Systematic Review and Meta-Analysis

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The efficiency and safety of manual therapy for cervicogenic cephalic syndrome (CCS)

A systematic review and meta-analysis

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Abstract

Background: Manual therapy is a common technique for the treatment of (CCS) cervicogenic cephalic syndrome, but the efficiency is various. The aim of the study is to evaluate the evidence pertaining to the efficiency and safety of using manual therapy to treat patients with CCS.

Methods: We searched the electronic databases including PubMed, ScienceDirect, and the Cochrane Library. Only randomized controlled trials (RCTs) were enrolled in this systematic review and cumulative meta-analysis.

Results: A total of 8 RCTs with 395 patients were included for meta-analysis. Patients who underwent manual therapy showed lower scores of visual analog scale (VAS) (weighted mean difference) WMD = 1.7, 95% confidence interval CI = 0.74–2.65, $P = .0005$); dizziness handicap inventory (DHI) (WMD = 0.66, 95%CI = 0.31–1, $P = .0002$); and neck disability index (NDI) (WMD = 0.59, 95%CI = 0.23–0.96, $P = .002$) and better rotation range of motion (ROM) of the cervical spine (WMD = −6.54, 95%CI = −7.60 to −5.48, $P < .0001$). However, these patients did not show much benefit from manual therapy with respect to the frequency of CCS episodes and head repositioning accuracy (HRA). No serious adverse effects were reported in our included studies lasting longer than 24 hours.

Conclusions: Manual therapy offers an effective and safe approach to treat CCS with lower VAS, DHI, and NDI scores and better cervical spinal movement. Further high-quality RCTs are required to provide more conclusive evidence.

Systematic review registration number: PROSPERO172740.

Abbreviations: CCS = cervicogenic cephalic syndrome, CD = cervicogenic dizziness, CH = cervicogenic headache, CI = confidence interval, DHI = Dizziness Handicap Inventory, HRA = head repositioning accuracy, NDI = Neck Disability Index, RCTs = randomized controlled trials, ROM = range of motion, VAS = visual analog scale, WMD = weighted mean difference.

Keywords: cervicogenic cephalic syndrome, manual therapy, meta-analysis, systematic review

1. Introduction

Cervicogenic cephalic syndrome (CCS) comprises a series of diseases that are characterized by cervicogenic headache (CH) and dizziness.[1] These symptoms are associated with rotation of the head and cervical spine due to dysfunction of cervical joints and are distinguished from other types of dizziness and headache.

Hilton first reported headaches that was caused by cervical spine abnormalities in 1860. CH could account for 15% to 20% of chronic headache patients.[2,3] Cervicogenic dizziness (CD) has been reported as the secondary complication of CH. More than half of the patients with CH show CD.[4] Therefore, the term CCS was introduced to describe and emphasize the symptoms of dizziness and headache originating especially from the upper cervical spine.

Despite the existence of a debate with respect to dizziness and headache of cervical origin, increasing evidence supports the usefulness of intervention manual therapy for CCS to improve the intensity, frequency, and duration of pain and dizziness; randomized controlled trials (ROM) of the cervical spine; functional performance of daily activities; and quality of life.[5,6] We used a systematic search to analyze the available literature on manual therapy used for treating CD and CH to evaluate its efficacy and safety.

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The datasets generated during and/or analyzed during the current study are publicly available.

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2. Evidence acquisition

We designed a protocol for systematic literature search with appropriate inclusion and exclusion criteria and carried out data extraction, quality assessment, and statistical analysis according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.

2.1. Systematic literature search

We conducted a systematic literature search from January 2019 to June 2019 without any restriction on publication type, region or language. The electronic databases including PubMed, Science Direct, and the Cochrane Library were considered as the primary sources. The following MeSH terms and their combinations were used to search included synonyms and related variants of disease such as [Title/Abstract]: cervicogenic dizziness/cervicogenic headache and manual therapy/chiropractic. When multiple reports were published for the same population, the most complete or most recent publication was considered.

2.2. Inclusion and exclusion criteria

The inclusion criteria were randomized controlled trials (RCTs) that referred to CD and/or CH treated by manual therapy and the reported quantitative outcomes regarding the effectiveness and safety before and after treatment. All review articles, case reports, meeting abstracts letters to the editor, and animal experimental studies were excluded.

2.3. Data extraction

Two authors (JX and CWJ) independently extracted and summarized data from the enrolled studies. Any disagreement was settled by DHG, a senior author.

The primary outcomes were frequency of episodes and VAS scores. If sufficient data were available in our study, we subdivided the VAS scores into pain and dizziness and frequency, as well, into dizziness and headache.

The secondary outcomes were ROM of the cervical spine, head repositioning accuracy (HRA), and dizziness handicap inventory (DHI) and neck disability index (NDI) scores. The ROM of the cervical spine was measured in 6 directions: extension, flexion, left rotation, right rotation, left lateral flexion, and right lateral flexion. HRA was also subdivided into left and right rotation.

