allow subgroup analysis for different types of neck manipulation and neck movement.

Review criteria

- A predefined search strategy, using the PUBMED, EMBASE, CINAHL PLUS and AMED medical databases, was employed to find studies that measured the association between neck manipulation and stroke. The study followed the PRISMA guidelines for systematic reviews, and the quality of each of the extracted studies was assessed using similar criteria that had been developed for a previous systematic review.

Message for the clinic

- Conclusive evidence seems to be lacking for a strong association between neck manipulation and stroke, and also appears to be absent for no association.
- Informed consent should be obtained from patients before neck manipulation is administered, advising them that neck movements, including manipulation, may increase the risk of a rare form of stroke.
- Premanipulative screening of vertebral arteries is still warranted, and Doppler ultrasound velocimetry shows potential for this.

Background

Neck manipulation, often referred to as cervical spinal manipulative therapy (cSMT), is a popular form of patient care. It is provided for the relief of cervical spine related conditions to approximately 80% of Australian chiropractic patients (1), and there are about 30% of Perth, Western Australian adults who have attended a chiropractor at some time in their life (2). There are also high levels of chiropractic utilisation in the USA and Canada, with 12% of adults attending a chiropractor per year, and 80% of visits involving SMT (3,4). Other health care practitioners, such as physiotherapists (5), osteopaths (6) and some medical practitioners (7) also provide cSMT.

It is recognised that cases of stroke, typically involving vertebral artery dissection (VAD) and to a lesser extent internal carotid artery dissection (ICAD), can occur soon after cSMT (8–10). There seems to be some consensus that cSMT and other neck movements can trigger cerebrovascular accidents in susceptible individuals, and that the precise incidence remains unknown. These strokes are generally considered to be rare, but there remains uncertainty about the level of contribution from cSMT (10,11).

Dissection of the vertebral artery (VA) and internal carotid artery (ICA) involves severe headache and neck pain before the presentation of stroke in approximately 80% of cases (12,13), and specific indicators for susceptibility are usually absent from the history

Int J Clin Pract, October 2012, 66, 10, 940–947, doi: 10.1111/j.1742-1241.2012.03004.x

and examination (10,13). Therefore, patients may present with dissection related pain in the belief that the pain is musculoskeletal, and cSMT may cause enlargement of the associated thrombus and/ or initiate embolisation leading to stroke (14,15). Such cases may either be cerebrovascular accidents in evolution, in which cSMT had hastened the inevitable (14), or strokes that occurred in patients for whom the dissection would have resolved spontaneously had the artery not been reinjured (16).

The fact that strokes can be triggered by ordinary daily activities involving movements or sustained positioning, especially cervical rotation and/or extension (17), suggests that not all stroke cases temporally related to cSMT have pre-existing arterial dissection. It seems likely that there is inherent fragility of the arterial wall (9) caused by genetic predisposition and biomechanical abnormalities, particularly of the VA during contralateral rotation, that increase the risk of dissection with neck movement (18).

There is controversy about the level of risk of stroke from cSMT, with one view claiming that there is a strong association between the two (19), and another suggesting that a strong association is absent (6). Rubinstein et al. (20) systematically reviewed the literature regarding potential risk factors for stroke from cranio-cervical artery dissection (CAD, which combines VAD and ICAD), including cSMT, and found two studies of association for cSMT that involved controls for comparison with cases. The first, by Rothwell et al. (21), indicated a strong association for cervical chiropractic visits within one week of a vertebrobasilar occlusive stroke. The second, by Smith et al. (22), found a strong association for cSMT within 30 days of CAD. However, both studies have major limitations that render their results inconclusive (20). Our systematic review updates Rubinstein et al. 's analysis for cSMT (20) and aims to assess the quality of the newer studies in comparison with the earlier ones, as well as to determine whether there is conclusive evidence of a strong association between cSMT and CAD stroke.

Methods

The design of this systematic review of the literature follows the Preferred Reporting Items for Systematic Reviews & Meta-Analysis (PRISMA) guidelines (23), as described in the following.

Protocol and registration

A specific registered protocol for systematic reviews of studies dealing with risk assessment seems to be lacking. We used a similar protocol to that employed by Rubinstein et al. (20) in their systematic review of risk factors for CAD for assessing the quality of the selected studies. Items are listed in Table 1 of the Results with some changes that we made as described in the following. We modified their item D to include socio-economic status matching, which is relevant to population-based case–control studies. Under 'Data analysis and presentation', we have added item N 'Positive if the analysis was likely to correct for confounders'. If the quality of the collected data was very poor, attempts at correcting confounding factors may be unsuccessful.

Eligibility criteria

Studies with designs, such as randomised control trial, cohort, case–control and case-crossover, were eligible for inclusion, whereas case reports, case series, abstracts and letters to the editor were excluded to ensure examination of the highest standard of research. Other criteria for inclusion were that studies: (i) had a population with a confirmed or assumed diagnosis of CAD, and also a control group, (ii) had individuals exposed to specific incidences of cSMT or mild neck trauma, noteworthy neck movements or positioning and (iii) were full reports. Studies were excluded if the dissections were because of surgery, arteriography or major trauma.

Information sources

Databases were accessed from 1966 to 2012, and included PubMed and Embase, which were last searched in 2005 by Rubinstein et al. (20), together with CINAHL Plus, and AMED.

Search and study selection

The search strategy used MESH headings that included: 'neck manipulation' combined (Boolean AND) 'stroke' with (NOT) 'surgery', with (NOT) 'animal'. Relevant combinations of free text terms, such as 'cervical manipulation' (AND) 'vertebral artery dissection' (OR) 'internal carotid artery dissection', were used for all databases. No restrictions were placed on the year of the study, gender or age of patients, or language. Papers were limited to those that deal with cSMT, or neck movement/positioning. All abstracts that met this search strategy were examined, as were the associated bibliographies. To test the reliability of the search strategy, both MJH and KV made searches, blinded from each other, using PubMed and the following string: 'neck manipulation' AND 'stroke', and these searches were compared.

Data extraction process

MJH collected only the eligible papers and scored their quality using the criteria set out in Table 1, whereas KV, CF, OL and GJH shared the papers between them and used the same scoring criteria. All five scorers were

Table 1 Methodological criteria for assessing the quality of studies on neck manipulation as a risk factor for vertebral/internal carotid artery dissection

	Rothwell et al. (21)	Smith et al. (22)	Dittrich et al. (24)	Cassidy et al. (25)	Thomas et al. (26)
Objective of the study					
A. Positive if the hypothesis and/or the objective of the study is clearly defined	+	+	+	+	+
Study population					
B. Positive if the main features of the study population were stated	+	+	+	+	+
C. Positive if the inclusion/exclusion criteria of the study population was clearly stated to enable replication of the study	+	+	+	+	+
D. Positive if controls were age-, sex-, and socio-economic status-matched, recruited in the same time frame as the cases, and were non-cerebrovascular stroke cases	+	–	–	+	–
E. Positive if subjects were consecutively included	+	–	+	+	?
Description of potential confounders					
F. Positive if comorbidity or concomitant disease, such as vascular risk factors, were reported and presented in the data	–	+	+	+	+
Assessment of risk factors					
G. Positive if neck manipulation was clearly defined	–	–	+	–	–
H. Positive if the outcome instruments used to determine the exposure to neck manipulation were valid and reliable	?	?	+	?	?
Assessment of outcome/disease (VA dissection)					
I. Positive if CAD, VAD, ICAD were clearly defined and the diagnosis of cases was confirmed	–	+	+	–	+
Blinded assessment					
J. Positive if determination of exposure was strictly applied without knowledge of outcome/disease status, when necessary	+	+	+	+	–
Data analysis and presentation					
K. Positive if the methods of statistical analysis were appropriately used and measures of association were estimated (including confidence intervals)	+	+	+	+	+
L. Positive if a stratified or multivariable analysis was used and potential confounders were used in the analysis	+	+	+	+	+
M. Positive if the number of cases examined in the final multivariable model were at least 10 times the number of independent variables used in the analysis	+	–	–	+	?
N. Positive if the analysis was likely to correct for all potential confounders	½+	½ +	½ +	½ +	½ +

KEY: '+' the item meets the criterion; '–' the item does not meet the criterion; '½ +' the item partially meets the criterion; '?' it is not clear that the criterion is met; 'N/A' the item does not apply to the study.

blinded from each other's results. Each study was scored for individual criteria using the following: a full positive score if the criterion was completely satisfied, a negative score if the criterion was not met in any way and a half positive score if the criterion was partially satisfied. Inadequately described items or items that were not applicable were noted. The scorers discussed their results and aimed to reach agreement, and in cases where agreement was not possible, APB made the final decision. If there were duplicated papers, we relied on the first paper.

Data items

Extracted data included characteristics of the study population, the risk factor, i.e. cSMT or neck movement/positioning, potential confounders and the strength of association.

Risk of bias in individual studies

The scorers addressed the types of potential bias that may occur in the selected papers, such as selection and recall bias. This was mainly done from the study level rather than the outcome level, and is discussed qualitatively rather than making any attempt to quantify the bias.

Summary measures

Results were expressed as crude odds ratios (OR_{crude}) and/or adjusted odds ratios (OR_{adj}), if available and 95% CIs.

Synthesis of results

We followed the example of Rubinstein et al. (20) and limited the analysis of data to that discussed thus far, and avoided any attempt to provide overall validity scores based on quality assessment. Rubinstein et al. (20) explained that such scoring may ignore the quality of individual items, and that it could result in some shortcomings being diluted.

Risk of bias across studies

To reduce the effect of publication bias, references in the primary source papers were also searched and assessed for eligibility.

Additional analysis

Other analyses, such as meta-analysis, were unlikely to be made because the Rubinstein et al. study found heterogeneity across their selection of studies that made pooling of results inappropriate. Subgroup analyses were unlikely to be achievable because of the small number of studies that are likely to be obtained.

Results

From 159 citations, using a search for 'neck manipulation' AND 'stroke' from PubMed, MJH and KV found the same five abstracts that fulfilled the criteria for inclusion, suggesting good reliability of the search strategy. The bibliographies of these papers, the other databases, and searches using different terms yielded no further relevant papers (Fig. 1).

The extracted studies are:

- Rothwell et al. (21), in a retrospective population-based nested case–control study, utilised hospitalisation records to identify cases and public health insurance billing records to detect exposures. Cases were patients with vertebrobasilar occlusive stroke, of whom an unknown proportion included VAD cases. Their exposure to cSMT, using cervical spine related visits to chiropractors as a proxy, was compared with age and sex-matched non-stroke controls. For those aged < 45 years, a strong measured association was found within 1 week of the stroke, with four cases (3.6%) compared with four controls (0.9%) [OR $_{crude}$ = 3.94 (95% CI = 0.99–15.78), (non-parametric bootstrap 95% CI = 0.64–46.28)];
- Smith et al. (22), in a retrospective nested case–control study, interviewed volunteer patients with confirmed diagnosis of CAD and age and sex-matched controls who had suffered from other causes of stroke. Their exposures to cSMT within 30 days of their stroke were compared, and there was a strong measured association, with seven cases of VAD (14%) compared with three controls (3%) [OR $_{adj}$ = 6.62 (95% CI = 1.4–30)] (20);
- Dittrich et al. (24), conducted a prospective case–control study, and identified exposure to cSMT and other activities involving various forms of neck movement through interview. Cases were patients with confirmed CAD, and controls were age and sex-matched patients who had suffered other types of stroke. There were seven cases (12.8%) who reported cSMT within 7 days of the CAD compared with three controls (6.4%). Differences in odds failed to reach significance [OR $_{crude}$ = 2.1 (95% CI = 0.5–9.1); OR $_{adj}$ = 1.5 (95% CI = 0.3–6.9), p = 0.3]. In a cumulative analysis of all the mechanical trigger factors, including cSMT, a significant difference was found between the two groups (p = 0.01);
- Cassidy et al. (25) is an extension of the Rothwell et al. (21) study using similar data, and is a population-based case–control and case-crossover study. They aimed to control confounding due to: (1) the pain presentation of VAD by comparing exposures of cervical related visits between those for chiropractors and primary care practitioners (PCPs) and (2) differences in health status of chiropractic and PCP patients using a case-crossover design. To factor in the unknown proportion of vertebra-basilar occlusive strokes caused by VAD, they performed a sensitivity analysis with positive predictive values for VAD ranging from 0.2 to 0.8;

Positive associations, especially with cervical and headache related visits, were only observed for chiropractic patients aged < 45 years, with 25 cases (24.5%) and 27 controls (6.6%) within 7 days for general visits. For headache or cervical visits within

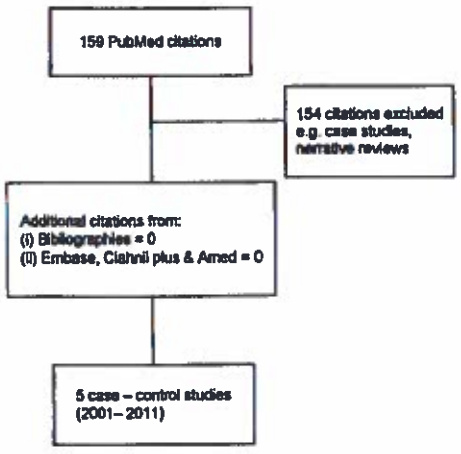


Figure 1 Flow diagram of the literature search strategy and its results

7 days, results in the case-control study were OR $_{crude}$ = 3.11 (95% CI = 1.16–8.35) and accelerated bias corrected bootstrap 95% CI = 1.07–9.60, and for visits within 3 days the case-crossover study gave OR $_{crude}$ = 17.7 (95% CI = 2.04–153.3), bootstrap unavailable. However, for the PCP visits similar associations were observed for patients aged < 45 years and ≥ 45 years. For headache or cervical visits within 7 days for patients aged < 45 years, the case–control study resulted in OR $_{crude}$ = 37.60 (95% CI = 4.80–294), and for within 3 days the case-crossover study yielded OR $_{crude}$ = 28.00 (95% CI = 3.44–227.58), and in both cases the bootstrap was unavailable. Sensitivity analysis resulted in attenuation of the estimates towards the null with lower positive predictive values, but the associations remained positive and significant (data not presented);

- Thomas et al. (26), in a retrospective case–control study, used hospital records to identify cases of CAD, most that were later confirmed, and exposures to cSMT and other instances of recent head or neck trauma within 3 weeks of the stroke. Age and sex-matched controls were patients with other types of stroke. They measured a strong association for cSMT with 11 cases (eight VAD, three ICAD) (23%) compared with controls (4%) [OR $_{crude}$ = 12.80 (95% CI = 1.58–104.3), OR $_{adj}$ = 12.7 (95% CI = 1.43–112.0)]. There was a strong observed association with recent head or neck trauma, with 30 cases (17 VAD, 13 ICAD) (64%) compared with three controls (7%) [OR $_{crude}$ = 25.5 (95% CI = 5.71–96.9) and OR $_{adj}$ = 23.5 (95% CI = 5.71–96.9)].

Tables 1 and 2 list the scores of quality assessment, and potential confounders for each of the five studies respectively. In Table 1, for each study, there were at least three out of the 14 items that failed to score completely positively, with the only prospective study, Dittrich et al., scoring the highest number of positive items, i.e. 11.5. Table 2 indicates that each study had at least three potential confounders and/ or biases.

Discussion

Potential confounders and biases

As per Table 2, information bias in the studies by Rothwell et al. (21) and Cassidy et al. (25) relates to the inaccuracy of using the ICD 9 hospital coding to

Table 2 Potential biases and confounders with their direction and strength

Studies	Potential biases & confounders	Possible effect on estimate of association
Rothwell et al. (21)	Information bias	
	Cases	Increase
	Exposures	Increase
	Confounders	
	VAD pain	Large increase
	Preferential diagnosis	Increase
Smith et al. (22)	Bias	
	Selection	Large increase
	Recall	Increase
	Confounder	
	Stroke controls	Increase
Dittrich et al. (24)	Bias	
	Recall	Increase
	Confounder	
	Stroke controls, VAD pain	Increase
Cassidy et al. (25)	Information bias	
	Cases	Increase
	Exposures	Increase or relative decrease
	Confounders	
	Preferential diagnosis	Increase
	Preferential extreme headache presentation to PCPs?	Relative decrease
	More PCP patients sporadic binge drinking & with acute infection?	Relative decrease
Thomas et al. (26)	Information bias, including Recall	Large increase
	Confounder	
	Stroke controls, VAD pain	Increase

identify cases of VAD (21,25). Non-VAD cases are perhaps more likely than VAD cases to have occurred co-incidentally with chiropractic visits because of sampling error, leading to an over-estimation of the association. Cassidy et al. attempted to validate their findings through sensitivity analysis, but set the lower limit of the positive predictive value at 0.2 (25), which may not have been low enough. In a study by Bogouslavski et al. (27), the proportion of vertebrobasilar occlusive strokes that were VAD related can be calculated to be approximately 8% (i.e. 17 dissection cases out of 213 vertebrobasilar occlusive strokes).

Information bias for identifying exposures for the two population-based studies is possible because of inaccuracy of the public health insurance billing codes for chiropractic and PCP visits. Some chiropractic visits may not have involved cSMT, thereby inflating the observed association, and some PCPs may have administered cSMT, which would have decreased the measured relative association for chiropractic visits. To obtain exposures retrospectively, Thomas et al. (26) relied on the hospital policy of asking all young stroke patients at the time of admission about cSMT and neck/head trauma; however, there may have been substantial non-compliance when dealing with patients lacking pain suggestive of CAD, i.e. mainly the controls. They (26) found only 9% of controls had cSMT or neck/head trauma within 3 weeks compared with the prospective Dittrich et al. study (21) that found perhaps up to 87.2% of controls who had cSMT and/or minor neck/head trauma within 1 week. This suggests significant under-reporting for the Thomas et al. study (26), which could have caused a marked over-estimation of association for cSMT and neck/head trauma.

The use of stroke patients for controls might artificially inflate the association for cSMT because less healthy and stroke-prone individuals, often with a lower socio-economic background, are less likely to attend a chiropractor (3,4). Selection bias especially, and recall bias may occur as patients who have suffered CAD following cSMT, and been told that they have a tear in their artery, have greater motivation to participate in an interview and are more likely to recall cSMT than patients with other forms of stroke. Smith et al. (22) had 72 out of 151 CAD patients volunteer for their survey, which would allow scope for major selection bias, especially considering that Dittrich et al.'s prospective study, which had avoided selection bias observed much lower ORs (24).

Patients with headache and neck pain from CAD may seek cSMT for relief, thereby causing an over-estimation of association (21,25). Cassidy et al.'s (25) use of PCP visits for comparison with control for pain confounding, could have introduced other confounders that artificially raised the baseline for comparison. PCPs prescribing Viox and other non-steroidal anti-inflammatory drugs (NSAIDs) might have contributed to occlusive strokes (28,29), which can be heralded by severe headache (30,31). Patients with extremely severe headache from CAD may have been more likely to see a PCP (32) than a chiropractor if the patient thought that the pain could be caused by a tumour or a bleed in the brain.

Cassidy et al. (25) used a case-crossover design to correct for the lower health status of PCP patients, (4) but this design is limited in controlling factors that can change rapidly (33,34). Binge drinking (35) and acute infection (36) may precipitate occlusive strokes, which are capable of causing severe headache before stroke presentation (30,31). If PCP patients are more prone to sporadic binge drinking, and acute infection than chiropractic patients, this could lead to baseline elevation of the PCP visit association for the case-crossover analysis. Cassidy et al. (25) suggested that a bias towards an increased association for chiropractic visits may occur because of a tendency of stroke specialists to be more inclined to order MRA or other imaging to confirm suspect VAD for patients who have reported previous cSMT than for other patients.

Clinical implications

Although Dittrich et al. (24) and Cassidy et al. (25) seem to be the two most robustly designed studies, considerable imprecision exists for all the studies. Therefore, conclusive evidence is absent for a strong association between cSMT and CAD, and is also lacking for no association. Considering this uncertainty, informed consent is warranted for cSMT that advises patients of a possible increase in the risk of a rare form of stroke, which also applies to other neck movements.

An accurate risk-benefit analysis for cSMT remains unavailable and additional research in this field is needed. However, the same need for research seems to apply to other therapies for neck related conditions, such as cervical mobilisation and electro-physical modalities, which also require informed consent. The potential risks of cSMT need to be placed in context with the high gastrointestinal complication rate of many NSAIDs used for arthritic conditions including neck pain that have caused many fatalities (37) including a very small proportion of relatively young and otherwise healthy individuals (38), and also the serious cardiovascular adverse effects of these medications (28,29).

According to Gordis: "If the absolute risk is low, even if the relative risk is significantly increased to

exposed individuals, the actual risk to exposed individuals will still be very low" (39). Stroke following cSMT is rare (10,11), and our study reveals that there is an absence of conclusive evidence of a strong association. Considering the uncertainties inherent with clinical care, we agree with Cassidy et al., who suggested that a patient's preference for cSMT should be respected (25).

As the possibility of an association between cSMT and VAD is unable to be ruled out, practitioners of cSMT are obliged to take all reasonable steps that aim to minimise the potential risk of stroke. There is evidence that cervical rotation places greater stresses on vertebral arteries than other movements such as lateral flexion (40), and so it would seem wise to avoid techniques that involve full rotation of the head. It would be helpful to be able to detect the haemodynamic changes related to VAD in neurologically silent cases, and premanipulative screening of VAs using Doppler ultrasound velocimetry has potential for this (18). As an example of its utilisation, Doppler velocimetry is taught to chiropractic students at the Institut Franco-Européen de Chiropratique as part of the routine screening of all their patients prior to the initial neck manipulation.

Conclusion

All of the extracted studies yielded inconclusive evidence regarding a strong association or no association between cSMT with CAD related stroke. Future studies regarding CAD risk need to aim to eliminate or at least minimise bias and confounding. Ideally, studies should have sufficient numbers of patients to enable subgroup analyses regarding different types of cSMT and neck movements/positioning. However, the rarity of these strokes will make accurate measurements of association very difficult, and it may not be achievable in the foreseeable future.

Author's contributions

MJH was responsible for the study design, extracted the relevant citations, scored studies for their quality, determined the presence of biases and confounders, and was responsible for referencing, and writing the manuscript. KV, CF, OL and GKH scored the relevant studies in a blinded fashion, checked for biases and confounders, and provided input regarding the manuscript. APB made the final decision in cases where consensus was unable to be reached, provided statistical advice regarding the studies and assisted in drafting the manuscript.

Acknowledgements

We gratefully acknowledge Fonds de Dotation pour la Recherche en Chiropratique (FDRC) for a grant that covered the costs of Open Access publication.

References

1 Ivancic IJ, Bryce D, Bolton PS. Use of prevocational test by clinicians to predict vulnerability of patients to vertebrobasilar insufficiency. *Chiror J Aust* 1993; 23: 59–63.

2 Stratton RG, Sweeney J, Grandage J. *Review of the Relationship of Chiropractic Services to the Public Health System in Western Australia Community Health Survey Report*. Perl, Western Australia: Perth Institute for Social Program Evaluation, Murdoch University, 1990: 75–6.

3 Hurwitz EL, Coulter ID, Adams AH et al. Use of chiropractic services from1985 through 1991 in the United States and Canada. *Am J Public Health* 1996; 88: 771–6.

4 Hurwitz EL, Chiang LM. A comparative analysis of chiropractic and general practitioner patients in North America and general practitioner patients in North America: findings from the joint Canada/United States Survey of Health, 2002-3. *BMC Health Serv Res* 2006; 6: 49–66.

5 Magarey ME, Rebbeck T, Coughlan B, Grimmer K, Rivett DA, Refshauge K. Pre-manipulative testing of the cervical spine review, revision and new clinical guidelines. *Man Ther* 2004; 9: 95–100.

6 Reggars J, French S, Walker B et al. Risk management for chiropractors and osteopaths: neck manipulation and vertebrobasilar stroke. *Aust Chiropr Osteopathy* 2003; 1: 9–15.

7 Haynes MJ. Stroke following cervical manipulation in Perth. *Chiropr J Aust* 1994; 24: 42–6.

8 Assendelft WJ, Bouter LM, Knipschild PG. Complications of spinal manipulation. A comprehensive review of the literature. *J Family Pract* 1996; 42: 475–80.

9 Rubinstein SM, Haldeman S, van Tulder MW. An etiologic model to help explain the pathogenesis of cervical artery dissection: implications for cervical manipulation. *J Manipulative Physiol Ther* 2006; 29: 336–8.

10 Lee VH, Brown RD Jr, Mandrekker JN, Mokri B. Incidence and outcome of cervical artery dissections: a population based study. *Neurology* 2006; 67: 1809–12.

11 Kapral MK, Bondy SJ. Cervical manipulation and the risk of stroke. *CMAJ* 2001; 165: 907–8.

12 Silbert PL, Mokri B, Schievink WL. Headache and neck pain in spontaneous internal carotid and vertebral artery dissections. *Neurology* 1995; 45: 1517–22.

13 Schievink WI. Current concepts: spontaneous dissection of the carotid and vertebral arteries. *New Eng J Med* 2001; 344: 898–906.

14 Terrett AGJ. *Malpractice Avoidance for Chiropractors: Vertebrobasilar Complications Following Spinal Manipulation*. West Des Moines: National Mutual Chiropractic Insurance Company; 1996:15.

15 Michaud TC. Uneventful upper cervical manipulation in the presence of a damaged vertebral artery. *J Manipulative Physiol Ther* 2002; 25: 472–8.

16 Mas JL, Henin D, Bousser M, Chain F, Hauer J. Dissecting aneurysms of the vertebral artery and cervical manipulation. A case report with autopsy. *Neurology* 1989; 39: 512–5.

