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Review Articles

Spinal Manipulations for Cervicogenic Headaches: A Systematic Review of Randomized Clinical Trials

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The objective of this systematic review was to assess the effectiveness of spinal manipulations as a treatment option for cervicogenic headaches. Seven databases were searched from their inception to February 2011. All randomized trials which investigated spinal manipulations performed by any type of healthcare professional for treating cervicogenic headaches in human subjects were considered. The selection of studies, data extraction, and validation were performed independently by 2 reviewers. Nine randomized clinical trials (RCTs) met the inclusion criteria. Their methodological quality was mostly poor. Six RCTs suggested that spinal manipulation is more effective than physical therapy, gentle massage, drug therapy, or no intervention. Three RCTs showed no differences in pain, duration, and frequency of headaches compared to placebo, manipulation, physical therapy, massage, or wait list controls. Adequate control for placebo effect was achieved in 1 RCT only, and this trial showed no benefit of spinal manipulations beyond a placebo effect. The majority of RCTs failed to provide details of adverse effects. There are few rigorous RCTs testing the effectiveness of spinal manipulations for treating cervicogenic headaches. The results are mixed and the only trial accounting for placebo effects fails to be positive. Therefore, the therapeutic value of this approach remains uncertain.

Key words: spinal manipulation, cervicogenic headache, effectiveness, systematic review, complementary and alternative medicine

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INTRODUCTION

Cervicogenic headache (CGH) is associated with a high burden of suffering and considerable socio-economic costs. The clinical classifications and definitions of CGH are ambiguous.[1] The International Headache Society classified CGH as "pain, referred from a source in the neck and perceived in one or more regions of the head and/or face" and stressed the importance of clinical evidence of a disorder or lesion within the cervical spine or soft tissues of the neck as a valid cause of headache.[2]

Spinal manipulation (SM) is a manual technique often practiced by chiropractors, osteopaths, physiotherapists, and some doctors to correct misalignments of the spinal joints.[3] Chiropractors suggest that SM is an effective treatment for CGH.[4] However, SM has repeatedly been criticized for not being biologically plausible.[5,6] The effectiveness, safety, and cost-effectiveness of SM have also been questioned.[7-10] Thus, it seems crucial to be certain about its benefits for patients suffering from CGH.

This systematic review is aimed at critically evaluating the evidence for or against the notion that SM is effective in treating CGH.

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Conflict of Interest: None

METHODS

Electronic searches were carried out in the following databases: Amed, Embase, Medline, Cinahl, Mantis, ICL, and Cochrane Central Register of Controlled Trials (from their inception until February 2011). Cervicogenic headache combined with spinal manipulative therapy, spinal manipulation, cervical manipulation, chiropractic manipulation, and osteopathic manipulation were employed as Medical Subject Heading (MeSH) terms or key words for our search. Our own extensive department files were also hand-searched. The abstract of the articles thus located were then screened in End Note to remove duplicates and irrelevant studies. No language limitations were imposed.

To be included, a clinical trial had to be randomized or quasi-randomized, test the feasibility or effectiveness of SM, and focus on the treatment of CGH in human subjects. Any pain-related outcome measures were considered eligible. Any type of control intervention was admissible. Abstracts were excluded.

For the purpose of this review, we defined SM as "the application of high-velocity, low-amplitude manual thrusts to the spinal joints slightly beyond the passive range of joint motion."[11]

Key data of the included trials were extracted according to pre-specified criteria (Table 1). Data extraction was performed by 2 independent reviewers (E. E., P. P.). The methodological quality of all reviewed studies was estimated using the Jadad score and the Cochrane tool.[12] Again, this was carried out by 2 independent reviewers (E. E., P. P.).

RESULTS

The search strategy generated a total of 626 "hits." After removal of duplicates, 470 abstracts were screened for inclusion. A total of 15 trials were retrieved for further evaluation, of which 9 randomized clinical trials (RCTs) involving 607 patients with CGH were eligible for inclusion (Figure).[4,13-20] Their key data are summarized in Table 1.