2.4. Quality assessment and statistical analysis

The methodological quality of included RCTs was assessed using the Cochrane risk of bias tool.[7] All RCTs with 5 or more "low

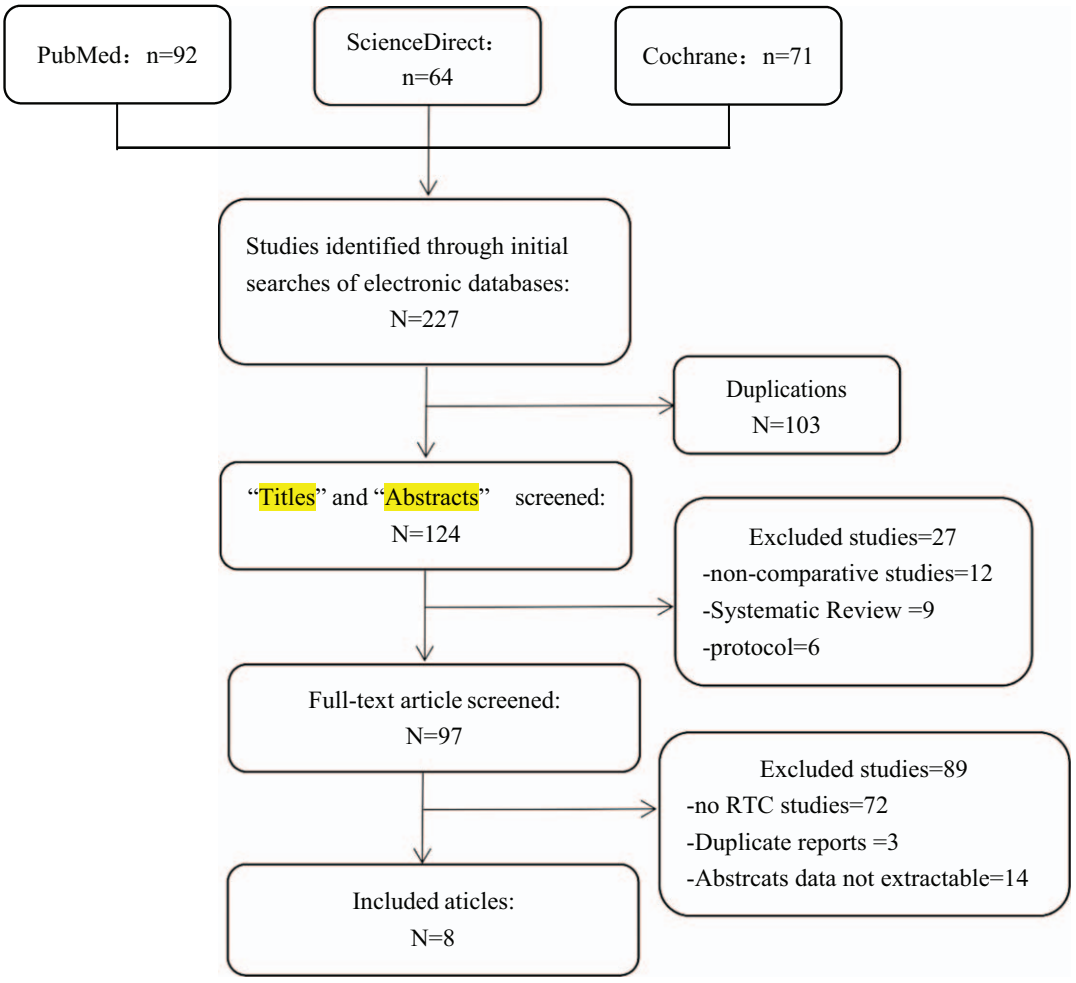

Figure 1. Flow diagram of studies selection.

Table 1

Characteristics of eligible studies.

Study	Level of evidence	Patients		Intervention		Baseline	Follow-up (months)
		Control	Experiment	Control	Experiment		
Chaibi et al[6] 2017	Level 2	4	4	P	MT	1,2,3,4,5	12 m
Gema et al[9] 2013	Level 2	6	7	Sham	MT	1,2,3,4,5,6	NA
Gwendolen et al.[10] 2002	Level 2	48	51	P	MT	1,2,3,4,5,6,7,8,	12 m
Julie et al[11] 2018	Level 2	10	12	Sham	MA	1,2,9,10,11,12,13	NA
Miguel et al[12] 2017	Level 1	41	41	Sham	MA	1,2,5,14,15	NA
Reid et al[13] 2014	Level 1	28	29	P	CM	1,2,3,4,5	NA
Reid et al[5] 2015	Level 2	28	29	P	CM	1,2,3,4,5,6	12 m
Reid et al[14] 2014	Level 2	28	29	P	CM	1,2,3,4,5	3 m

1 = gender, 2 = age, 3 = frequency, 4 = duration, 5 = intensity, 6 = pain history, 7 = trauma, 8 = medication pretreatment, 9 = cognitive function, 10 = dizziness, 11 = concerns of falling, 12 = mood, 13 = physical function, 14 = height, 15 = weight.

CM = cervical mobility, P = placebo, sham = same position but without treatment, MT = manual therapy, NA = data not available, MA = multimodal approach.

risk" were defined as high quality. Data were analyzed using Review Manager 5.3 (Cochrane Collaboration, Oxford, UK). Weighted mean difference (WMD) was used to compare continuous variables and 95% confidence intervals (CIs) were used to present the results. If studies presented data as range values and means, the statistical analysis technique described by Hozo[8] was used.

Statistical heterogeneity among studies was assessed by using the Chi-Squared test with significance set at $P < .10$ and quantified using the I^2 test. In case of heterogeneity, the random-effects model was used; otherwise, the fixed-effects model was used.

3. Evidence synthesis

Eight studies including 395 subjects (202 patients and 193 controls) met the predefined inclusion criteria and were considered for analysis (Fig. 1). Agreement between the 2 reviewers was 95% for quality assessment and 92% for study selection.

