

Spinal manipulation: an update of a systematic review of systematic reviews

Paul Posadzki, Edzard Ernst

Abstract

Objectives The aim of this update is to critically evaluate the evidence for or against the effectiveness of spinal manipulation in patients with any type of clinical condition.

Design Four electronic databases were searched to identify all relevant systematic reviews of the effectiveness of spinal manipulation in any condition published between 2005 and January 2011. Reviews were defined as systematic, if they included an explicit and repeatable inclusion and exclusion criteria for studies.

Results Forty-five systematic reviews were included relating to the following conditions: low back pain (n=7), headache (n=6), neck pain (n=4), asthma (n=4), musculoskeletal conditions (n=3), any non-musculoskeletal conditions (n=2), fibromyalgia (n=2), infant colic (n=2), any medical problem (n=1), any paediatric conditions (n=1), carpal tunnel syndrome (n=1), cervicogenic dizziness (n=1), dysmenorrhoea (n=1), gastrointestinal problems (n=1), hypertension (n=1), idiopathic scoliosis (n=1), lateral epicondylitis (n=1), lower extremity conditions (n=1), pregnancy and related conditions (n=1), psychological outcome (n=1), shoulder pain (n=1), upper extremity conditions (n=1) and whiplash injury (n=1). Positive or, for multiple SR, unanimously positive conclusions were drawn for psychological outcomes (n=1) and whiplash (n=1).

Conclusion Collectively these data fail to demonstrate convincingly that spinal manipulation is an effective intervention for any condition.

Spinal manipulation (SM) is a manual technique commonly used by chiropractors, osteopaths, physiotherapists, physicians or bone setters. The aim usually is to correct misalignments or subluxations of the spinal joints.¹ However, subluxations have repeatedly been found to be an invalid concept.^{e.g.2;3} Therefore, the use of spinal manipulation as a means to adjust subluxations is of debatable biological plausibility. Despite its implausibility, SM is still widely used for a broad range of conditions.

Numerous clinical trials of SM have been published. Their data are often less than uniform. In such a situation, systematic reviews (SRs) might provide the most conclusive answer regarding the effectiveness of SM. In 2006, a SR of SRs pertaining to spinal manipulation was published.⁴ In this article, we were able to include 16 SRs published between 2000 and May 2005. Our conclusion was that “we have found no convincing evidence from systematic reviews to suggest that SM is a recommendable treatment option for any medical condition”.⁴ Since then, numerous new SRs have been published which necessitates an update of our original SR.

The aim of this update was to critically evaluate the data from SRs of SM as a treatment for any human condition.

Methods

Electronic literature searches were conducted to identify all systematic reviews of SM for any indication published between May 2005 and January 2011. Searches were conducted in the following electronic databases: Medline, Embase, AMED, Cochrane Database. The following search terms were used: [Chiropract* OR spinal manipul* OR manual therap* OR osteopath*] AND [systematic ADJ review]. No language barriers were imposed.

Abstracts of reviews thus located were read and those appearing to meet the inclusion criteria were retrieved for further evaluation by both authors (EE, PP). Systematic reviews were defined as articles that included an explicit and repeatable literature search method and if there were explicit and repeatable inclusion and exclusion criteria for studies. To get included, systematic reviews had to pertain to the effectiveness of SM for any type of medical condition and to include evidence from at least two controlled clinical trials. Complex packages of therapeutic interventions that included SM as one of several treatments were excluded. Reviews that depended upon previous systematic reviews for their primary data were also excluded.

Two authors independently extracted the data from the identified articles according to pre-defined criteria (Table 1). Disagreements were resolved through discussions between the authors.