Populations of individuals with CGH were relatively homogenous across RCTs.[4,13-15,17,18] Control interventions were heterogeneous ranging from sham manipulation,[13] light massage,[4] drugs,[17] physical therapy,[15,16] to no intervention.[14,18]

Ammer and Rathkolb[16] compared: (1) SM plus electrotherapy; (2) electrotherapy over the forehead/neck plus ultrasound and UV light over the neck muscles; and (3) munaripacks-mustard paste (cayenne pepper and kaolinerde combined in water) plus massage. They reported a significant reduction in pain in all 3 groups after 2 weeks of therapy. This study lacked appropriately described randomization, allocation concealment, power calculations, and intention to treat analysis. A further caveat was that it did not test SM as a single therapy but in combination with electrotherapy. Thus, it does not allow causal inferences regarding SM. We scored this study as 2.

Bitterli[20] aimed to assess the effectiveness of mobilization combined with SM vs SM alone and wait list controls. They reported that the group which received preliminary mobilization improved by 35% after this treatment, but there was no further improvement after SM. This study lacked appropriate randomization, concealed allocation, blinding, intention to treat analysis, power analysis and was of small sample size. We scored it as 1.

Borusiak et al[13] investigated the effectiveness of SM in children and adolescents with CGH. They did not report any significant differences in terms of percentage of days with headache, total duration of headache, days with school absence due to headache, consumption of analgesics or intensity of headache. This was a very well-designed trial. We scored it as 4.

Haas et al[4] aimed to compare the efficacy of 2 doses of SM and 2 doses of light massage for CGH. They reported clinically important differences favoring SM. The sources of bias included relatively wide confidence intervals and lack of blinding. We scored it as 3.

Haas et al[14] aimed to make preliminary estimates of the relationship between headache outcomes and the number of visits to a chiropractor. They reported that there was substantial benefit in pain relief for 9 and 12 treatments compared with 3 visits. This study is burdened with a risk of bias related to insufficiently described randomization, lack of blinding and selective outcome reporting. We scored it as 3.

Howe et al[17] aimed to assess the effectiveness of SM in patients with subacute, chronic mechanical neck disorder (with radicular findings) and headache

Table 1.—Controlled Studies of Spinal Manipulations for the Treatment of Cervicogenic Headaches