3.1. Characteristics of eligible studies (Table 1)

Of the 8 included RCTs, 6 used manual therapy (high-velocity, low-amplitude techniques) or mobilization (low-velocity, low-amplitude techniques) as the intervention. The remaining 2 RCTs used multimodal approach such as instrument-assisted manipulation and pressure on the active trigger point. All studies used sham or placebo as the control group.

3.2. Methodological quality of included studies

Methodological quality of the included studies is shown in Figure 2. The quality of enrolled studies, assessed with the Cochrane risk of bias tool, was low. Two out of the 8 studies[12,13] adopted an appropriate protocol before RCTS. The physical therapist was not blinded to the patients' conditions in any study. More than one-third of the participants dropped out in 1 study and subsequently, did not undergo intention-to-treat (ITT) analysis in 1 study.[6] The sample sizes of the included studies ranged from 8 to 99 and was relatively inadequate. None of the studies mentioned the follow-up duration more than12 months, and most studies only offered the data after completion of treatment

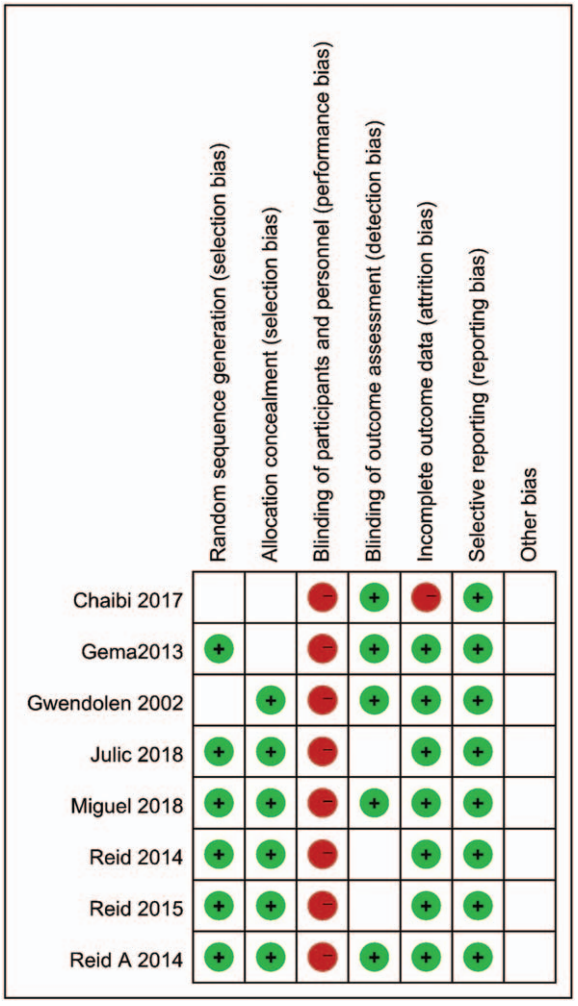

Figure 2. Methodological quality of included studies (green = low risk red = high risk, bland = unclear).

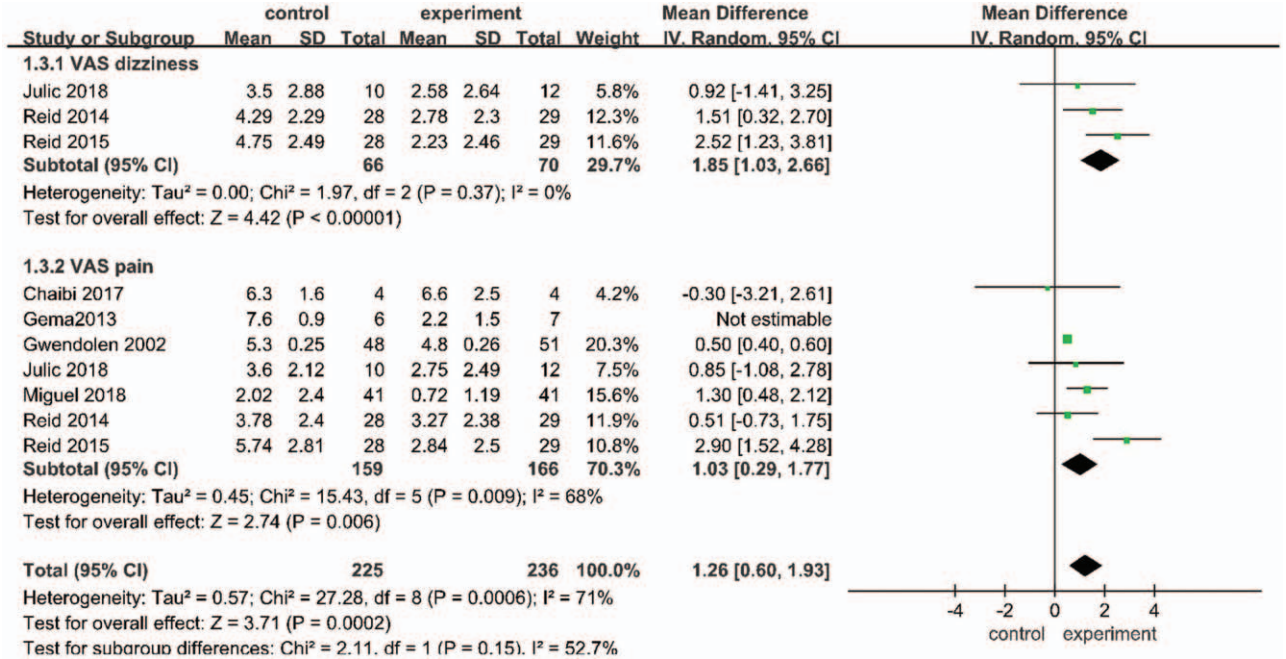

Figure 3. Forest plot and meta-analysis of VAS.