Results

After removal of duplicates, the searches generated 59 articles. Thirteen articles were excluded (Figure 1). The reasons for exclusion were: based on previous systematic reviews (n=3), practise guideline (n=2), protocol only (n=1), no explicit exclusion and inclusion criteria (n=5), no conclusion regarding effectiveness (n=2). Forty-five SRs met the above inclusion criteria.⁵⁻⁴⁹

Key data of these reviews are summarized in Table 1. These SRs related to the following conditions: low back pain (n=7), headache (n=6), neck pain (n=4), asthma (n=4), musculoskeletal conditions (n=3), any non-musculoskeletal conditions (n=2), fibromyalgia (n=2), infant colic (n=2), any medical problem (n=1), any paediatric conditions (n=1), carpal tunnel syndrome (n=1), cervicogenic dizziness (n=1), dysmenorrhoea (n=1), gastrointestinal problems (n=1), hypertension (n=1), idiopathic scoliosis (n=1), lateral epicondylitis (n=1), lower extremity conditions (n=1), pregnancy and related conditions (n=1), psychological outcome (n=1), shoulder pain (n=1), upper extremity conditions (n=1) and whiplash injury (n=1). There was some overlap between these categories.

The SRs included chiropractic or osteopathic manipulations as well as manual therapy or any type of SM. Twenty SRs included more than 10 primary studies;^{5;8;10;12;20-24;28;30-32;36;39;41;42 47 48;49} and 6 included a meta-analysis.^{5;20;22;40;41;48} The conclusions drawn from most SRs were frequently cautious or negative (Table 2). For instance, for low back pain three SRs arrived at positive conclusions,^{10;40;49} one arrived at equivocal conclusions³⁷ and three arrived at negative conclusions.^{5;12;20} For asthma three SRs arrived at negative conclusions^{7;15;25} and one arrived at equivocal conclusions.²⁷ For headaches two reached positive conclusions^{9;19} whereas three reached negative conclusions^{6;18;29}

For infant colic both reviews arrived at negative conclusions.^{17;26} There is insufficient evidence to determine whether SM can be beneficial in upper extremity conditions^{24;30;31} For lower extremity conditions, one review arrived at positive conclusions.⁸ Thus there was an undeniable degree of contradiction between these SRs.

Table 1. Systematic reviews of spinal manipulations published since 2000

Legend: NSAIDs–Non Steroid Anti Inflammatory Drugs; SM–spinal manipulation; RCT–randomised clinical trial; TTH–tension type headache.

First author (year) [ref]	Interventions	Condition treated	n	Meta-analysis	Overall result (quote)	Direction of conclusion	Comment
Assendelft (2004) ⁵	Any type of SM	Low back pain	39	Yes	No evidence that SM is superior to other standard treatments for acute or chronic low back pain	(-)	RCTs of mobilization were also included
Bronfort (2004) ¹⁰	SM and mobilization	Low back pain and neck pain	69	No	. . . recommendations can be made with some confidence regarding the use of SM and/or mobilization as a viable option for treatment of both low back pain and neck pain	(+)	Conclusions based on 43 RCTs meeting admissibility criteria for evidence
Dagenais (2010)	SM	Acute low back pain	14	No	Several RCTs have been conducted to assess the efficacy of SMT for acute LBP using various methods	(+)	
Ernst (2003) ¹²	Chiropractic SM	Low back pain	12	No	Effectiveness . . . not supported by compelling evidence from the majority of RCTs	(-)	Focus exclusively on SM as performed by chiropractors
Ferreira (2002) ¹⁹	SM	Chronic low back	12	Yes	(SM) . . . is not substantially more effective than sham treatment in reducing pain, nor is it more effective than NSAIDs in improving disability in chronic low back pain patients. It is not clear whether . . . (SM) . . . is more effective than NSAIDs in reducing pain in chronic low back pain patients	(-)	Mostly moderate quality data was included
Licciardone (2005) ⁴⁰	Osteopathic manipulative therapy	Low back pain	6	Yes	Osteopathic manipulative therapy significantly reduces low back pain. The level of pain reduction is greater than expected from placebo effects alone and persists for at least 3 months.	(+)	Significant heterogeneity of meta-analysed data
Stuber (2008) ³⁷	Chiropractic care	Pregnancy-related low back pain	6	No	However, the low-to-moderate quality of evidence of the included studies preclude any definitive statement as to the efficacy of such care	(+/-)	Quasi-experimental design, case series, and cross-sectional case series study included
Astin (2002) ⁶	Any type of SM	Headache disorders	8	No	The data available to date do not support . . . that SM is an effective treatment for headache	(-)	Rigorous systematic review
Bronfort (2001) ⁹	SM	Chronic headache	9	No	SM appears to have a better effect than massage for cervicogenic headache . . . an effect comparable to commonly used first line prophylactic prescription medications for tension-type headache and migraine	(+)	Only 9 primary studies included