First Author (Year)	Study Design	Characteristics of Participants (n)	Diagnostic Criteria	Experimental Intervention (Therapist)	Control Intervention	Primary Outcome Measure	Main Result	Duration of Follow-Up	Comment
Ammer (1990)[16]	RCT with 3 groups	45 patients with acute, subacute, chronic neck disorder with headache	None	SM + GC 10 treatments over 2 weeks (physiotherapist)	(i) Electrotherapy GC, ultrasound, ultraviolet; (ii) massage, MMP	Pain (0-5)	No between group differences	None	—
Bitterli (1977)[20]	Quasi RCT with 3 groups	30 patients with chronic neck disorder with headache or degenerative changes	None	(i) SM (mean 6.2 manipulations over 3.2 sessions) and mobilization (3 sessions); (ii) SM (mean 7.2 manipulations over 3.8 sessions) (medical doctor)	Wait list	Pain (VAS 100 mm)	No between group differences	12 weeks	High risk of bias related to low-quality methodological design
Borusiak (2010)[13]	Multicenter placebo-controlled RCT with 2 parallel groups (patient and evaluator blind)	52 children and adolescents with cervicogenic headache	IHS	SM (HVLA once only without rotation and extension) (medical doctor)	Placebo manipulation	(i) Percentage of days with headache; (ii) total duration of headache; (iii) days with school absence due to headache; (iv) consume of analgesics; (v) intensity of headache	No between group differences in any outcome measures	2 months	Well-designed trials with low risk of bias. Success of blinding patients was not tested
Haas (2004)[14]	Open RCT with 3 parallel groups	24 patients with cervicogenic headache	IHS	(1) 1; (2) 3; (3) 4 sessions of HLVA thrusts/week plus up to 2 physical modalities/session (chiropractor)	None	Pain disability	More sessions tended to generate better effects	12 weeks	Pilot study with appropriate aim
Haas (2010)[4]	2 × 2 balanced factorial design	80 patients with cervicogenic headache	IHS	SM (once or twice per week for 8 weeks) (chiropractor)	Gentle massage	Pain and disability	Small dose effects of adjusted mean difference ≤5.6	24 weeks	—
Howe (1983)[17]	RCT with 2 groups	52 patients with subacute, chronic mechanical neck disorder with radicular findings and headache	None	SM (up to 3 manipulation in 1 session) 1 session only (medical doctor)	Azapropazone	Pain	Significantly less pain in the treatment group	3 weeks	—
Jull (2002)[18]	RCT with 4 groups	200 patients with chronic neck disorder with headache	Sjaastad et al[30]	(i) SM; (ii) EX; (iii) SM + EX (minimum 8 and a maximum of 12 treatments over 6 weeks, each session no longer than 30 minutes) (physiotherapist)	No intervention	Change in headache frequency from baseline to immediately after treatment and at month 12	At the 12-month follow-up, both SM and EX had significantly reduced headache frequency in comparison to control ($P < .05$)	12 months	No control of placebo effects
Li (2007)[19]	Quasi RCT with 2 groups	70 patients with degenerative changes and cervicogenic headache	Sjaastad et al[30]	10 sessions of manipulation of the cervical spine daily (20-30 minutes/session) (rehabilitant)	TENS	(i) Pain (NRS); (ii) frequency and duration of headaches; (iii) ROM	Significantly less pain in the treatment group ($P < .01$)	1 week	High risk of bias related to methodological design
Nilsson (1995)[15]	RCT with 2 parallel groups	54 patients with chronic neck pain with headache	IHS	SM (dose: 12 toggle recoil and 10 diversified technique) twice weekly for 3 weeks (medical doctor, chiropractor)	PT	(i) Pain (VAS 100 mm); (ii) analgesic use; (iii) headache intensity per episode; and (iv) number of headache hours per day	Significant between group differences in all measures	1 week	Lack of blinding and appropriately described randomization

EX = exercise; GC = galvanic current; HVLA = high-velocity low-amplitude thrust; IHS = International Headache Society; MMP = cayenne pepper and kaolinerde combined in water; MT = manual therapy; NDI = Neck Disability Index; NRS = numeric rating scale; PT = physiotherapy; RCT = randomized clinical trial; ROM = range of motion; SM = spinal manipulation; TENS = transcutaneous electrical nerve stimulation; VAS = visual analog scale; — = inconclusive results.

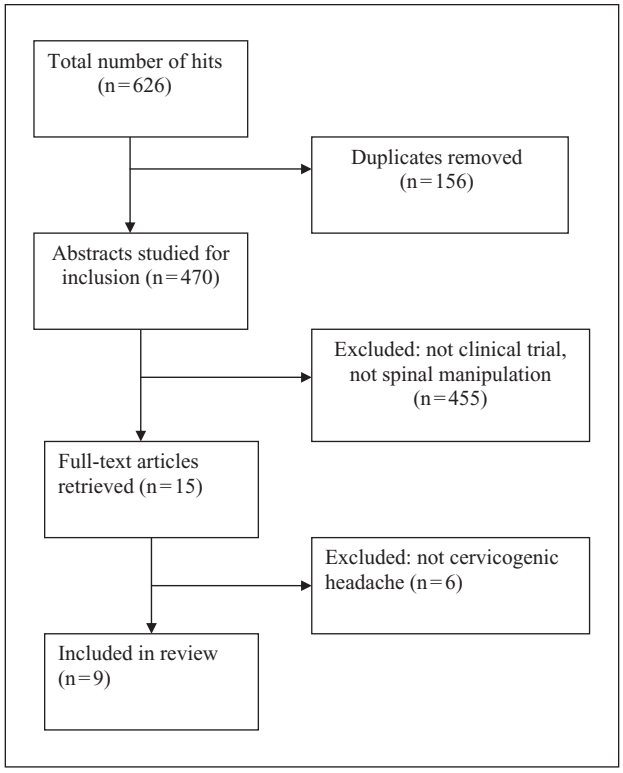

Figure.—Flowchart of eligibility assessment and inclusion.

