Conservative physical therapy management for the treatment of cervicogenic headache: a systematic review

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Purpose: The purpose of this systematic review was to assess the effectiveness of conservative physical therapy management of cervicogenic headache (CGH).

Introduction: CGH affects 2.2–2.5% of the adult population with females being four times more affected than men. CGHs are thought to arise from musculoskeletal impairments in the neck with symptoms most commonly consisting of suboccipital neck pain, dizziness, and lightheadedness. Currently, both invasive and non-invasive techniques are available to address these symptoms; however, the efficacy of non-invasive treatment techniques has yet to be established.

Methods: Computerized searches of CINAHL, ProQuest, PubMed, MEDLINE, and SportDiscus, were performed to obtain a qualitative analysis of the literature. Inclusion criteria were: randomized controlled trial design, population diagnosed with CGH using the International Headache Society classification, at least one baseline measurement and one outcomes measure, and assessment of a conservative technique. Physiotherapy evidence-based database scale was utilized for quality assessment.

Results: One computerized database search and two hand searches yielded six articles. Of the six included randomized controlled trials, all were considered to be of 'good quality' utilizing the physiotherapy evidence-based database scale. The interventions utilized were: therapist-driven cervical manipulation and mobilization, self-applied cervical mobilization, cervico-scapular strengthening, and therapist-driven cervical and thoracic manipulation. With the exception of one study, all reported reduction in pain and disability, as well as improvement in function.

Conclusion: Calculated effect sizes allowed comparison of intervention groups between studies. A combination of therapist-driven cervical manipulation and mobilization with cervico-scapular strengthening was most effective for decreasing pain outcomes in those with CGH.

Keywords: Cervicogenic headaches, Systematic review, Physical therapy management, Conservative management

Introduction

Headaches are a common condition affecting 47% of the global population,^{1,2} with cervicogenic headaches (CGHs) accounting for 15–20% of all chronic and recurrent headaches.^{3–6} CGHs affect 2.2–2.5% of the adult population^{4,7–9} and appear to affect women four times more than men.¹⁰ CGH, also referred to as occipital headaches, are the most common persistent symptom following cervical neck/spine trauma such as a whiplash injury.^{11–17}

The International Headache Society (IHS) has identified that there are 14 different types and subcategories of headache classifications.¹⁸ These headaches have been classified as either primary,

resulting from vascular or muscular origin, or secondary, which result from another source such as inflammation or head and neck injuries.¹⁸ The IHS has classified a CGH as a secondary headache¹⁸ with 'pain referred from a source in the neck and perceived in one or more regions of the head and/or face'.¹⁸ This classification has also described the pain as being unilateral⁹ or bilateral,^{19–21} affecting the head or face but has most commonly affected the occipital region,^{19,20} frontal region,^{19,22} or retro-orbital region.²³ CGH is commonly associated with suboccipital neck pain^{15,20} but can also be associated with ipsilateral arm discomfort.⁹ Other symptoms associated with CGH include dizziness,^{19,23–25} nausea,^{19,23,25} lightheadedness, inability to concentrate, retro-ocular pain, and visual disturbances.^{19,25,26}

CGHs are thought to arise from musculoskeletal impairment(s) in the neck.²⁷ These dysfunctions have

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been described as arising from the joints, muscles,²⁸ ligaments, and other soft tissues in the neck.^{29,30} Although controversy exists, several authors have agreed on the etiology of CGHs as those arising from cervical levels C3 and above,^{15,19,28,30–33} with literature supporting the primary cause as a dysfunction at the C2-3 zygapophysial joints.²⁹ Additional literature supports that CGH can arise from dysfunction of the C2-3 and C3-4 discs or facet joints^{28,34–36} as well as dysfunction of the atlantoaxial (C1-2) and atlanto-occipital (C0-1) joints.³⁷ These dysfunctions are associated with trauma^{11,12} as well as prolonged neck flexion or poor static postures.^{23,31,38} Upper cervical joint restrictions and tenderness are often present with a CGH and can be detected by a manual therapy examination.^{19,23,25,38}

Because of the various area and severity of dysfunction, there are a variety of treatment techniques that healthcare practitioners can use in the treatment of CGH. Treatments include invasive and/or non-invasive techniques.¹² The invasive treatment techniques consist of injections, dry needling, and surgery.¹² The non-invasive treatment techniques consist of transcutaneous electrical nerve stimulation (TENS),¹⁹ massage,¹⁹ exercise,^{17,19} manipulation,^{17,19,39,40} or mobilization.^{26,30,34,40} Of the non-invasive approaches, the most commonly cited in the literature are manipulation and mobilization.^{17,19,26,30,33,40} Although many treatment techniques have been presented, the most effective form of non-invasive CGH treatment has yet to be established.¹² Therefore, the purpose of this systematic review was to assess the effectiveness of various conservative physical therapy interventions in the management of CGH.