3.3. Primary outcomes

3.3.1. Visual analog scale (VAS). Five studies reported the VAS score on a scale of 1 to 10, and another 2 studies initially reported the VAS score on a scale of 1 to 100 which was eventually changed to a 1 to 10 scale for the sake of comparison. The data from 7 out of 8 studies that assessed VAS scores in 338 patients showed significant differences between the control and patient groups (WMD = 1.70, 95%CI = 0.74–2.65, $P = .0005$). Dizziness VAS and headache VAS were available for 3 studies and 7 studies, respectively, which showed significant intergroup differences (WMD = 1.85, 95%CI = 1.03–2.66, $P < .0001$ and WMD = 1.68, 95%CI = 0.44–2.92, $P = .008$), respectively (Fig. 3 and Table 2).

3.3.2. Frequency. Two and 3 studies mentioned the frequency of dizziness and headache, respectively; there were no significant

Table 2

Outcomes of the meta-analysis.

Outcomes	Study number	Patients		WMD	*P* value	Study heterogeneity			
		Control	Experiment			x^2	df	I^2, %	*P* value
Primary outcomes									
VAS	7	165	173	1.7[0.74, 2.65]	.0005	78.68	9	89	<.0001
Pain	7	165	173	1.68[0.44, 2.92]	.008	67.23	6	91	<.0001
Dizziness	3	66	70	1.85 [1.03, 2.66]	<.0001	1.97	2	0	.37
Secondary outcomes									
DHI	3	66	70	0.66 [0.31, 1.00]	.0002	3.65	2	45	.16
NDI	2	58	63	0.59 [0.23, 0.96]	.002	0.28	1	0	.6
Frequency	5	114	120	0.01 [−0.25, 0.27]	.93	9.9	4	60	.04
Pain	3	58	62	−0.33 [−0.69, 0.03]	.07	0.49	2	0	.78
Dizziness	2	56	58	0.38 [0.00, 0.75]	.05	2.29	1	56	.13
ROM	4	103	106	−6.54 [−7.60, −5.48]	<.0001	37.58	23	39	.03
Flexion	4	103	106	−7.36 [-10.11, −4.61]	<.0001	5.49	3	45	.14
Extension	4	103	106	−8.36 [−11.60, −5.13]	<.0001	5.30	3	43	.15
LR	4	103	106	−8.31 [−11.09, −5.52]	<.0001	1.4	3	0	.71
RR	4	103	106	−7.70 [−10.26, −5.13]	<.0001	5.81	3	48	.12
LLF	4	103	106	−5.23 [−7.41, −3.04]	<.0001	4	3	25	.26
RLF	4	103	106	−4.14 [-6.56, −1.73]	.0008	6.53	3	54	.09
HRA	2	56	58	−0.82 [-1.72, 0.08]	.07	3.17	3	5	.37
LR	2	56	58	−1.03 [−2.32, 0.26	.12	0.09	1	0	.09
RR	2	56	58	−0.61 [−1.87, 0.64]	.34	2.87	1	65	.76

DHI = dizziness handicap inventory, HRA = head repositioning accuracy, LLF = left lateral flexion, LR = left rotation, NDI = neck disability index, RLF = right lateral flexion, ROM = range of motion, RR = right rotation, WMD = weighted mean difference.

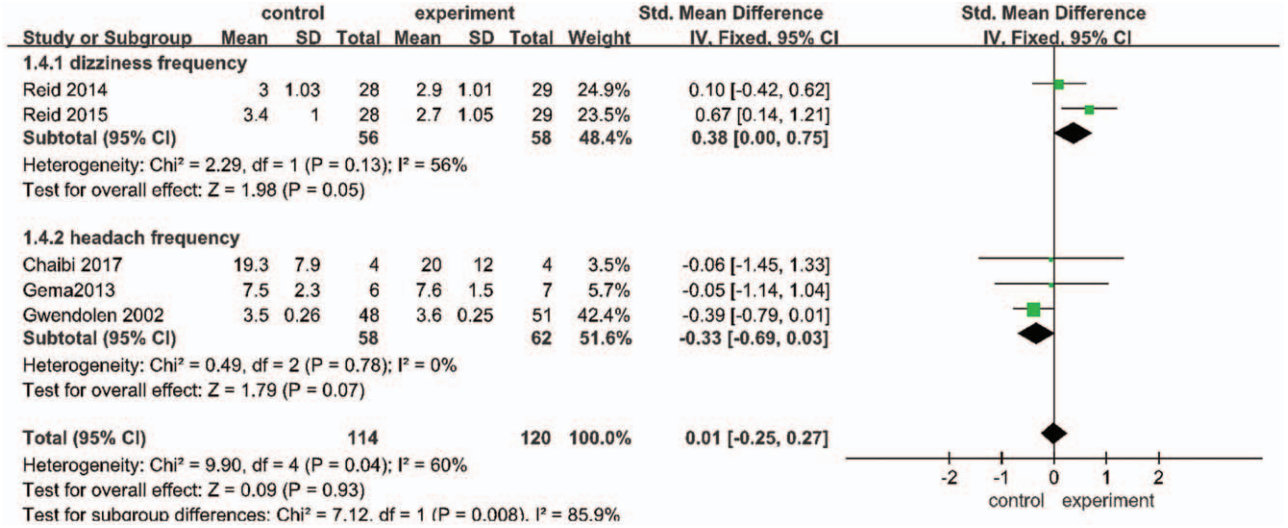

Figure 4. Forest and meta-analysis of frequency.