17 Haldeman S, Kohlbeck FJ, McGregor M. Risk factors and precipitating neck movements causing vertebral artery dissection after cervical trauma and spinal manipulation. *Spine* 1999; 24: 785–94.

18 Haynes MJ. Vertebral arteries and cervical movement: Doppler ultrasound for pre-manipulative screening. *J Manipulative Physiol Ther* 2002; 9: 556–67.

19 Ernst E. Vascular accidents after neck manipulation. Cause or coincidence? *Int J Clin Practice* 2010; 64: 673–7.

20 Rubinstein SM, Peerdeman SM, van Tulder MW, Riphagen I, Haldeman S. A systematic review of the risk factors for cervical artery dissection. *Stroke* 2005; 36: 1575–8.

21 Rothwell DM, Bondy SJ, Williams JI. Chiropractic manipulation and stroke. A population -based case-control study. *Stroke* 2001; 32: 1054–60.
22 Smith WS, Johnston SC, Skalabrin EJ et al. Spinal manipulative therapy is an independent risk factor for vertebral artery dissection. *Neurology* 2003; 60: 1424–8.
23 Moher D, Liberati A, Tetzlaff J, Altman DG, the PRISMA Group. The preferred reporting items for systematic reviews and meta-analysis: the PRISMA statement. *PLOSMed* 2009; 6: e1000097–103.
24 Dittrich R, Rohsbach D, Heidbreder A et al. Mild mechanical traumas are possible risk factors for cervical artery dissection. *Cerebrovasc. Dis* 2006; 23: 275–81.
25 Cassidy JD, Boyle E, Cote P et al. Risk of vertebrobasilar stroke and chiropractic care: results of a population based case-control and case-crossover study. *Spine* 2008; 33(Suppl. 4): 176–83.
26 Thomas LC, Rivet DA Thomas LC, Rivet DA Attia JR, Parsons M, Levi C. Risk factors and clinical features of craniocervical dissection. *Man Ther* 2011; 16: 351–6.
27 Bogousslavsky J, Van Melle G, Regli F. The Lausanne stroke registry: analysis of 1,000 consecutive patients with first stroke. *Stroke* 1988; 19: 1083–92.
28 Bottone FG, Barry WT. Postmarketing surveillance of serious adverse events associated with the use of rofecoxib from 1999-2002. *Curr Med Res Opin* 2009; 25: 1535–50.
29 Caughey GE, Roughhead EE, Pratt N, Killer G, Gilbert AL. Stroke risk and NSAIDs: an Australian population based study. *MJA* 2011; 195: 525–9.
30 Schwedt TJ, Dodick DW. Thunderclap stroke: embolic cerebellar infarcts presenting as thunderclap headache. *Headache* 2006; 46: 520–2.
31 Gosrau G, Dannenburg C, Reichmann H, Sabatowski R. Thunderclap headache caused by cerebellar infarction. *Schmerz* 2008; 22: 82–6.
32 Maigne JY. Letter to the editor. *Spine* 2008; 33: 2838.Re: Cassidy JD, Boyle E, Cote P, He Y, Hogg-43.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(Suppl. 4): 176–83.
33 Redelmeir DA, Tibshirani RJ. Interpretation and bias in case cross-over studies. *J Clin Epidemiol* 1997; 50: 1281–7.
34 Koepsell TD, Weiss NS. *Epidemiological Methods. Studying the Occurrence of Illness.* Oxford: Oxford University Press, 2003: 409–10.
35 Reynolds K, Lewis B, Nolan JDL, Kinney JL, Sathya B, He J. Alcohol consumption and risk of stroke. *JAM* 2003; 289: 579–88.
36 Palm F, Urbanec C, Grau A. Infection, its treatment and the risk for stroke. *Curr Vasc Pharmacol* 2009; 7: 146–52.
37 Dabbs V, Lauretti WJ. A risk assessment of cervical manipulation vs NSAIDs for the treatment of neck pain. *J Manipulative Physiol Ther* 1995; 25: 42–6.
38 Tsokos M, Schmoldt A. Contribution of nonsteroidal anti-inflamatory drugs to deaths associated with peptic ulcer disease: a prospective toxicological analysis of autopsy blood samples. *Arch Pathol Lab Med* 2001; 125: 1572–4.
39 Gordis L. *Epidemiology.* Philadelphia: Saunders, 2009: 102.
40 Haynes MJ. Doppler studies comparing the effects of cervical rotation and lateral flexion on vertebral artery blood flow. *J Manipulative Physiol Ther* 1996; 19: 378–84.

Paper received April 2012, accepted July 2012

SPINE Volume 22, Number 4, pp 435–441

Frequency and Characteristics of Side Effects of Spinal Manipulative Therapy

Ola Senstad, DC,* Charlotte Leboeuf-Yde, DC, MPH, PhD,† and Christian Borchgrevink, MD‡

Study Design. A prospective clinic-based survey.

Objectives. To study the type, frequency, and characteristics of unpleasant side effects after spinal manipulative therapy.

Summary of Background Data. Spinal manipulative therapy is a commonly used treatment, but there is little knowledge of its side effects.

Methods. Information regarding unpleasant reactions after spinal manipulative therapy was collected after 47[illegible] treatments on 1058 new patients by 102 Norwegian chiropractors (response rate, 70%) through structured interviews.

Results. At least one reaction was reported by 55% of the patients some time during the course of a maximum of six treatments. Of the reported reactions, the most common were local discomfort (53%), headache (12%), tiredness (11%), or radiating discomfort (10%). Reactions were mild or moderate in 85% of patients. Sixty-four percent of reactions appeared within 4 hours of treatment, and 74% had disappeared within 24 hours. Uncommon reactions were dizziness, nausea, hot skin, or "other" complaints, each accounting for 5% or less of reactions. It was unusual that symptoms commenced later than on the day after treatment, were of long duration (more than the latest on the day after onset), were rated as severe, or that they resulted in reduced activities of daily living. There were no reports of serious complications in this study.

Conclusions. Results showed a clear pattern of common and uncommon reactions to spinal manipulative therapy and their frequency, duration, and severity. [Key words: chiropractic, [illegible], incidence, side effects, spinal manipulative therapy] Spine 1997;22:435–441

The clinical value of spinal manipulative therapy (SMT) has been tested extensively in controlled clinical trials. A recent meta-analysis concludes that the method is effective in the management of low back pain,[10] and a contemporary guideline on acute low back problems in adults produced by a multidisciplinary expert panel recommends the use of SMT.[1] Because SMT is becoming increasingly accepted and used, it is important to study all aspects of its clinical outcome, including the negative ones.

Several types of severe side effects of SMT, such as cauda equina,[3] residual neurologic deficit, tetraplegia, and death,[13] have been reported. Attempts have been made to estimate their frequency, either by reviewing the literature for such reports[12,14] or by collecting retrospective information from the health care community.[4] Examples of estimates of the risk for severe accidents are less than five cases of stroke per 100,000 patients who had received cervical manipulation from a chiropractor during a 5-year period[4] and one case per 300,000–500,000 cervical manipulations.[12]

It is rare for SMT to cause life-threatening or severely crippling accidents. Nonetheless, it is a well-accepted clinical fact that SMT often results in other, less severe side effects, usually referred to by chiropractors as "normal reactions" and "adverse reactions."[5] Attempts have been made to describe and classify these based on clinical experience. For example, Kleynhans[5] lists some reactions, dividing them into "functional" and "painful." His examples of common reactions are perspiration over trunk and axillae (very common), early or heavy menstruation (often), diffuse pain lasting less than 2 days (40% of patients), muscular aches and pains (frequent in patients with good results), and epigastric pain (not rare), whereas he lists as "rare" episodes of generalized tremor, fainting, palpitation, cold perspiration, and nausea (one to two cases in 1000). According to Maigne,[7] abdominal bloating and diarrhea also can occur.

Because no information could be found based on systematic clinical observations regarding the type, incidence, period of latency, duration, or severity of reactions to SMT, the current study was undertaken.

■ Methods

A prospective survey was conducted among chiropractors in Norway, each of whom were asked to recruit 12 consecutive new patients. To be included, these patients had to make at least one return visit, be aged 7 years or older, and have received treatment to the spinal column. The chiropractor noted

From the *Private practice, Harstad, Norway, the †Nordic Institute for Chiropractic and Clinical Biomechanics, Odense, Denmark, and the ‡Ullevål Hospital, Oslo, Norway.
Supported by a grant from the Research Council of Norway. Computer equipment was provided by the Norwegian Chiropractors' Association and the Swedish Chiropractors' Association.
Acknowledgment date: October 31, 1995.
First revision date: February 6, 1996.
Second revision date: July 23, 1996.
Acceptance date: July 31, 1996.
Device status category: 1.

the patients' age and sex, what spinal regions had been treated, and the type of treatment undertaken.

Patients were asked by the treating chiropractor if they had experienced any unpleasant reactions after the *previous* treatment and, if so, to explain what was felt. If the answer was "yes," the patient was asked three questions for each type of reaction:

How long time after the treatment did the reaction start?

How long did the reaction last?

Could you perform your daily activities?

In addition, the patient was asked to grade the discomfort of each reaction on a scale from 1 to 4, with 1 being "minor discomfort" and 4 being "unbearable discomfort."

The chiropractor fit the answers into a closed-ended questionnaire, previously tested in a pilot study,[9] with the possibility to include additional symptoms. This was done at the return visits after a maximum of six treatments. The patient thus had to complete seven visits for the recording of six treatments.

Instructions to the chiropractors were provided by letter and in newsletters from the Norwegian Chiropractors' Association at the beginning of the study and again halfway through the study. The questions to the patient were stated clearly on the questionnaire, and the chiropractor was informed to read them exactly as written. The chiropractor also was instructed to inform patients of the purpose of the study, assure them of anonymity in the study, and to tell them that participation was voluntary. Patients were known to the chiropractor but identified only as a code number on the questionnaire. Patients therefore could be identified as belonging to a specific chiropractor through this code number, but the identity of this chiropractor was unknown to the research team.

All but three (one nonmember of the national association, the first author, and his assistant) of the 151 registered chiropractors practicing in Norway in early 1994 were invited to participate in the study. Two declined (one because of illness and the other because he no longer accepted new patients).

By May 1994, about 50% of the chiropractors had returned their data. Because the identity of respondents was unknown to the research team, a new set of identical questionnaires was sent to all chiropractors. They were asked this time to monitor their first 10 new patients, if they had not already collected their information. Data collection was interrupted in October 1994.

Results have been reported as descriptive statistics with percentages rounded off to whole figures. The analysis included the 95% confidence intervals, but because these rarely varied more than two or three points on either side of the point estimate, these have not been included in the text. When several types of reactions were recorded after one treatment, a maximum of the two most severe or long-lasting ones was selected, and the most severe or long-lasting of these was chosen if the analyses allowed only for one symptom to be included.

According to the local research ethics committee, no permission was necessary for this type of study because it was considered a quality-assurance project consisting of information normally obtained in practice, and all information submitted for central analysis was anonymous (Professor B. Strømme, personal communication, June, 1992).

Table 1. Number of Revisits per Patient

Number of Revisits	Number of Patients	Percentage Patients
1	37	3.5
2	111	10
3	176	17
4	151	14
5	178	17
6	405	38

Results

Description of Study Sample

Of the 146 chiropractors, 102 (70%) participated in the study. One thousand, one hundred and nineteen sets of questionnaires were returned, 61 of which did not fulfill the inclusion criteria or were too incomplete for analysis, resulting in 1058 acceptable sets. Because not all patients' treatments were recorded six times, the number of questionnaires with valid information was 4712.

The patients consisted of 556 women (53%) and 502 men (47%). Twenty-one percent were aged 7–26 years, 52% were aged 27–46 years, 22% were aged 47–66 years, and 4% were aged 67–88 years.

The number of return visits per patient ranged between one and six, with six being the most common (truncated data; Table 1).

The lumbar, thoracic, and cervical regions were treated in 9% of patients, two of these regions in 32%, and only one region in 59% of patients. The cervical and thoracic spines accounted for 9%, respectively, and the lumbar spine for 82% of these sole-segment treatments. Altogether, 75% of the recorded treatment sessions included treatment to the lumbar spine, 42% to the thoracic spine, and 33% to the cervical spine.

Thirty-eight percent of all recorded treatment sessions were reported to have consisted of only regular SMT, usually described as short-lever dynamic thrusts[10] or high-velocity, low-amplitude thrust techniques.[8] In 36% of recordings, regular SMT was combined with soft-tissue treatment. A combination of several methods was noted in 25% of patients. Traction only or soft-tissue treatment only was recorded in less than 1% each.

Number of Reactions

Altogether, 580 patients (55%) reported at least one reaction at least once through the period of observation, and of the 4712 treatments, 1174 (25%) resulted in at least one type of reaction. Two reactions or more were reported after 251 (5%) treatments.

Types of Reactions

Among the reported side effects, the most common was local discomfort, which accounted for more than half of the symptoms, followed by headache, tiredness, and radiating discomfort, which together accounted for another one third. Reports of dizziness, nausea, and skin were rare (Figure 1).

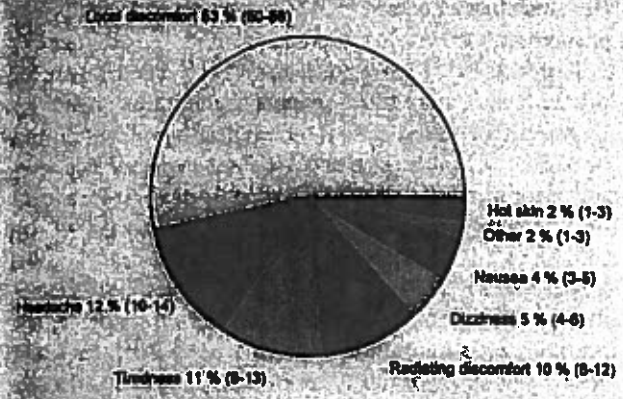


Figure 1. Types of reactions (n = 1421). Up to two types of reactions were recorded per patient and registration. (Seven cases of reports of a third reaction were excluded from the analysis, by removing the least conspicuous of the three, *i.e.*, the least troubling or least long-lasting.)

Most types of reactions were listed under the suggested symptoms on the questionnaire, but 31 replies (2%) were specified under "other." For a description of these, see Table 2.

Onset and Duration of Reactions

Most of the reactions (64%) began within 4 hours, and most (74%) had disappeared within the first 24 hours (Table 3).

Table 2. Specific Types of Reactions Provided Under the Heading of "Other"

Altered sensitivity
Feeling of pinprick in scalp for few minutes
Prickly feeling in scalp
Numb sensation in skin
Chilliness (general and local)
Feeling of swollen face
Visible changes
Skin rash
Gastrointestinal symptoms
Vomited 2 hours after treatment
Stomach pain
Constipation
Chest symptoms
Feeling of tightness in chest
Difficult to breathe
Psychological symptoms
Crying and depression
Crying and anxiety
Aggression
Oversensitivity to sounds
Restless, tense sleep
Feeling of remoteness
Feeling physically tense all night
Feeling of heaviness all over
Symptoms in ears
Buzzing in the ears
Pain in the ears
Dripping in ears
Musculoskeletal reactions not expected from treatment
Tenderness and stiffness in extremities
Cramps in legs
Shoulder pain
Stiffness in legs

Table 3. Onset and Duration of Reactions*

Onset of Reaction After SMT	Number	% (95% CI)
Within 10 minutes	198	17 (15–19)
Between 10 minutes and 4 hours	556	47 (44–50)
After 4 hours (usually day of treatment or following day)	373	32 (29–35)
Not stated	47	4 (3–5)
Reactions disappeared	**Number**	**% (95% CI)**
During day of treatment	864	74 (72–76)
During day 2	183	16 (14–18)
During day 3 or later	81	7 (6–8)
Not stated	48	4 (3–5)

* n = 1174. If several reactions were reported at the same recording, the one that was the most severe or lasted the longest was included in the analysis. SMT = spinal manipulative therapy. CI = confidence interval.

Among the different types of reactions, radiating discomfort lasted the longest, more than 24 hours in 64%, followed by local discomfort (51%). The values for the other types of reactions ranged between 25% and 45%.

Severity of Reactions

The reactions were mainly characterized as mild (35%) or moderate (50%). Fourteen percent were described as definitely unpleasant and 1% as unbearable. In 11%, it was stated that patients could not perform their daily activities after SMT because of reactions.

There was no association between severity of reaction and the number of recorded sessions. This indicates that people with severe reactions usually were not dismissed from treatment earlier than others.

All types of reactions but one exhibited the same pattern in relation to the reported degree of severity; mild and severe were reported less frequently than moderate. The only exception was tiredness, which most often was characterized as mild, followed by moderate and, least often, severe (Figure 2).

Radiating discomfort was reported as severe (26%) significantly more often than, for example, local discomfort (15%).

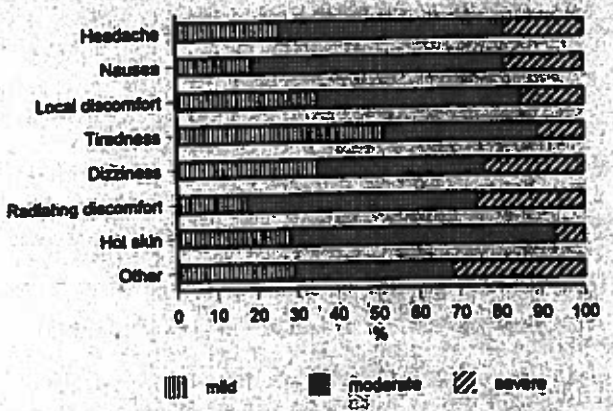


Figure 2. Type of reaction by severity.

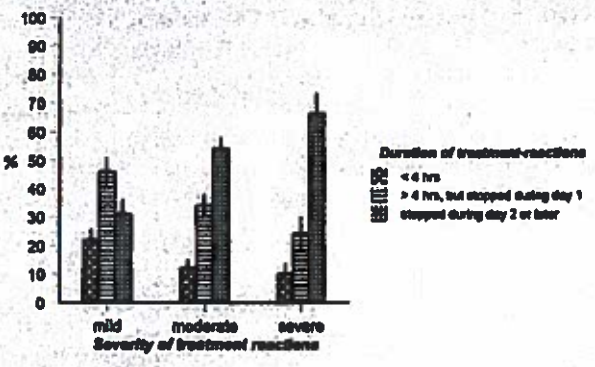


Figure 3. Duration of treatment reactions by severity of treatment reactions.

There was a positive association between the severity and duration of reactions (Figure 3).

A closer look at the 14 reports of "unbearable discomfort" reveals that these came from 12 people, two men and 10 women (two of the women reported unbearable discomfort after two treatment sessions each; Table 4). After three of these 14 treatments, daily activities had been reduced, and in most instances (nine of 14), such reactions lasted into day 2 or longer.

Discussion

In clinical practice, it is important to differentiate between "normal" and "abnormal" side effects because the latter may indicate a need to reconsider diagnosis or therapy. Although chiropractors and others who extensively use SMT procedures probably have learned intuitively to discern usual from unusual reactions in their patients, no information based on systematic clinical observations exists that can confirm or refute such empirical experience.

Table 4. Description of 14 Cases of "Unbearable Discomfort" Reported by 12 Patients*

Case	Type of Reaction	Reaction Lasted Into	Reduced Daily Activities
1	Headache and nausea	Day 2	No information provided
2†	Tiredness and oversensitivity to sound	Day 2	Yes
	Prickly feeling in scalp and tiredness	Day 1	No
3†	Headache and nausea	Day 3	No
	Headache and nausea	Day 3	No
4	Local discomfort	Day 2	No
5	Headache	Day 1	Yes
6	Local discomfort	Day 2	No
7	Local discomfort	Day 3	No
8	Local discomfort	Day 1	Yes
9	Vomiting and headache	Day 1	No
10	Headache	Day 1	No
11	Local and radiating discomfort	Day 3	No
12	Local discomfort and dizziness	Day 3	No

* When two reactions have been listed, the first symptom is the most severe or long-lasting.
† Same person reported "unbearable discomfort" after two separate treatment sessions

The results of this study may help differentiate between these side effects. According to the Norwegian Chiropractors' Association, the estimated mean number of patient visits per chiropractor per year is 5700 (personal communication, the Chairman of the Norwegian Chiropractors' Association). Hence, the results of this study (including 4712 patient visits) should reflect what a Norwegian chiropractor can expect to encounter in clinical practice over a period of almost 1 year, at least if he or she sees many new patients.

Can the Data Be Trusted?

To obtain optimum cooperation from the chiropractors and to maximize the response rate among patients, we opted for a model that could be as closely integrated into the clinical situation as possible. This study design has its strengths and weaknesses.

For example, there was broad representation among Norwegian chiropractors, and the sample size of patients was large and the number of treatments was many. But because chiropractors returned their questionnaires anonymously, it was impossible to compare the responders with the nonresponders. It also was impossible to obtain reports from patients who refused to participate in the survey, those who attended one treatment only, or those who interrupted treatment before the sixth revisit. It is, of course, possible that the latter two groups opted out because of unpleasant reactions. On the other hand, a recent quality-assurance study of Swedish chiropractic patients indicates that factors other than dissatisfaction or side effects are associated with early withdrawal from chiropractic treatment.[6]

For practical reasons, we used consecutive sampling. However, it was not possible to verify whether the chiropractors selected their patients in some other biased fashion. In the previous Swedish study,[6] it was shown that patient profiles were almost identical in two study samples obtained through different study designs: patients collected consecutively in the chiropractor's office (as in the current study) and patients obtained through simple randomization through a central register. The factors studied were age, sex, marital status, occupation (including unemployment), type of problem, and concomitant sick leave.

Another concern is that data collected in the clinic may be positively biased. However, in the previous Swedish study,[6] there was no difference in the amount of dissatisfaction, number of unpleasant reactions, or duration of these reactions in the two samples, although the data in the first study were collected while the patient was in the chiropractor's office and in the second study through a postal survey.

The data collection was prospective and systematized. The model and questionnaire had been tested in a pilot study,[9] and the low number of "other" types of reactions

(ie., those not proposed in the closed-ended questionnaire) indicates that the survey instrument was suitable for its purpose. But because the study was incorporated into normal clinical practice, the data collection could not be blinded. Thus, patients had to remember and explain accurately their reactions to the chiropractor, who then was expected to interpret this information and record it objectively. Although most visits would have taken place with fairly short intervals, it also is possible that some were more widely spaced, which might have affected further the accuracy of reporting. The validity of the study results also was contingent on the honesty of the chiropractors. Our findings that there was no association between severity of reaction and number of visits indicates that it would not have been common for patients with severe reactions to be willfully excluded from treatment.

No severe incident was reported throughout the study, and no complaints or claims were filed with the Department of Health or with the insurance company in Zurich that insures the whole Norwegian chiropractic profession, and none had become known to the Chiropractic Ethics Committee by the time of this writing (July 1995). This is, of course, not unexpected, considering the low incidence of severe side effects reported in the literature.

Although there is concern that most of the methodologic weaknesses of the study may result in underreporting of reactions, there also is the possibility of overreporting. For example, the study included only new patients. These may have been more anxious than other patient groups, resulting in a larger number of reactions. Also, the study model contains no control group. It therefore is not known whether some of the reported reactions are incidental or only a description of symptoms already present.

Identification of Common Reactions to Spinal Manipulation Therapy

Thus, within the limitations of this study, it can be concluded that a little more than half of all new SMT patients will report at least one unpleasant reaction throughout their course of treatment, and that one quarter of all treatments over the first seven visits will result in at least one reaction. This information is supported by the results from the Swedish study,[6] in which 48% (95% CI, 44–52%) reported at least one reaction during the course of treatment, which lasted up to 6 weeks. Typically, such reactions arise shortly after treatment, within 4 hours, or possibly on the day of treatment or the following day. Less than one fifth of reactions arise within 10 minutes of treatment, suggesting that the manipulation itself is rarely painful. Their duration is short, with symptoms usually disappearing on the day of their appearance. Symptoms usually are (in about 50%) described as local discomfort or possibly (in about 10%, respectively) as headache, tiredness, or discomfort in an area away from the one treated ("radiating discomfort"). All symptoms (except tiredness), whether common or uncommon, follow the same pattern in relation to the severity of symptoms; "moderate" being more commonly reported than "mild" or "severe." Radiating discomfort is reported significantly most often to be severe and to last the longest. Eighty-nine percent of patients report that they do not curtail their activities of daily living after treatment.

Description of Uncommon Reactions

What, then, characterizes uncommon reactions? Among the reported symptoms, dizziness, nausea, hot skin, or "other" complaints are reported rarely, with each accounting for 5% or less of the total reported symptoms. It is rare for these to begin later than on the day after treatment or be of long duration (not gone at the latest by the next day). Whether some symptoms become permanent is not known from this study, but clinical experience indicates that this would be extremely rare. It also is uncommon (11%) that activities of daily living be reduced, and when they are, it is uncommon for this to be caused by "unbearable" reactions (only three of 14). As a comparison, 1% (95% CI, 0–2 patients) in the Swedish study reported that their symptoms had worsened after the treatment was concluded.[6]

Significance of the Findings

The results from this study confirm the findings of the previous pilot study,[7] but they fail to identify some of the previously proposed, empirically generated examples of side effects.[5,7] This could be because clinical experience tends to focus on the rare and impressive. Another possibility is that the findings from this study may be nonrepresentative or that the reporting of symptoms, to some degree, is culturally determined.

It is likely that common and benign reactions that also follow a distinct pattern can be considered "normal." Whether they also, as is commonly thought by chiropractors and others, have a good prognostic value,[5,7] is not known. It also is not known whether uncommon reactions or common reactions of an unusual pattern are adverse side effects or precursors of such. In addition, it is not clear whether unusual reactions occur as a predictable physiologic response to SMT or whether they are related to inadequacies surrounding the therapeutic encounter as has been suggested.[5] However, the findings in this study make it possible to provide an estimate of the likelihood of patients experiencing an unpleasant side effect of SMT and to predict, with some certainty, their type, latency, duration, and severity.