Methods

In order to provide a thorough descriptive systematic review, the PRISMA Explanation and Elaboration documentation and guidelines were used.⁴¹

Search strategy

The computerized searches were performed by two reviewers (SG and SR) through databases of

CINAHL, ProQuest, PubMed, MEDLINE, and SportDiscus. The search strategies are outlined in Table 1. Once articles were obtained, reference lists were manually searched by two reviewers (SG and SR) to identify potentially eligible publications that were not identified during the database searches. Articles reviewed were limited to the English language.

Inclusion and exclusion criteria

Studies included in this review were required to fulfill the following criteria: a randomized controlled trial (RCT), a population with diagnosed CGH using the IHS classification, at least one validated outcome measure assessed function, disability, or pain, a baseline measurement, and a conservative intervention consisting of manual therapy or exercise. Studies were excluded on the following criteria: primary focus on neck pain, a diagnosis of a migraine headache and/or tension-type headache, primary treatment of pharmacological intervention, or if the study failed to meet the minimum quality assessment score on the physiotherapy evidence-based database (PEDro) scale.

Quality assessment

The quality of the articles included in this review was assessed using the PEDro scale. The PEDro scale has been validated to measure only one construct which is the methodological quality of clinical trials.⁴² The PEDro scale has been shown to have a reliability coefficient of 0.68, which is considered to be fair to good reliability.⁴³ The authors of this systematic review utilized the quality cutoff score of fair (5/10) on the PEDro scale.

Data collection and analysis

This systematic review includes a qualitative analysis of the studies included in this manuscript. Two authors (SG and SR) independently reviewed titles, abstracts, and keywords of retrieved publications to assess eligibility. Inclusion criteria were established prior to initiating the search. Two authors (SAR and

Table 1 Results of computerized search strategies

Search terms	Results found in CINAHL	Results found in PubMed	Results found in ProQuest	Results found in MEDLINE	Results found in SportDiscus
Conservative Management AND Cervicogenic Headache	0	8	43	0	0
Conservative Management AND Cervical Headache	0	19	518	0	0
Conservative Management AND Headache	14	171	1864	89	8
Manual Treatment AND Cervicogenic Headache	0	33	113	3	1
Manual Treatment AND Cervical Headache	1	62	773	0	0
Manual Treatment AND Headache	1	238	4640	9	6
Treatment AND Cervicogenic Headache	99	419	265	164	42
Treatment AND Cervical Headache	3	1071	3370	68	20
Treatment AND Headache	3885	33 766	33 856	18 834	2029
Exercise AND Cervicogenic Headache	29	25	120	20	13
Exercise AND Cervical Headache	2	48	1043	5	1
Exercise AND Headache	290	663	7746	642	188

SD) independently reviewed each study in full text to determine inclusion. The same two reviewers independently assessed the methodological quality of all the included studies and recorded the findings. Agreement was calculated using kappa statistics.

Effect sizes were calculated by one author (SAR) and reviewed by a second author (SD). This was performed by utilizing the means and standard deviations, which were acquired through independent contact of authors or extracted from within the article. Effect sizes were used to show the magnitude of the difference or relationship between interventions within a study or across multiple studies.^{44,45}

Results

Study description and methodological quality

After a computerized search, 105 abstracts were pulled based on title (5 from SportDiscus, 13 from MEDLINE, 30 from PubMed, 7 from ProQuest, 24 from CINAHL, and 26 from hand searches). After abstract review, authors SG and SR deemed 81 of these abstracts inappropriate, leaving 24 full text articles to retrieve, review, and affirm for study inclusion. Of the 24 full text articles pulled, 18 were eliminated for reasons outlined in Table 2.^{12,27,46–61}

Kappa scores for agreement regarding both original and hand search title screening and abstract review resulted in a score of 1.00, which is considered perfect