in general practice. They reported a significant immediate improvement in symptoms of those with pain or stiffness in the neck, and pain/paresthesia in the shoulder, and a nearly significant improvement in those with pain/paresthesia in the arm/hand. This study lacked appropriately described randomization, power calculations, allocation concealment, blinding and description of dropouts. We scored this study as 1.

Jull et al[18] aimed to determine the effectiveness of SM and a low-load exercise program for CGH when used alone and in combination, as compared with a control group. They reported that both SM and specific exercise had significantly reduced headache frequency and intensity, and the neck pain and effects were maintained at the 12-month follow-up assessment. Lack of blinding and power calculation may increase the risk of biases. We scored this study as 4.

Li et al[19] aimed to compare the effects of SM and transcutaneous electrical nerve stimulation on patients with CGH. They reported statistically insignificant changes in pain (numeric rating scale score) and significant changes in frequency and duration of headaches in favor of SM. However, this trial lacks allocation concealment, appropriate randomization, blinding and intention to treat analysis. We scored it as 0.

Nilsson et al[15] aimed to determine whether SM has any effect on CGH. They reported significant changes in analgesic use per day, headache intensity per episode, and number of headache hours per day. This trial lacks allocation concealment, appropriate randomization, and blinding procedures. We scored this study as 2.

DISCUSSION

The purpose of the present review was to critically evaluate the evidence for or against the effectiveness of SM for the treatment of CGH. Nine RCTs met our eligibility criteria. The results of 6 RCTs suggested that SM is effective for treating CGH compared to physical therapy, light massage, drug therapy, or no intervention.[4,14,15,17-19] Three RCTs showed no differences in pain, headache duration and frequency compared to placebo manipulation, physical therapy, massage, or wait list controls. Most trials had major methodological flaws (Tables 2 and 3). Three (out of 5) RCTs were of low quality and these favored SM.[15,17,19] Three (out of 4) RCTs that were of high quality favored SM.[4,14,18] One high-quality study (out of 4) showed no effect.[13] Six RCTs adhered to International Headache Society diagnostic criteria or these described by Sjaastad et al.[4,13-15,18,19] Three RCTs failed to adhere to any diagnostic criteria.[16,17,20] The evidence from RCTs of SM for treatment of CGH is thus ambiguous and, for several reasons, inconclusive.

Our findings should be viewed in the context of other reviews. Vernon et al[21] published a review of complementary and alternative therapies in the treatment of tension-type headache and CGH. Even though it included several RCTs of SM, its focus was not on summarizing the totality of the evidence for or against SM. In a similar vein, Fernández de las Peñas et al[22] included 2 RCTs only, ie, 22.2% of the available data we managed to locate. Therefore, this review failed to evaluate the totality of the available evidence.

Populations of individuals with CGH were relatively homogenous across RCTs.[4,13-15,17,18] However,

Table 2.—Quality Assessment of the Included Studies (Jadad Score)

First Author (Year)	Random Sequence Generation	Appropriate Randomization	Blinding of Participants or Personnel	Blinding of Outcome Assessors	Withdrawals and Dropouts	Sum (Jadad Score)
Ammer (1990)[16]	1	0	0	0	1	2
Bitterli (1977)[20]	0	0	0	0	1	1
Borusiak (2010)[13]	1	1	1	0	1	4
Haas (2004)[14]	1	1	0	0	1	3
Haas (2010)[4]	1	1	0	0	1	3
Howe (1983)[17]	1	0	0	0	0	1
Jull (2002)[18]	1	1	0	1	1	4
Li (2007)[19]	0	0	0	0	0	0
Nilsson (1995)[15]	1	0	0	0	1	2