					headache. This conclusion rests upon a few trials of adequate methodological quality. Before any firm conclusions can be drawn, further testing should be done.		
Fernandez-de-las-Penas (2006) ¹⁸	Any type of manual therapy including SM	Tension type headache	6	No	The author found no rigorous evidence that manual therapies have a positive effect in the evolution of TTH. The most urgent need for further research is to establish the efficacy beyond placebo of the different manual therapies currently applied in patients with TTH.	(-)	Different manual therapy modalities were included
Fernandez-de-las-Penas (2005) ¹⁹	SM	Cervicogenic headache	2	No	Spinal manipulative therapy might be effective in reducing headache intensity, headache duration, medication intake (level 1), and headache frequency (level 3) in patients with CeH.	(+)	Low quantity of the data
Lenssinck (2004) ²⁹	Physiotherapy and/or spinal manipulation	Tension type Headache	8	No	. . . there is insufficient evidence to either support or refute the effectiveness of physiotherapy and (SM) compared to other treatments	(-)	Included five RCTs of SM including two high quality RCTs of chiropractic with contradictory results
Ernst (2003) ¹³	Chiropractic SM	Neck pain	4	No	The notion that chiropractic SM is more effective than conventional exercise . . . was not supported by rigorous trial data	(-)	Focus exclusively on SM as performed by Chiropractors
Gross (2004) ²²	Any type of SM and mobilization	Neck problems	33	Yes	The evidence did not favour manipulation and/or mobilisation done alone or in combination with various other physical medicine agents; when compared to one another, neither was superior. There was insufficient evidence available to draw conclusions for neck disorder with radicular findings.	(-)	42% of the included data was of high quality
Gross (2010) ⁴¹	SM or mobilisation	Neck pain, headache, whiplash injuries	27	Yes	Cervical manipulation and mobilisation produced similar changes. Either may provide immediate- or short-term change; no long-term data are available. Thoracic manipulation may improve pain and function. Optimal techniques and dose are unresolved. 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.	(+/-)	Low to moderate quality evidence was included
Vernon (2005) ³⁸	SM, manual therapy	Acute neck pain not	4	No	There is limited evidence of the benefit of spinal	(-)	Combination of modalities included