Table 2 Rationale for excluded full text articles

Article title	Exclusion rationale
Akansha S, <i>et al.</i> 2011 ⁴⁶ •Multimodal therapy in cervicogenic headache — a randomized controlled trial	Could not acquire*
Badtke G. 1991 ⁴⁷ •The role of manual therapy in treatment of headache	Article unavailable in English language
Bender SD. 2006 ⁴⁸ •Cervicogenic headache	Unsuitable study design
Erickson D. 1964 ⁴⁹ • Conservative management of cervical syndromes	Unsuitable study design: not an RCT
Feng FL, Schofferman J. 2003 ⁵⁰ •Chronic neck pain and cervicogenic headache	Unsuitable design: article review
Haas M, <i>et al.</i> 2004 ⁵¹ • Dose response for chiropractic care of chronic cervicogenic headache and associated neck pain: a randomized controlled trial	Low quality of evidence
Haldeman S, Dagenais S. 2010 ⁵² • Choosing a treatment for cervicogenic headache: when? What? How? Much?	Unsuitable design: commentary on a randomized control trial
Jull G. 1997 ²⁷ •Management of cervicogenic headache	Unsuitable study design
Jull G. 2002 ⁵³ • Use of high and low velocity cervical manipulative therapy procedures by Australian manipulative physiotherapists	Lack of an outcome measure
McCorry P. 2000 ⁵⁴ • Headache and exercise	Could not acquire*
Rosendahl B. 1964 ⁵⁵ • Cervical headache and its treatment	Article unavailable in English language
Schoensee SK, <i>et al.</i> 1995 ¹² • The effect of mobilization on cervical headaches	Unsuitable study design
Schulman EA, <i>et al.</i> 1987 ⁵⁶ • Advances in the treatment of headache	Unsuitable design: article review
Vavrek D, <i>et al.</i> 2010 ⁵⁷ • Physical examination and self-reported pain outcomes from a randomized trial on chronic cervicogenic headache	Unsuitable study design
von Piekartz H, Ludtke K. 2011 ⁵⁸ • Effect of treatment of temporomandibular disorders in patients with cervicogenic headache: a single-blind, randomized controlled study	Unsuitable interventions
Wihlidal L. 1993 ⁵⁹ • Neck pain & headaches	Could not acquire*
Yelland M. 2003 ⁶⁰ • Manipulative therapy and a low load exercise regimen each reduced the frequency and intensity of cervicogenic headache	Unsuitable study design: commentary article
Ylinen J, <i>et al.</i> 2010 ⁶¹ • Effect of neck exercises on cervicogenic headache: a randomized controlled trial	Lacking appropriate cervicogenic headache diagnostic criteria

Note: *Could not acquire=not accessible through interlibrary loan.

Figure 1 PRISMA flowchart of inclusion.

agreement.⁶² Full text review for both original and hand search results resulted in a kappa score of 0.57, which is considered moderate agreement.⁶² As outlined in the PRISMA flow chart (Fig. 1), six of the studies met the inclusion criteria.

The six RCTs included a total of 457 participants from ages of 7–15 and 18–60 years old. Of these, 32.8% were males and 67.2% were female, and all had confirmed CGH using the IHS criteria. Table 3 summarizes the quality scores of the included studies.^{4,63–67} Methodological weaknesses were found in all studies. Specifically, two of the studies received a PEDro score of 6/10,^{4,66} two received a score of 7/10,^{64,67} and two received a score of 8/10.^{63,65} All studies were qualified as ‘good’ regarding the level of internal validity based on the PEDro score grading according to Maher *et al.*⁶⁸ The most common methodological weakness in all six studies was failure to blind therapists administering the therapy; however, due to the type of intervention being delivered manually from the practitioner, this was not feasible considering five of the RCTs performed manipulation as a treatment and one focused on self-sustained

natural apophyseal glides (SNAGs). Three RCTs^{4,64,66} failed to blind the subjects and three^{4,66,67} failed to provide point measures as well as measures of variability for one key outcome. Three^{4,66,67} failed to analyze key outcomes by ‘intention to treat’ when subjects allocated to a treatment did not receive the treatment. All RCTs reported the use of cervical manipulation or mobilization. The characteristics of the included studies are outlined in Table 4.

Outcome assessments

Outcome measures, assessed in the articles, varied depending on the domains of pain, function, and/or disability that the authors of the studies sought to report.

The outcome measures used in the studies included:

1. Headache frequency defined as the number of headache days per week,⁶⁶ the mean number of headache hours per day,^{4,67} and percent of days with headache.⁶³
2. Headache intensity which was measured using the visual analog scale.^{4,63,66,67}
3. Headache duration measured in total hours and average number of hours headaches lasted in the past week.⁶⁶