control interventions were heterogeneous ranging from sham manipulation,[13] light massage,[4] drugs,[17] physical therapy,[15,16] to no intervention.[14,18] Primary outcome measures were also heterogeneous ranging from numeric rating scale,[16] Modified Von Korff pain and disability scale,[4,14] visual analog scale,[15] and diaries (percentage of days with headache, total duration of headache, days with school absence due to headache, consumption of analgesics, intensity of headache, headache intensity per episode, and number of headache hours per day).[13,15,18] Frequency and duration of SM sessions varied across RCTs from 1 session only[13,17] to 22 sessions.[15] Most RCTs failed to describe SM technique in sufficient depth (Table 4).[14-17,19,20] Given such variability and lack of standardization of SM treatments, it is difficult to independently replicate these studies and/or draw any firm conclusions.

Four of the 9 RCTs reported adverse effects (AEs).[13,18-20] Five RCTs failed to provide that information (Table 5).[4,14-17] The non-reporting of AEs is in violation of all guidelines of reporting clinical trials and, arguably, of medical ethics. It is also worth noting that several hundred severe complications after upper spinal manipulations have been reported (eg, Ernst[23] and Terrett[24]).

Table 3.—Quality Assessment of Included Studies (Cochrane Tool)

First Author (Year)	Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel, or Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Sum
Ammer (1990)[16]	1	–1	–1	0	0	0	–1
Bitterli (1977)[20]	–1	–1	–1	0	0	–1	–4
Borusiak (2010)[13]	1	1	1	1	1	1	6
Haas (2004)[14]	1	0	–1	1	0	0	1
Haas (2010)[4]	1	1	–1	1	1	0	3
Howe (1983)[17]	0	–1	–1	–1	–1	–1	–5
Jull (2002)[18]	1	–1	1	1	1	0	3
Li (2007)[19]	–1	–1	–1	–1	–1	–1	–6
Nilsson (1995)[15]	1	–1	–1	1	0	0	0

+1 = low risk of bias; 0 = unclear risk of bias; –1 = high risk of bias.

Table 4.—Details of Spinal Manipulation (SM) Intervention

First Author (Year)	Details of SM Intervention (Direct Quote Where Appropriate)
Ammer (1990)[16]	Manipulation was given at first and sixth treatment day with pulsed galvanic current (50/70), 20 minutes of duration in each blocked segment.
Bitterli (1977)[20]	Patients in the group B were treated by a doctor who was also a qualified manual therapist. They received an average of 7.2 directed manipulations of the cervical spine using a technique described by Maigne.
Borusiak (2010)[13]	"Patients were lying on the side and a cervical high-velocity, low-amplitude lateral-directed manipulation without rotation or extension was performed. Forces of this intervention are known and vary from 50 Nm in newborns and infants to 350 Nm in adults."
Haas (2004)[14]	"The principal therapy was high-velocity, low-amplitude spinal manipulation as described by Bergmann et al. [. . .] Specific manipulation and other modalities were determined at each visit by the therapist through ongoing evaluation of the participants."
Haas (2010)[4]	"The two SMT groups received high-velocity low-amplitude spinal manipulation of the cervical and upper thoracic (transitional region) spine at each visit as described by Peterson and Bergmann et al. This form of manipulation is the most commonly used by chiropractors. Modifications in manipulation recommended for older patients were permitted as required."
Howe (1983)[17]	"The techniques are similar with only minor differences to those described by Bourdillon.[3] The essence of manipulations is to move the joint or joints as far as comfortably possible and then apply a quick thrust of moderate force but with small amplitude in the same direction."
Jull (2002)[18]	"The manipulative therapy (MT) intervention followed the regimen described by Maitland et al. This regimen includes the use of both low-velocity cervical joint mobilization techniques (in which the cervical segment is moved passively with rhythmical movements) and high-velocity manipulation techniques in the treatment of cervical joint disorders."
Li (2007)[19]	Patients were in supine position. Clinician positioned the patients' head to the side and manipulated 3 to 5 cervical vertebrae after taking out the slack.
Nilsson (1995)[15]	"Manipulative methods used were toggle recoil for the upper cervical region and diversified technique for the mid and lower cervicals, as determined by the chiropractor on the basis of palpatory examination findings."