	and TENS	due to whiplash			manipulation ... in the treatment of acute neck pain not due to whiplash injury.		
Hestbaek (2010) ⁴⁶	Chiropractic care	Musculoskeletal conditions in children and adolescents	3	No	Although the major reason for paediatric patients to attend a chiropractor is spinal pain, no adequate studies have been performed in this area.	(+/-)	
Posadzki (2010) ³²	Osteopathic manipulation	Musculoskeletal pain	16	No	The notion that osteopathic manipulative therapy alleviates musculoskeletal pain is currently not based on the evidence from independently replicated high quality clinical trials.	(-)	Various quality RCTs were considered
Vernon (2009) ³⁹	Chiropractic care	Myofascial trigger points and myofascial pain syndrome	112	No	Manual-type therapies and some physiologic therapeutic modalities have acceptable evidentiary support in the treatment of MPS and TrPs.	(+)	Physical therapies were also evaluated along SM
Balon (2004) ⁷	Chiropractic care	Asthma or allergy	6	No	No evidence to support the use of chiropractic SM	(-)	Four of the six trials tested SM; three of these studies were negative
Ernst (2009) ¹⁵	SM	Asthma	3	No	Spinal manipulation is not an effective treatment for asthma	(-)	Rigorous systematic review; included the highest quality RCTs
Hondras (2002) ²⁵	Manual therapy	Asthma	5	No	Insufficient evidence to support the use of manual therapies	(-)	Both trials of chiropractic spinal manipulation were negative
Kaminskyj (2010) ²⁷	Chiropractic SM	Asthma	8	No	The evidence suggests chiropractic care should be used as an adjunct, not a replacement, to traditional medical therapy.	(+/-)	case series, case studies, surveys, and randomized controlled trials included
Ernst (2003) ¹⁴	Chiropractic SM	Non-spinal pain syndromes	8	No	The claim that SM is effective for such conditions is not based on data from rigorous clinical studies	(-)	Conditions included fibromyalgia, carpal tunnel syndrome, infantile colic, otitis media, dysmenorrhoea and chronic pelvic pain
Hawk (2007) ²³	Chiropractic care	Nonmusculoskeletal conditions	179	No	Evidence from controlled studies and usual practice supports chiropractic care (the entire clinical encounter) as providing benefit to patients with asthma, cervicogenic vertigo, and infantile colic.	(+)	Various clinical conditions like asthma, cervicogenic vertigo, and infantile colic and research designs
Ernst (2009) ¹⁶	Chiropractic SM	Fibromyalgia	3	No	There is no evidence to suggest that chiropractic care is effective for fibromyalgia	(-)	Poor quality and low quantity of the primary data
Schneider (2009) ³⁶	Chiropractic care	Fibromyalgia syndrome	17	No	Several nonpharmacologic treatments and manual-type therapies have acceptable evidentiary support in the treatment of fibromyalgia syndrome	(+)	Systematic reviews, meta-analyses, published guidelines, and consensus document included

Shaw (2010) ⁴⁷	Chiropractic care	Whiplash-Associated Disorders	27	No	There is a baseline of evidence that suggests chiropractic care improves cervical range of motion and pain in the management of Whiplash-Associated Disorders.	(+)	Low level of scientific evidence only
Ernst (2009) ¹⁷	Chiropractic SM	Infant colic	3	No	The totality of this evidence fails to demonstrate the effectiveness of this treatment.	(-)	Poor quality and low quantity of the primary data
Husereau (2003) ²⁶	Any type of SM	Infant colic	4	No	No convincing evidence	(-)	Most trials were of low methodological quality
Gotlib (2008) ²¹	Chiropractic SM	Paediatric conditions	57	No	The health claims made by chiropractors with respect to the application of manipulation as a health care intervention for paediatric health conditions continue to be supported by only low levels of scientific evidence	(+/-)	Case studies, observational studies were included in this review along with RCTs.
McHardy (2008) ³⁰	Chiropractic manipulation	Upper extremity conditions	64	No	There is a small amount of chiropractic research into upper limb conditions that is comprised mostly of low level of evidence	(+/-)	Case reports and clinical trials included
Herd (2008) ²⁴	SM or mobilisation	Lateral epicondylitis	13	No	Currently, limited evidence exists to support a synthesis of any particular technique whether directed at the elbow or cervical spine.	(-)	The presence of consistent methodological flaws was reported
Hunt (2009) ⁴⁴	Chiropractic SM	Carpal tunnel syndrome	1	No	There is insufficient evidence to suggest that chiropractic is effective for the treatment of CTS. Therapy should continue to focus on the use of NSAIDs, corticosteroid injection, splinting and surgical release of the median nerve. Further research into the utility of chiropractic for CTS is required.	(-)	
Pribicevic (2010) ³¹	Chiropractic manipulation	Shoulder pain	30	No	The evidence for chiropractic management of shoulder pain is limited to low level evidence in the form of case reports and case series and 1 small controlled trial.	(+/-)	Only two articles of reasonably sound methodology were included
Brantingham (2009) ⁸	Manipulative therapy	Lower extremity conditions	39	No	There are a growing number of peer-reviewed studies of manipulative therapy for lower extremity disorders.	(+/-)	Low level of scientific evidence
Ernst (2008) ⁴³	Chiropractic SM	Hypertension	4	No	Until evidence to the contrary emerges, chiropractic spinal manipulation cannot be considered an effective treatment for hypertension	(-)	
Ernst (2011) ⁴⁵	Chiropractic care	Gastrointestinal problems	2	No	There is no supportive evidence that chiropractic is an effective treatment for gastrointestinal disorders.	(-)	