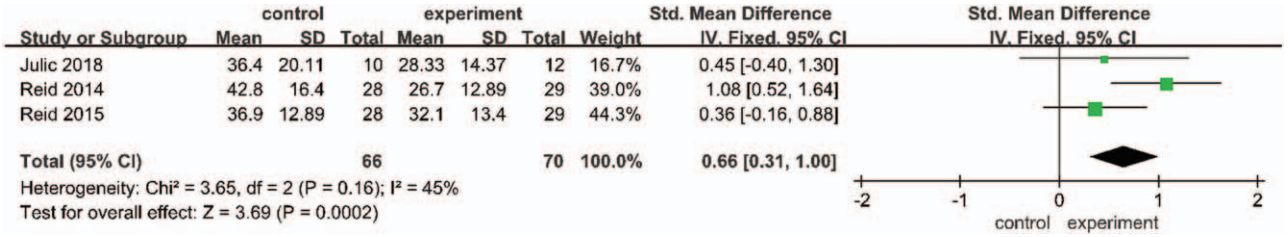

Figure 5. Forest plot and meta-analysis of DHI.

intergroup differences (WMD = 0.38, 95%CI = 0.00–0.75, P = .05 and WMD = −0.33, 95%CI = −0.69 to 0.03, P = .07) (Fig. 4 and Table 2).

3.4. Secondary outcomes

3.4.1. DHI and NDI. The reliability and validity of the DHI and NDI scales to measure the multifaceted impact of spinal disease on patient functionality and quality of life have been well established. No significant differences were found in the control group compared with the experiment group with respect to both DHI and NDI (WMD = 0.66, 95%CI = 0.31–1.00, P = .0002 and WMD = 0.59, 95%CI = 0.23–0.96, P = .002) (Figs. 5 and 6, Table 2).

3.4.2. ROM of the cervical spine. Data from 4 studies that measured ROM of the cervical spine after treatment showed significant intergroup differences (WMD = -6.54, 95%CI = −7.60 to −5.48, P < .0001). When the ROM of the cervical spine was further classified into 6 directions, the significant intergroup differences persisted (Fig. 7 and Table 2).

3.4.3. HRA. Analysis of HRA showed no significant intergroup differences (WMD = −0.82, 95%CI = −1.72 to 0.08, P = .07). There were no differences even after dividing the HRA into left and right rotation (Fig. 8 and Table 2).

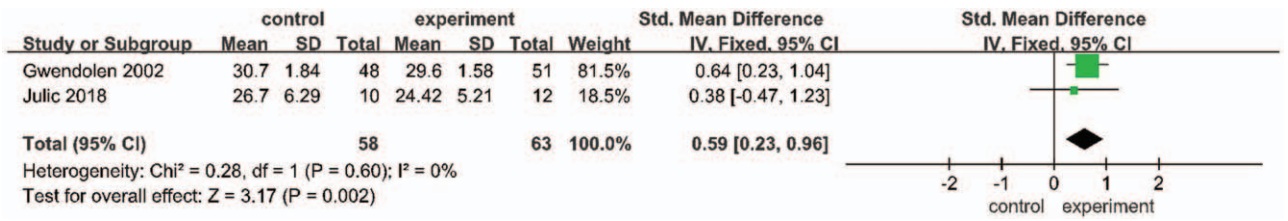

Figure 6. Forest plot and meta-analysis of NDI.