References

1. Bigos S, Bowyer O, Braen G, et al. Acute low back problems in adults. Clinical Practice Guideline No. 14. AHCPR Publication No. 95-0642. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services, 1994.

2. Dvorak J, Orrelli F. How dangerous is manipulation to the cervical spine? Case report and results of a survey. Manual Med 1985;2:1–4.
3. Haldeman S, Rubinstein SM. Cauda equina syndrome in patients undergoing manipulation of the lumbar spine. Spine 1992;17:1469–73.
4. Haynes MJ. Stroke following cervical manipulation in Perth. Chiropractic Journal of Australia 1994;24:42–6.
5. Kleynhans AM. Complications of and contraindications to spinal manipulative therapy. In: Haldeman S, ed. Modern Developments in the Practice and Principles of Chiropractic. Norwalk, CT: Appleton-Century-Crofts, 1980:359–82.
6. Leboeuf-Yde C, Andrén J-Å, Gernandt M, Malmqvist S. Quality assurance in chiropractic practice: A comparison of two study methods. J Manipulative Physiol Ther 1996;19:513–7.
7. Maigne R. Edited by Lilberson WT. Orthopaedic Medicine: A New Approach to Vertebral Manipulation (3rd ed). Springfield, IL: Charles C Thomas, 1972:153–5.
8. Reggars JW, Pollard HP. Analysis of zygapophyseal joint cracking during chiropractic manipulation. J Manipulative Physiol Ther 1995;18:65–71.
9. Senstad O, Leboeuf-Yde C, Borchgrevink C. Side-effects of chiropractic spinal manipulation: Types, frequency, discomfort and course. Scand J Prim Health Care 1996;14:50–3.
10. Shekelle PG, Adams AH, Chassin MR, Hurwitz EL, Brook RH. Spinal manipulation for low-back pain. Ann Intern Med 1992;117:590–8.
11. Shekelle PG, Hurwitz EL, Coulter I, Adams AH, Genovese B, Brook RH. The appropriateness of chiropractic spinal manipulation for low back pain: A pilot study. J Manipulative Physiol Ther 1995;18:265–70.
12. Terrett A. Vascular accidents from cervical spinal manipulation: Report on 107 cases. Journal of the Australian Chiropractors' Association 1987;17:131–44.
13. Terrett AGJ. Misuse of the literature by medical authors in discussing spinal manipulative therapy injury. J Manipulative Physiol Ther 1995;18:203–10.
14. Terrett A, Kleynhans AM. Complications from manipulations of the low back. Chiropractic Journal of Australia 1992; 22:129–39.

Address reprint requests to

Charlotte Leboeuf-Yde, DC, MPH, PhD
Nordic Institute for Chiropractic and Clinical Biomechanics
Klosterbakken 20
DK-5000 Odense C
Denmark

■ Point of View

Scott Haldeman, DC, MD, PhD
Department of Neurology
University of California at Irvine
Santa Ana, California

Whenever a treatment method moves from the fringes of health care and becomes established as an accepted approach for a particular condition, there is a natural change in the emphasis of the research. Spinal manipulation and chiropractic care has been the subject of a sufficient number of controlled clinical trials to establish its role in the treatment of certain patients with spinal pain. It has received favorable mention in a number of government reports and is rapidly being integrated into government and private health care plans.

It now is essential that research be conducted in areas other than comparative efficacy trials. The potential side effects, complications, contraindications, and idiosyncrasies of spinal manipulation need to be studied so that a more realistic comparison between therapeutic approaches can be made and so that positive and negative responses of patients can be anticipated.

The research by Senstad et al represents the first time that common side effects and symptom provocation from routine spinal manipulation or chiropractic practice has been described in a quantitative fashion. Many of these complaints are well known to practitioners who use spinal manipulation, but their frequency and duration never have been documented.

It is comforting to note that there were no permanent complications experienced by more than 1000 new patients and after 4712 treatment sessions. The authors do not suggest that these side effects would be a contraindication to manipulation but that they should be understood and even expected. The rare case of vertebrobasilar artery compromise and even rarer cauda equina syndrome after spinal manipulation should not, however, be ignored because these complications can result in serious permanent deficits.

It is fairly easy to explain why certain individuals may experience local or radiating discomfort after manipulation because a mechanical force often is applied to a painful area of the spine during the procedure. It is, however, more difficult to explain why people would have systemic symptoms, such as tiredness, nausea, hot or

Bilag 8

ORIGINAL ARTICLES

THE BENEFITS OUTWEIGH THE RISKS FOR PATIENTS UNDERGOING CHIROPRACTIC CARE FOR NECK PAIN: A PROSPECTIVE, MULTICENTER, COHORT STUDY

Sidney M. Rubinstein, DC, MSc,[a] Charlotte Leboeuf-Yde, DC, MPH, PhD,[b] Dirk L. Knol, PhD,[c] Tammy E. de Koekkoek, DC,[d] Charles E. Pfeifle, DC,[e] and Maurits W. van Tulder, PhD[f,g]

ABSTRACT

Objective: This study describes both positive clinical outcomes and adverse events in patients treated for neck pain by a chiropractor.

Methods: This study was a prospective, multicenter, observational cohort study. Patients with neck pain of any duration who fulfilled the inclusion criteria were recruited in a practice-based study. Data were collected on the patients and from the chiropractors at baseline, the first 3 visits, and at 3 and 12 months. Clinical outcome measures included (1) neck pain in the 24 hours preceding the visit, (2) neck disability, (3) treatment satisfaction, (4) global assessment, and (5) adverse events. *Recovery* was defined as "completely improved" or "much better" using the global assessment scale. An *adverse event* was defined as either a new related complaint or a worsening of the presenting or existing complaint by >30% based upon an 11-point numerical rating scale.

Results: In all, 79 chiropractors participated, recruiting 529 subjects, representing 4891 treatment consultations. Follow-up was possible for 90% and 92%, respectively, at 3 and 12 months. Most patients had chronic, recurrent complaints; mild to moderate disability of the neck; and a mild amount of pain at baseline; and two thirds had sought previous care for the presenting complaint in the preceding 6 months. Adverse events following any of the first 3 treatments were reported by 56%, and 13% of the study population reported these events to be severe in intensity. The most common adverse events affected the musculoskeletal system or were pain related, whereas symptoms such as tiredness, dizziness, nausea, or ringing in the ears were uncommon (<8%). Only 5 subjects (1%) reported to be much worse at 12 months. No serious adverse events were recorded during the study period. Of the patients who returned for a fourth visit, approximately half reported to be recovered, whereas approximately two thirds of the cohort were recovered at 3 and 12 months.

Conclusion: Adverse events may be common, but are rarely severe in intensity. Most of the patients report recovery, particularly in the long term. Therefore, the benefits of chiropractic care for neck pain seem to outweigh the potential risks. (J Manipulative Physiol Ther 2007;30:408-418)

Key Indexing Terms: *Neck pain; Chiropractic; Manipulation, Spinal; Adverse effects; Cervical vertebrae*

[a] Research Fellow, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, 1081 BT Amsterdam, the Netherlands.

[b] Research Professor, The Back Research Center, Part of Clinical Locomotion Science, University of Southern Denmark, DK-5750 Ringe, Denmark.

[c] Statistician, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, 1081 BT Amsterdam, the Netherlands.

[d] Private practice, Soest, the Netherlands.

[e] Private practice, Oosterhout, the Netherlands.

[f] Professor of Health Technology Assessment, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, Amsterdam, the Netherlands.

[g] Professor, Department of Health Economics and Health Technology Assessment, Institute of Health Sciences, Faculty of Earth and Life Sciences, Amsterdam, the Netherlands.

Submit requests for reprints to: Sidney Rubinstein, DC, MSc, Research Fellow, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, Van der Boechorststraat 7, 1081 BT Amsterdam, the Netherlands (e-mail: *sm.rubinstein@vumc.nl*).

Paper submitted January 10, 2007; in revised from April 11, 2007; accepted 15 April 2007.

0161-4754/$32.00

doi:10.1016/j.jmpt.2007.04.013

Neck pain is a common and costly complaint in Western society.[1,2] Studies of manipulation for nonspecific neck pain have suggested that manipulation is an effective therapy, particularly when combined with exercise.[3,4] However, as with other interventions for the treatment of neck pain, such as nonsteroidal anti-inflammatory drug use,[5-7] cervical spine manipulation is not without adverse events. On the one hand, cases of stroke following cervical spine manipulation are rare but well-documented,[8-10] whereas on the other hand, much less is known about the much more common adverse, but benign, events.

Previous observational studies have shown that adverse events, such as increased pain or stiffness and, to a lesser degree, radiating symptoms and headache, following manipulative treatment to the neck and/or back are relatively common, mild in intensity, and self-limiting.[11-15] Only one previous study has specifically targeted cervical spine manipulation and examined the relationship of these adverse events to positive outcome measures. That study concluded that subjects with adverse events were less satisfied with care, perceived less improvement in their neck symptoms, and had more pain and disability at all follow-up measurements.[15] In contrast, studies of low back pain involving manipulation have identified certain adverse events as a positive predictor of outcomes.[16,17]

It must be noted here that various terms have been used in previous literature to describe adverse events following chiropractic treatments, such as *unpleasant reactions*, *side effects*, or *adverse reactions*. However, according to international clinical trial terminology, the established term for this phenomenon is *adverse events* and is the term that will be used further throughout this article. This has been further operationally defined in the "Methods" section.

The primary objective of this present report, therefore, is to describe both positive clinical outcomes and adverse events following the first 3 treatments in a large cohort presenting with neck pain to 79 chiropractors. A secondary objective is to describe the sociodemographic and clinical profile of these subjects.

Methods

Study Design and Source Population

A prospective, multicenter, practice-based cohort study was conducted for patients with neck pain. Subjects who fulfilled the inclusion criteria (defined below) were recruited by chiropractors in their private clinics throughout the Netherlands and were followed up after 3 and 12 months. Each participating chiropractor was asked to recruit 10 consecutive new patients.

Recruitment of Chiropractors and Subjects

Chiropractor Inclusion Criteria and Recruitment. All 189 chiropractors who were members in good standing of the Netherlands Chiropractors' Association were invited to participate. Participants were required to carry out the examination and treatment personally. Chiropractors undergoing their internship were excluded. Recruitment was pursued by means of a flyer mailed to all members of the Netherlands Chiropractors' Association, by personal invitation, and through a presentation at a national chiropractic association meeting.

Patient Inclusion and Exclusion Criteria. All new patients between the ages of 18 and 65 years with neck pain of any duration who had not undergone chiropractic care or manual therapy in the prior 3 months were eligible for recruitment. In this report, neck pain includes those with neck and neck-related pain, that is, cervicothoracic and/or periscapular pain. Although inclusion was based upon a primary complaint of neck pain, patients who also had pain in other areas were not excluded. Patients were required to have a basic understanding of the Dutch language and be able to independently complete the series of questionnaires. Subjects were recruited between September 1, 2004, and April 15, 2005.

Subjects were excluded if they had a red flag (eg, suspected infection, fracture, tumor, metastasis, or intravenous drug use) or any other condition thought to be a contraindication for cervical spine manipulation (eg, luxation or instability of the vertebral articulations). This was left to the judgment of the chiropractor.

In order to check for possible recruitment bias during the inclusion phase, a sample was taken in 5 practices in which the number of subjects recruited to the study was cross-checked with the actual number of eligible patients during the recruitment period. The total number of new patients seen in these practices during this period was also recorded. Selection of these practices was based upon geographic proximity to the research center.

Study Protocol. Prior to the start of data collection, a number of training sessions were conducted with the chiropractors throughout the country in order to present the study methods, increase consistency among chiropractors in applying these, and limit problems associated with patient recruitment. Both the chiropractor and his/her assistant(s) were asked to attend.

Data Collection and Clinical Outcome Variables

Procedure. Data were collected from patients within individual practices by means of a self-administered questionnaire at baseline and prior to treatment at the second and fourth visits. In order to increase the response rate, patients were also provided with an envelope in which to place their completed questionnaires. All forms were precoded in order to ensure anonymity. Additional follow-ups were conducted from a central data collection center at the university at 3 and 12 months using postal questionnaires. If the participant failed to respond to a written reminder at 12 months, a shortened structured telephone interview was conducted. This interview consisted of 5 questions regarding pain, perceived recovery, and treatment

satisfaction. The clinical outcome measures used throughout the study were pain and disability,[18-20] perceived recovery,[21-23] treatment satisfaction,[15,24] and adverse events (or concomitant symptoms) following treatment.

Chiropractor

Chiropractors completed a questionnaire administered once at the beginning of the study relating to basic sociodemographic information concerning himself/herself and treatment practices (eg, years of experience, types of techniques and/or therapies commonly used).

Patient

Pain, Disability, and Recovery. At all points of data collection, an 11-point numerical rating scale (NRS) was used to assess pain in the 24 hours preceding the visit. Disability was also measured at these times using the Neck Disability Index (NDI); however, disability was not recorded at the second visit.[25,26] The NDI has been demonstrated to be a sensitive and valid instrument.[27] Perceived recovery was measured at all follow-up times and scored using a 6-point Likert scale, as follows: (1) "completely improved," (2) "much better," (3) "somewhat better," (4) "unchanged," (5) "somewhat worse," and (6) "much worse." Those subjects who were either "completely improved" or "much better" were considered to be "recovered."

Treatment Satisfaction. Satisfaction was measured at the fourth visit and at 3 and 12 months using a 10-item instrument[28] that was used in a prior study of adverse events to cervical spine manipulation.[15,24] Two other questions were also posed at these same time intervals: (1) "How satisfied are you with the treatment by your chiropractor?" (11-point NRS, ranging from "very dissatisfied" to "very satisfied") and (2) "Would you visit a chiropractor again with this or a similar complaint?" (yes/no).

Adverse Events. The following symptoms were assessed at every time interval, except items 1 and 2, which were not measured at baseline because they relate only to the previously administered treatment: (1) increased pain/stiffness at the treated area, (2) increased pain/stiffness in another treatment-related area, (3) headache, (4) tiredness/fatigue, (5) radiating pain in the arm or hand, (6) dizziness or lightheadedness, (7) nausea, (8) ringing in the ears, (9) confusion or disorientation, (10) depression or fear, and (11) any other not specified reaction. Adverse events were measured using a similar questionnaire as in the Scandinavian studies.[13,14,29] Intensity of adverse events was also graded using an 11-point NRS. At the second visit, patients were queried about any potential events following the first visit. In the data analysis, an adverse event reported at the second visit was defined as either (1) a new related complaint that was not present at baseline or (2) a worsening of the presenting complaint or an existing complaint by >30% compared with baseline. Thirty percent was chosen as a cutoff because it has been demonstrated that this represents a minimally clinically important difference on an 11-point NRS.[30] At the fourth visit, patients were queried about any events following the second or third visit. A similar definition was used to define adverse events at the fourth visit as the second visit; however, at the fourth visit, the comparison was made with the second visit, not baseline. *Intense* adverse events were defined as any adverse event fulfilling our definition of an adverse event and that also scored ≥8 in intensity on the 11-point NRS. This term must not be confused with *serious* adverse events, which refer to events resulting in death, life-threatening situations, the need for admittance to a hospital, or temporary or permanent disability.

The following were also assessed at baseline: age, sex, sociodemographics, and the nature and severity of the presenting complaint. Patients were also queried about previous chiropractic, manual therapy, and medical care for the same or similar complaints. Fear of, or apprehension concerning, the treatment and treatment expectation were also assessed using 11-point NRS scales. Health status was measured on a 100-point vertical scale, ranging from worst (0) to best (100) possible health; and fear of movement or reinjury was measured through the 17-item Tampa Scale for Kinesiophobia.[31]

Intervention

The treatment was left to the discretion of the chiropractor. The type of manipulative and/or mobilization technique used was recorded on standardized forms immediately following the first and third treatment, as well as the use of any adjunct therapy, the number of adjustments given, the area that was treated, whether the chiropractor considered that rotation was used, and whether multiple manipulative attempts were directed at a single segment.

Approval

The study was approved by the Institutional Review Board of the Vrije University Medical Centre, Amsterdam, the Netherlands. Informed consent was not required because this is an observational study.

Statistical Methods

Mean values and standard deviation (SD) were calculated for continuous variables. These variables were also examined for skewness and kurtosis; and where relevant, medians and interquartile ranges (IQRs) were presented instead of the mean. Frequency distributions were calculated for categorical variables. For reporting of many of the baseline variables, there were few missing values (<5% of cohort); therefore, in many cases, only a percentage is reported. Response-function imputation was used for missing data for the disability questionnaire, the Tampa Scale for Kinesiophobia, and the patient satisfaction scale when ≤50% of the data was missing, although this was only necessary for a small percentage of patients; and in most cases, ≤10% of the data was missing.[32] Imputation was performed separately

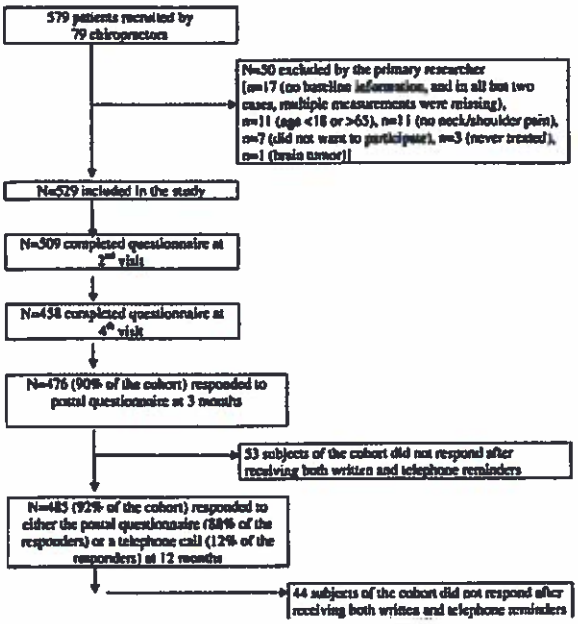


Fig 1. *Flowchart demonstrating recruitment and follow-up throughout the study period.*

for each of the aforementioned questionnaires and based the correlation between each variable with a missing value with the other responses in those questionnaires. All data were analyzed in SPSS version 12.0 (SPSS Inc, Chicago, Ill). Accuracy of the entered data was checked using a random sample of 25 patients. The baseline data entry form was used, which contained 94 variables. Two data entry mistakes were discovered, resulting in an error of 0.1%; and it was concluded that the data had been accurately entered.

Results

Participating Chiropractors

In total, 79 chiropractors (79 of 190; 42% of the available population) participated in the study. Reasons among the chiropractors for not participating included residing outside the country (n = 2), pregnancy leave (n = 3), retiring (n = 3), not interested (n = 4), and did not regularly perform manipulative techniques (n = 2). One chiropractor was excluded because of pending statutory problems. The remaining 96 did not respond to various requests. Three chiropractors who agreed to participate did not recruit any patients. Of those who did recruit subjects, each chiropractor recruited 7.6 ± 2.9 (mean ± SD) patients.

Study Population

During the 7-month recruitment period, 579 patients were recruited. Fifty subjects were excluded for various reasons (Fig 1), resulting in a cohort of 529 subjects. Ninety-six percent and 87% of the study population returned for a second and fourth visit, respectively, whereas 90% and 92% responded to the long-term follow-up at 3 and 12 months, respectively. Twelve percent of the 92% that responded at

Table 1. *Sociodemographic and clinical baseline characteristics for patients in the Netherlands chiropractic neck pain cohort study (n = 529)*

Sociodemographic variables	Percentage (%)
Sex, female	69.0
Age, y (mean, SD)	41.2 (11.5)
Highest level of education achieved	
Elementary school	4.8
High school	31.4
Technical school	55.0
University or postgraduate education	8.8
Employment status	
Full-time (>32 h/wk)	44.2
Part-time	33.3
Not working (including unemployed, housewives)	12.2
Sick leave or workers compensation	7.2
Retired	3.1
Clinical baseline variables	
Duration of the presenting complaint	
1 d-<4 wk	8.4
4-12 wk	16.8
>12 wk-1 y	23.2
>1 y	51.6
Self-assessed health trend regarding the presenting complaint	
Getting better	4.6
Getting worse	21.2
Staying the same	26.1
Rather varied	48.1
Previous episode with this complaint (% yes)	71.6
Radiating pain in an upper extremity (% yes)	52.0
Paresthesia and/or "dead" feeling in an upper extremity (% yes)	39.3
Morning pain related to the chief complaint (% yes)	70.1
Night pain related to the chief complaint (% yes)	36.9
Presently involved in judicial proceedings in regard to this complaint (% yes)	2.5
Medication use	
None	65.8
Over-the-counter pain medication	5.5
Prescription pain medication	6.2
Other prescription (nonpain) medication	21.9
Bruxism (% yes)	24.2
Who have you seen for this complaint? (% yes)[a]	
General practitioner	66.9
Specialist	18.9
Chiropractor or manual therapist	36.7
Physical therapist	25.5
Cesar/Mensendieck therapy (ie, postural and exercise therapy)	3.4
Acupuncturist	2.6
Other doctor or therapist than those mentioned above	10.4

[a] Multiple answers possible.

Table 2. *Concomitant symptoms reported at baseline and throughout the study period*

Type of other symptom and severity of the complaint[a]	Baseline (n = 529) (%)	2nd visit (n = 509) (%)	4th visit (n = 458) (%)	3 mo (n = 476) (%)	12 mo (n = 485) (%)
Tiredness or fatigue	77.3	22.0	14.0	66.0	66.1
Headache	75.4	26.2	16.0	71.8	71.5
Dizziness or light-headedness	60.0	18.1	10.6	48.9	53.5
Radiating pain	52.0	18.9	14.1	55.7	55.3
Nausea	34.8	11.8	5.7	21.4	21.0
Depression or fear	28.6	4.8	3.1	22.7	22.2
Confusion or disorientation	27.3	6.7	4.8	22.1	19.8
Ringing in the ears	23.0	9.9	7.1	29.8	29.5
Other symptoms	–	2.6	4.7	5.8	5.5
Median no. of symptoms per patient (IQR)	3 (2-5)	0 (0-2)	0 (0-0)	2 (1-5)	2 (0-4)

En dash (–) indicates unrecorded data.
[a] Responses are ordered according to prevalence at baseline from highest to lowest.

12 months were evaluated using the shortened telephone assessment instead of completing the written questionnaire. Potential response bias was assessed in order to compare responders to nonresponders. However, an analysis at 3 and 12 months showed no obvious differences between these 2 groups in the baseline variables (available upon request). A total of 4891 treatment consultations were registered during the 12-month period, and chiropractors delivered 9.3 ± 5.3 (mean ± SD; median, 8.0; range, 0-38) treatments per patient. Almost all patients (90%) returned for a second visit within 8 days of the first visit, and 90% returned for a fourth visit within 6 weeks of the first visit.

Baseline Characteristics for the Chiropractors

The participating chiropractors were 37.6 ± 9.4 years old (mean ± SD; range, 22-74) and had 10.2 ± 6.3 years of experience (mean ± SD; median, 9.5; range, 1-28 years). Most were male (65%), had received their chiropractic education at a European institution (66%), worked full-time (96%), and regularly used the following techniques (in hierarchal order, from more to less common): diversified manipulation (a high-velocity, low-amplitude manipulative technique commonly used by chiropractors), Activator (a hand-held, spring-loaded instrument designed to deliver a measured force), soft-tissue massage or trigger point therapy, and/or mobilization.

Baseline Characteristics for the Patients

Sociodemographic and clinical baseline characteristics are presented in Table 1. The recruited subjects were predominantly female, middle-aged, had a high school or technical school education, and were employed. Most of the patients had a chronic complaint that was intermittent in nature, had morning pain, had at least one prior episode related to the complaint, and were not currently using any medication. Two thirds had seen a general practitioner for the presenting complaint, and approximately one fifth had seen a specialist in the 6 months prior to a visit to the chiropractor. Approximately one third had undergone prior chiropractic care or manual therapy ever. The subjects had little fear of, or apprehension concerning, the treatment (median, 0; IQR, 0-2), expected the treatment to be effective (mean, 7.0; SD, 2.0), and were generally healthy (mean, 67.8; SD, 17.2), whereas most (87%) had mild to moderate disability. Only 7% had a high level of kinesiophobia (mean, 34.1; SD 6.2).[33]

Concomitant Symptoms at All Measurement Periods

At baseline, 94% of the patients had at least one concomitant symptom other than neck pain; and half of the cohort had 3 or more other symptoms (Table 2). Twenty-two percent rated at least one of these symptoms as severe in intensity (≥8 on the 11-point NRS scale). The most common symptoms were headache, tiredness, dizziness, or radiating pain, and less frequently, nausea or ringing in the ears. At the second and fourth visits, only 34% and 22%, respectively, of the cohort had concomitant symptoms. At 3 and 12 months, when most patients had likely discontinued care or had been discharged, the estimated prevalence of these concomitant symptoms approached the baseline values once again.

Treatment Techniques and Type of Care Delivered

The treatment techniques and other therapies used at the first and third visits are presented in Table 3. The principal techniques used at the first and third visits were diversified, soft-tissue or trigger point therapy, Activator, and mobilization. Most patients (85%) underwent an upper or lower cervical spine manipulation at both the first and third visits. In almost all subjects (97%), a manipulative technique (ie, diversified, Activator, Gonstead, or toggle-recoil) was used at any of the first 3 treatments; and occasionally, chiropractors used multiple manipulative attempts directed at the same segment.