Proctor (2001) ³³	Any type of SM	Primary and secondary dysmenorrhoea	5	No	There is no evidence that SM is effective	(-)	Four of the five RCTs were of high velocity, low amplitude thrusts
Khorsan (2009) ⁵⁰	SM	Pregnancy and related conditions	12	No	Overall, this body of evidence is best described as emergent.	(+/-)	Limited evidence available
Reid (2005) ³⁵	Manual therapy mainly Manipulation and mobilisation	Cervicogenic dizziness	9	No	. . . there is limited evidence at present to support the use of manual therapy in treating cervicogenic dizziness	(-)	Only one of the trials was randomized
Romano (2008) ³⁴	Manual therapy	Idiopathic scoliosis	2	No	The lack of any kind of serious scientific data does not allow us to draw any conclusion on the efficacy of manual therapy as an efficacious technique for the treatment of adolescent idiopathic scoliosis.	(-)	Uncontrolled trials were included
Lisi (2005) ⁴²	Chiropractic manipulation	Lumbar disc disease	16	No	The evidence is limited, and definitive conclusions on safety and effectiveness cannot be made	(+/-)	Case reports and case series mainly
Williams (2007) ⁴⁸	SM	Psychological outcomes	12	Yes	There was some evidence that spinal manipulation improved psychological outcomes compared with verbal interventions	(+)	
Ernst (2001) ¹¹	SM	Any condition	8	No	The most rigorous of these studies suggest that SM is not associated with clinically-relevant specific therapeutic effects	(-)	Included only sham controlled, double-blind RCTs

Table 2. Conditions with multiple SRs

Condition	Conclusion		
	Positive	Negative	Neutral or unclear
Asthma		3	1
Fibromyalgia syndrome	1	1	
Headache	2	3	1
Infant colic		2	
Low back pain	3	3	1
Musculoskeletal conditions	1	1	1
Neck pain	1	3	1
Nonmusculoskeletal conditions	1	1	

Table 3. Quality ratings for included systematic reviews of spinal manipulations for any medical condition

Legend: Scoring: Each Question is Scored as 1, 0, or -1.

1 means that: (a) the review states the databases used, date of most recent searches, and some mention of search terms; (b) the review searches at least 2 databases and looks at other sources; (c) the review states the criteria used for deciding which studies to include in the overview; (d) the review reports how many studies were identified by searches, numbers excluded, and appropriate reasons for excluding them; (e) the review states the criteria used for assessing the validity of the included studies; (f) the review reports validity assessment and did some type of analysis with it; (g) the report mentions that quantitative analysis was not possible and reasons that it could not be done; (h) the review performs a test for heterogeneity before pooling or does appropriate subgroup testing, appropriate sensitivity analysis, or other such analysis; (i) the conclusions made by the author(s) are supported by the data and/or analysis reported in the review.

0 means that the above mentioned criteria were partially fulfilled.

-1 means that none of the above criteria were fulfilled.