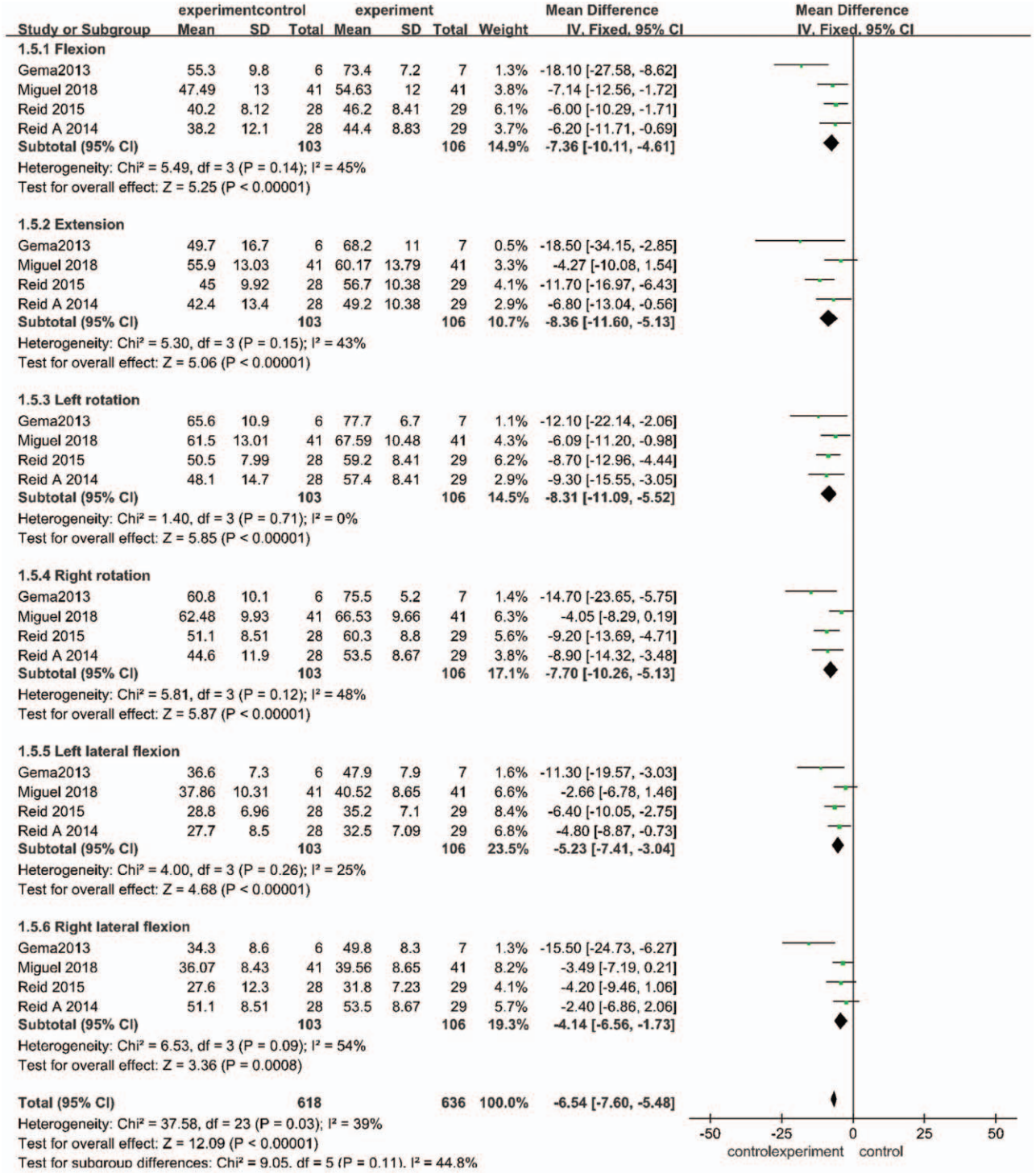

Figure 7. Forest plot and meta-analysis of ROM of the cervical spine.

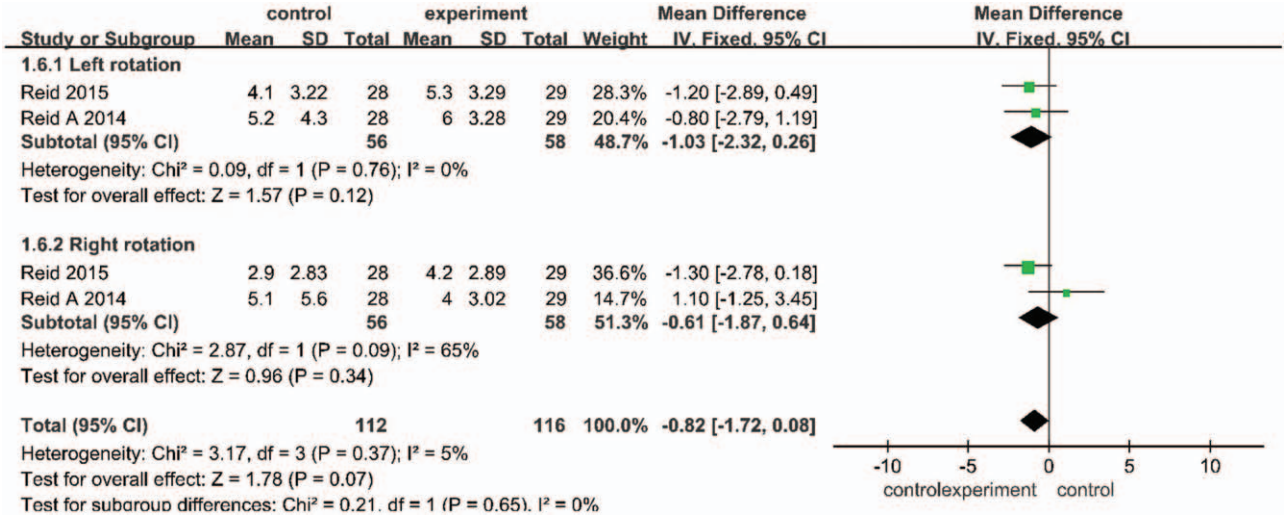

Figure 8. Forest plot and meta-analysis of HRA.

3.5. Adverse effects

Only 2 studies[6,11] reported mild adverse events such as transient increases in dizziness and headache, which was considered common with manual therapy.

3.6. Publication bias

The VAS of headache and dizziness from all studies included in this meta-analysis are indicated in funnel plots (Fig. 9). Although the distribution was uneven around the vertical axis, most of the points were within the 95% CI threshold, thus suggesting no obvious publication bias.

3.7. Discussion

The results of our meta-analysis of 8 RCTs (n = 395 subjects) treated with manual therapy for CD and CEH showed that it was both effective and safe, with significantly reduced scores of VAS, DHI, and NDI and improved ROM of the cervical spine. We found no significant differences in HRA and the frequency of dizziness and headache.