A particular concern relates to vascular accidents caused by arterial dissection after upper spinal manipulation.[25-28] The estimates as to the incidence of these complications vary hugely.[10] Underreporting of AEs in RCTs is likely to generate a false impression about the safety of SM.

Three of the 6 RCTs that suggested SM to be effective were conducted by chiropractors.[4,14,15] Three RCTs performed by non-chiropractors showed no effect (Table 6).[13,16,20] This could either indicate a degree of bias on the side of chiropractors, as noted previously[29] or mean that chiropractors are better trained in SM and therefore more effective than other professions administering this treatment.

Our review has several limitations. Even though our searches were extensive, we cannot be entirely sure that all relevant articles were located. Publication bias may have resulted in negative studies remaining unpublished. The number of trials included in our review, their total sample size, and their methodological quality were too low to allow definitive judgments. Even though all included RCTs were considered to have relatively homogenous CGH populations, statistical pooling was not feasible due to lack of reporting of sufficient raw data. However, this review has several strengths including the comprehensive search strategy, the inclusion of only the highest quality trial design and use of suggested methods for systematic reviews of interventions for CGH.

Future studies of SM should be in line with accepted standards of trial design and reporting (eg, CONSORT guidelines). In particular, studies should be of adequate sample size based on power calculations, use validated outcome measures, control for non-specific effects, and minimize other sources of bias. Reporting of these studies should be such that results can be independently replicated.

In conclusion, the evidence that SM is effective for CGH is not conclusive. Further rigorous research in this area is needed. Until conclusive data are avail-

Table 5.—Adverse Effects (AEs) Reported in Randomized Clinical Trials

First Author (Year)	Details of AEs
Ammer (1990)[16]	NIP.
Bitterli (1977)[20]	Manipulation and mobilization were well tolerated with the customary reaction of minimal benign reaction lasting less than 24 hours.
Borusiak (2010)[13]	"No severe or moderate side effects were noticed (. . .) hot skin and dizziness being reported most often in 15 (treatment group: 6; placebo group: 9) and 11 patients (treatment group: 7; placebo group: 4), respectively." No significant between-group differences.
Haas (2004)[14]	NIP.
Haas (2010)[4]	NIP.
Howe (1983)[17]	NIP.
Jull (2002)[18]	"As a minor and temporary side effect, 6.7% of the headaches experienced by subjects during the 6-week intervention period were reported by subjects in the headache diaries as provoked by treatment."
Li (2007)[19]	None reported.
Nilsson (1995)[15]	NIP.

NIP = no information provided.

able, SM cannot be regarded as an evidence-based approach in the treatment of CGH.

STATEMENT OF AUTHORSHIP

Category 1

(a) Conception and Design
Edzard Ernst

(b) Acquisition of Data
Paul Posadzki

(c) Analysis and Interpretation of Data
Edzard Ernst; Paul Posadzki

Category 2

(a) Drafting the Article
Paul Posadzki

(b) Revising It for Intellectual Content
Edzard Ernst; Paul Posadzki

Table 6.—Positive vs Negative Trials by Type of Healthcare Professional

First Author (Year) Profession	Positive	Negative	Equivocal
Ammer (1990)[16] PT	—	✓	—
Bitterli (1977)[20] MD	—	✓	—
Borusiak (2010)[13] MD	—	✓	—
Haas (2004)[14] DC	✓	—	—
Haas (2010)[4] DC	✓	—	—
Howe (1983)[17] MD	✓	—	—
Jull (2002)[18] PT	—	—	✓
Li (2007)[19] R	—	—	✓
Nilsson (1995)[15] DC, MD	✓	—	—

DC = doctor of chiropractic; MD = medical doctor; PT = physiotherapist; R = rehabilitant; — = inconclusive results.

Category 3

(a) Final Approval of the Completed Article
Edzard Ernst; Paul Posadzki

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