

CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

In a 64-year-old woman with chronic cervicogenic dizziness/headache, is active exercise such as cervical spine AROM exercise/stretching exercise more effective than passive treatment such as manual therapy for reducing symptoms of dizziness (e.g. DHI) / headache (e.g. pain scale)?

AUTHOR

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CLINICAL SCENARIO

I received a 64-year-old woman diagnosed with cervical radiculopathy and tension headache. The patient complained of dizziness and headache more than neck pain. Potential serious conditions (i.e. red flag) and vestibular impairments had ruled out, so dizziness and headache originating from cervical spine are considered as her impairments and interventions for cervical spine were mainly provided. However, the outcome was not favourable particularly after manual therapy intervention, although I considered that manual therapy was indicated based on high irritability of dizziness and headache.

Cervicogenic dizziness is defined as "non-rotatory dizziness described as unsteadiness that is associated with neck pain and/or stiffness is triggered by cervical movements or positions".⁶ It is reported as 7.5% of all dizziness.⁷ Cervicogenic headache is defined as "pain referred from a source in the neck and perceived in one or more regions of the head and/or neck".⁴ It accounts for 15-20% of all chronic and recurrent headache and affects 2.2-2.5% of the adult population.⁴ Physical therapy interventions for the cervical spine are considered to be effective to reduce symptom of dizziness and headache. I usually provide both manual therapy and therapeutic exercise in these populations when indicated because I believe that both interventions are effective and multimodal approach is superior than single intervention for most cases. However, this particular patient was able to tolerate active therapeutic exercises but not manual therapy, so I wondered if there is superiority between intervention types or actually combination of the interventions is the best effect for such patient.

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

- In 57 studies which met inclusion/exclusion criteria, 8 studies are selected based on quality of evidence and relevance to the clinical question. In the 8 studies, 2 studies are systematic reviews and 6 are randomized controlled trials, 4 studies are about cervicogenic headache and 4 are cervicogenic dizziness.
- Some types of manipulation/mobilization approaches, therapeutic exercise, and combination of both provide more than moderate effect in reduction of headache.⁴ The combination of manual therapy and self-exercise is more effective than control group in improvement of symptom of dizziness.⁶ In both studies regarding to headache and dizziness, there are no statistical group difference found between intervention groups (i.e. manual therapy vs. exercise). It is recommended to provide the combination of manual therapy and exercise therapy as it appears to have favourable clinically important outcome.
- Future research about the effectiveness of therapeutic exercise, self-exercise, and combination of manual therapy and exercises is necessary to conduct another systematic review and to help clinicians to determine which therapeutic approach is the more effective in this type of population.

CLINICAL BOTTOM LINE

The current evidence suggests that physical therapy intervention including manual therapy, therapeutic exercises, and combination of them are effective to improve symptoms of dizziness and headache. There are no studies provide evidence of superiority of any specific treatment approach, but multimodal approach with manual therapy and exercise therapy is recommended to treat cervicogenic dizziness and headache.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

The above information should fit onto the first page of your CAT

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	Intervention (or Assessment)	Comparison	Outcome(s)
cervicogenic dizziness	“range of motion”	“manual therapy”	“Dizziness Handicap Inventory” (DHI)
cervical dizziness	stretch*	mobilization	“Visual Analogue Scale”
cervicogenic vertigo	strength*	mobilisation	“headache scale”
cervical vertigo	exercis*	manipulation	
cervicogenic headache			
cervical headache			

Final search strategy (history):

Show your final search strategy (full history) from PubMed.

The PubMed Search History

Search	Add to builder	Query	Items found
#11	Add	Search (#9 AND #10)	54
#10	Add	Search ("randomized controlled trial"[Publication Type] OR "review"[Publication Type] OR "meta analysis"[Publication Type])	2795587
#9	Add	Search (#7 NOT #8)	113
#8	Add	Search (sport OR concussion)	271088
#7	Add	Search (#1 AND #2 AND #3 AND #4)	131
#6	Add	Search (#1 AND #3 AND #4)	432
#5	Add	Search (#1 AND #2 AND #4)	421
#4	Add	Search ("Dizziness Handicap Inventory" OR "Visual Analogue Scale" OR "pain" OR "headache scale")	641412
#3	Add	Search ("manual therapy" OR mobilization OR mobilisation OR manipulation)	7276956
#2	Add	Search ("range of motion" OR stretch* OR strength* OR exercis*)	770778
#1	Add	Search ((cervicogenic OR cervical) AND (dizziness OR vertigo OR headache))	9367

In the table below, show how many results you got from your search from each database you searched.

Databases and Sites Searched	Number of results	Limits applied, revised number of results (if applicable)
PubMed	113	54 – limits search with publication types (“RCT”, “review”, and “meta-analysis”)
CINAHL	112	19 – limits search with publication types (“RCT”, “SR”, and “meta-analysis”)
Web of Science	104	74 – limits search with document type (“article”) and language (“English”)

After the three databases search above, all the revised number of results are combined and overlapped results between databases are eliminated. The total number of results are 117 before the inclusion and exclusion criteria are applied.