Table 3 Quality scores of included studies utilizing the PEDro scale

Task	Borusiak <i>et al.</i> ⁶³	Haas <i>et al.</i> ⁶⁴	Hall <i>et al.</i> ⁶⁵	Jull <i>et al.</i> ⁶⁶	Nilsson ⁴	Nilsson <i>et al.</i> ⁶⁷	Additional information
1. Random allocation of subjects	+	+	+	+	+	+	Randomized controlled trials and those that stated subjects were randomly assigned received a +
2. Allocation concealment	+	+	–	+	+	+	If the individual determining subject eligibility was unaware of group allocation, the study received a +
3. Similar groups at baseline	+	–	+	+	+	+	If one measure of severity of the condition and one key outcome were measured at baseline, the study received a +
4. Subjects blinded	+	–	+	–	–	+	If subjects did not know which group they were allocated to, the study received a +
5. Therapists administering treatment blinded	–	–	–	–	–	–	If therapists were not able to distinguish between treatments applied to different groups, the study received a +
6. Assessors blinded	–	+	+	+	+	+	If assessors were not able to distinguish between subjects from each group, the study received a +
7. One key outcome obtained from 85% of subjects initially allocated to groups	+	+	+	+	+	+	A statement of the number of subjects initially allocated to a group and the number of subjects from whom key outcomes were obtained (must be greater than 85%) must be included to receive a +
8. 'Intention to treat' used for analysis of one key outcome	+	+	+	–	–	–	The study must mention the use of 'intention to treat analysis' or that all subjects received treatment or control conditions as allocated to receive a +
9. Between-group statistics for one key outcome reported	+	+	+	+	+	+	Statistical comparison of one group with another must be included to receive a +
10. Point measures and measures of variability for one key outcome	+	+	+	–	–	–	A point measure such as effect size and measure of variability including standard deviations, standard errors, etc. must be included for one key outcome to receive a +
Score (∑/10)	8	7	8	6	6	7	
Internal validity	G	G	G	G	G	G	

Note: 9–10=excellent; 6–8=good; 4–5=fair; <4=poor scored as: E, G, F, P scored for low (L), moderate (M), and high (H) risk of bias.

- Headache and neck pain intensity measured by using the modified Von Korff pain scale.⁶⁴ (The modified Von Korff pain scale for CGHs is the average of three 11-point numerical rating scales: CGH pain today, worst CGH pain in the last 4 weeks, and average cervicogenic pain in the last 4 weeks.⁶⁹)
- Disability which was measured by the modified Von Korff disability scale.⁶⁴
- Flexion rotation test (FRT) measured using a modified cervical range of motion device.⁶⁵
- Headache severity measured by a headache questionnaire which was a composite score of headache intensity, frequency, and duration.⁶⁵
- Neck pain and disability which were assessed using the Northwick Park Neck Pain Questionnaire.⁶⁶
- Analgesic use, which was measured by the mean number of pain killers per day^{4,67} and percent of days needing analgesic medication.⁶³
- General health status using the physical and mental component summary scales of the SF-12.⁶⁴
- Missing school lessons secondary to headache when applicable to the population.⁶³

Effects of interventions

Manipulative/mobilization therapy; thrust and non-thrust

All of the studies included in this review, Borusiak *et al.*,⁶³ Haas *et al.*,⁶⁴ Hall *et al.*,⁶⁵ Jull *et al.*,⁶⁶

Nilsson,⁴ and Nilsson *et al.*⁶⁷ assessed the effect of manipulation or mobilization interventions on patients diagnosed with CGHs. Haas *et al.*⁶⁴ and Nilsson *et al.*⁶⁷ scored a 7/10, and Jull *et al.*⁶⁶ and Nilsson⁴ scored a 6/10 on the PEDro scale (Table 3). There was conflicting evidence regarding the effects of manipulative therapy on CGHs amongst these six studies. Haas *et al.*,⁶⁴ Hall *et al.*,⁶⁵ Nilsson *et al.*,⁶⁷ and Jull *et al.*⁶⁶ concluded that manipulative therapy was significantly effective. However; the studies by Borusiak *et al.*,⁶³ and Nilsson⁴ indicated no clinically or statistically significant differences.

Boursiak *et al.*⁶³ scored an 8/10 on the PEDro scale, and was the only study to research the efficacy of thrust cervical manipulative therapy (CMT) in children and adolescents with recurring CGH, aged 7–15 years. Outcomes measures utilized were: percentage of days with headache, duration of headache, percentage of missed school days due to headache, percentage of days where medication was needed, and intensity of headache. The authors found no statistically significant differences between the CMT group and the sham CMT group. Additionally, the calculated effect sizes for these outcome measures were as follows: percentage of days with headache (–0.02),