* Operationalisation of the Oxman criteria⁵¹, adapted from reference.⁵²

Study, Year [Ref]	Search Methods? (a)	Search Comprehensive? (b)	Inclusion Criteria? (c)	Bias Avoided? (d)	Validity Criteria? (e)	Validity Assessed? (f)	Methods for Combining Studies? (g)	Appropriately Combined? (h)	Conclusions Supported? (i)	Sum
Assendelft (2004) ⁵	1	1	1	1	1	1	1	1	1	9
Astin (2002) ⁶	1	1	1	1	1	1	1	1	1	9
Balon (2004) ⁷	1	-1	-1	-1	-1	-1	-1	-1	1	-7
Brantingham (2009) ⁸	1	1	1	-1	0	0	-1	-1	-1	-1
Bronfort (2001) ⁹	1	1	1	1	1	0	1	0	1	7
Bronfort (2004) ¹⁰	1	1	1	0	1	1	1	0	0	6
Dagenais (2010) ⁴⁹	1	-1	0	1	1	1	-1	-1	0	1
Ernst (2001) ¹¹	1	1	1	1	1	1	1	-1	1	8
Ernst (2003) ¹²	1	1	1	1	1	1	1	-1	1	8
Ernst (2003) ¹³	1	1	1	1	1	1	1	-1	1	8
Ernst (2003) ¹⁴	1	1	1	1	1	1	1	-1	1	8
Ernst (2008) ⁴³	1	1	1	1	1	1	-1	-1	1	7
Ernst (2009) ¹⁵	1	1	1	1	1	1	1	-1	1	8
Ernst (2009) ¹⁶	1	1	1	1	1	1	-1	-1	1	7
Ernst (2009) ¹⁷	1	1	1	1	1	1	1	-1	1	8

Ernst (2011) ⁴⁵	1	1	1	1	1	1	1	1	-1	1	8
Fernandez-de-las-Penas (2006) ¹⁸	1	1	0	0	1	0	1	1	1	1	6
Fernandez-de-las-Penas (2005) ¹⁹	1	0	-1	-1	1	0	-1	-1	-1	-1	-3
Ferreira (2002) ¹⁹	1	1	1	1	1	1	1	1	1	1	9
Gotlib (2008) ²¹	0	0	0	0	-1	-1	-1	-1	-1	0	-4
Gross (2004) ²²	1	1	1	0	1	1	1	1	1	1	8
Gross (2010) ⁴¹	1	0	1	0	1	1	1	1	1	1	7
Hawk (2007) ²³	1	1	0	1	1	1	-1	-1	-1	-1	2
Herd (2008) ²⁴	1	1	1	1	0	0	0	0	0	0	4
Hestbaek (2010) ⁴⁶	1	0	1	-1	-1	-1	-1	-1	-1	0	-3
Hondras (2002) ²⁵	1	1	1	1	1	1	1	1	1	1	9
Hunt (2009) ⁴⁴	1	1	1	1	1	1	1	1	1	1	9
Husereau (2003) ²⁶	1	1	1	1	1	1	1	1	1	0	8
Kaminskyj (2010) ²⁷	1	1	0	-1	0	0	-1	-1	-1	0	-1
Khorsan (2009) ⁵⁰	1	1	1	1	1	0	-1	-1	-1	1	4
Lenssinck (2004) ²⁹	1	1	1	1	1	1	1	1	0	1	8
Licciardone (2005) ⁴⁰	1	1	1	0	-1	-1	1	1	1	-1	2
Lisi (2005) ⁴²	1	1	0	0	0	0	-1	-1	-1	-1	-1
McHardy (2008) ³⁰	1	1	0	0	0	0	-1	-1	-1	0	0
Posadzki (2010) ³²	1	1	1	1	1	1	1	0	0	1	8
Pribicevic (2010) ³¹	1	1	0	0	0	0	-1	-1	-1	0	0
Proctor (2001) ³³	1	1	1	1	1	1	1	1	0	1	8
Romano (2008) ³⁴	1	1	0	0	-1	-1	-1	-1	-1	0	-2
Reid (2005) ³⁵	1	1	0	0	1	1	1	1	0	0	5
Schneider (2009) ³⁶	1	1	0	0	0	0	-1	-1	-1	-1	-1
Shaw (2010) ⁴⁷	1	1	0	-1	0	-1	-1	-1	-1	-1	-3
Stuber (2008) ³⁷	1	1	0	0	0	0	-1	-1	-1	0	0
Vernon (2005) ³⁸	1	1	0	-1	0	0	0	0	0	0	1
Vernon (2009) ³⁹	1	1	0	-1	0	0	0	0	0	0	1
Williams (2007) ⁴⁸	1	1	1	1	1	1	1	1	1	1	9