Pain and/or dizziness were the leading symptoms for which patients sought help from a physical therapist, and our primary treatment goal was improvement of pain and/or dizziness. The VAS score data indicate that manual therapy helped alleviate both these symptoms. It has been reported that abnormal proprioceptors could cause a loss of normal afferent input resulting in pain or dizziness.[15] In fact, the upper cervical muscles and joints showed an abundance of proprioceptors and were extremely well developed as compared to in other parts of the body.[16] Hence, the main focus of therapy was to improve zygapophyseal joint function and alleviate muscle spasms in the upper cervical spine.[17]

DHI and NDI are used for quantitative evaluation of the impact of dizziness and headaches in daily life, which includes not only the physical symptoms but also the emotional and functional quotients.[18] Patients showed lower DHI and NDI scores than the controls, indicating that manual therapy was multi-targeting. The efficiency of manual therapy was associated with the regulation of the central nervous system. The functional brain regions referring to the regulation of emotion and analgesia were altered after treatment.[19] It is plausible that pain or dizziness is also related to anxiety, depression, and frustration, which could be reduced after manual therapy.

The ROM of the cervical spine had a functional impact on the daily activities; accordingly, several studies have used it as a parameter of treatment outcome. There was significant difference in patients' ROM of the cervical spine in all directions compared with the controls. Brooks et al[20] reported that isometric muscle strength could be immediately acquired after treatment and was regarded as recovery from fatigue. This could likely be the mechanism of improving ROM of the cervical spine in all directions after treatment. There were no obvious differences in HRA with respect to the frequency of dizziness and headache.

A limitation of our meta-analysis is the possible selection bias inherent in the included studies. More data from well-designed RCTs will be needed in future to validate these findings.

No serious adverse effects were reported in our included studies. These do not appear to be minor adverse effects, even if they did resolve by 24 hours. But Gergen and Jeong[21,22] reported infarction of the posterior inferior cerebellar artery and mild traumatic brain injury (mTBI) which occurred likely because of shedding of the thrombus after manual therapy. Therefore, it is essential for the physical therapist to evaluate the risks before initiating treatment.

4. Conclusions

This meta-analysis showed that manual therapy could be associated with lower scores of VAS, DHI, and NDI and better cervical spinal movement. However, HRA and the frequency of dizziness and headache seem to be similar in both controls and patients with CD and/or CH. Nonetheless, despite our rigorous methodology, we were unable to draw definitive conclusions owing to the inherent limitations of the included RCTs. Therefore, well-designed RCTs with long-term follow-up evaluation are essential to validate our analysis in the future.

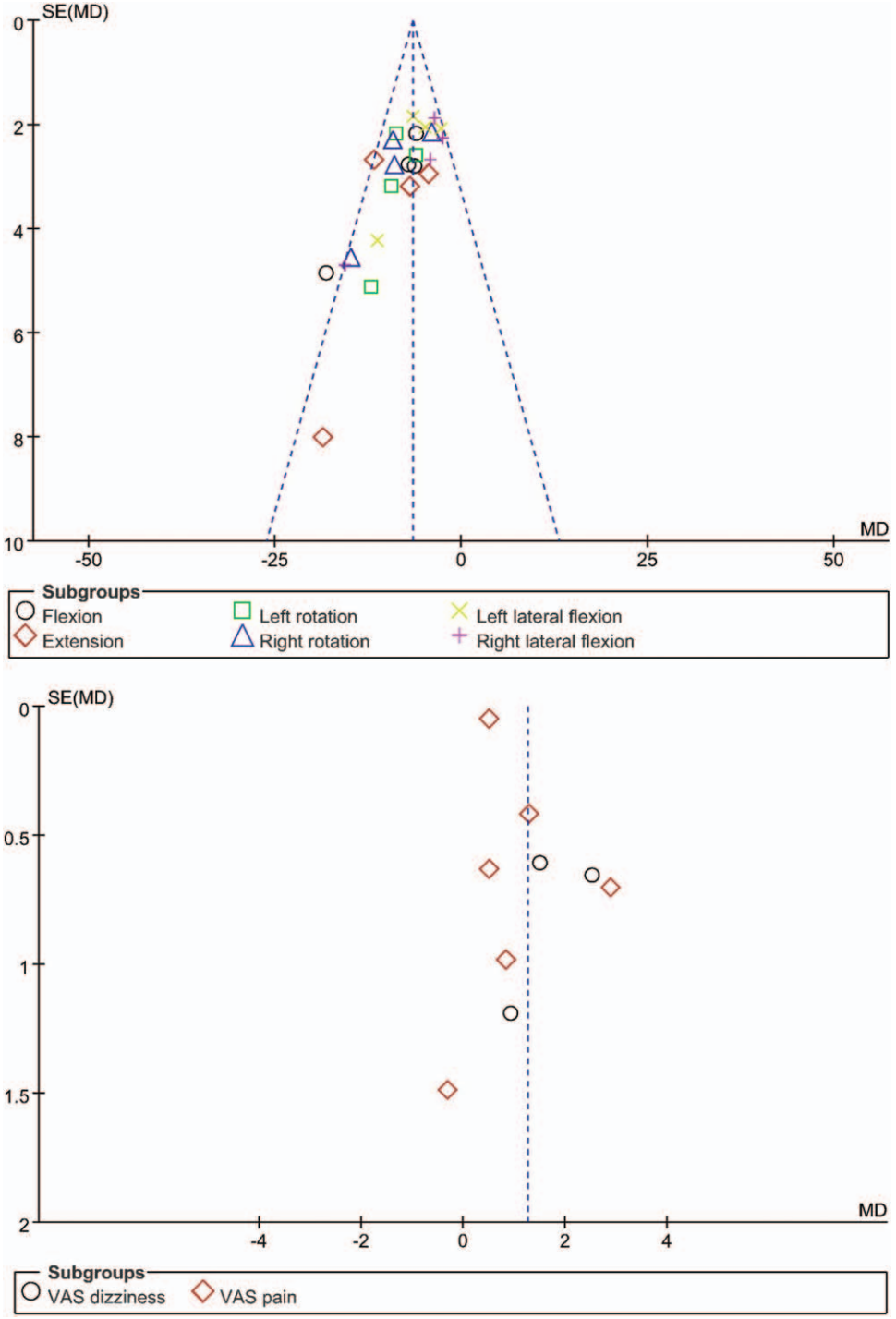

Figure 9. Funnel plots depicting the meta-analysis of ROM of the cervical spine and VAS.