Table 4 Characteristics of randomized controlled trials

Country	Study participants	PEDro	Interventions	Outcome measures	Results
Germany (Borusiak et al.) ⁶³	52 participants (21M and 31F)	8/10	SMT consisting of cervical high-velocity, low amplitude lateral directed manipulation without rotation or extension (<i>n</i> =24)	Days with headache (in %)	Statistically significant differences in percentage of days with headache in both the treatment (<i>P</i> =0.009) and placebo (<i>P</i> =0.027) group at the 2-month follow-up utilizing a <i>P</i> -value of 0.05
	Age 7–15 years		Light touch to same spinal segments without thrust	Total duration of headache (in hours)	No statistically significant differences in either group in regards to other outcome measures
	Mean age: 11.6 ± 2.3 years	(<i>n</i> =28)		Days missing school lessons due to headache (in %)	No statistically differences reported between groups for any of the outcome measures
	Headache at least once a week for more than 6 months			Days with necessity of analgesics (in %)	
	Physician diagnosed cervicogenic headache			Intensity of headache (VAS/NAS)	
				Measurements assessed at baseline and at the 2-month follow-up period	
USA (Haas et al.) ⁶⁴	80 participants (16M and 64F)	7/10	Cervical and upper thoracic SMT once a week for 8 weeks with optional 5 minutes of moist heat and 2 minutes of light massage at each visit (<i>n</i> =20)	Headache pain (measured using MVK pain scale)	Statistically significant reductions in headache intensity were noted in the 16 session SMT group compared to the light massage groups at both the 12- and 24-week follow-ups
	Mean age: 36 ± 11 years		Cervical and upper thoracic SMT twice a week for 8 weeks with optional 5 minutes of moist heat and 2 minutes of light massage at each visit (<i>n</i> =20)	Headache disability (measured using MVK scales)	Statistically significant reductions in neck pain and use of over the counter medications were noted in the 16 session SMT group compared to light massage groups
	At least five cervicogenic headaches per month for 5 months		5 minutes of moist heat and 5 minutes of light massage once a week for 8 weeks (<i>n</i> =20)	Number of headaches in the past 4 weeks	While SMT groups fared better than light massage groups in all outcomes measures, statistically significant differences were only noted in the 16 session SMT group
	Had to fulfill the IHS criteria for cervicogenic headache		5 minutes of moist heat and 5 minutes of light massage twice a week for 8 weeks (<i>n</i> =20)	Neck pain (measured using MVK disability scale)	
	One chiropractor was responsible for cervicogenic headache diagnoses and participant eligibility			Neck disability (measured using MVK disability scale)	
				Over the counter medication usage (number of times in the last 4 weeks)	

Table 4 Continued

Country	Study participants	PEDro	Interventions	Outcome measures	Results
Australia (Hall et al.) ⁶⁵	32 participants (13M and 19 F)	8/10	C1–C2 SNAG using a cervical self-SNAG strap with force applied to the C1 level via horizontal pressure from the cervical strap with head movement towards restricted side ($n=16$)	Outcome measures taken at baseline and follow-ups at week 12 and week 24 Cervical FRT measured in degrees	A statistically significant increase in C1–C2 rotation was observed in the C1–C2 self-SNAG group immediately after intervention (15° increase) when compared to the placebo self-SNAG group (5° increase)
			C1–C2 self-SNAG as described above, but with no head movement (placebo) ($n=16$)	Headache severity index (measured on a 0–100 scale with larger scores indicating greater severity)	Statistically significant reductions in headache severity index score were observed in the C1–C2 self-SNAG group at both 4-week and 12-month follow-ups when compared to the placebo group
			Participants were eligible based on guidelines of the Headache Classification Subcommittee of the IHS and Cervicogenic Headache International Study Group Participants also had to exhibit a positive functional rotation test as described by Stratton and Bryan with at least a 10° reduction in rotation at C1–C2	Outcome measures were taken at baseline, and at 4-week and 12-month follow-ups	
Australia (Jull et al.) ⁶⁶	200 participants (60M and 140F)	6/10	Cervical SMT consisting of both low-velocity cervical joint mobilizations and high-velocity cervical manipulations for a total of 8–12 treatments ($n=51$)	Headache frequency (number of headache days in the past week)	Statistically significant reductions in headache intensity, frequency, and neck pain were observed in the SMT only group at week 7 compared to the control group, however at the 12-month follow-up, reductions in neck pain failed to reach statistical significance
			Low-load endurance cervico-scapular muscle exercise twice a day ($n=52$)	Headache duration (average number of hours that headaches lasted in the past week)	Statistically significant reductions in headache intensity and frequency as well as neck pain were observed in the exercise only group over the control group at both week 7 and the 12-month follow-up
			Combined SMT and cervico-scapular muscle exercise ($n=49$)	Headache intensity (rated on the VAS)	Statistically significant reductions in all outcomes measures were observed in the combined SMT and exercise group over the control group at week 7 and at the 12-month follow-up
	Mean age: 36.7 years		Control group receiving no treatment ($n=48$)	Neck pain (measured using the Northwick Park Neck Pain Questionnaire)	
	Participants had to exhibit a headache frequency of at least one headache per week over a 2-month to 10-year span				