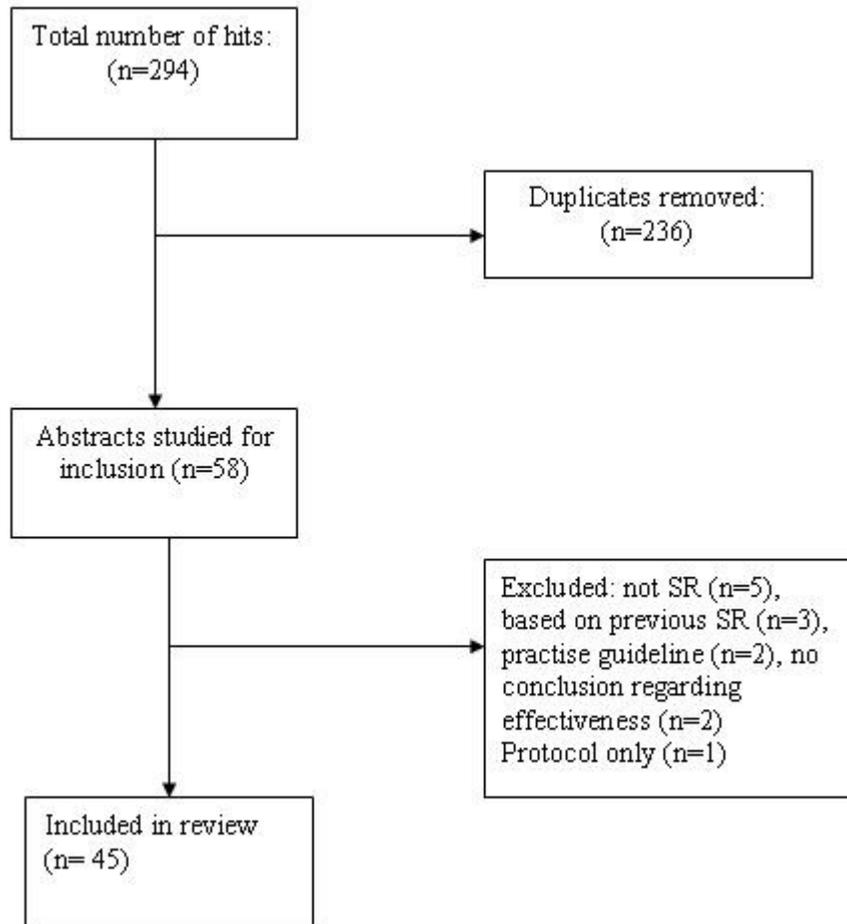
Table 4. Summary of findings

Legend: score 5–9 indicates high quality; score 4 or less indicates low quality; (-) negative; (+) positive; (+/-) equivocal

Study (year) [ref]	Published since May 2005 to January 2011	Quality of systematic review (Oxman criteria)	Chiropractors or osteopaths as 1st authors	Conclusions
Assendelft (2004) ⁵		9	No	(-)
Astin (2002) ⁶		9	No	(-)
Balon (2004) ⁷		-7	Yes	(-)
Brantingham (2009) ⁸	✓	-1	Yes	(+/-)
Bronfort (2001) ⁹		7	Yes	(+)
Bronfort (2004) ¹⁰		6	Yes	(+)
Dagenais (2010) ⁴⁹	✓	1	Yes	(+)
Ernst (2001) ¹¹		8	No	(-)
Ernst (2003) ¹²		8	No	(-)
Ernst (2003) ¹³		8	No	(-)
Ernst (2003) ¹⁴		8	No	(-)
Ernst (2008) ⁴³	✓	7	No	(-)
Ernst (2009) ¹⁵	✓	8	No	(-)
Ernst (2009) ¹⁶	✓	7	No	(-)
Ernst (2009) ¹⁷	✓	8	No	(-)
Ernst (2011) ⁴⁵	✓	8	No	(-)
Fernandez-de-las-Penas (2006) ¹⁸	✓	6	No	(-)
Fernandez-de-las-Penas (2005) ¹⁹	✓	-3	No	(+)
Ferreira (2002) ¹⁹		9	No	(-)
Gotlib (2008) ²¹	✓	-4	Yes	(+/-)
Gross (2004) ²²		8	No	(-)
Gross (2010) ⁴¹	✓	7	No	(+/-)
Hawk (2007) ²³	✓	2	Yes	(+)
Herd (2008) ²⁴	✓	4	No	(-)
Hestbaek (2010) ⁴⁶	✓	-3	Yes	(+/-)
Hondras (2002) ²⁵		9	Yes	(-)
Hunt (2009) ⁴⁴	✓	9	No	(-)