Table 3. *Treatment techniques used, therapies performed, and other treatment parameters recorded at the first and third treatments*

Techniques, therapies, and other treatment parameters	1st visit (n = 529) (%)	3rd visit (n = 458) (%)
Technique used (% yes)[a,b]		
Diversified	78.3	76.7
Soft-tissue or Nimmo (trigger point therapy)	28.9	33.8
Activator	15.1	19.7
Traction	12.3	12.9
Gonstead	11.0	8.7
Mobilization	9.3	12.3
Sacrooccipital technique or cranial technique	4.7	5.3
Toggle	2.6	2.8
Other therapies used (% yes)[a,b]		
Exercise advice	35.7	24.8
Heat or ice	17.4	11.5
Other technique or therapy (eg, acupuncture, homeopathy, heel lifts, Thompson drop)	17.3	17.6
Dietary advice	5.3	2.1
Total no. of adjustments given in the neck		
None	15.2	9.6
1	25.2	20.3
2-3	49.6	60.2
>3	10.0	10.0
Treated area[b]		
Upper cervical spine (C0-C2)	49.9	48.8
Mid-lower cervical spine (C3-C7)	53.7	57.3
Upper thoracic spine (T1-4)	53.9	52.4
Mid-lower thoracic spine (T5-T12)	40.1	34.0
Lumbar spine	13.4	16.8
Pelvis/sacrum	23.4	18.9
Rotation was used during the treatment (% yes)	56.6	58.8
Multiple manipulative attempts were performed during the treatment at the same segment (% yes)	16.9	19.5

[a] Responses are ordered according to prevalence at the first visit, from highest to lowest.
[b] Multiple responses possible.

Clinical Outcome Measures

The clinical outcome measures are presented for all time intervals in Table 4. Pain and disability of the neck steadily decreased up to 3 months, but there was no further improvement at 12 months. Approximately one fifth (21%, n = 105 of 509) and one half of the subjects (48%, n = 219 of 458) were recovered from their presenting complaint at the second and fourth visit, respectively, whereas approximately two thirds (65%, n = 308 of 476; 64%, n = 310 of 485) were recovered at 3 and 12 months, respectively. Of those recovered at 3 months, 18% (n = 55 of 308) were no longer recovered at 12 months; and of those not yet recovered at 3 months, 30% (n = 49 of 165) went on to recover at 12 months. Therefore, although the overall percentage of recovery at 3 and 12 months was approximately the same for the study population, at 3 months, some subjects continued to improve, whereas others that were recovered had recurrent symptoms. At 3 and 12 months, only 2 and 5 subjects, respectively, reported to be much worse. Most patients were moderately to highly satisfied with their chiropractors and their treatments throughout the study period, and most (range, 84%-99%) would visit a chiropractor again for this or any other spinal complaint.

Adverse Events After Treatment

Prevalence of Adverse Events. Forty-eight percent of those subjects who returned for a second visit indicated a new, related complaint or worsening of the presenting or existing complaint following the first visit (as reported at the second visit), and 26% of those who returned for a fourth visit indicated an adverse event following the second or third visit. In total, 56% of the study population indicated an adverse event following any of the first 3 treatments. At the second visit, most of the subjects (90%) indicated that the event began within 2 days of the treatment. Most (85% and 81% at the second and fourth visits, respectively) perceived the event to have no to minor influence on their activities of daily living.

Type, Frequency, and Severity of Adverse Events. In all, 571 and 166 adverse events were registered at the second and fourth treatments, respectively; and only a relatively small percentage of these adverse events were deemed to be severe in intensity (14% and 15%, respectively) (Table 5). The most common adverse events reported at the second and fourth visits were musculoskeletal or pain related (72% and 75% of all events, respectively). Individual nonmusculoskeletal adverse events such as tiredness, dizziness, nausea, or ringing in the ears were relatively uncommon (<8%), although 19% of the study population reported at least one nonmusculoskeletal adverse event at any of the first 3 treatments.

The total number of adverse events recorded by individual patients at the second and fourth visits are presented in Table 6. Of those subjects who had an adverse event at the second or fourth visit, the median number of events per patient was 2 (IQR, 1-3) and 1 (IQR, 1-1), respectively. In total, 13% (n = 67 of 529) reported an intense adverse event at any of the first 3 treatments. Of these, 64% (n = 43 of 67) reported only one intense event. However, none of the subjects with an intense adverse event were worse or much worse at the end of the study period. Finally, no serious adverse events were reported during the study period.

Discussion

In contrast to clinical trials of prescription medication, researchers in the area of conservative care for muscu-

Table 4. *Clinical outcomes for all measurements at baseline, second visit, fourth visit, 3 months, and 12 months*

Clinical outcome measures	Baseline (n = 529)		2nd visit (n = 509)		4th visit (n = 458)		3 mo (n = 476)		12 mo (n = 485)	
	n	%	n	%	n	%	n	%	n	%
Neck pain in the 24 h preceding the visit (0-10)[a]										
None (0)	28	5.4	20	4.0	32	7.0	103	21.6	124	25.6
Mild (1-3)	127	24.6	181	35.9	210	45.9	212	44.5	203	41.9
Moderate (4-7)	302	58.4	263	52.2	195	42.6	146	30.7	127	26.2
Severe (8-10)	60	11.6	40	7.9	21	4.6	15	3.2	30	6.2
Mean (SD)	4.8 (2.4)		4.3 (2.2)		3.6 (2.2)		2.8 (2.4)		2.8 (2.6)	
NDI (0-50)[b]										
None (0-4)	39	7.4	–		87	19.0	165	34.7	160	38.8
Mild (5-14)	298	56.9	–		283	61.8	241	50.6	193	46.8
Moderate (15-24)	160	30.5	–		80	17.5	59	12.4	49	11.9
Severe or "complete" disability (>25)	27	5.2	–		8	1.7	11	2.3	10	2.4
Median (IQR)	12.0 (8.0-17.0)		–		8.0 (5.0-12.0)		6.0 (3.0-11.0)		7.0 (3.0-11.0)	
Patient satisfaction										
Would you visit a chiropractor again for this or any other complaint? (% yes)	–		99.4		98.7		89.9		83.8	
Degree of satisfaction with the chiropractor (0-10)[c] (mean [SD])	–		7.7 (1.7)		7.8 (1.8)		7.7 (1.8)		7.6 (2.0)	
Treatment satisfaction (0-40)[d]	–		–		33.5 (5.2)		32.7 (6.3)		32.9 (6.7)	
Global assessment										
Completely improved			3	0.6	13	2.9	45	9.5	70	14.6
Much better			102	20.6	206	45.5	263	55.6	240	50.0
Somewhat better			194	39.2	175	38.6	107	22.6	83	17.3
Unchanged			145	29.3	39	8.6	50	10.6	67	14.0
Somewhat worse			43	8.7	18	4.0	6	1.3	15	3.1
Much worse			8	1.6	2	0.4	2	0.4	5	1.0

En dash (–) indicates missing or unrecorded data.
[a] Ranging from no pain (0) to excruciating pain (10).
[b] Ranging from no disability (0) to severely disabled (50).
[c] Ranging from not satisfied (0) to very satisfied (10).
[d] Ranging from not satisfied (0) to very satisfied (40) according to the scale from Cherkin et al.[28]

loskeletal complaints have focused their attention on treatment effectiveness and, to a much lesser degree, on adverse events. This study, consisting of patients treated in a wide variety of chiropractic practices and settings, describes both positive and negative, and short- and long-term clinical outcomes for a relatively large study population with neck pain. Although adverse events have been described in previous clinical trials of treatment effectiveness with cervical spine manipulation,[4,34] studies such as these provide limited information on these types of events because of their small sample sizes. Earlier studies on adverse events following spinal manipulation have focused on describing types and patterns of adverse events of the entire spine,[12-14,29] but did not describe positive outcomes. To our knowledge, only one other study has examined both positive and negative clinical outcomes in patients with neck pain undergoing chiropractic treatments[15]; however, our study has a larger sample size. In addition, given the study design chosen, it was possible to examine a large number of treatments delivered by a diverse group of chiropractors and was not specifically aimed at the effect of spinal manipulation alone. Therefore, these findings might be more generalizable to clinical practice than those obtained in a single-center, controlled trial setting.

In short, there are 2 major findings. Firstly, in relation to "risks," despite the fact that more than half of the study population experienced an adverse event, only 1% (5 subjects) of a cohort who had undergone 4891 treatment consultations reported to be much worse at the end of the study period; and there were no serious neurologic complications reported within this time frame. Although

Table 5. *Type, frequency, and severity of adverse events, and frequency of intense adverse events recorded at the second and fourth visits*

	2nd visit compared with baseline (n = 509)					4th visit compared with second visit (n = 458)				
			Intensity	Intense events[b]				Intensity	Intense events[b]	
Type of adverse event[a]	n	%[c]	Mean (SD)	n	%[c]	n	%[c]	Mean (SD)	n	%[c]
Increased treatment-related pain (musculoskeletal)										
Increased pain at the treated area[d]	148	29.1	5.0 (2.1)	20	3.9	7	1.5	4.7 (1.9)	0	0
Increased pain >30% in the 24 h preceding the visit	112	22.0	4.8 (2.0)	8	1.6	85	18.6	5.1 (2.0)	12	2.6
Increased pain at an other treatment-related area[e]	100	19.6	4.7 (2.4)	16	3.1	11	2.4	5.9 (2.3)	2	0.4
Headache	51	10.0	5.6 (2.3)	14	2.8	13	2.8	3.7 (1.9)	1	0.2
Radiating pain	–	–	–	–	–	9	2.0	5.3 (2.7)	3	0.7
Nonmusculoskeletal										
Tiredness or fatigue	39	7.7	5.9 (1.9)	8	1.6	8	1.7	4.0 (2.8)	1	0.2
Dizziness or light-headedness	38	7.5	5.0 (2.1)	5	0.9	6	1.3	3.8 (2.6)	0	0
Nausea	28	5.5	3.8 (2.2)	1	0.2	6	1.3	4.2 (2.2)	0	0
Ringing in the ears	19	3.7	3.4 (1.8)	0	0	4	0.9	3.0 (1.6)	0	0
Other type of adverse event[e]	13	2.6	5.6 (2.7)	4	0.8	9	2.0	6.8 (2.5)	6	1.3
Psychological										
Confusion or disorientation	14	2.8	4.9 (2.2)	1	0.2	6	1.3	1.5 (0.5)	0	0
Depression or fear	9	1.8	4.3 (2.4)	1	0.2	2	0.4	1.0 (0)	0	0
Total no. of events	571			78		166			25	

En dash (–) indicates unrecorded data (ie, no baseline comparison).

[a] As defined in the text.

[b] Defined as an adverse event that scored ≥8 in severity.

[c] Percentage of the total number of patients at that measurement period.

[d] For these symptoms, a reaction was considered to be any new symptom (ie, ≥1 on the 11-point NRS).

[e] Other complaints include strange feeling in the head, cannot focus/cannot see well, concentration problems/problems with trying to find words to express oneself, bad dreams, burning feeling (location unspecified), problems with jaw, neck "cracks," stomach pain, joints crack, tired/heavy arms, tingling in the fingers.

the number of patients with an intense adverse event seems high, none of these patients were worse or much worse at the end of the study period; therefore, these adverse events should in no way be misconstrued as a measure or indication of harm or be confused with (the lack of) perceived recovery. In addition, only 2 subjects reported to be much worse at 3 months, when most patients are likely to have completed or discontinued care.

Secondly, regarding "benefits," although many of the subjects had chronic, recurrent neck pain and had undergone prior care for this complaint, many patients experienced benefit from the treatment (based upon diminished pain and disability, the percentage of patients recovered and percentage satisfied with care). Furthermore, many responded relatively quickly to treatment (48% were recovered at the fourth visit); and a significant proportion of patients continued to improve up to 3 months (65%). It is, however, difficult to compare these findings to other studies, especially regarding the rate of recovery and involving other forms of therapy, because both the inclusion criteria and outcome measures may differ. The most similar study is a multicenter study of persistent low back pain treated by chiropractors.[35] Although the pattern of recovery was different, the percentage of patients who became worse was similarly low in both studies.

The results of this study also confirm earlier work that suggests that adverse events are most prevalent at the beginning of treatment and diminish thereafter in frequency.[13,14] This should have clinical consequences for the practitioner, who might choose to modify his/her treatment approach or limit himself/herself to certain interventions at the start of treatment when the patient is more likely to have a reaction.

Another important finding was that some of the same symptoms that are often viewed as a consequence of treatment, such as headache, nausea, dizziness, tiredness, or depression, were present in many subjects at baseline.

Table 6. *Total number of adverse events and severe adverse events observed in individual patients at the second and fourth visits*

	2nd visit (n = 509)				4th visit (n = 458)			
	Adverse event		Intense event[a]		Adverse event		Intense event[a]	
No. of events per patient	n	%	n	%	n	%	n	%
0	266	52.3	456	89.6	339	74.0	436	95.2
1	95	18.7	35	6.9	94	20.5	20	4.4
2	61	12.0	12	2.4	12	2.6	1	0.2
3	40	7.9	5	1.0	8	1.7	1	0.2
4	20	3.9	1	0.2	3	0.7		
5	15	2.9			1	0.2		
6	8	1.6			0	0		
≥7	4	0.8			1	0.2		

[a] Defined as an adverse event according to our definition, which also scored ≥8 in intensity on an 11-point NRS.

Furthermore, more than one fifth noted that the symptom was severe in intensity at baseline. This underlies the fact that without a proper reference, there is the real potential to erroneously ascribe previously unreported symptoms to the treatment. In fact, according to our study, many of these concomitant symptoms decreased following the first treatment and continued to improve following the second and third treatments. However, the prevalence of these symptoms returned to their baseline values at 3 and 12 months, suggesting either a short-term positive effect of the treatment or placebo effect.

There are some limitations to this study, however. Firstly, in relation to the data collection, the questionnaires used have not been previously validated, although they were modeled after previous side effects studies.[13,14] Furthermore, given the method of data collection in the clinics (ie, close-ended, self-reported questionnaires), the possibility of response bias cannot be ruled out, meaning it is possible that prompting a patient about the presence of a symptom via the questionnaires might have led to overreporting.

Secondly, the lack of a control group means that it cannot be determined whether the observed adverse events or recovery is a response to the treatment or the result of natural history. Although a control group is obviously desirable, studies such as this one are best designed to describe patterns and changes over time, to investigate the relationship between prognostic factors and outcomes, and to identify subgroups most likely to respond to manipulation for investigation in future clinical trials. Additional reports are forthcoming from this data set.

Thirdly, although this was a prospective study, there is also the potential for recall errors because patients were required to remember and report something about a reaction that took place at prior visit(s). However, almost all (90%) of the second visits had taken place shortly following the first visit, whereas most (79%) of the fourth visits took place within a month of the first visit, so this error is likely to be minimal.

Fourthly, because a convenience sampling of chiropractors was used to collect data, it is possible that more cautious and conservative chiropractors participated. However, a comparison of the practice characteristics of the participating chiropractors with the results of a recent study conducted in the Netherlands,[36] and with a relatively recent European study,[37] suggests that participants in this study were sociodemographically similar to their nonparticipating colleagues.

Fifthly, it is possible that those patients deemed by the practitioners likely to have a favorable outcome were more readily recruited. Analysis of recruitment in a sample of 5 of the participating practices revealed that, on average, 78% of the eligible patients were recruited; therefore, recruitment bias was likely to be minimal. Furthermore, practices that saw the highest number of new patients during the recruitment period recruited the fewest eligible patients; therefore, it seems more likely that failure to include individual patients was the result of time constraints in the practices.

Lastly, imaging of the cervical spine was only performed when necessary, at the discretion of the chiropractor. In the Netherlands, few chiropractors have their own radiograph apparatus; and few refer for imaging. Consequently, it is possible that underlying pathology might have been missed by the clinician. However, only one patient was found to have serious pathology; and she was identified at the beginning of the study (based upon history and physical examination) and was excluded from participation. Furthermore, we had a high follow-up rate at the end of the study and no other cases were identified during this period, so this is unlikely to have influenced our results.

Implications for Clinical Practice

Patients respond quickly to care, with the most dramatic improvement occurring in the first 3 treatments. After 3 months, a small percentage will have recurrent symptoms, whereas some will continue to improve; however, most of the patients remain stable. Clinicians should be aware that extended treatment programs might have limited added value when patients do not demonstrate some reasonable improvement by the fourth visit.

Implications for Research

Many symptoms resembling an adverse event were present in nearly all the subjects at baseline and diminished in frequency in the population during the first 3 months. This demonstrates the need to record baseline status for concomitant symptoms to avoid erroneously ascribing their incidence to treatment.

Conclusion

Despite the fact that adverse events following treatment are common, and in some cases severe in intensity, this study shows that the benefits of chiropractic care for neck pain seem to outweigh the potential risks.

Practical Applications

- Most patients in this study had chronic, recurrent complaints; mild to moderate disability of the neck; and a mild amount of pain at baseline.
- Approximately half of the cohort was recovered at the fourth visit from their presenting complaint, whereas approximately two thirds were recovered at 3 and 12 months.
- Fifty-six percent of the study population indicated an adverse event following any of the first 3 treatments, which was typically musculoskeletal or pain related and was mild to moderate in intensity. Only 5 subjects (1%) reported to be much worse at 12 months.
- Although adverse events are common, many patients benefit from treatment.
- For the participants in this study, the benefits of chiropractic care for neck pain seem to outweigh the potential risks.

Acknowledgment

This study was partially funded by The European Chiropractors' Union (grant number A.03-1) and by the Foundation for Chiropractic Education and Research (Fellowship number 06-03-04).

References

1. Borghouts JA, Koes BW, Vondeling H, Bouter LM. Cost-of-illness of neck pain in the Netherlands in 1996. Pain 1999;80:629-36.
2. Cote P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. Spine 1998;23:1689-98.
3. Gross AR, Hoving JL, Haines TA, et al. A Cochrane review of manipulation and mobilization for mechanical neck disorders. Spine 2004;29:1541-8.
4. Hoving JL, Koes BW, de Vet HC, et al. Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain. A randomized, controlled trial. Ann Intern Med 2002;136:713-22.
5. Gabriel SE, Jaakkimainen L, Bombardier C. Risk for serious gastrointestinal complications related to use of nonsteroidal anti-inflammatory drugs. A meta-analysis. Ann Intern Med 1991;115:787-96.
6. Ofman JJ, MacLean CH, Straus WL, et al. A metaanalysis of severe upper gastrointestinal complications of nonsteroidal antiinflammatory drugs. J Rheumatol 2002;29:804-12.
7. Hallas J, Lauritsen J, Villadsen HD, Gram LF. Nonsteroidal anti-inflammatory drugs and upper gastrointestinal bleeding, identifying high-risk groups by excess risk estimates. Scand J Gastroenterol 1995;30:438-44.
8. Assendelft WJ, Bouter LM, Knipschild PG. Complications of spinal manipulation: a comprehensive review of the literature. J Fam Pract 1996;42:475-80.
9. Dziewas R, Konrad C, Drager B, Evers S, Besselmann M, Ludemann P, et al. Cervical artery dissection—clinical features, risk factors, therapy and outcome in 126 patients. J Neurol 2003;250:1179-84.
10. Haldeman S, Kohlbeck FJ, McGregor M. Risk factors and precipitating neck movements causing vertebrobasilar artery dissection after cervical trauma and spinal manipulation. Spine 1999;24:785-94.
11. Barrett AJ, Breen AC. Adverse effects of spinal manipulation. J R Soc Med 2000;93:258-9.
12. Cagnie B, Vinck E, Beernaert A, Cambier D. How common are side effects of spinal manipulation and can these side effects be predicted? Man Ther 2004;9:151-6.
13. Leboeuf-Yde C, Hennius B, Rudberg E, Leufvenmark P, Thunman M. Side effects of chiropractic treatment: a prospective study. J Manipulative Physiol Ther 1997;20:511-5.
14. Senstad O, Leboeuf-Yde C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. Spine 1997;22:435-40.
15. Hurwitz EL, Morgenstern H, Vassilaki M, Chiang LM. Adverse reactions to chiropractic treatment and their effects on satisfaction and clinical outcomes among patients enrolled in the UCLA Neck Pain Study. J Manipulative Physiol Ther 2004;27:16-25.
16. Axen I, Rosenbaum A, Robech R, Wren T, Leboeuf-Yde C. Can patient reactions to the first chiropractic treatment predict early favorable treatment outcome in persistent low back pain? J Manipulative Physiol Ther 2002;25:450-4.
17. Axen I, Rosenbaum A, Robech R, Larsen K, Leboeuf-Yde C. The Nordic back pain subpopulation program: can patient reactions to the first chiropractic treatment predict early favorable treatment outcome in nonpersistent low back pain? J Manipulative Physiol Ther 2005;28:153-8.
18. Bolton JE, Wilkinson RC. Responsiveness of pain scales: a comparison of three pain intensity measures in chiropractic patients. J Manipulative Physiol Ther 1998;21:1-7.
19. Potter RG, Jones JM, Boardman AP. A prospective study of primary care patients with musculoskeletal pain: the identification of predictive factors for chronicity. Br J Gen Pract 2000;50:225-7.
20. Heijmans WFGJ, Lutke Schipholt HJA, Elvers JWH, Oostendorp RA. Neck Disability Index Dutch version (NDI-DV) bij chronische "whiplash" patienten: onderzoek naar de betrouwbaarheid. Ned Tijdschr voor Fysiotherapie 2006;112: 94-9.
21. Macfarlane GJ, Thomas E, Croft PR, Papageorgiou AC, Jayson MI, Silman AJ. Predictors of early improvement in low back pain amongst consulters to general practice: the

influence of pre-morbid and episode-related factors. Pain 1999;80:113-9.
22. Beurskens AJ, de Vet HC, Koke AJ, Lindeman E, van der Heijden GJ, Regtop W, et al. A patient-specific approach for measuring functional status in low back pain. J Manipulative Physiol Ther 1999;22:144-8.
23. Feinstein AR. Clinimetrics. New Haven and London: Yale University Press; 1987.
24. Hurwitz EL, 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.
25. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther 1991;14: 409-15.
26. Vernon H. The Neck Disability Index: patient assessment and outcome monitoring in whiplash. J Musculoskelet Pain 1996;4:95-104.
27. Hains F, Waalen J, Mior S. Psychometric properties of the Neck Disability Index. J Manipulative Physiol Ther 1998;21:75-80.
28. Cherkin D, Deyo RA, Berg AO. Evaluation of a physician education intervention to improve primary care for low-back pain. II. Impact on patients. Spine 1991;16:1173-8.
29. Senstad O, Leboeuf-Yde C, Borchgrevink CF. Side-effects of chiropractic spinal manipulation: types frequency, discomfort and course. Scand J Prim Health Care 1996;14:50-3.
30. Farrar JT, Young JP, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain 2001;94:149-58.
31. Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain 1995;62:363-72.
32. van Ginkel JR, van der Ark LA. SPSS syntax for missing value imputation in test and questionnaire data. Appl Psychol Meas 2005;29:152-3.
33. Swinkels-Meewisse I. Pain-related fear in acute low back pain. The prognostic impact on performance, disability, and participation. Eindhoven, The Netherlands: University of Maastricht; 2006.
34. Bronfort G, Evans R, Nelson B, Aker PD, Goldsmith CH, Vernon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. Spine 2001;26:788-97.
35. Leboeuf-Yde C, Gronstvedt A, Borge JA, et al. The Nordic back pain subpopulation program: a 1-year prospective multicenter study of outcomes of persistent low-back pain in chiropractic patients. J Manipulative Physiol Ther 2005;28:90-6.
36. Imbos N, Langworthy J, Wilson F, Regelink G. Practice characteristics of chiropractors in the Netherlands. Clin Chiropr 2005;8:7-12.
37. Pedersen P, Breen AC. An overview of European chiropractic practice. J Manipulative Physiol Ther 1994;17:228-37.

Bilag 9

COMMENTARY

ADVERSE REACTIONS TO CHIROPRACTIC CARE IN THE UCLA NECK PAIN STUDY: A RESPONSE

Anthony L. Rosner, PhD[a]

As an adjunct to the UCLA Neck Pain Study, in which outcomes of patients who undergo cervical manipulation have been compared to those of individuals treated by mobilization, Hurwitz et al[11] have recently catalogued all the adverse symptoms apparently encountered by both groups during the clinical trial. As detailed a review as this study is, there are statements in the text as well as quirks and gaps in the data that must be brought to light for the actual risks of manipulation to be appreciated in their true perspective. Issues addressed include (1) problems with the time sequence of events; (2) comparative odds ratios and frequencies with procedures other than manipulation; (3) the effect of preceding conditions; (4) relativity to other interventions; and (5) the lack of details regarding technique and the number of adjustments.

During the past decade, the issues of cerebrovascular accidents (CVAs) and spinal manipulation have become linked in a debate of ever-increasing intensity. A copious number of studies have investigated spinal manipulation as a putative causative factor of CVAs.[1-6] Additional studies have examined more minor and transient events which have been observed to follow cervical manipulations, in the effort to more thoroughly assess the risk-benefit ratios of cervical manipulation as well as to attempt to gain a deeper understanding of the mechanisms that might possibly trigger more serious adverse events.[7-10]

Adding to the latter body of evidence is an adjunct to the UCLA Neck Pain Study, in which the outcomes of patients who underwent cervical manipulation have been compared to those of individuals treated by mobilization. Hurwitz et al [11] catalogued all the adverse symptoms apparently encountered by both groups during the clinical trial. The investigators indicate that some 85 patients (30.4%) out of the 280 participants polled had adverse symptoms, most commonly increased neck pain or stiffness with less frequently reported instances of headache or radiating pain. Patients randomized to manipulation were reported to be more likely than those assigned to mobilization to report an adverse symptom (odds ratio, 1.44; 95% CI 0.83-2.49).[11]

If a true assessment of the risks and mechanisms that accompany cervical manipulation is to be made, however, one must examine more closely the design of those studies to be better equipped to provide more definitive data. Despite the extent of detail in the Hurwitz et al [11] study, in particular, there are statements in the text as well as inconsistencies and gaps in the data which are worth examining in order that the actual risks of manipulation are appreciated in a more complete perspective.