Author contributions

Conceptualization: Hong-Gen Du.
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Methodology: Qin Huang.
Project administration: Wen-Jun Chen.
Software: Zu-Kang Qiao.
Supervision: Wen-Jun Chen.
Writing – original draft: Xin Jin.
Writing – review & editing: Xin Jin.

References

[1] Lin Y, Lai C, Chang W, et al. Immediate effects of ischemic compression on neck function in patients with cervicogenic cephalic syndrome. J Manip Physiol Ther 2012;35:301–7.

[2] Tambawala SS, Karjodkar FR, Sansare K. Prevalence of ponticulus posticus on lateral cephalometric radiographs, its association with cervicogenic headache and a review of literature. World Neuro Surg 2017;103:566–75.
[3] Haldeman S, Dagenais S. Cervicogenic headaches: a critical review. Spine J 2001;1:31–46.
[4] Thompson-Harvey A, Hain TC. Symptoms in cervical vertigo. Laryngoscope investigative otolaryngology 2018;4:109–15.
[5] Susan A. Reid MMedSc Phty BPGBManual therapy for cervicogenic dizziness long-term outcomes of a randomised trial. Manual Ther 2015; 20:148–56.
[6] Chaibi A, Knackstedt H, Tuchin PJ, et al. Chiropractic spinal manipulative therapy for cervicogenic headache: a single-blinded, placebo, randomized controlled trial. BMC Res Notes 2017;10:1–8.
[7] Cumpston M, Li T, Page MJ, et al. Updated guidance for trusted systematic reviews: a new edition of the Cochrane handbook for systematic reviews of interventions. Cochrane database of systematic reviews 2019;10:142.
[8] Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. BMC Med Res Methodol 2005;5:13.
[9] Bodes-Pardo G, Pecos-Martín D, Gallego-Izquierdo T, et al. Manual treatment for cervicogenic headache and active trigger point in the sternocleidomastoid muscle: a pilot randomized clinical trial. J Manip Physiol Ther 2013;36:403–11.
[10] Jull G, Trott P, Potter H, et al. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. Spine 2002;27: 1835.
[11] Kendall JC, French SD, Hartvigsen J, et al. Chiropractic treatment including instrument-assisted manipulation for non-specific dizziness and neck pain in community-dwelling older people: a feasibility randomised sham-controlled trial. Chiropr Man Therap 2018;26:11–4.
[12] Malo-Urriés M, Tricás-Moreno JM, Estébanez-de-Miguel E, et al. Immediate effects of upper cervical translatoric mobilization on cervical mobility and pressure pain threshold in patients with cervicogenic headache: a randomized controlled trial. J Manip Physiol Ther 2017;40:649–58.
[13] Reid SA, Phty M, Robin Callister P. Effects of cervical spine manual therapy on range of motion, head repositioning, and balance in participants with cervicogenic dizziness: a randomized controlled trial. Arch Phys Med Rehab 2014;95:1603–12.
[14] Susan A, Reid DARM. Comparison of mulligan sustained natural apophyseal glides and maitland mobilizations for treatment of cervicogenic dizziness: a randomized controlled trial. Phys Ther 2014; 94:466–76.
[15] Reid SA, Rivett DA. Manual therapy treatment of cervicogenic dizziness: a systematic review. Manual Ther 2005;10:4–13.
[16] Peng B. Cervical vertigo: historical reviews and advances. World Neuro Surg 2018;109:347–50.
[17] Mohamed AA, Shendy WS, Semary M, et al. Combined use of cervical headache snag and cervical snag half rotation techniques in the treatment of cervicogenic headache. J Phys Ther Sci 2019;31:376–81.
[18] Micarelli A, Viziano A, Augimeri I, et al. Diagnostic route of cervicogenic dizziness: usefullness of posturography, objective and subjective testing implementation and their correlation. Disabil Rehabil 2019;1–8.
[19] Qiumao H, Jiajie L, Jiayou Z, et al. A study on the characteristics of intracerebral information response in the treatment of cervical dizziness and headache with traditional Chinese medicine massage. Chin Manipul Rehabil Med 2019;21:19–24.
[20] Brooks CP, Woodruff LD, Wright LL, et al. The immediate effects of manual massage on power-grip performance after maximal exercise in healthy adults. J Altern Complement Med 2005;11:1093–101.
[21] Gergen DM. Management of mild traumatic brain injury symptoms in a 31-year-old woman using cervical manipulation and acupuncture: a case report. J Chiropr Med 2015;14:220–4.
[22] Jeong DK, Hwang S. A case of posterior inferior cerebellar artery infarction after cervical chiropractic manipulation. Korean J Neurotrauma 2018;14:159.