Table 4 Continued

Country	Study participants	PEDro	Interventions	Outcome measures	Results
Denmark (Nilsson) ⁴	Participants were screened and diagnosed by their general practitioner			Outcome measures were taken at baseline, at 7 weeks (immediately after treatment), and at 3, 6, and 12 months after the intervention	
	39 participants (17M and 22F)	6/10	Cervical SMT of high-velocity, low amplitude using toggle recoil at upper cervical and chiropractor determined techniques at the lower cervical twice a week for 3 weeks (<i>n</i> =20)	Mean number of NSAIDs per day	No statistically significant reductions in outcome measures were observed post-treatment in the SMT group compared to the low-level laser/massage group
	Age: 20–57 years		Low-level laser treatment in the upper cervical region and deep friction massage (including trigger points) in the lower cervical and upper thoracic region twice a week for 3 weeks (<i>n</i> =18)	Mean headache hours per day	
	Mean age: 39 years		Drop outs (<i>n</i> =1)		
Denmark (Nilsson et al.) ⁶⁷	Participants needed to report headache ≥5 days per month for at least 3 months			Mean headache intensity per episode (measured using VAS)	
	Participants needed to fulfill the cervicogenic headache criteria of the IHS			Outcome measures were taken at baseline (week 2) and post-treatment (week 6)	
	54 participants (23M and 31F)	7/10	Cervical SMT of high-velocity, low amplitude using toggle recoil at upper cervical and chiropractor determined techniques at the lower cervical twice a week for 3 weeks (<i>n</i> =28)	Mean number of NSAIDs per day	Statistically significant reductions in headache hours per day were observed in the SMT group (5.2–2.0 mean headache hours per day) compared to the low-level laser/massage group (4.0–2.4 mean headache hours per day) at week 5
	Age: 20–60 years		Low-level laser treatment in the upper cervical region and deep friction massage (including trigger points) in the lower cervical and upper thoracic region twice a week for 3 weeks (<i>n</i> =25)	Mean headache hours per day	Statistically significant reductions in headache intensity were observed in the SMT group (44/100–28/100 mm) compared to the low-level laser/massage group (41/100–36/100 mm) at week 5
	Mean age: 37 years		Drop outs (<i>n</i> =1)	Mean headache intensity per episode (measured using VAS, 100 mm scale)	No statistically significant reduction in NSAIDs was identified between the two groups at week 5
	Participants needed to report headache ≥5 days per month for at least 3 months			Outcome measures were taken at baseline (week 1) and post-treatment (week 5)	
	Participants needed to fulfill the cervicogenic headache criteria of the IHS				

Note: M=male; F=female; SMT=spinal manipulative therapy; VAS=visual analog scale; NAS=numeric analog scale; IHS=International Headache Society; MVK=modified Von Korff; SNAG=sustained natural apophyseal glide; FRT=flexion rotation test.

duration of headache (0.10), percentage of missed school days due to headache (0.15), percentage of days where medication was needed (0.01), and headache intensity (−0.27). These values suggest that the conservative intervention had a small effect on the outcomes measured (Table 5).

Haas *et al.*⁶⁴ scored a 7/10 on the PEDro scale, and investigated the effects of two doses (eight and 16 treatment sessions) of cervical and upper thoracic manipulation in those with chronic CGH compared to a placebo group. Outcome measures were: CGH pain intensity, neck pain, neck disability, CGH disability, CGH frequency measured in a 4-week period, and over the counter analgesic use measured in a 4-week period. The manipulation had statistically significant decreases in neck disability, CGH frequency, and analgesic use with effect sizes of −0.34, −0.25, and −0.25, respectively. There were no statistically significant decreases between the manipulation and placebo groups in regards to CGH pain intensity, neck pain, and CGH disability. The corresponding effects sizes were −0.39, −0.37, and −0.39, respectively.

Hall *et al.*⁶⁵ scored a 7/10 on the PEDro scale. Their study explored the efficacy of a C1–C2 self-SNAG in relation to two CGH outcomes; CGH intensity and FRT in subjects with CGH. When compared to a placebo SNAG group, the true SNAG group displayed a statistically significant decrease in

CGH intensity and an increase in FRT range of motion. The manipulation group displayed effect sizes of −0.63 at 4 weeks and −0.67 at 12 months in regards to CGH intensity and 0.57 in regards to FRT range of motion.

Jull *et al.*⁶⁶ scored a 6/10 on the PEDro scale for their study which investigated the effects that combined cervical manipulation and mobilization would have on the four CGH outcomes: CGH frequency, CGH intensity, CGH duration, and neck pain. At 7 weeks, the manipulation group displayed statistically significant reductions in CGH frequency, intensity, and neck pain. The corresponding effect sizes were 0.71, 0.62, and 0.53, respectively. Reductions in these outcomes were statistically significant at 12 months as well. However, there was no statistically significant reduction in CGH duration at 7 weeks or at the 12-month follow-up with an effect size of 0.33 at 7 weeks. There were insufficient data available to calculate effect sizes at the 12-month follow-up.