SIGNIFICANCE AND TIME SEQUENCE OF ODDS RATIOS

A review of all the odds ratios reflecting the relative risks of manipulation vs mobilization raises several questions regarding their significance. To begin, all odds ratios are well within the confidence intervals shown in the data, indicating that they do not approach statistical significance. Secondly, one of the tables (Table 3 in Hurwitz et al[11]) in this investigation reports the increased risk of *all* adverse events attributed to manipulation compared to mobilization and reflects an odds ratio of 1.44 within 24 hours of the treatment. However, precisely the same odds ratio of 1.44 is shown for *any* time of onset. The odds ratios for neck pain, stiffness, and soreness—by far the most common symptom reported by the authors—actually *decrease* for onsets less than 24 hours, whereas the respective odds ratios for other conditions (radiating pain, fatigue, headache, neurological symptoms) are shown to increase. It has been suggested elsewhere that if the association with the treatment were to be real, a positive gradient linking presumed cause and outcome should be present.[12]

Therefore, one might anticipate a marked drop-off of the odds ratio as more time elapses between treatment and effect. That may not be the case here and contradicts a body of literature involving adverse reactions after cervical manipulation, in which the number of incidents did indeed

[a] Foundation for Chiropractic Education and Research, Brookline, Mass.

Submit requests for reprints to: Anthony L. Rosner, PhD, Foundation for Chiropractic Education and Research, 1330 Beacon Street, Suite 315, Brookline, MA 02446-3202
(e-mail: *rosnerfcer@aol.com*).

Paper submitted August 8, 2005; in revised form December 12, 2005.
J Manipulative Physiol Ther 2006;29:248-251.
0161-4754/$32.00

doi:10.1016/j.jmpt.2006.02.002

decline as the time between treatment and effect increased beyond 24 hours.[7-10,13] This argument must not be construed, however, to dismiss the significance of the effects of an intervention beyond 24 hours. Furthermore, the lack of statistical significance of the odds ratios may make any arguments about their presumed change or lack of change a moot issue.

Comparative Odds Ratios and Frequencies

In reviewing the relative risks of groups of patients undergoing treatments, the same table reported above also compared the reporting rates of adverse events in patients experiencing electromagnetic stimulation (EMS) in their therapy and those lacking such a procedure. In terms of neck pain stiffness and soreness—2 events that the authors have most commonly linked with manipulation—the odds ratio for any onset was 1.50 (95% CI 0.86-2.62), comparable to the corresponding figure for manipulation vs mobilization (1.38; 95% CI 0.79-2.40). The obvious question one would raise here is whether many or all of the adverse reactions reported here are specifically the result of cervical manipulation. Furthermore, it is not clear from this study whether the logistic regression model used by the authors included all of the 3 treatment factors used (manipulation vs mobilization, heat vs no heat, EMS vs no EMS). If the factors were not included, the odds ratios reported for manipulation vs mobilization would have been confounded by the other 2 components.

Effect of Preceding Conditions

A number of predisposing conditions at baseline were shown by Hurwitz et al [11] to significantly elevate the likelihood of reporting a specific adverse reaction to treatment:

	Odds ratio
(*a*) Moderate or severe headache *vs* mild	5.18 (95% CI, 1.88-14.9)
(*b*) Elevated neck disability scores	3.15 (95% CI, 1.01-9.80)

These factors would have the effect of inflating the overall risk ratios observed in the entire cohort of patients undergoing therapy, manipulative or otherwise. The question might be raised as to whether the distribution of these conditions was the same in the mobilization and manipulative groups, although a correction for baseline severity was presumably provided in the regression models. It has already been reported elsewhere that preexisting conditions may have considerable bearing upon the more serious events that have been attempted to be linked to cervical manipulation.[14-16]

Relativity to Other Interventions

For this issue to be seen in its proper perspective, it needs to be viewed in comparison to all the other medical and lifestyle options that are available to the individual patient. By the authors' own statement,[11] "Complication rates from surgical and pharmaceutical treatments for neck pain are estimated to be much higher than those from spinal manipulation or other chiropractic interventions." Risks are inherent in every medical procedure or lifestyle activity that we encounter. In terms of interventions of the spine, chiropractic has been shown to be many orders of magnitude safer than medication or surgery.

Assuming that each patient receives an average of 10 manipulations in treatment,[17] death rates after cervical manipulation calculate to anywhere between 1/100 and 1/400 the rates seen in the use of nonsteroidal anti-inflammatory drugs for the same condition.[18,19] Death rates from lumbar spine operations are reported to be 300 times higher than the rate produced by CVAs in spinal manipulation[20,21]; for cervical surgeries, recent death rates have been estimated to be 700-fold greater.[20] As Rome[22] has pointed out, risks for "virtually all" medical procedures ranging from the taking of blood samples,[22] use of vitamins,[23] drugs,[23] "natural" medications,[24] and vaccinations[25] are routinely accepted by the public as a matter of course. In short, it must be emphasized that the magnitude of what are apparently minor and short-lived exacerbations in this study does not itself provide sufficient grounds for excluding manipulation to the upper cervical region.

Lack of Details Regarding Technique and Number of Adjustments

The study fails to provide information regarding the specific techniques of chiropractic manipulation applied or their number other than the expression "at least one adjustment" provided in the paper. Although a higher number of transient complications have been reported to be associated with primarily rotatory maneuvers in the upper cervical region,[26] the authors do indicate in their study that their procedures involved minimal extension and rotation. There is also a lack of information regarding the actual numbers of manipulations applied, their frequency, or the specific regions adjusted, the latter also having been shown to influence the rates of transient reactions reported.[26]

Until the preceding question and previous issues are understood and resolved, there would be little from the current study which can be drawn to alter the present course of cervical manipulation, particularly because the data are preliminary and do not reach statistical significance, and the benefits of such procedures have been amply shown elsewhere.[27-52] In particular, several reports exist that indicate superior outcomes from manipulation when compared to mobilization.[53-56] There is no question that the

side-effects and complications that can be unequivocally associated with manipulation need to be studied in detail such that their frequency and severity can be diminished even further, despite the fact that the preponderance of evidence has shown that it is a far safer alternative than medical or surgical interventions for the complaints presented.

In summary, the issue of adverse events after cervical manipulation compared to mobilization requires further study, with statistically robust data, further details on the interventions applied and the clinicians involved, and subgroups in which one intervention compared to the other might provide superior benefits. Until such data can be provided, the conclusion from the Hurwitz et al[11] study can only be regarded as preliminary.

Practical Applications

- Regarding the adverse reactions attributed to cervical manipulation in the UCLA Neck Pain Study, several anomalies appear which require further explanation for the complete acceptance of the findings.
- 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 from which to design future investigations in the effort to alleviate these problems.

References

1. Lee KP, Carlini WG, McCormick GF, Walters GW. Neurologic complications following chiropractic manipulation: a survey of California neurologists. Neurology 1995;45:1213-5.
2. Bin Saeed A, Shuaib A, Al-Sulaiti G, Emery D. Vertebral artery dissection: warning symptoms, clinical features and prognosis in 26 patients. Can J Neurol Sci 2000;27:292-6.
3. Hufnagel A, Hammers A, Schonle P-W, Bohm K-D, Leonhardt G. Stroke following chiropractic manipulation of the cervical spine. J Neurol 1999;246:683-8.
4. Norris JW, Beletsky V, Nadareishvilli ZG. Sudden neck movement and cervical artery dissection: the Canadian Stroke Consortium. Can Med Assoc J 2000;163:38-40.
5. Rothwell DM, Bondy SJ, Williams JI. Chiropractic manipulation and stroke: a population-based case-control study. Stroke 2001;32:1054-60.
6. Smith WS, Johnston SC, Skalabrin EJ, Weaver M, Azari P, Albers GW, et al. Spinal manipulative therapy is an independent risk factor for vertebral artery dissection. Neurology 2003;60:1424-8.
7. Klougart N, LeBouef-Yde C, Rasmussen LR. Safety in chiropractic practice: Part II. Treatment in the upper neck and the rate of cerebrovascular incidents. J Manipulative Physiol Ther 1996;19:563-9.
8. Senstad O, LeBouef-Yde C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. Spine 1997;22:435-41.
9. Cagnie B, Vinck E, Beernaert A, Cambier D. How common are side effects of spinal manipulation and can these side effects be predicted? Man Ther 2004;9:151-6.
10. Haldeman S, Kohlbeck FJ, McGregor M. Unpredictability of cerebrovascular ischemia associated with cervical spine manipulation therapy. Spine 2002;27:49-55.
11. Hurwitz EL, Morgenstern H, Vassilaki M, Chiang L-M. Frequency and clinical predictors of adverse reactions to chiropractic care in the UCLA Neck Pain Study. Spine 2005;30:1477-84.
12. Hill AB. The environment and disease: association or causation? Proc R Soc Med 1965;58:295-300.
13. Terret AGJ. Current concepts in vertebrobasilar complications following spinal manipulation. West Des Moines (Iowa): NCMIC Group Inc; 2001.
14. Rosner A. CVA risks in perspective. Man Med 2003;3:1-9.
15. Rosner A. Stroke and spinal manipulation: basic questions. J Qual Health Care 2004;3:12-5.
16. Rosner A. Spontaneous cervical artery dissections: another perspective. J Manipulative Physiol Ther 2004;27:124-32.
17. Carey TS, Garrett J, Jackman A, McLaughlin C, Fryer J, Smucker DR, et al. The outcomes and costs of care for acute low back pain among patients seen by primary care practitioners, chiropractors, and orthopedic surgeons. N Engl J Med 1995;333:913-7.
18. Dabbs V, Lauretti W. A risk assessment of cervical manipulation vs NSAIDS for the treatment of neck pain. J Manipulative Physiol Ther 1995;18:530-6.
19. Gabriel SE, Jaakkimainen L, Bombardier C. Risk of serious gastrointestinal complications related to the use of nonsteroidal anti-inflammatory drugs: a meta-analysis. Ann Intern Med 1991;115:787-96.
20. Deyo RA, Cherkin DC, Loesser JD, Bigos SJ, Ciol MA. Morbidity and mortality in association with operations on the lumbar spine. J Bone Joint Surg Am 1992;74:536-43.
21. Boullet R. Treatment of sciatica: a comparative survey of the complications of surgical treatment and nucleolysis with chymopapain. Clin Orthop 1990;251:144-52.
22. Rome PL. Perspective: an overview of comparative considerations of cerebrovascular accidents. Chiropr J Aust 1999;29:87-102.
23. Horowitz SH. Peripheral nerve injury and causalgia secondary to routine venipuncture. Neurology 1994;44:962-4.
24. Anonymous. Readers' Q & A. Aust Med 1998;5:18.
25. Burgess MA, McIntyre PB, Heath TC. Rethinking contraindications to vaccination. Med J Aust 1998;168:476-7.
26. Klougart N, LeBouef-Yde C, Rasmussen LR. Safety in chiropractic practice: Part II. Treatment in the upper neck and the rate of cerebrovascular incidents. J Manipulative Physiol Ther 1996;19:563-9.
27. Cassidy JD, Lopes AA, Yong-Hing K. The immediate effect of manipulation versus mobilization on pain and range of motion in the cervical spine: a randomized controlled trial. J Manipulative Physiol Ther 1992;15:570-5.
28. Khan S, Cook J, Gargan M, Bannister G. A symptomatic classification of whiplash injury and the implications for treatment. J Orthop Med 1999;21:22-5.
29. Woodward MN, Cook JCH, Gargan MF, Bannister GC. Chiropractic treatment of chronic "whiplash" injuries. Injury 1996;27:643-5.
30. Boline P, Kassak K, Bronfort G, Nelson C, Anderson AV. Spinal manipulation vs. amitriptyline for the treatment of

chronic tension-type headaches: a randomized clinical trial. J Manipulative Physiol 1995;18:148-54.
31. Bitterli J, Graf F, Robert F, Adler R, Mumaler M. Zur objektivierung der manualtherapeutischen beeinflussbarket des spondylogenen korpschemerzes [Objective criteria for the evaluation of chiropractic treatment of spondylotic headache]. Nernarzt 1977;48:159-62.
32. Hoyt WH, Shaffer F, Bard DA, Benesler JS, Blankenhorn III GD, Gray JH, et al. Osteopathic manipulation in the treatment of muscle-contraction headache. J Am Osteopath Assoc 1979;78:322-5.
33. Bove G, Nilsson N. Spinal manipulation in the treatment of episodic tension-type headache. JAMA 1998;280: 1576-9.
34. Nilsson N. A randomized controlled trial of the effect of spinal manipulation in the treatment of cervicogenic headache. J Manipulative Physiol Ther 1995;18:435-40.
35. Nilsson N, Christensen HW, Hartvigsen J. The effect of spinal manipulation in the treatment of cervicogenic headache. J Manipulative Physiol Ther 1997;29:326-30.
36. Whittingham W. Randomized placebo controlled clinical trial of efficacy of chiropractic treatment for chronic cervicogenic headaches. Proceedings of the 6th Biennial Congress, World Federation of Chiropractic; 2001 May 21-26; Paris, France. Toronto: World Federation of Chiropractic; 2001.p. 231-2.
37. Nelson CF, Bronfort G, Evans R, Boline P, Goldsmith C, Anderson AV. The efficacy of spinal manipulation, amitriptyline and the combination of both therapies in the prophylaxis of migraine headache. J Manipulative Physiol Ther 1998;21: 511-9.
38. Tuchin PJ, Pollard H, Bonello R. A randomized controlled trial of chiropractic spinal manipulative therapy for migraine. J Manipulative Physiol Ther 2000;23:91-5.
39. Parker G, Tupling H, Pryor D. A controlled trial of cervical manipulation for migraine. Aust N Z J Med 1978;8:589-93.
40. Hurwitz EL, Aker PD, Adams AH, Meeker WC, Shekelle PG. Manipulation and mobilization of the cervical spine: a systematic review of the literature. Spine 1996;21:1746-60.
41. Kjellman GV, Skagren EI, Oberg BE. A critical analysis of randomised clinical trials on neck pain and treatment efficacy: a review of the literature. Scand J Rehabil Med 1999;31:139-52.
42. Bronfort G, Assendelft WJJ, Evans R, Haas M, Bouter L. Efficacy of spinal manipulation for chronic headaches: a systematic review. J Manipulative Physiol Ther 2001;24: 457-66.
43. Vernon H, McDermaid CS, Hagino C. Systematic review of randomized clinical trials of complementary/alternative therapies in the treatment of tension-type and cervicogenic headache. Complement Ther Med 1999;7:142-55.
44. McCrory DC, Penzien DB, Hasselblad V, Gray RN, et al. Evidence report: behavioral and physical treatments for tension-type and cervicogenic headache. Des Moines (Iowa): Foundation for Chiropractic Education and Research; 2001.
45. Gross AR, Hoving DL, Haines TA, Goldsmith CH, Ka T, Aker P, et al. A Cochrane Review of manipulation and mobilization for mechanical neck disorders. Spine 2004;29:1541-8.
46. Davis PT, Hulbert JR, Kassak KM, Meyer JJ. Comparative efficacy of conservative medical and chiropractic treatments for carpal tunnel syndrome: a randomized clinical trial. J Manipulative Physiol Ther 1998;21:317-26.
47. Winters JC, Sobel JS, Groenier KH, Arendzen HJ, Meyboom-de Jong B. Comparison of physiotherapy, manipulation, and corticosteroid injection for treating shoulder complaints in general practice: randomised, single blind study. BMJ 1997;314:1320-5.
48. Mercer C, Nook BC. The efficacy of chiropractic spinal adjustments as a treatment protocol in the management of infantile colic. Proceedings of the 5th Biennial Congress, World Federation of Chiropractic; 1999 May 17-22; Auckland, New Zealand. Toronto: World Federation of Chiropractic; 1999. p. 170-1.
49. Wiberg JMM, Nordsteen J, Nilsson N. The short-term effect of spinal manipulation in the treatment of infantile colic: a randomized controlled trial with a blinded observer. J Manipulative Physiol Ther 1999;22:517-22.
50. Reed WR, Beavers S, Reddy SK, Kern G. Chiropractic management of primary nocturnal enuresis. J Manipulative Physiol Ther 1994;17:596-600.
51. Froehle RM. Ear infection: a retrospective study examining improvement from chiropractic care and analyzing for influencing factors. J Manipulative Physiol Ther 1996;19:169-77.
52. Fallon J. The role of chiropractic adjustment in the care and treatment of 332 children with otitis media. J Clin Chiropr Pediatr 1997;2:167-83.
53. Koes BW, Bouter LM, van Mameren H, Essers AHM, Verstegen GMJR, Hofhuizen DM, et al. A blinded randomized clinical trial of manual therapy and physiotherapy for chronic back and neck complaints: physical outcome measures. J Manipulative Physiol Ther 1992;15:16-23.
54. Koes BW, Bouter LM, van Mameren H, Essers AHM, Verstegen GMJR, Hofhuizen DM, et al. Randomised clinical trial of manipulative therapy and physiotherapy for persistent back and neck complaints: results of one year follow up. BMJ 1992;304:601-5.
55. Koes BW, Bouter LM, van Mameren H, Essers AHM, Verstegen GMJR, Hofhuizen DM, et al. A randomized clinical trial of manual therapy and physiotherapy for persistent back and neck complaints: subgroup analysis and relationship between outcome measures. J Manipulative Physiol Ther 1993;16:211-9.
56. Hsieh C-Y, Phillips RB, Adams AH, Pope MH. Functional outcomes of low back pain: comparison of four treatment groups in a randomized controlled trial. J Manipulative Physiol Ther 1992;15:4-9.

Bilag 10

SPINE Volume 33, Number 4S, pp S176–S183

Risk of Vertebrobasilar Stroke and Chiropractic Care

Results of a Population-Based Case-Control and Case-Crossover Study

J. David Cassidy, DC, PhD, DrMedSc,*†‡ Eleanor Boyle, PhD,* Pierre Côté, DC, PhD,*†‡§ Yaohua He, MD, PhD,* Sheilah Hogg-Johnson, PhD,†§ Frank L. Silver, MD, FRCPC,¶‖ and Susan J. Bondy, PhD†

Study Design. Population-based, case-control and case-crossover study.

Objective. To investigate associations between chiropractic visits and vertebrobasilar artery (VBA) stroke and to contrast this with primary care physician (PCP) visits and VBA stroke.

Summary of Background Data. Chiropractic care is popular for neck pain and headache, but may increase the risk for VBA dissection and stroke. Neck pain and headache are common symptoms of VBA dissection, which commonly precedes VBA stroke.

Methods. Cases included eligible incident VBA strokes admitted to Ontario hospitals from April 1, 1993 to March 31, 2002. Four controls were age and gender matched to each case. Case and control exposures to chiropractors and PCPs were determined from health billing records in the year before the stroke date. In the case-crossover analysis, cases acted as their own controls.

Results. There were 818 VBA strokes hospitalized in a population of more than 100 million person-years. In those aged <45 years, cases were about three times more likely to see a chiropractor or a PCP before their stroke than controls. Results were similar in the case control and case crossover analyses. There was no increased association between chiropractic visits and VBA stroke in those older than 45 years. Positive associations were found between PCP visits and VBA stroke in all age groups. Practitioner visits billed for headache and neck complaints were highly associated with subsequent VBA stroke.

Conclusion. VBA stroke is a very rare event in the population. The increased risks of VBA 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 excess risk of VBA stroke associated chiropractic care compared to primary care.

Key words: vertebrobasilar stroke, case control studies, case crossover studies, chiropractic, primary care, complications, neck pain. **Spine 2008;33:S176–S183**

Neck pain is a common problem associated with considerable comorbidity, disability, and cost to society.[1–5] In North America, the clinical management of back pain is provided mainly by medical physicians, physical therapists and chiropractors.[6] Approximately 12% of American and Canadian adults seek chiropractic care annually and 80% of these visits result in spinal manipulation.[7,8] When compared to those seeking medical care for back pain, Canadian chiropractic patients tend to be younger and have higher socioeconomic status and fewer health problems.[6,8] In Ontario, the average number of chiropractic visits per episode of care was 10 (median 6) in 1985 through 1991.[7] Several systematic reviews and our best-evidence synthesis suggest that manual therapy can benefit neck pain, but the trials are too small to evaluate the risk of rare complications.[9–13]

Two deaths in Canada from vertebral artery dissection and stroke following chiropractic care in the 1990s attracted much media attention and a call by some neurologists to avoid neck manipulation for acute neck pain.[14] There have been many published case reports linking neck manipulation to vertebral artery dissection and stroke.[15] The prevailing theory is that extension and/or rotation of the neck can damage the vertebral artery, particularly within the foramen transversarium at the C1–C2 level. Activities leading to sudden or sustained rotation and extension of the neck have been implicated, included motor vehicle collision, shoulder checking while driving, sports, lifting, working overhead, falls, sneezing, and coughing.[16] However, most cases of extracranial vertebral arterial dissection are thought to occur spontaneously, and other factors such as connective tissue disorders, migraine, hypertension, infection, levels of plasma homocysteine, vessel abnormalities, atherosclerosis, central venous

From the *Centre of Research Expertise for Improved Disability Outcomes (CREIDO), University Health Network Rehabilitation Solutions, Toronto Western Hospital, and the Division of Heath Care and Outcomes Research, Toronto Western Research Institute, Toronto, ON, Canada; †Department of Public Health Sciences, Management and Evaluation, University of Toronto, Toronto, ON, Canada; ‡Department of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada; §Institute for Work & Health, Toronto, ON, Canada; ¶University Health Network Stroke Program, Toronto Western Hospital, Toronto, ON, Canada; and ‖Division of Neurology, Department of Medicine, Faculty of Medicine, University of Toronto, Toronto, ON, Canada.

Supported by Ontario Ministry of Health and Long-term Care. P.C. is supported by the Canadian Institute of Health Research through a New Investigator Award. S.H.-J. is supported by the Institute for Work & Health and the Workplace Safety and Insurance Board of Ontario. The opinions, results, and conclusions are those of the authors and no endorsement by the Ministry is intended or should be inferred.

The manuscript submitted does not contain information about medical device(s)/drug(s).

University Health Network Research Ethics Board Approval number 05-0533-AE.

Address correspondence and reprint requests to J. David Cassidy, DC, PhD, DrMedSc, Toronto Western Hospital, Fell 4-114, 399 Bathurst Street, Toronto, ON, Canada M5T 2S8; E-mail: dcassidy@uhnresearch.ca

catherization, cervical spine surgery, cervical percutaneous nerve blocks, radiation therapy and diagnostic cerebral angiography have been identified as possible risk factors.[17–21]

The true incidence of vertebrobasilar dissection is unknown, since many cases are probably asymptomatic, or the dissection produces mild symptoms.[22] Confirming the diagnosis requires a high index of suspicion and good vascular imaging. The cases that are most likely to be diagnosed are those that result in stroke.[19,22] Ischemic stroke occurs when a thrombus develops intraluminally and embolizes to more distal arteries, or less commonly, when the dissection extends distally into the intracranial vertebral artery, obliterating branching vessels.[22] The best incidence estimate comes from Olmstead county, where vertebral artery dissection causing stroke affected 0.97 residents per 100,000 population between 1987 and 2003.[23]

To date there have been two case-control studies of stroke following neck manipulation. Rothwell *et al* used Ontario health data to compare 582 cases of VBA stroke to 2328 age and sex-matched controls.[24] For those aged <45 years, cases were five times more likely than controls to have visited a chiropractor within 1 week of VBA stroke. Smith *et al* studied 51 patients with cervical artery dissection and ischemic stroke or transient ischemic attack (TIA) and compared them to 100 control patients suffering from other strokes not caused by dissections.[25] Cases and controls came from two academic stroke centers in the United States and were matched on age and sex. They found no significant association between neck manipulation and ischemic stroke or TIA. However, a subgroup analysis showed that the 25 cases with vertebral artery dissection were six times more likely to have consulted a chiropractor within 30 days before their stroke than the controls.

Finally, because patients with vertebrobasilar artery dissection commonly present with headache and neck pain,[23] it is possible that patients seek chiropractic care for these symptoms and that the subsequent VBA stroke occurs spontaneously, implying that the association between chiropractic care and VBA stroke is not causal.[23,26] Since patients also seek medical care for headache and neck pain, any association between primary care physician (PCP) visits and VBA stroke could be attributed to seeking care for the symptoms of vertebral artery dissection.

The purpose of this study is to investigate the association between chiropractic care and VBA stroke and compare it to the association between recent PCP care and VBA stroke using two epidemiological designs. Evidence that chiropractic care increases the risk of VBA stroke would be present if the measured association between chiropractic visits and VBA stroke exceeds the association between PCP visits and VBA strokes.

Methods

Study Design

We undertook population-based case-control and case-crossover studies. Both designs use the same cases. In the case-control design, we sampled independent control subjects from the same source population as the cases. In the case-crossover design, cases served as their own controls, by sampling control periods before the study exposures.[27] This design is most appropriate when a brief exposure (*e.g.*, chiropractic care) causes a transient change in risk (*i.e.*, hazard period) of a rare-onset disease (*e.g.*, VBA stroke). It is well suited to our research questions, since within person comparisons control for unmeasured risk factors by design, rather than by statistical modeling.[28–30] Thus the advantage over the case control design is better control of confounding.

Source Population

The source population included all residents of Ontario (109,020,875 person-years of observation over 9 years) covered by the publicly funded Ontario Health Insurance Plan (OHIP). Available utilization data included hospitalizations with diagnostic coding, and practitioner (physician and chiropractic) utilization as documented by fee-for-service billings accompanied by diagnostic coding. We used two data sources: (1) the Discharge Abstract Database (DAD) from the Canadian Institute for Health Information, which captures hospital separations and ICD codes, and (2) the OHIP Databases for services provided by physicians and chiropractors. These databases can be linked from April 1992 onward.