Husereau (2003) ²⁶		8	No	(-)
Kaminskyj (2010) ²⁷	✓	-1	Yes	(+/-)
Khorsan (2009) ⁵⁰	✓	4	No	(+/-)
Lenssinck (2004) ²⁹		8	No	(-)
Licciardone (2005) ⁴⁰	✓	2	Yes	(+)
Lisi (2005) ⁴²	✓	-1	Yes	(+/-)
McHardy (2008) ³⁰	✓	0	Yes	(+/-)
Posadzki (2010) ³²	✓	8	No	(-)
Pribicevic (2010) ³¹	✓	0	Yes	(+/-)
Proctor (2001) ³³		8	No	(-)
Romano (2008) ³⁴	✓	-2	No	(-)
Reid (2005) ³⁵		5	No	(-)
Schneider (2009) ³⁶	✓	-1	Yes	(+)
Shaw (2010) ⁴⁷	✓	-3	No	(+)
Stuber (2008) ³⁷	✓	0	Yes	(+/-)
Vernon (2005) ³⁸	✓	1	Yes	(-)
Vernon (2009) ³⁹	✓	1	Yes	(+)
Williams (2007) ⁴⁸	✓	9	No	(+)

Figure 1. Flowchart of eligibility assessment and inclusion



Discussion

In the last decade, dozens of systematic reviews have assessed the value of SM in a wide variety of clinical conditions. Our own SR is now out-dated,⁴ and the present article is an attempt to update it. Twenty nine SRs have been published^{8;15-19;21;23;24;27;28;30-32;34;36-49} since our previous assessment.⁴ Nine of those 29 SRs suggested that SM is effective^{8;19;23;36;39;40 48 47;49} and twenty failed to do so.^{15-18;21;24;27;28;30-32;34;37;38;41-46} Therefore, most of these SRs failed to produce convincing evidence to suggest that SM is of therapeutic value.

We have previously shown that the conclusions of SRs of SM for back pain appear to be influenced by authorship and methodological quality. Osteopaths or chiropractors tend to publish low methodological quality systematic reviews associated with positive conclusions (Table 3 and 4). Seven (38%) of the 18 SRs published either by chiropractors or osteopaths arrived at overtly positive conclusions^{8;9;23;36;39;40;49} and 11 (62%) arrived at negative or equivocal conclusions.^{7;10;21;25;27;30;31;37;38;42;46} Twenty four (88%) of the 27 SRs by independent research groups reached negative or equivocal conclusions.^{5-8;11-18;20-22;24-35;37;38;41-46} Only three (12%) arrived at positive conclusions.^{19;47;48}

The present analysis has several limitations that should be considered when interpreting its conclusions. Even though a thorough search strategy was employed, there is no guarantee that all relevant articles were located. The validity of conducting a SR of SR has its limitations; all SRs are prone to publication bias within the primary research data which they include and therefore any such bias may have been inherited in our study. Thirteen of the SR were from our unit; this fact might have introduced bias in our evaluation.

In conclusion, the notion that SM is an effective treatment option for any condition is currently not based on the evidence from rigorous SRs.

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Author information: Paul Posadzki, Honorary University Fellow; Edzard Ernst, Director; Complementary Medicine, Peninsula Medical School, Universities of Exeter & Plymouth, Exeter, UK

Correspondence: Paul Posadzki, Complementary Medicine, Peninsula Medical School, Universities of Exeter & Plymouth, 25 Victoria Park Road, Exeter EX2 4NT UK. Fax: +44 (0)1392 427562; email: Paul.Posadzki@pcmd.ac.uk

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