Nilsson⁴ scored a 6/10 on the PEDro scale. This study examined patients with CGH and the effect that high-velocity, low amplitude cervical manipulation would have on: CGH hours per day, use of analgesics, or CGH intensity when compared to a placebo group. No statistically significant findings were present in the manipulation group in regards to CGH hours per day, CGH intensity, and use of

Table 5 Calculated effect size interpretation of conservative treatment groups compared to placebo/control groups on unique outcome measures

Unique outcome measures	Cervical thrust ^{4,63,67}	Cervical and upper thoracic thrust ⁶⁴	Non-thrust cervical SNAG ⁶⁵	Combination of cervical thrust and non-thrust ⁶⁶	Exercise only ⁶⁶	Cervical thrust and non-thrust techniques with exercise ⁶⁶
Days with CGH (%/days per week)	−0.02	—	—	0.71†	0.87†	0.68†
Duration of CGH (hours)	0.10*	—	—	0.33†	0.00†	0.53†
Missed school days (%)	0.15	—	—	—	—	—
Medication usage (% of days/# of times)	0.001*	−0.25	—	—	—	—
CGH intensity (VAS/NAS/MVK/ headache severity index 100% scale)	−0.27*	−0.39	−0.67	0.62†	0.72†	0.76†
CGH disability (MVK)	—	−0.32	—	—	—	—
Number of CGH (#)	—	−0.25	—	—	—	—
Neck pain (MVK/VAS/Northwick Park Neck Pain Questionnaire)	—	−0.37	—	0.53†	0.56†	0.64†
Neck disability (MVK/Northwick Park Neck Pain Questionnaire)	—	−0.34	—	—	—	—
FRT gains (°)	—	—	0.57	—	—	—

Notes: Effect sizes were rounded to the nearest hundredth and calculated utilizing the following equation: $u_1/SD_1 - u_2/SD_2$. Negative effect sizes indicate reduction in symptoms in favor of the intervention group.

CGH=cervicogenic headache; SNAG=sustained natural apophyseal glide; VAS=visual analog scale; NAS=numerical analog scale; MVK=modified Von Korff; FRT=flexion rotation test; —: outcome was not assessed.

*Effect size not calculated due to insufficient data from authors.

†Effect size pre-calculated utilizing the following equation: $(u_1 - u_2)/SD_{total}$, a more conservative calculation criteria for evaluating relative effect sizes.^{70,71}

+/-0.2=minimal effect, +/-0.5=moderate effect, +/-0.8=large effect.

analgesics. The effect sizes were unable to be calculated due to insufficient data supplied by the authors and inability to successfully contact authors for required data.

Nilsson *et al.*⁶⁷ scored a 7/10 on the PEDro scale. The purpose of this study was to determine whether high-velocity, low amplitude cervical manipulation would have an effect on: CGH hours per day, use of analgesics, or CGH intensity in a population with CGH when compared to a placebo group. The manipulation group displayed statistically significant reductions in CGH hours and CGH intensity. Concurrently, there was no statistically significant reduction in analgesic use. The effect sizes were unable to be calculated due to insufficient data supplied by the authors and inability to successfully contact authors for required data.

Therapeutic exercise

Jull *et al.*⁶⁶ was the only RCT which investigated the effects of only exercise in the treatment of CGH. The exercise-only group displayed statistically significant improvements ($P < 0.001$) at 7 weeks when compared to the control group for headache frequency, headache intensity, and neck pain, but not headache duration. Improvements in neck pain, headache frequency, and intensity were still statically significant compared to the control group at month 12. At 7 weeks, effect sizes for the exercise group were 0.87 for frequency of headache, 0.72 for intensity of headache, 0.00 for headache duration, and 0.56 for neck pain (Table 5). There were insufficient data available to calculate effect sizes at the 12-month period.

Combination treatment of thrust and non-thrust mobilization/manipulation and exercise therapy

Jull *et al.*⁶⁶ was the only RCT that studied the effects of exercise as well as thrust and non-thrust manipulation. During the seventh week of the study, the cervico-scapular exercise and manipulation group displayed statistically significant improvements in all outcome measures when compared to the control group. Additionally, statistically significant improvements persisted at the 12-month follow-up period. Effect sizes at 7 weeks were: 0.68 for frequency of headache, 0.76 for intensity of headache, 0.53 for duration of headache, and 0.64 for neck pain (Table 5). There were insufficient data available to calculate effect sizes at the 12-month period.