Cases

We included all incident vertebrobasilar occlusion and stenosis strokes (ICD-9433.0 and 433.2) resulting in an acute care hospital admission from April 1, 1993 to March 31, 2002. Codes were chosen in consultation with stroke experts and an epidemiologist who participated in a similar past study (SB).[24] Cases that had an acute care hospital admission for any type of stroke (ICD-9433.0, 433.2, 434, 436, 433.1, 433.3, 433.8, 433.9, 430, 431, 432, and 437.1), transient cerebral ischemia (ICD-9435) or late effects of cerebrovascular diseases (ICD-9438) before their VBA stroke admission or since April 1, 1991 were excluded. Cases residing in long-term care facilities were also excluded. The index date was defined as the hospital admission date for the VBA stroke.

Controls

For the case-control study, four age and sex-matched controls were randomly selected from the Registered Persons Database, which contains a listing of all health card numbers for Ontario. Controls were excluded if they previously had a stroke or were residing in a long-term care facility.

For the case crossover study, four control periods were randomly chosen from the year before the VBA stroke date, using a time-stratified approach.[31] The year was divided into disjoint strata with 2 week periods between the strata. For the 1 month hazard period, the disjoint strata were separated by 1 month periods and the five remaining control periods were used in the analyses. We randomly sampled disjoint strata because chiropractic care is often delivered in episodes, and this strategy eliminates overlap bias and bias associated with time trends in the exposure.[32]

Exposures

All reimbursed ambulatory encounters with chiropractors and PCPs were extracted for the one-year period before the index date from the OHIP database. Neck-related chiropractic visits were identified using diagnostic codes: C01–C06, cervical and cervicothoracic subluxation; C13–C15, multiple site subluxation; C30, cervical sprain/strain; C40, cervical neuritis/neuralgia; C44, arm neuritis/neuralgia; C50, brachial radiculitis; C51, cervical radiculitis; and C60, headache. For PCP visits, we included community medicine physicians if they submitted ambulatory fee codes to OHIP. Fee codes for group therapy and signing forms were excluded. Headache or neck pain-related PCP visits were identified using the diagnostic codes: ICD-9307, tension headaches; 346, migraine headaches; 722, intervertebral disc disorders; 780, headache, except tension headache and migraine; 729, fibrositis, myositis and muscular rheumatism; and 847, whiplash, sprain/strain and other traumas associated with neck (These codes include other diagnoses, and we list only those relevant to neck pain or headache). There is no limit on the number of reimbursed PCP visits per year. However, there are limits chiropractors, but less than 15% of patients surpass them.[24]

Statistical Analysis

Conditional logistic regression was used to estimate the association between VBA stroke after chiropractor and PCP visits. Separate models were built using different *a priori* specified hazard periods, stratified by age (<45 years and ≥45 years) and by visits with or without head and neck pain related diagnostic codes. For the chiropractic analysis, the index date was included in the hazard period, since chiropractic treatment might cause immediate stroke and patients would not normally consult a chiropractor after having a stroke. However, the index day was excluded from the PCP analysis, since patients might consult these physicians after experiencing a stroke. We tested different hazard periods, including 1 day, 3 days, 1 week, 2 weeks, and 1 month before the index date. Exposure occurred if any chiropractic or PCP visits were recorded during the designated hazard periods.

We also measured the effect of cumulative numbers of chiropractic and PCP visits in the month before the index date by computing the odds ratio for each incremental visit. These estimates were similarly stratified by age and by diagnostic codes related to headache and/or neck pain. Finally, we conducted analyses to determine if our results were sensitive to chiropractic and PCP visits related to neck complaints and headaches. We report our results as odds ratios (OR) and 95% confidence intervals. Confidence intervals were estimated by accelerated bias corrected bootstraps with 2000 replications using the variance-covariance method.[33] All statistical analyses were performed using STATA/SE version 9.2.[34]

■ Results

A total of 818 VBA strokes met our inclusion/exclusion criteria over the 9 year inception period. Of the 3272 matched control subjects, 31 were excluded because of prior stroke, one had died before the index date and 76 were receiving long-term care. Thus, 3164 control subjects were matched to the cases. The mean age of cases and controls was 63 years at the index date and 63% were male. Cases had a higher proportion of comorbid conditions (Table 1). Of the 818 stroke cases, 337 (41.2%) were coded as basilar occlusion and stenosis, 443 (54.2%) as vertebral occlusion and stenosis and 38 (4.7%) had both codes.

Table 1. Age, Sex, and Comorbid* Condition of Cases and Controls

Variable	Cases (n = 818)	Controls (n = 3164)
Age: mean, median (SD)†	63.1, 68 (15.5)	62.6, 65 (15.4)
Males: n (%)	518 (63.3)	2022 (63.9)
Hypertension*: n (%)	276 (33.7)	738 (23.3)
Heart Disease*: n (%)	275 (33.6)	506 (16.0)
Diabetes*: n (%)	155 (19.0)	247 (7.8)
High Cholesterol*: n (%)	62 (7.6)	200 (6.3)
At least one comorbid condition§: n (%)	515 (63.0)	1294 (40.9)

*Comorbid conditions determined by ambulatory diagnostic codes from the Ontario Health Insurance Plan (OHIP) during year prior to index date.
†SD is standard deviation.
§Indicates the presence of at least one of hypertension, heart disease, diabetes or high cholesterol.

Overall, 4% of cases and controls had visited a chiropractor within 30 days of the index date, while 53% of cases and 30% of controls had visited a PCP within that time (Table 2). For those under 45 years of age, 8 cases (7.8%) had consulted a chiropractor within 7 days of the index date, compared to 14 (3.4%) of controls. For PCPs, 25 cases (24.5%) under 45 years of age had a consultation within 7 days of the index date, compared to 27 (6.6%) of controls. With respect to the number of visits within 1 month of the index date, 7.8% of cases under the age of 45 years had three or more chiropractic visits, whereas 5.9% had three or more PCP visits (Table 2).

The case control and case crossover analyses gave similar results. (Tables 3–7) Age modified the effect of chiropractic visits on the risk of VBA stroke. For those under 45 years of age, there was an increased association between chiropractic visits and VBA stroke regardless of the hazard period. For those 45 years of age and older, there was no association. Each chiropractic visit in the month before the index date was associated with an increased risk of VBA stroke in those under 45 years of age (OR 1.37; 95% CI 1.04–1.91 from the case crossover analysis) (Table 7). We were not able to estimate bootstrap confidence intervals in some cases because of sparse data.

Similarly, we found that visiting a PCP in the month before the index date was associated with an increased risk of VBA stroke regardless of the hazard period, or the age of the subject. Each PCP visit in the month before the stroke was associated with an increased risk of VBA stroke both in those under 45 years of age (OR 1.34; 95% CI 0.94–1.87 from the case crossover analysis) and 45 years and older (OR 1.52; 95% CI 1.36–1.67 from the case crossover analysis) (Table 7).

Our results were sensitive to chiropractic and PCP visits related to neck complaints and headaches, and we observed sharp increases in the associations when restricting the analyses to these visits (Tables 3–7). Overall,

Table 2. No. (n) and Percentage (%) of Chiropractic (DC) and Primary Care Physician (PCP) Visits Before the Index Date

	Entire Cohort		Age <45 yr		Age ≥45 yr	
Exposures	Cases (n = 818)	Controls (n = 3164)	Cases (n = 102)	Controls (n = 408)	Cases (n = 716)	Controls (n = 2756)
Most recent DC visit						
0–1 day: n (%)	6 (0.7)	22 (0.7)	*	*	*	21 (0.8)
0–3 days: n (%)	9 (1.1)	40 (1.3)	*	6 (1.5)	*	34 (1.2)
0–7 days: n (%)	14 (1.7)	56 (1.8)	8 (7.8)	14 (3.4)	6 (0.8)	42 (1.5)
0–14 days: n (%)	27 (3.3)	88 (2.8)	12 (11.8)	17 (4.2)	15 (2.1)	71 (2.6)
0–30 days: n (%)	36 (4.4)	125 (4.0)	13 (12.7)	18 (4.4)	23 (3.2)	107 (3.9)
Most recent PCP visit						
1–1 day: n (%)	63 (7.7)	41 (1.3)	12 (11.8)	6 (1.5)	51 (7.1)	35 (1.3)
1–3 days: n (%)	111 (13.6)	130 (4.1)	18 (17.6)	10 (2.5)	93 (13.0)	120 (4.4)
1–7 days: n (%)	205 (25.1)	290 (9.2)	25 (24.5)	27 (6.6)	180 (25.1)	263 (9.5)
1–14 days: n (%)	311 (38.0)	517 (16.3)	38 (37.3)	46 (11.3)	273 (38.1)	471 (17.1)
1–30 days: n (%)	437 (53.4)	945 (29.9)	48 (45.1)	83 (20.3)	391 (54.6)	862 (31.3)
No. of DC visits						
None in past month	782 (95.6)	3039 (96.0)	89 (87.3)	390 (95.6)	693 (96.8)	2649 (96.1)
1 or 2 in past month	21 (2.6)	96 (3.0)	*	13 (3.2)	16 (2.2)	83 (3.0)
3 or more in past month	15 (1.8)	29 (0.9)	8 (7.8)	*	7 (1.0)	24 (0.9)
Mean (SD†) in past month	0.13 (0.82)	0.08 (0.52)	0.50 (1.65)	0.09 (0.49)	0.08 (0.60)	0.08 (0.53)
No. of PCP visits						
None in past month	381 (46.6)	2219 (70.1)	56 (54.9)	325 (79.7)	325 (45.4)	1894 (68.7)
1 or 2 in past month	384 (46.9)	875 (27.7)	40 (39.2)	79 (19.4)	344 (48.0)	796 (28.9)
3 or more in past month	53 (6.5)	70 (2.2)	6 (5.9)	*	47 (6.6)	66 (2.4)
Mean (SD) in past month	0.85 (1.09)	0.41 (0.73)	0.74 (1.01)	0.27 (0.61)	0.87 (1.10)	0.43 (0.74)

*Cell size <8 and cannot be reported.
†SD is standard deviation.

these associations were more pronounced in the PCP analyses. However, the data are sparse, and we were unable to compute bootstrap confidence intervals in many cases.

Discussion

Our study advances knowledge about the association between chiropractic care and VBA stroke in two respects. First, our case control results agree with past case control studies that found an association between chiropractic care and vertebral artery dissection and VBA stroke.[24,25] Second, our case crossover results confirm these findings using a stronger research design with better control of confounding variables. The case-crossover design controls for time independent confounding factors, both known and unknown, which could affect the risk of VBA stroke. This is important since smoking, obesity, undiagnosed hypertension, some connective tissue disorders and other important risk factors for dissection and VBA stroke are unlikely to be recorded in administrative databases.

We also found strong associations between PCP visits and subsequent VBA stroke. A plausible explanation for this is that patients with head and neck pain due to vertebral artery dissection seek care for these symptoms, which precede more than 80% of VBA strokes.[23] Since it

Table 3. Odds Ratios and 95% Confidence Intervals (CI) and Accelerated and Bias Corrected Bootstrap 95% CI for Case-Control Estimates of the Association Between Chiropractic (DC) Visits and Vertebrobasilar Stroke

	Case-Control		Age <45 yr		Age ≥45 yr	
Exposures	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
Any DC visit						
0–1 day	1.06 (0.43–2.62)	0.36–2.61	12.00 (1.25–115.38)	*	0.55 (0.16–1.85)	0.14–1.93
0–3 days	0.87 (0.42–1.81)	0.40–1.78	3.33 (1.02–10.92)	0.80–14.00	0.44 (0.16–1.26)	0.12–1.25
0–7 days	0.98 (0.54–1.77)	0.51–1.79	2.41 (0.98–5.95)	0.80–6.29	0.55 (0.23–1.30)	0.21–1.23
0–14 days	1.22 (0.78–1.90)	0.77–1.92	3.07 (1.41–6.70)	1.25–7.31	0.82 (0.47–1.45)	0.45–1.47
0–30 days	1.14 (0.78–1.67)	0.75–1.62	3.13 (1.48–6.63)	1.34–7.21	0.83 (0.52–1.32)	0.51–1.30
Headache or cervical DC visit						
0–1 day	1.59 (0.56–4.54)	0.44–4.67	*	*	0.63 (0.14–2.81)	0.00–3.37
0–3 days	1.22 (0.51–2.88)	0.48–3.01	5.00 (1.34–18.62)	*	0.41 (0.09–1.77)	0.00–1.72
0–7 days	1.42 (0.71–2.86)	0.68–3.00	3.11 (1.16–8.35)	1.07–9.60	0.71 (0.24–2.10)	0.17–2.18
0–14 days	1.36 (0.79–2.33)	0.78–2.34	3.27 (1.36–7.90)	1.23–8.67	0.84 (0.41–1.75)	0.35–1.68
0–30 days	0.98 (0.60–1.61)	0.56–1.57	3.00 (1.26–7.12)	1.18–8.00	0.63 (0.33–1.19)	0.30–1.13

*Unable to compute due to small numbers.

Table 4. Odds Ratios and 95% Confidence Intervals (CI) and Accelerated and Bias Corrected Bootstrap 95% CI for Case-Control Estimates of the Association Between Primary Care Physician (PCP) Visits and Vertebrobasilar Stroke

	Case Control		Age <45 yr		Age ≥45 yr	
Exposure	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
Any PCP visit						
1–1 day	7.22 (4.70–11.08)	4.62–11.23	11.21 (3.59–35.03)	2.67–52.00	6.65 (4.18–10.58)	4.18–10.73
1–3 days	3.61 (2.76–4.73)	2.73–4.75	9.53 (3.96–22.97)	3.52–28.00	3.21 (2.41–4.27)	2.38–4.32
1–7 days	3.27 (2.67–4.00)	2.73–4.00	4.81 (2.57–9.02)	2.40–8.72	3.12 (2.52–3.87)	2.52–3.87
1–14 days	3.11 (2.61–3.69)	2.62–3.65	4.66 (2.78–7.84)	2.71–7.85	2.95 (2.48–3.54)	2.47–3.54
1–30 days	2.76 (2.35–3.24)	2.35–3.26	3.57 (2.17–5.86)	2.08–6.16	2.67 (2.25–3.17)	2.28–3.17
Headache or cervical PCP visit						
1–1 day	32.00 (7.36–139.17)	*	12.00 (1.25–115.36)	*	52.00 (6.80–397.50	*
1–3 days	25.19 (8.78–72.24)	8.69–104.00	25.64 (3.13–209.78)	*	25.04 (7.41–84.62)	*
1–7 days	16.72 (8.39–33.29	8.52–35.63	37.60 (4.80–294.70)	*	14.39 (6.88–30.08)	6.88–35.31
1–14 days	10.89 (6.53–18.16)	6.59–18.76	37.60 (4.80–294.70)	*	9.48 (5.56–16.19)	5.56–16.61)
1–30 days	6.96 (4.66–10.41)	4.68–10.42	11.45 (3.68–35.62)	3.50–53.57	6.42 (4.17–9.89)	4.20–10.18

*Unable to compute due to small numbers.

is unlikely that PCPs cause stroke while caring for these patients, we can assume that the observed association between recent PCP care and VBA stroke represents the background risk associated with patients seeking care for dissection-related symptoms leading to VBA stroke. Because the association between chiropractic visits and VBA stroke is not greater than the association between PCP visits and VBA stroke, there is no excess risk of VBA stroke from chiropractic care.

Our study has several strengths and limitations. The study base includes an entire population over a 9-year period representing 109,020,875 person-years of observation. Despite this, we found only 818 VBA strokes, which limited our ability to compute some estimates and bootstrap confidence intervals. In particular, our age stratified analyses are based on small numbers of exposed cases and controls (Table 2). Further stratification by diagnostic codes for headache and neck pain related visits imposed even greater difficulty with these estimates. However, there are few databases that can link incident VBA strokes with chiropractic and PCP visits in a large enough population to undertake a study of such a rare event.

A major limitation of using health administrative data are misclassification bias, and the possibility of bias in assignment of VBA-related diagnoses, which has previously been raised in this context.[24] Liu *et al* have shown that ICD-9 hospital discharge codes for stroke have a poor positive predictive value when compared to chart review.[35] Furthermore, not all VBA strokes are secondary to vertebral artery dissection and administrative databases do not provide the clinical detail to determine the specific cause. To investigate this bias, we did a sensitivity analysis using different positive predictive values for stroke diagnosis (ranging from 0.2 to 0.8). Assuming nondifferential misclassification of chiropractic and PCP cases, our analysis showed attenuation of the estimates towards the null with lower positive predictive values, but the conclusions did not change (*i.e.*, associations remained positive and significant— data not shown). The

Table 5. Odds Ratios and 95% Confidence Intervals (CI) and Accelerated and Bias Corrected Bootstrap 95% CI for Case-Crossover Estimates of the Association Between Chiropractic (DC) Visits and Vertebrobasilar Stroke

	Case Crossover		Age <45 yr		Age ≥45 yr	
Exposure	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
Any DC visit						
0–1 day	1.77 (0.66–4.79)	0.49–5.60	5.04 (0.82–30.99)	*	1.09 (0.30–4.02)	0.00–4.84
0–3 days	1.14 (0.52–2.51)	0.50–2.76	3.44 (0.96–12.28)	*	0.61 (0.20–1.84)	0.18–2.11
0–7 days	0.80 (0.41–1.56)	0.35–1.85	12.19 (2.52–58.98)	*	0.30 (0.12–0.77)	*
0–14 days	1.50 (0.89–2.52)	0.84–2.74	4.49 (1.60–12.63)	*	0.98 (0.51–1.87)	0.47–2.01
0–30 days	1.25 (0.76–2.06)	0.74–2.13	3.60 (1.39–9.35)	1.48–10.84	0.86 (0.47–1.56)	0.45–1.57
Headache or cervical DC visit						
0–1 day	6.67 (1.59–27.90	*	*	*	2.67 (0.45–15.96)	*
0–3 days	2.42 (0.88–6.66)	0.70–8.00	17.70 (2.04–153.32)	*	0.70 (0.14–3.40)	0.00–6.00
0–7 days	1.77 (0.80–3.94)	0.68–4.68	*	*	5.18 (0.16–1.66)	*
0–14 days	3.16 (1.57–6.36)	1.43–7.35	33.61 (4.24–266.38)	*	1.40 (0.58–3.34)	0.45–3.41
0–30 days	2.17 (1.09–4.31)	0.97–4.68	29.47 (3.60–241.54)	*	1.03 (0.45–2.39)	0.37–2.42

*Unable to compute due to small numbers.

Table 6. Odds Ratios and 95% Confidence Intervals (CI) and Accelerated and Bias Corrected Bootstrap 95% CI for Case-Crossover Estimates of the Association Between Primary Care Physician (PCP) Visits and Vertebrobasilar Stroke

	Case Crossover		Age <45 yr		Age ≥45 yr	
Exposure	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
Any PCP visit						
1–1 day	4.36 (3.02–6.28)	3.09–6.54	15.24 (4.29–54.20)	3.70–68.00	3.72 (2.52–5.50)	2.53–5.64
1–3 days	2.91 (2.25–3.77)	2.24–3.71	5.62 (2.56–12.36)	2.10–14.60	2.68 (2.03–3.53)	2.02–3.55
1–7 days	2.36 (1.93–2.89)	1.92–2.95	2.90 (1.64–5.13)	1.56–5.09	2.30 (1.85–2.85)	1.85–2.93
1–14 days	2.38 (1.99–2.86)	1.96–2.87	3.53 (2.09–5.97)	1.96–6.49	2.26 (1.86–2.74)	1.85–2.80
1–30 days	2.42 (2.01–2.91)	2.01–2.96	2.99 (1.81–4.96)	1.69–5.09	2.34 (1.92–2.85)	1.91–2.96
Headache or cervical PCP visit						
1–1 day	16.00 (5.35–47.86)	5.20–72.00	*	*	13.00 (4.24–39.87)	4.00–56.00
1–3 days	13.00 (5.89–28.71)	6.00–31.00	28.00 (3.44–227.58)	*	10.86 (4.56–25.83)	4.57–32.00
1–7 days	8.28 (4.86–14.10)	4.87–14.82	20.00 (4.38–91.28)	*	6.99 (3.93–12.44)	3.85–12.85
1–14 days	7.28 (4.60–11.52)	4.58–11.36	9.46 (2.95–30.31)	2.86–44.00	6.92 (4.20–11.40)	4.19–11.85
1–30 days	5.65 (3.88–8.22)	3.80–8.30	12.42 (3.95–38.99)	3.59–54.74	5.04 (3.37–7.54)	3.32–7.53

*Unable to compute due to small numbers.

reliability and validity of the codes to classify headache and cervical visits to chiropractors and PCPs is not known.

It is also possible that patients presenting to hospital with neurologic symptoms who have recently seen a chiropractor might be subjected to a more vigorous diagnostic workup focused on VBA stroke (*i.e.*, differential misclassification).[36] In this case, the predictive values of the stroke codes would be greater for cases that had seen a chiropractor and our results would underestimate the association between PCP care and VBA stroke.

A major strength of our study is that exposures were measured independently of case definition and handled identically across cases and controls. However, there was some overlap between chiropractic care and PCP care. In the month before their stroke, only 16 (2.0%) of our cases had seen only a chiropractor, while 20 (2.4%) had seen both a chiropractor and PCP, and 417 (51.0%) had just seen only a PCP. We were not able to run a subgroup analysis on the small number of cases that just saw a chiropractor. However, subgroup analysis on the PCP cases (n = 782) that did not visit a chiropractors during the 1 month before their stroke did not change the conclusions (data not shown).

Our results should be interpreted cautiously and placed into clinical perspective. We have not ruled out neck manipulation as a potential cause of some VBA strokes. On the other hand, it is unlikely to be a major cause of these rare events. Our results suggest that the association between chiropractic care and VBA stroke found in previous studies is likely explained by presenting symptoms attributable to vertebral artery dissection. It might also be possible that chiropractic manipulation, or even simple range of motion examination by any practitioner, could result in a thromboembolic event in a patient with a pre-existing vertebral dissection. Unfortu-

Table 7. Odds Ratios and 95% Confidence Intervals (CI) and Accelerated and Bias Corrected Bootstrap 95% CI for Case-Control and Case Crossover Estimates of the Association Between the Total Number of Chiropractic (DC) and Primary Care Physician (PCP) Visits in the Month Prior to the Index Date

	All Cases		Age <45 yr		Age ≥45 yr	
Exposures	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI	Odds Ratio (95% CI)	Bootstrap 95% CI
Case control estimates						
Any DC visit	1.14 (1.02–1.27)	1.00–1.27	1.58 (1.19–2.10)	1.19–2.19	1.01 (0.86–1.17)	0.83–1.18
Any PCP visit	1.77 (1.61–1.93)	1.61–1.94	2.12 (1.58–2.84)	1.53–3.01	1.73 (1.57–1.90)	1.58–1.91
Headache or cervical DC visit	1.13 (0.98–1.30)	0.96–1.31	1.57 (1.17–2.11)	1.08–2.18	0.95 (0.77–1.18)	0.67–1.20
Headache or cervical PCP visit	6.33 (4.27–9.37)	4.38–9.18	10.00 (3.26–30.63)	*	5.67 (3.85–8.95)	4.04–9.04
Case crossover estimates						
Any DC visit	1.10 (0.99–1.22)	0.97–1.24	1.37 (1.10–1.70)	1.04–1.91	0.98 (0.84–1.14)	0.80–1.15
Any PCP visit	1.49 (1.36–1.63)	1.34–1.66	1.34 (1.05–1.70)	0.94–1.87	1.52 (1.38–1.67)	1.36–1.68
Headache or cervical DC visit	1.18 (1.02–1.37)	0.99–1.45	2.80 (1.43–5.48)	*	1.01 (0.83–1.22)	0.74–1.29
Headache or cervical PCP visit	3.99 (2.88–5.53)	2.74–5.80	10.64 (3.45–32.78)	3.53–43.56	3.53 (2.51–4.98)	2.35–5.25

*Unable to compute due to small numbers.

nately, there is no acceptable screening procedure to identify patients with neck pain at risk of VBA stroke.[37] These events are so rare and difficult to diagnose that future studies would need to be multicentered and have unbiased ascertainment of all potential exposures. Given our current state of knowledge, the decision of how to treat patients with neck pain and/or headache should be driven by effectiveness and patient preference.[38]

■ Conclusion

Our population-based case-control and case-crossover study shows an association between chiropractic visits and VBA strokes. However, we found a similar association between primary care physician visits and VBA stroke. This suggests that patients with undiagnosed vertebral artery dissection are seeking clinical care for headache and neck pain before having a VBA stroke.

■ Key Points

- Vertebrobasilar artery stroke is a rare event in the population.
- There is an association between vertebrobasilar artery stroke and chiropractic visits in those under 45 years of age.
- There is also an association between vertebrobasilar artery stroke and use of primary care physician visits in all age groups.
- We found no evidence of excess risk of VBA stroke associated chiropractic care.
- The increased risks of vertebrobasilar artery stroke associated with chiropractic and physician visits is likely explained by patients with vertebrobasilar dissection-related neck pain and headache consulting both chiropractors and primary care physicians before their VBA stroke.

Acknowledgments

The authors acknowledge the members of the Decade of the Bone and Joint 2000–2010 Task Force on Neck Pain and its Associate Disorders for advice about designing this study. In particular, they acknowledge the help of Drs. Hal Morgenstern, Eric Hurwitz, Scott Haldeman, Linda Carroll, Gabrielle van der Velde, Lena Holm, Paul Peloso, Margareta Nordin, Jaime Guzman, Eugene Carragee, Rachid Salmi, Alexander Grier, and Mr. Jon Schubert.

References

1. Borghouts JA, Koes BW, Vondeling H, et al. Cost-of-illness of neck pain in The Netherlands in 1996. *Pain* 1999;80:629–36.
2. Côté P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. *Spine* 1998;23:1689–98.
3. Côté P, Cassidy JD, Carroll L. The factors associated with neck pain and its related disability in the Saskatchewan population. *Spine* 2000;25:1109–17.
4. Côté P, Cassidy JD, Carroll L. Is a lifetime history of neck injury in a traffic collision associated with prevalent neck pain, headache and depressive symptomatology? *Accid Anal Prev* 2000;32:151–9.
5. Côté P, Cassidy JD, Carroll LJ, et al. The annual incidence and course of neck pain in the general population: a population-based cohort study. *Pain* 2004; 112:267–73.
6. Côté P, Cassidy JD, Carroll L. The treatment of neck and low back pain: who seeks care? who goes where? *Med Care* 2001;39:956–67.
7. Hurwitz EL, Coulter ID, Adams AH, et al. Use of chiropractic services from 1985 through 1991 in the United States and Canada. *Am J Public Health* 1998;88:771–6.
8. Hurwitz EL, Chiang LM. A comparative analysis of chiropractic and general practitioner patients in North America: findings from the joint Canada/United States Survey of Health, 2002–03. *BMC Health Serv Res* 2006;6:49.
9. Aker PD, Gross AR, Goldsmith CH, et al. Conservative management of mechanical neck pain: systematic overview and meta-analysis. *BMJ* 1996; 313:1291–6.
10. Gross AR, Kay T, Hondras M, et al. Manual therapy for mechanical neck disorders: a systematic review. *Man Ther* 2002;7:131–49.
11. Hurwitz EL, Aker PD, Adams AH, et al. Manipulation and mobilization of the cervical spine. A systematic review of the literature. *Spine* 1996;21: 1746–59.
12. McClune T, Burton AK, Waddell G. Whiplash associated disorders: a review of the literature to guide patient information and advice. *Emerg Med J* 2002;19:499–506.
13. Peeters GG, Verhagen AP, de Bie RA, et al. The efficacy of conservative treatment in patients with whiplash injury: a systematic review of clinical trials. *Spine* 2001;26:E64–E73.
14. Norris JW, Beletsky V, Nadareishvili ZG. Sudden neck movement and cervical artery dissection. The Canadian Stroke Consortium. *CMAJ* 2000;163: 38–40.
15. Ernst E. Manipulation of the cervical spine: a systematic review of case reports of serious adverse events, 1995–2001. *Med J Aust* 2002;176:376–80.
16. Haldeman S, Kohlbeck FJ, McGregor M. Risk factors and precipitating neck movements causing vertebrobasilar artery dissection after cervical trauma and spinal manipulation. *Spine* 1999;24:785–94.
17. Rubinstein SM, Peerdeman SM, van Tulder MW, et al. A systematic review of the risk factors for cervical artery dissection. *Stroke* 2005;36:1575–80.
18. Inamasu J, Guiot BH. Iatrogenic vertebral artery injury. *Acta Neurol Scand* 2005;112:349–57.
19. Schievink WI. Spontaneous dissection of the carotid and vertebral arteries. *N Engl J Med* 2001;344:898–906.
20. D'Anglejan-Chatillon J, Ribeiro V, Mas JL, et al. Migraine—a risk factor for dissection of cervical arteries. *Headache* 1989;29:560–1.
21. Pezzini A, Caso V, Zanferrari C, et al. Arterial hypertension as risk factor for spontaneous cervical artery dissection. A case-control study. *J Neurol Neurosurg Psychiatry* 2006;77:95–7.
22. Savitz SI, Caplan LR. Vertebrobasilar disease. *N Engl J Med* 2005;352: 2618–26.
23. Lee VH, Brown RD Jr, Mandrekar JN, et al. Incidence and outcome of cervical artery dissection: a population-based study. *Neurology* 2006;67: 1809–12.
24. Rothwell DM, Bondy SJ, Williams JI. Chiropractic manipulation and stroke: a population-based case-control study. Stroke 2001;32:1054–60.
25. Smith WS, Johnston SC, Skalabrin EJ, et al. Spinal manipulative therapy is an independent risk factor for vertebral artery dissection. *Neurology* 2003;60: 1424–8.
26. Arnold M, Bousser MG, Fahrni G, et al. Vertebral artery dissection: presenting findings and predictors of outcome. *Stroke* 2006;37:2499–503.
27. Maclure M. The case-crossover design: a method for studying transient effects on the risk of acute events. *Am J Epidemiol* 1991;133:144–53.
28. Kelman CW, Kortt MA, Becker NG, et al. Deep vein thrombosis and air travel: record linkage study. *BMJ* 2003;327:1072.
29. Mittleman MA, Maclure M, Tofler GH, et al. Triggering of acute myocardial infarction by heavy physical exertion. Protection against triggering by regular exertion. Determinants of Myocardial Infarction Onset Study Investigators. *N Engl J Med* 1993;329:1677–83.
30. Redelmeier DA, Tibshirani RJ. Association between cellular-telephone calls and motor vehicle collisions. *N Engl J Med* 1997;336:453–8.
31. Janes H, Sheppard L, Lumley T. Overlap bias in the case-crossover design, with application to air pollution exposures. *Stat Med* 2005;24:285–300.
32. Janes H, Sheppard L, Lumley T. Case-crossover analyses of air pollution exposure data: referent selection strategies and their implications for bias. *Epidemiology* 2005;16:717–26.
33. Efron B, Tibshirani RJ. *An Introduction to the Bootstrap*. New York: Chapman and Hall/CRC, 1993.
34. STATA/SE [computer program]. College Station, Tex: Stata Corp, 2006.
35. Liu L, Reeder B, Shuaib A, et al. Validity of stroke diagnosis on hospital

discharge records in Saskatchewan, Canada: implications for stroke surveillance. *Cerebrovasc Dis* 1999;9:224–30.
36. Boyle E, Côté P, Grier AR, et al. Examining vertebrobasilar artery stroke in two Canadian provinces. *Spine*, in press.
37. Côté P, Kreitz BG, Cassidy JD, et al. The validity of the extension-rotation test as a clinical screening procedure before neck manipulation: a secondary analysis. *J Manip Physiol Therap* 1996;159–64.
38. van der Velde G, Hogg-Johnson S, Bayoumi A, et al. Identifying the best treatment among common non-surgical neck pain treatments: a decision analysis. *Spine* 2008;33(Suppl):S184–S191.

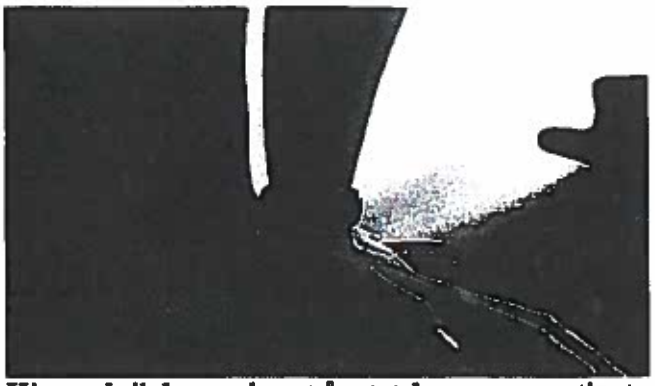
Bilag 11

Original tekst fra artikel fra www.dr.dk

27. FEB. 2014 KL. 07:00

Professor: Vi kender ikke effekten af knæk hos kiropraktoren

Kiropraktik koster hvert år statskassen og patienterne flere hundrede millioner kroner. Men der er for lidt dokumentation af kendt rygbehandling, hvor man "knækker" ryggen.



Kiropraktik koster hvert år statskassen og patienterne flere hundrede millioner kroner.
Foto: DR © DR

Af Jakob Bang Schmidt

Flere hundredtusinder danskere går hvert år til kiropraktor med smerter i muskler og led.

De mange behandlinger koster årligt statskassen over 100 millioner kroner, mens patienterne betaler omkring det femdobbelte af egen lomme.

Men fagfolkene er ikke overbeviste om, at den behandlingsmetode som kiropraktorerne er mest kendt for, nemlig at manipulere eller "knække" ryggen, rent faktisk har en effekt. Det fortæller DR's Detektor.
Professor i klinisk biomekanik, kiropraktorernes uddannelse, Jan Hartvigsen fra Syddansk Universitet, erkender, at det videnskabelige grundlag ikke er stærkt.
- Vi har ikke stærk evidens eller dokumentation for nogen af de behandlinger, der bliver givet til rygpatienterne, siger han.

Sparsom dokumentation om kolikbørn

Udover manipulation af rygsøjlen behandler kiropraktorerne også kolikbørn med manipulation.
Dansk Kiropraktor Forening vurderer, at omkring 4.000 spædbørn modtog kiropraktorbehandling mod kolik i 2011.
Men også på dette område halter det gevaldigt med den videnskabelige dokumentation, erkender Jan Hartvigsen.
- Hvis vi kigger på den forskning, der ligger til grund for den evidens, der er, så er det meget sparsomt.
Jan Hartvigsen var med i opstartfasen af kiropraktoruddannelsen på Syddansk Universitet og er i dag forskningschef for uddannelsen.

Tvivlsom effekt

Heller ikke hos Det Nordiske Cochrane Center i København, som løbende indsamler lægevidenskabelig dokumentation for effekten af forskellige behandlingsformer, er man sikker på effekten af manipulation.
Det fortæller leder af centeret, professor Peter Gøtzsche.
- Jeg synes overordnet set, at man må sige, at effekten er noget tvivlsom. Og det svarer jo også til, at det teoretiske grundlag er yderst tvivlsomt.
For år tilbage blev kiropraktik betegnet som såkaldt alternativ behandling på linje med healing, akupunktur og zoneterapi. Men i 1991 blev kiropraktorerne autoriseret, og kiropraktorer kan i dag både behandle og diagnosticere patienter.

Autoriseringen betyder tilmed, at kiropraktorernes uddannelse nu foregår på universitetet.

Placebo-effekt kan spille ind

Peter Gøtzsche vil ikke afvise, at kiropraktorernes behandling kan have en effekt på rygsmerter.

Han påpeger dog, at effekten kan bunde i en såkaldt placebo-effekt, hvor patienten føler bedring, selv om der ikke er nogen reel effekt.

- Den der menneskelige ting, at hvis nogen er venlige over for dig, så vil du gerne være venlig den modsatte vej. Og det er du jo netop ved at sige: Jeg tror nok, det har hjulpet lidt, siger professoren.

Ønsker mere forskning

Der arbejdes i øjeblikket på at få mere viden om effekterne ved manipulationsbehandling og anden rygbehandling, fortæller Jan Hartvigsen.

En stor del af det offentlige tilskud, som kiropraktorerne modtager fra Regionerne, bruges eksempelvis til at finansiere forskning.

- Vi mangler meget mere forskning. Vi kan faktisk ikke være bekendt over for patienterne, at vi ikke har bedre svar på deres problemer, når de kommer til os, siger han.

- Vi ønsker at få flere svar. Vi ønsker at være bedre.

Hør mere om kiropraktik i Detektor på P1 klokken 15:03 eller i aften klokken 21:00 på DR2.

Klage over manglende information om risiko for blodprop som følge af manipulation af nakke

Sagsnummer: 14POB039
Offentliggørelsesdato: 4. april 2014
Juridisk tema: Information og samtykke

Patientombuddet finder ikke grundlag for at kritisere Klinik <**> for indhentelse af informeret samtykke fra <****> den 16. maj 2012. Patientombuddet finder ikke grundlag for at kritisere Klinik <****> for den behandling, som <****> modtog den 16. maj 2012.**

KLAGEN

Der er klaget over følgende:

1. At <****> ikke blev informeret tilstrækkeligt på Klinik <****>, forud for behandlingen den 16. maj 2012.

<****> har blandt andet anført, at han ikke blev gjort opmærksom på den risiko, der er forbundet med manipulation af nakken.

2. At <****> ikke modtog en korrekt behandling på Klinik <****>, den 16. maj 2012.

<****> har blandt andet anført, at han som følge af kiropraktormanipulationen med samtidig hørbar vævslæsion efterfølgende fik en blodprop i halsrygmarven, der medførte halvsidig lammelse.

BEGRUNDELSE

Patientombuddet har, medmindre andet er anført, lagt vægt på oplysningerne i journalen.

Begrundelse for afgørelsen af 1. klagepunkt
Den 16. maj 2012 blev <****> set på Klinik <****>, hvor han modtog manipulationsbehandling af nakken.

Det fremgår af en udtalelse til sagen Klinik <****>, at <****> var kendt i klinikken siden 2006, og at han i flere omgange var blevet behandlet for nakke- og rygsmerter, der ofte var udløst i forbindelse med motion i form af mountainbike kørsel. De tidligere behandlinger havde været ukomplicerede og med god effekt.

Patientombuddet kan oplyse, at det fremgår af sundhedsloven § 16, stk. 1, at en patient har ret til at få information om sin helbredstilstand og om behandlingsmulighederne, herunder om risiko for komplikationer og bivirkninger. Det fremgår af § 16, stk. 4, i samme lov, at informationen skal være mere omfattende, når behandlingen medfører nærliggende risiko for alvorlige komplikationer og bivirkninger.

Ligeledes kan Patientombuddet oplyse, at det fremgår af Sundhedsstyrelsens vejledning af 16. september 1998 om information og samtykke og om videregivelse af helbredsoplysninger mv., at det ikke entydigt kan fastsættes, i hvilket omfang en sundhedsperson har pligt til at informere om mulige komplikationer mv. i forbindelse med undersøgelse og behandling. Det fremgår, at sundhedspersonen som udgangspunkt altid skal give information om alvorlige og ofte forekommende komplikationer mv. Når der er tale om alvorlige og sjældent forekommende eller bagatelagtige og ofte forekommende komplikationer mv., skal sundhedspersonen ofte give information herom. Der kan som udgangspunkt ikke stilles krav om, at sundhedspersonen skal informere om bagatelagtige og sjældent forekommende komplikationer mv.

Patientombuddet kan videre oplyse, at kiropraktorer tidligere har betragtet de såkaldte cerebrovaskulære skader, som er karskader som i <****>s tilfælde, som en alvorlig og ekstrem sjælden komplikation (mellem 0,12 og 2 tilfælde pr. 1 million behandlinger) til manipulationsbehandling af nakken. De seneste års forskning har imidlertid sat store spørgsmålstegn ved denne antagelse, idet der er veludførte studier, som indikerer, at karskader med efterfølgende blodprop udvikler sig uafhængigt af behandling.

Det er på denne baggrund Patientombuddets vurdering, at der ikke forud for kiropraktorbehandling af nakken rutinemæssigt skal gives information om den eventuelle risiko for karskader med efterfølgende blodprop. Patientombuddet har herved lagt vægt på, at risikoen ifølge den seneste forskning på området er så lille, at den er vanskelig eller umulig at fastslå.

På den baggrund finder Patientombuddet, at der ved indhentelse af informeret samtykke til den behandling, som <****> modtog i Klinik <****>, den 16. maj 2012, blev handlet i overensstemmelse med normen for almindelig anerkendt faglig standard.

Begrundelse for afgørelsen af 2. klagepunkt
Den 16. maj 2012 blev <****> set på Klinik <****> på grund af spændinger i nakke samt hovedpine, især udløst fra nakken. Der var endvidere klager over stivhed og træthed i lænden.

Objektivt blev det fundet, at foroverbøjning af nakken udløste en trækkende fornemmelse fra kraniekanten til højre skulderblad, og at der ved bagoverbøjning blev udløst en smerte nederst i nakken. Ved sidebøjning og rotation af nakken til både højre og venstre var der muskulær stivhed over skulderåget. Ved føleundersøgelse med hænderne af nakken og skulderågets muskulatur og ledforbindelse blev der påvist ømhed svarende til munkekutte musklen og den store muskel på brystkassens forside. Der blev påvist let nedsat ledbevægelighed svarende til 5. og 6. nakkehvirvel. Nakkens øvrige led var med naturlig bevægelighed.

Undersøgelsen af lænden var upåfaldende bortset fra nedsat bevægelighed i det nederste lændeled.

Der blev målt forhøjet blodtryk (143/109).

Der blev behandlet med trykmassage i skulderågsmuskler, udspænding af brystmuskulatur samt manipulationsbehandling af nederste led i lænden, et led i brystryggen samt leddet mellem 5. og 6. nakkehvirvel. Ved behandlingen af nakken blev den såkaldte Gonstead teknik anvendt. Behandlingen blev givet med moderat styrke og dybde.

Det fremgår af klinikkens udtalelse til sagen, at der ved den ledfrigørende behandling af nakken blev udløst et lille klik fra leddet. <****> gav ikke udtryk for ubehag eller smerte ved behandlingen. Idet der efter behandlingen af nakken blev fundet uforandrede forhold, blev det vurderet, at den lette nedsatte ledbevægelighed svarende til 5. og 6. nakkehvirvel var uden betydning for nakkegenerne.

Efter behandlingen var der fri bevægelighed i nakken. Der blev tilrådet daglige udspændingsøvelser af muskulaturen på brystkassens forside og tilrådet lægekontakt vedrørende blodtrykket.

Patientombuddet kan oplyse, at ledfrigørende behandling af nakken er et sædvanligt og accepteret valg ved behandling af nakkesmerter, der stammer fra nakkens led og muskler. I kiropraktorpraksis foregår den oftest i kombination med nakkeøvelser samt behandling af muskulaturen med blandt andet udspænding, massage og nålebehandling.

Patientombuddet kan videre oplyse, at Gonstad teknikken er en meget sædvanlig og særdeles udbredt teknik, og at det er almindeligt, at behandlingen ledsages af et hørbart "klik". Et sådant klik er et normalt fysiologisk fænomen, som af behandleren betragtes som et udtryk for veludført behandling, og det er således ikke udtryk for,

at der er sket vævsskade.

Den 23. maj og den 7. juni 2012 blev <****> set til kontrol på Klinik <****>. Der blev ikke ved disse konsultationer foretaget behandling af nakken. Ved konsultationen den 7. juni 2012 havde der ikke været hovedpine siden den 23. maj 2012. Han blev herefter afsluttet.

Patientombuddet har bemærket, at <****> den 13. juni 2012 blev set af egen læge på grund af hoved- og nakkesmerter gennem 4 dage. Der var fortsat forhøjet blodtryk. Det blev vurderet, at der var tale om spændingshovedpine eventuelt udløst af nakkemyoser. Den 20. juni 2012 blev <****> igen set af egen læge. Der havde været hovedpine hele ugen, som dog var aftagende. Det blev noteret, at han fortsat cyklede mountainbike, og at der aktuelt havde været flere fald i den forbindelse. Der var forsat forhøjet blodtryk. Senere samme dag fik <****> konstateret spaltning af blodkarrene på begge sider af halsen og et lille infarkt i halsrygmarven.

Patientombuddet kan oplyse, at skader på nakkepulsårerne med efterfølgende blodprop er en meget sjælden lidelse, som ofte starter med, at patienten oplever smerter/stivhed i nakken og eventuelt hovedpine. Der er usikkerhed om årsagerne til disse skader. Der kan eventuelt være tale om et forudgående trauma, men skaderne ses også opstået spontant, altså uden forudgående trauma.

Det er Patientombuddets vurdering, at der ved konsultationen i Klinik <****> den 16. maj 2012 blev optaget en relevant sygehistorie og foretaget en relevant og fyldestgørende objektiv undersøgelse. Det er videre Patientombuddets vurdering, at det på baggrund af de objektive fund var relevant at foretage manuel behandling. Patientombuddet har herved lagt vægt på, at <****> tidligere havde haft god effekt af tilsvarende behandling med samme teknik. Det er endvidere Patientombuddets vurdering, at behandlingen blev udført på relevant vis.

Det er endeligt Patientombuddets vurdering, at den omstændighed, at <****> godt en måned senere fik konstateret en halskar-lidelse og rygmarvsinfarkt, ikke er ensbetydende med, at der blev handlet under normen for almindelig anerkendt faglig standard ved behandlingen i Klinik <****>.

Patientombuddet finder på den baggrund, at den behandling, som <****> modtog den 16. maj 2012 i Klinik <****>, var i overensstemmelse med normen for almindelig anerkendt faglig standard.

Sidst opdateret: 4. april 2014

Patientombuddet - Finsensvej 15 - 2000 Frederiksberg - Tlf.: 72 28 66 00 - Fax: 72 28 66 01 - E-mail: pob@patientombuddet.dk
CVR-nr.: 33043066 - EAN-nummer: 5798000363090

Bilag 13.

"Combined chiropractic interventions for low back pain: A Cochrane Review":

Link:
http://onlinelibrary.wiley.com.proxy1-bib.sdu.dk:2048/doi/10.1002/14651858.CD005427.pub2/full

Bilag 14. "Spinal manipulative therapy for acute low back- pain":

Link:
http://onlinelibrary.wiley.com.proxy1-bib.sdu.dk:2048/doi/10.1002/14651858.CD008880.pub2/full

Bilag 15

Fakta samlet som bilag til beretningen af:

Professor i Klinisk Biomekanik Niels Wedderkopp, MD, Ph.D., ortopædkirurgisk afdeling, Sygehus Lillebælt Vejle-Middelfart, Institut for Regional Sundhedsforskning og Center for Research in Childhood Health, IOB, Syddansk Universitet, der blandt andet har undervist på det danske kiropraktorstudium på Syddansk Universitet

og

tidligere overlæge ved Neurokirurgisk afdeling på Rigshospitalet og stifter af Rygcentret, neurokirurg, Lektor og dr. med Svend Erik Børgesen.

Nærmest al berøring er 'manuel behandling' – og hverken det, eller manipulation er at betegne som farligt:
"Bare det at du strækker eller bøjer et led, altså f.eks bare vipper op og ned med en tå, som zoneterapeuter f.eks gør, er at betegne som "Manuel behandling af led", som der står i loven er forbeholdt kiropraktorer. Når som helst en behandler tager fat omkring en knogle – en arm eller et ben f.eks, og laver en bevægelse, så er det at bevæge leddet på en anden - og dermed udfører man faktisk "manuel behandling af kroppens led". Så manipulation og ledmobilisering i bred forstand og almindelig massage, hvor kropsdele bøjes og strækkes er altså kiropraktik ifølge den nuværende lov. Det er selvfølgelig ikke hensigtsmæssigt og bør ændres, så vi ikke uden grund kriminaliserer en kæmpe gruppe behandlere. Især fordi både manipulation og manuel behandling af led må siges at være ufarligt" – Professor i klinisk biomekanik Niels Wedderkopp.

Videnskabelighed konkludere at manipulation er ufarligt – og i øvrigt uden evidens:
"Der er korrekt, at der ikke findes valide argumenter for at gøre manipulation eller "manuel behandling af kroppens led" til forbeholdt virksomhedsområde. Der er ikke faglige eller saglige grunde til det, da både manipulation og manuel behandling af kroppens led må betegnes som ufarlige. Da loven blev indført i 1991 var der ingen videnskabelig evidens for effekten af kiropraktiske behandlinger. I dag, 24 år senere, må vi erkende, at den videnskabelige forskning, der siden er lavet på området konkluderer, at der stadig ikke videnskabeligt er påvist effekt af manipulation. Faktisk viser flere forsøg, at placebogrupper opnår samme effekt, som behandlede grupper.
Herudover – og meget vigtigt - så påviser den forskning, der er foreligger, samtidig, at manipulation ikke kan betegnes som farligt. (Bilag 4-10 og 13-14: videnskabelig litteratur på området) *Det er derfor fagligt u-underbygget og forkert, når det påstås, at manipulation er farligt"* – Professor i klinisk biomekanik Niels Wedderkopp.

"Der er ikke fagligt belæg for at manipulation skal være forbeholdt virksomhedsområde, da det ikke er forbundet med særlig fare. Når der lovgives på et område, så en bestemt behandlingsform forbeholdes en enkelt disciplin, må loven nødvendigvis være baseret både på dokumenteret risiko og på dokumenteret behandlingseffekt. Det kan ikke dokumenteres at kiropraktisk behandling har nogen klinisk effekt. (se blandt andet bilag 4.

Cochrane review). *Det kan heller ikke, ifølge samme Cochrane review dokumenteres at manipulationsbehandling indebærer en væsentlig risiko. Der er således ikke belæg for at reservere behandlingsformerne manuel behandling og manipulation til en enkelt behandlingsdisciplin. Sundhedsstyrelsen har oplyst at det er sundhedsfaglige overvejelser og risikoen for komplikationer til manipulationsbehandling, som begrunder afgrænsning af behandlingstilladelse. Da denne risiko ikke er dokumenteret – tværtimod -, falder begrundelsen for forbeholdet bort"* - Tidligere overlæge ved Neurokirurgisk afdeling på Rigshospitalet og stifter af Rygcentret, Lektor og dr. med Svend Erik Børgesen

Bivirkninger er uhyre sjældne:
*"Hverken manipulation eller "manuel behandling af kroppes led" er at betegne som farligt. Det er f.eks mere sandsynligt, at der opstår alvorlige bivirkninger af f.eks indtaget af ganske almindeligt smertestillende håndkøbsmedicin end ved at modtage en manipulationsbehandling. Ved gennemgangen af de nyeste review over den internationale videnskabelige litteratur (*rapporter/artikler/undersøgelser*) på området* (Bilag 4-10 og 13-14) *herunder et Cochrane-studie, der sammenholder og sammenfatter resultaterne af al forskning på området og dermed er den højeste form for evidens, og hvor det i sidstnævnte konstateres at "*there was no evidence of serious adverse events demonstrated in any of the trials*" – godtgøres det, at manipulation ikke med rimelighed kan betegnes som farligt, men derimod det modsatte. Det må betegnes som ufarligt"* – Professor i klinisk biomekanik Niels Wedderkopp.