Discussion

The purpose of this systematic review was to assess the effectiveness of various conservative physical therapy interventions in the management of CGH. Interventions assessed included: cervical and/or upper thoracic manipulation in isolation, cervical SNAG mobilization, cervical manipulation and mobilization, and

cervical manipulation and mobilization with exercise. Based on effect sizes, the results indicate that both cervical manipulation and mobilization, along with exercise, were the most effective conservative interventions for decreasing CGH intensity, frequency, and neck pain, which is consistent with the literature.^{72,73}

One interesting finding is the lack of variety in conservative physical therapy treatment techniques. Though many other conservative treatment options are available, such as modalities, traction, and deep tissue massage, no RCTs reported the use of these conservative interventions. Of the six RCTs included in this body of literature, two had the same lead author with very similar methodologies. Five of the six included studies that utilized manipulation or mobilization as the primary conservative intervention. Additionally, only one study⁶⁶ compared exercise only to a combination of exercise with mobilization and manipulation. No other RCT studies were found to use a combination method of active strengthening with manual therapy.

Another finding of interest was that significant differences were found between the self-SNAG group and the placebo group in terms of FRT range and headache intensity. However, what is known about mobilization in general is that it produces a hypoalgesic effect thereby increasing pressure pain thresholds and reducing visual analog pain scale scores.⁷⁴ This may explain why the self-SNAG decreased headache index scores. However, it does not explain the increase in FRT ranges. Additionally, a study by Hall and Robinson⁷⁵ identified no clinical significance in cervical ROM in patients with CGH who received repeated trials of the FRT as an intervention.

The clinical importance of this systematic review is that it has provided a comprehensive review of the conservative physical therapy treatment approaches for patients diagnosed with CGH. Based on the literature, a variety of manual procedures, whether patient-driven or therapist-driven, with the combination of therapeutic exercise may improve patients' pain outcomes.⁷⁶ The current review indicates that cervical spinal manipulation is effective in the management of CGH, which is consistent with a recent literature review.⁷³ However, no studies have evaluated the difference between manipulation and mobilization for CGH. Some patient populations are not appropriate for manipulation of the cervical spine due to patient values, patient history, and/or other examination findings. Therefore, future studies should be designed prospectively to identify which approach provides better patient outcomes or recovery.

Some studies included in this review indicated statistically significant reductions in headache intensity and frequency and neck pain, with complementary

effect sizes ranging from minimal to moderate;^{64–66} whereas one⁶³ failed to reach statistical significance with less than minimal effect sizes (Table 5). Some RCTs that met the inclusion criteria for this study indicated statistically significant reductions in CGH intensity and analgesic use, but did not provide enough statistical reporting information for calculation of effect sizes.^{4,67}

Not surprisingly, a very recent systematic review⁷³ also reviewed five of the manipulation studies that met the inclusion criteria for this systematic review. There are several differences, however, in the findings from the current review to those of Chaibi and Russell.⁷³ The latter study did not capture the article by Hall *et al.*,⁶⁵ which scored well on the PEDro scale and provided useful information for CGH management utilizing a C1–C2 self-SNAG.

Due to the variety of physical therapy approaches that conservatively treat CGH, it is critical to evaluate all conservative physical therapy management techniques and review the effectiveness on patient outcomes. Table 5 summarizes the effectiveness of each intervention by reporting effect sizes, which sets this review apart from previous ones. In addition, Table 5 summarizes the variety of outcome measures used in the eligible studies.

Limitations

There are a number of limitations to this study. One limitation is that articles included in this review were limited to those published in English. Additionally, while extensive literature searches were performed, there is the possibility that not all literature was captured and that biases may have existed within the search strategy utilized. This study's external validity must be considered with caution due to variability in manual therapy technique, background/experience of clinicians, and methods of patient instruction. Additionally, many of the included articles had potential biases that may limit their external validity including a lack of strict inclusion criteria, various clinicians from different backgrounds/experience/training and observational bias. Lastly, two of the studies^{4,67} did not report specific data required to calculate effect sizes. On the other hand, the study by Jull *et al.*⁶⁶ utilized pre-calculated effect sizes that employed a more conservative approach to calculate effect size compared to the calculations used in this systematic review.

Conclusion

The results of this systematic review indicate that conservative physical therapy treatment techniques are effective interventions for decreasing CGH intensity and frequency, as well as neck pain, based on the calculated effect sizes. Additionally, a combination of thrust and non-thrust manipulation does

not appear to provide significant symptom reduction compared to exercise alone. Therefore, utilizing a combination of mobilization, manipulation, and cervico-scapular strengthening exercises to treat a patient with CGH may be the most effective intervention based on the results of this systematic review. While this finding is an important step towards determining effective treatment for patients with CGH, it is important to keep in mind that the quality of the studies in this review was 'good', but not 'excellent.'

Due to the diversity of outcome measures found in this study, the data were heterogeneous, and therefore a meta-analysis of this topic was not possible. The summative report of outcome measures presented in Table 5 is novel and should be used to guide future studies of this topic.

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