Langt større risiko for skade, ved at lave almindelig motion:
"Det er vanskeligt at finde behandlingstyper, der har så lav skadestatus.
Manuel behandling og manipulation er forbundet med ekstremt lav risiko.
Selv behandling i form at almindelig fysisk aktivitet - altså træning, øvelser og motion, giver flere og større skader end manipulation gør" – Professor i klinisk biomekanik Niels Wedderkopp.

Røntgen sikrer ikke imod skader – det er for-samtalerne før behandling, der er vigtige:
" Det er en kendsgerning, at de fleste af de lidelser der oplistes af Sundhedsministeren i svaret til sundhedsudvalget af 28 maj 2014 (Jf. bilag 3), *som værende risikoen ved manipulationsbehandlinger, ikke vil fremgå af et røntgenbillede. Det er derfor et overflødigt redskab i forhold til at undgå de, i svaret, nævnte skader, da de ikke vil kunne påvises på en røntgenoptagelse. Hvad angår f.eks. gennemblødningsforstyrrelser i pulsårene til hjernen og størkningsforstyrrelser af blodet, som nævnes I svaret fra Sundhedsministeren, må det konstateres, at det ikke vil være muligt for en kiropraktor at konstatere disse. Dermed er muligheden for at undgå det, ikke større med en kiropraktisk uddannelse.*
Det skal endvidere understreges meget kraftigt, at sandsynligheden for at der opstår de nævne fatale følger af en manipulationsbehandling foretaget på en patient med en af de nævnte tilstande, må siges at være nærmest ikke eksisterende. Da det har ikke været muligt, at finde kendte tilfælde for dette, det må betegnes som en teoretisk fare" – Professor i klinisk biomekanik Niels Wedderkopp.

Det er ikke længden eller titlen på uddannelsen, der er vigtig:
"Hvis en alternativ behandler har en uddannelse, der lever op til det Sundhedsstyrelsens kræver for at RAB-godkende vedkommende, er der sikkerhed for, at der er gennemgået 200 timers anatomi/fysiologi samt 100 timer patologi/sygdomslære.
Og 200 timers anatomi/fysiologi samt 100 timer patologi/sygdomslære må siges at give den fornødne viden til at foretage de nødvendige for-samtaler og vide, hvordan man undgår at lave skader på patienter/klienter.
Hvis dette niveau af uddannelse er sikret, er risikoen for at provokere alvorlige skader reduceret til at være ubetydelig. Nødvendig og tilstrækkelig baggrund opnås f.eks. gennem ovennævnte uddannelse, således som den er fastlagt i bekendtgørelsen om brancheadministreret registrering af alternative behandlere.– Tidligere overlæge ved Neurokirurgisk afdeling på Rigshospitalet og stifter af Rygcentret, Lektor og dr. med Svend Erik Børgesen

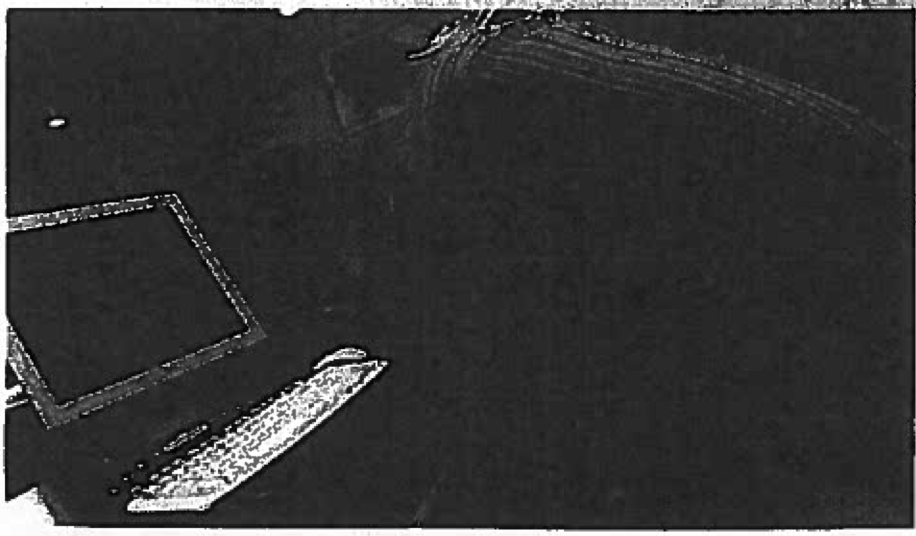
"Det må konkluderes, at en kiropraktor, trods den lange uddannelse, ikke vil være bedre til at undgå skader, sammenlignet med en anden behandler, der har grundlæggende kendskab til anatomi og fysiologi og sygdomslære, hvilket f.eks fysioterapeuter, Body-sds-terapeuter, massører, zoneterapeuter, osteopater og diverse andre alternative behandlere også har, som en del af deres uddannelsespensum. Det er ikke længden af uddannelsen, der er afgørende. Det er kendskabet til anatomi og fysiologi, samt sygdomslære og patologi. Hvad angår risikoen for at gøre skade på en patient/klient ved en manipulationsbehandling, mindskes den altså ikke ved at lade en kiropraktor udføre manipulationen, fremfor en alternativ behandler, der har modtaget den fornødne undervisning og dermed har det fornødne kendskab til at undgå at lave skader".
Professor i klinisk biomekanik Niels Wedderkopp.

DR dk NYHEDER TV RADIO MERE
Nyhedsoverblik | Politik | Sporten | Viden | Kultur | Debat | Levevis | Regionalt | Vejr

27. FEB. 2014 KL. 10.00

Politik – ikke fakta – bag blåstempling af kiropraktik

Beslutningen om at autorisere kiropraktik var drevet af socialdemokraten Erling Christensen, som valgte at se bort fra, at der var ringe videnskabelig dokumentation for behandlingens effekt. Det fortæller DR's Detektor.



Da politikerne autoriserede kiropraktik, valgte de at se bort fra, at der var ringe videnskabelig dokumentation for effekten ved rygbehandling.

Af Jakob Bang Schmidt

Det var ikke håndfaste videnskabelige beviser for effekten af kiropraktorernes rygbehandlinger, der betød, at behandlingsformen blev autoriseret.

Autoriseringen af kiropraktik, som tidligere blev anset for alternativ behandling, var i høj grad drevet af daværende folketingsmedlem for Socialdemokratiet Erling Christensen. Det fortæller DR's Detektor.

I 1991 fik han kiropraktik anerkendt, ved at samle et politisk flertal sammen med SF og Fremskriftpartiet uden om den daværende KVR regering.

Autoriseringen kom på trods af, at der var ringe videnskabelig dokumentation for effekten ved kiropraktorernes behandlingsmetoder. Dertil kom, at et kiropraktorudvalg under Indenrigsministeriet år forinden havde valgt ikke at anbefale en autorisering.

- Lægerne kunne jo ikke fortælle mig, at børnene og SID-manden ikke fik gavn af kiropraktik. Jeg kunne derimod sige, at mennesker kommer til mig og siger, at de har gavn af det, og derfor vil jeg støtte det, siger han til Detektor.

Ville hjælpe børn med kolik

Før autoriseringen hørte kiropraktikken til alternativ behandling på linje med healing, meditation og akupunktur. Anerkendelsen

betød blandt andet, at kiropraktorerne fik deres egen universitetsuddannelse.

Kiropraktik har traditionelt været særlig populær til behandling af rygsmerter og børn med kolik. Det var netop muligheden for at behandle kolikramte børn, der i 1991 fik Erling Christensen til at arbejde for en autorisering af kiropraktorerne.

Han sad dengang i Folketingets Retsudvalg, hvor han fik kendskab til flere grove sager om misrøgt af spædbørn. Sager som, han mente, blandt andet opstod på grund i kolik.

- De kunne få lyst til at slå barnet ind mod en radiator for at få ro. Tænk sig, hvis man kunne hjælpe de mennesker, fortæller han om de tanker, der i starten af 90'erne gjorde, at han ville autorisere kiropraktik som behandlingsform.

Tvivlsom effekt på kolik

Der er dog ingen dokumentation for, at kiropraktorernes behandling virker mod kolik, fortæller professor i klinisk biomekanik, kiropraktorernes uddannelse ved Syddansk Universitet, Jan Hartvigsen:

- Vi har en tradition for, at det er en behandling, folk er glade for. Men hvis vi kigger på den forskning, der ligger til grund for den evidens, der er, så er det meget sparsomt.

Erling Christensen holder fast i, at beslutningen om at autorisere kiropraktik, var den rigtige.

- Om der var dokumentation, evidens, som man kalder det så flot i videnskabelige kredse, det var jeg da ligeglad med. Det, det handler om for mig, det var, kunne det hjælpe.

Hør mere om kiropraktik i Detektor på P1 klokken 15:03 eller i aften klokken 21:00 på DR2.



TV 2 får kritik for moske-dokumentar: Her er nyhedsdirektørens svar
KL. 15.47

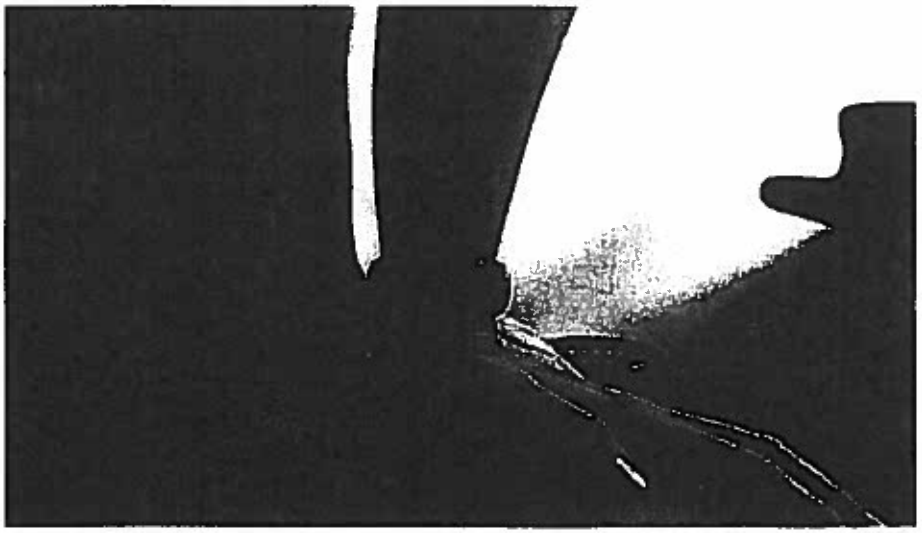
Zornig fortryder intet: Jeg gjorde det eneste anstændige
KL. 15.30

Terrorsagen: 20-årig tiltalt gentog 'det husker jeg ikke' igen og igen
KL. 16.11

27. FEB. 2014 KL. 07.00

Professor: Vi kender ikke effekten af knæk hos kiropraktoren

Kiropraktik koster hvert år statskassen og patienterne flere hundrede millioner kroner. Men der er for lidt dokumentation af kendt rygbehandling, hvor man "knækker" ryggen.



Kiropraktik koster hvert år statskassen og patienterne flere hundrede millioner kroner. (Foto: DR © DR)

Af Jakob Bang Schmidt

Flere hundredtusinder danskere går hvert år til kiropraktor med smerter i muskler og led.

De mange behandlinger koster årligt statskassen over 100 millioner kroner, mens patienterne betaler omkring det femdobbelte af egen lomme.

Men fagfolkene er ikke overbeviste om, at den behandlingsmetode som kiropraktorerne er mest kendt for, nemlig at manipulere eller "knække" ryggen, rent faktisk har en effekt. Det fortæller DR's Detektor.

Professor i klinisk biomekanik, kiropraktorernes uddannelse, Jan Hartvigsen fra Syddansk Universitet, erkender, at det videnskabelige grundlag ikke er stærkt.

- Vi har ikke stærk evidens eller dokumentation for nogen af de behandlinger, der bliver givet til rygpatienterne, siger han.

Sparsom dokumentation om kolikbørn

Udover manipulation af rygsøjlen behandler kiropraktorerne også kolikbørn med manipulation.

Dansk Kiropraktor Forening vurderer, at omkring 4.000 spædbørn modtog kiropraktorbehandling mod kolik i 2011.

Men også på dette område halter det gevaldigt med den videnskabelige dokumentation, erkender Jan Hartvigsen.

- Hvis vi kigger på den forskning, der ligger til grund for den evidens, der er, så er det meget sparsomt.

Jan Hartvigsen var med i opstartfasen af kiropraktoruddannelsen på Syddansk Universitet og er i dag forskningschef for uddannelsen.

Tvivlsom effekt

Heller ikke hos Det Nordiske Cochrane Center i København, som løbende indsamler lægevidenskabelig dokumentation for effekten af forskellige behandlingsformer, er man sikker på effekten af manipulation.

Det fortæller leder af centeret, professor Peter Gøtzsche.

- Jeg synes overordnet set, at man må sige, at effekten er noget tvivlsom. Og det svarer jo også til, at det teoretiske grundlag er yderst tvivlsomt.

For år tilbage blev kiropraktik betegnet som såkaldt alternativ behandling på linje med healing, akupunktur og zoneterapi. Men i 1991 blev kiropraktorerne autoriseret, og kiropraktorer kan i dag både behandle og diagnosticere patienter.

Autoriseringen betyder tilmed, at kiropraktorernes uddannelse nu foregår på universitetet.

Placebo-effekt kan spille ind

Peter Gøtzsche vil ikke afvise, at kiropraktorernes behandling kan have en effekt på rygsmerter.

Han påpeger dog, at effekten kan bunde i en såkaldt placebo-effekt, hvor patienten føler bedring, selv om der ikke er nogen reel effekt.

- Den der menneskelige ting, at hvis nogen er venlige over for dig, så vil du gerne være venlig den modsatte vej. Og det er du jo netop ved at sige: Jeg tror nok, det har hjulpet lidt, siger professoren.

Ønsker mere forskning

Der arbejdes i øjeblikket på at få mere viden om effekterne ved manipulationsbehandling og anden rygbehandling, fortæller Jan Hartvigsen.

En stor del af det offentlige tilskud, som kiropraktorerne modtager fra Regionerne, bruges eksempelvis til at finansiere forskning.

- Vi mangler meget mere forskning. Vi kan faktisk ikke være bekendt over for patienterne, at vi ikke har bedre svar på deres problemer, når de kommer til os, siger han.

- Vi ønsker at få flere svar. Vi ønsker at være bedre.

Hør mere om kiropraktik i Detektor på P1 klokken 15:03 eller i aften klokken 21:00 på DR2.



TV 2 får kritik for moske-dokumentar: Her er nyhedsdirektørens svar
Kl. 15.47

Zornig fortryder intet: Jeg gjorde det eneste anstændige
Kl. 15.30

Terrorsagen: 20-årig tiltalt gentog 'det husker jeg ikke' igen og igen
Kl. 16.11

03. APR. 2014 KL. 17.40

Retssag kan stoppe alternative behandlere

En retssag i maj mod en alternativ behandler kan ende med at ramme alle alternative behandlere, der "knækker" kroppens led. Det fortæller DR's Detektor i dag.

(Foto: Jens Astrup © Scanpix)

Af Jytte Bergmann Moll & Marie Rask Glerup

En retssag mod medstifteren af den alternative behandlingsform, Body SDS-uddannelsen, kan komme til at koste en lang række alternative behandlere muligheden for at udføre deres job.

Body SDS er særligt blevet kendt, fordi én af stifterne, Ole Føli, der er den anklagedes far, har været cykelholdet CSC's faste mirakelmager.

Nu er hans søn og medstifter af Body SDS-uddannelsen, Bengt Valentino Andersen, tiltalt for at have lavet kiropraktik uden at være autoriseret kiropraktor. I den konkrete sag behandlede han skuespilleren Tommy Kenter i en tv-udsendelse på TV2/Lorry.

Autorisationsloven giver nemlig kiropraktorer og læger monopol på at udføre manipulationer af kroppens led. Dét, der populært sagt kaldes "knækket". Men kiropraktorerne har ikke videnskabelige beviser for, at knækket virker - de har blandt andet fået monopolet på grund af et politisk flertal i begyndelsen af 90´erne.

LÆS OGSÅ: Professor: Vi kender ikke effekten af knæk hos kiropraktoren

Anklagen kommer fra Sundhedsstyrelsen

Det er Sundhedsstyrelsen, der har rejst sagen, og anklagemyndigheden mener, at han skal frakendes retten til at massere.

Bengt Valentino Andersen allerede dømt i en lignende sag i 2009. Dengang behandlede han led på en patient i et indslag i TV-Avisen.

- Han overtrådte professionsforbeholdet. Det, domstolen gik ind og vurderede, var, at han udførte manuel behandling af kroppens led og den virksomhed er forbeholdt kiropraktorer, siger lektor i sundhedsret på Syddansk Universitet, Kent Kristensen.

Bengt Valentino Andersen fik en bøde tilbage i 2009. Han blev ikke frakendt retten til massere, men det kan han risikere i den nye retssag - og hvis det sker, så risikerer alle andre alternative behandlere, som laver knæk af led i deres behandling, at blive hevet for retten af Sundhedsstyrelsen.

Ingen videnskabelig dokumentation for "knækket"

Kiropraktorerne er de eneste alternative behandlere, der er blevet fuldt optaget i det etablerede sundhedssystem. Og det er på trods af, at der ikke er evidens for at kiropraktisk manipulation virker.

Som Detektor tidligere har fortalt, var kiropraktik en mærkesag for det tidligere socialdemokratiske folketingsmedlem, Erling Christensen. Og kiropraktorerne blev primært autoriserede, fordi Socialdemokraterne, SF og Fremskridtspartiet tilbage i 1991 lykkes med at sætte den daværende regering i mindretal.

- Vi så ikke nogen lægefaglig evidens for, at det virkede. Der var det grundlag - du kan kalde det politisk eller hvad du vil - men det grundlag, at vi mente, at mennesker fik gavn af behandlingen, sagde Erling Christensen i Detektor den 27. februar 2014.

LÆS OGSÅ: Politik – ikke fakta – bag blåstempling af kiropraktik

Bengt Valentino Andersen afviser, at det greb, han bruger, er et kiropraktisk greb, men alligevel kan han blive dømt til ikke at måtte udøve sit job som massør.

Ryg-ekspert: Autorisationslov halter

Neurokirurg Svend Erik Børgesen, der gennem sin karriere har opereret masser af patienter med ondt i ryggen, undrer sig over, at kiropraktorernes autorisation kan ramme andre fag, når kiropraktorerne selv stadig mangler videnskabelige beviser for effekten af knækket.

- Det er jo i virkeligheden lidt mærkeligt, at man har en lov, der er baseret på manglende evidens, og den lov skal så gøre et fag i stand til at dunke et andet fag i hovedet med den tilladelse. Det virker lidt forkert, siger han til Detektor.

Svend Erik Børgesen understreger, at Body SDS, ligesom kiropraktisk manipulation, heller ikke har videnskabelig dokumentation for effekten af deres behandling, men finder det stadig kritisabelt, at kiropraktorerne gennem autorisationen får et monopol på deres behandling trods, at de ikke har stærk evidens for dens effekt.

Sundhedsstyrelsen holder øje

Men hvis retten i Roskilde i maj kender Bengt Valentino Andersen skyldig i at have lavet kiropraktik, vil det også få konsekvenser for andre alternative behandlere, der benytter sig af manipulationsgreb, siger Sundhedsstyrelsen:

- Grunden til, at vi har en autorisationslov, er, at der kan være visse områder, der kan være farlige. Så det er klart, at hvis vi finder ud af, at det er en udbredt virksomhed, så er det noget, vi bliver nød til at gøre noget ved som Sundhedsstyrelse, siger Anne Mette Dons, tilsynschef i Sundhedsstyrelsen.

LÆS OGSÅ: LA og K vil se på kiropraktik-monopol

Se mere i Detektor på DR2 torsdag klokken 21.



TV 2 får kritik for moske-dokumentar: Her er nyhedsdirektørens svar
KL. 15.47

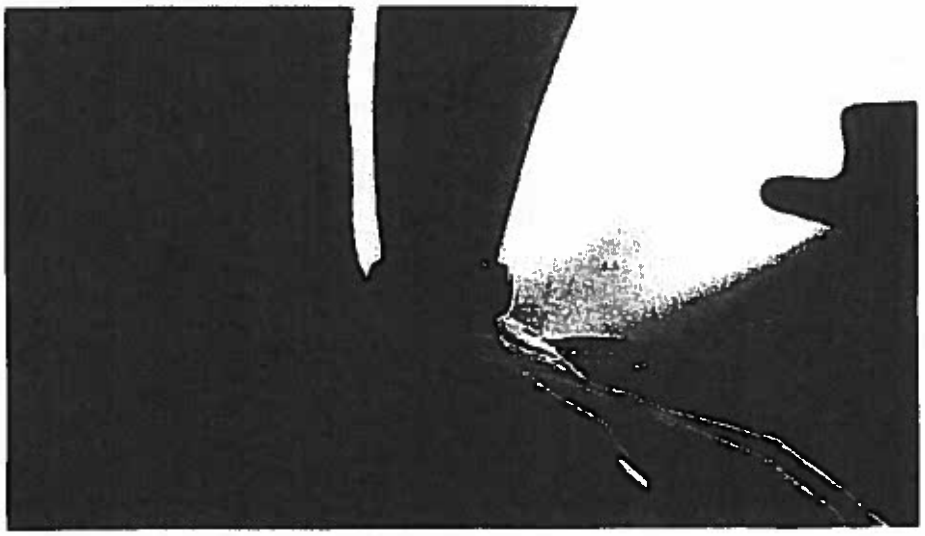
Zornig fortryder intet: Jeg gjorde det eneste anstændige
KL. 15.30

Terrorsagen: 20-årig tiltalt gentog 'det husker jeg ikke' igen og igen
KL. 16.11

03. APR. 2014 KL. 21.39

LA og K vil se på kiropraktik-monopol

Flere politikere vil se på loven, der giver kiropraktorer monopol på 'knækket'. Loven risikerer nemlig, at gøre massevis af alternative behandlinger ulovlige.



Kiropraktorer bør ikke være de eneste, som har lov til at udføre behandling, hvor man "knækker" kroppens led. (Foto: DR © DR)

En retssag i maj mod stifteren af behandlingsformen Body SDS kan komme til at koste en lang række alternative behandlere muligheden for at udføre deres job.

Det fortæller DR's Detektor torsdag.

Sundhedsstyrelsen mener, at Body SDS-behandler, Bengt Valentino Andersen, har udført kiropraktik uden at være uddannet kiropraktor.

Og det må han ikke, fordi kiropraktorer og læger har monopol på at udføre manipulationer af kroppens led - selvom de mangler videnskabelige beviser for effekten af "knækket".

Liberal Alliance og de Konservative vil derfor have autorisationsloven op til diskussion, hvis Bengt Valentino Andersen frakendes retten til at fortsætte som massør.

LÆS OGSÅ: Retssag kan stoppe alternative behandlere | Nyheder | DR

Definition er alt for bred

Kiropraktik er defineret alt for bredt i loven. Det bør ændres, ellers kan vi risikere, at massevis af alternative behandlere kan blive kendt ulovlige.

Sådan lyder det fra De Konservatives sundhedsordfører, Mai Mercado.

- Der skal også være en form for fornuft. Kiropraktik er så bredt defineret, at nærmest alt kan gå ind under. Sådan er det slet ikke for andre behandlingsformer som for eksempel fysioterapi, siger hun.

LÆS OGSÅ: Professor: Vi kender ikke effekten af knæk hos kiropraktoren

Må ikke reklamere for knæk

Anders Samuelsen, formand for Liberal Alliance, er enig med Mai Mercado. Definitionen dækker for bredt. Men han har også et andet løsningsforslag:

- Kiropraktorer bør være de eneste, som har ret til at reklamere, så man sikrer, at ingen antyder, at de er uddannet til noget, de ikke er, siger han.

På den måde kan alternative behandlerne fortsætte som nu.

LÆS OGSÅ: Politik – ikke fakta – bag blåstempling af kiropraktik

Stor efterspørgsel i befolkningen

Begge politikere synes nemlig, at de alternative behandlere skal kunne fortsætte med at udøve den praksis, som masser af danskere hver dag sætter pris på og som ikke er til fare for dem.

- Jeg ser ikke noget problem i, at de udfører den behandling. Jeg har ikke hørt om nogen, der er kommet til skade, siger Anders Samuelsen.

- Body SDS har fungeret i mange år, og man må anerkende, at der er en stor efterspørgsel efter behandlingen. Man skal have mulighed for at træffe det valg, at man gerne vil til alternativ behandling, siger Mai Mercado.

LÆS OGSÅ: Kiropraktorerne: Knækket er en vigtig del af kiropraktik

Sundhedsstyrelsen åbner for kig på definition

Men Sundhedsstyrelsen mener, at det giver god mening, at lade 'knækket' være i trygge hænder hos de autoriserede:

- Grunden til, at vi har en autorisationslov, det er, at der kan være visse områder, der kan være farlige. Og hvis de er farlige, så skal man have en bestemt autorisation for at udføre dem, siger Anne Mette Dons, der er tilsynschef i Sundhedsstyrelsen.

Men hun åbner alligevel for, at det kan være nødvendigt, at gå ind og se på, hvordan man definerer manipulation af kroppens led:

- Hvis vi finder ud af, at det er udbredt virksomhed, så er det noget, vi bliver nødt til at gøre noget ved som sundhedsstyrelse. Men man kan selvfølgelig blive nødt til at afklare, om det bare er et spørgsmål om, hvordan man definerer tingene, siger hun.