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
<ul style="list-style-type: none"> The subject of research is associated with population of interest (i.e. cervicogenic dizziness and cervicogenic headache). The researches in tension-type headache and Migraine headache are included when cervical spine is intervened. The study used physical therapy-related interventions (e.g. AROM ex, stretching, strengthening, manual therapy, modalities, chiropractic) The outcome of intervention is associated with dizziness/vertigo, headache, and/or other specific assessment done in this population of interest (e.g. cervical proprioception). Heterogenic study (e.g. neck pain) is included only when the population of interests are separately studied and mentioned in the study.
Exclusion Criteria
<ul style="list-style-type: none"> The subject of research is NOT related to population of interest (e.g. temporomandibular joint disorder, central nervous system impairments, vestibular impairments, cervical artery dissection/insufficiency, post-surgical conditions). Intervention is not provided (e.g. study about screening and examination). Protocol of randomized control trial is excluded when the data of outcome is lacking. Article of concept of intervention Abstracts, conference proceedings, letters to the editor, dissertations, narrative review articles Not published in English

After both inclusion and exclusion criteria are applied, the number of selected studies are 57.

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
Dunning et al. (2016) ¹	PEDro – 8/11	Level 1b	High	RCT
Jull et al. (2002) ²	PEDro – 8/11	Level 1b	High	RCT
Luedtke et al. (2016) ³	AMSTAR- 10/11	1a	Moderate	systematic review & meta-analysis
Racicki et al (2013) ⁴	AMSTAR- 8/11	1a	High	systematic review
Reid et al. (2014) ⁵	PEDro – 10/11	Level 1b	Moderate	RCT
Reid et al. (2015) ⁶	PEDro – 10/11	Level 1b	High	RCT
Reid et al. (2014) ⁷	PEDro – 10/11	Level 1b	High	RCT
Treleaven et al. (2016) ⁸	PEDro – 6/11	Level 1b	Moderate	RCT

*Indicate tool name and score

**Use Portney & Watkins Table 16.1 (2009); if downgraded, indicate reason why

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- **Racicki (2013)** – This systematic review is considered the most relevant to the proposed clinical question regarding to cervicogenic dizziness as it compares different intervention approaches including manual therapy and active exercises. Although the risk of bias is rated as 8/11 by AMSTAR which might be higher than the other selected study, this is the highest quality of evidence (1a). The study by Jull et al² could be another study to be selected, but it is included in this systematic review and considered as more relevant and comprehensive.
- **Reid SA (2015)⁶** - This is a randomized controlled trial which directly compares different interventions (Mulligan versus Maitland mobilization with exercise) in terms of influence on dizziness as asked in the proposed question. The level of evidence (1b) and risk of bias (10/11 by PEDro) is good enough to be considered as best evidence compared with other studies.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of "Conservative Physical Therapy Management for the Treatment of Cervicogenic Headache: A Systematic Review." By Racicki et al., 2013⁴

Aim/Objective of the Study/Systematic Review:

The purpose of this systematic review is to assess the effectiveness of several types of conservative interventions used by physical therapist and to establish evidence of the most effective form of conservative management for the treatment of cervicogenic headache.

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

- **Study Design:** A systematic review of randomized controlled trials. This review follows the PRISMA Explanation and Elaboration documentation and guideline.
- **Search Strategy:** A literature search is performed through CINAHL, ProQuest, PubMed, MEDLINE, and SportDiscus. The search terms used are the combinations of the following keywords: "conservative management", "manual treatment", "treatment", "exercise", "cervicogenic headache", "cervical headache", "headache".
- **Section Criteria:** Two authors (SG and SR) of this study obtain articles from the database search and the other potentially eligible articles from the reference lists not identified through the database search. Eligibility of studies are independently assessed by these two authors through reviewing titles, abstracts, and keywords. Full text of the eligible studies as well as methodological quality are reviewed by the other two authors (SAR and SD) and agreement was calculated by kappa statistics to finalized studies to include.
- **Quality Assessment:** The PEDro scale is used to assess the methodological quality of included studies with the quality cut-off score of fair (5/10).
- **Analysis:** Effect size is calculated to determine the magnitude of difference or relationships between interventions both within an individual study or across multiple studies.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

- It appears to be laboratory-based research based on the type of research (i.e. systematic review)
- The research is conducted in academic setting in the United States.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

- The subjects are diagnosed as cervicogenic headache by the International Headache Society classification.
- For systematic review, **6 articles** are selected for qualitative review from 2549 total records review via database searching and hand search of reference lists; 2490 studies are eliminated by title review, additional 81 studies are eliminated based on exclusion criteria, additional 18 studies are further eliminated after the full-text review.
- The Kappa scores of title and abstract review is 1.00 considered as "perfect agreement" and of full text review is 0.57 considered as "moderate agreement" between two reviewers.
- The subjects of the 6 included studies are the following: **458 subjects** as total, **aging between 7-15 and 18-60 years old, 67.2%** consisting of **woman**.
- All studies are reviewed as weak in methodological quality (2 studies are 6/10, the other 2 are 7/10, and the rest are 8/10 in PEDro scale).

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

In this systematic review, the one type of intervention is compared with different groups including the other interventions and placebo or the combination of several interventions is compared with the other groups as qualitative analysis. The details of each comparison will be described in the section below.

Experimental

1. **Manipulative/mobilization therapy; thrust and non-thrust:** This intervention is used in all 6 studies included. The examples of this intervention are thrust cervical manipulative therapy/high-velocity, low amplitude cervical manipulation, cervical and upper thoracic manipulation, cervical mobilization, and SNAG.
2. **Therapeutic exercise²** (the following detail is not mentioned in this systematic review): This intervention is used only in one study. It emphasizes on low-load endurance exercises using neck flexor synergy/craniocervical flexion exercises, pressure biofeedback and includes scapulothoracic muscles training, postural correction, cervical isometric exercise, and muscle lengthening exercise if needed.
3. **Combination treatment of thrust and non-thrust mobilization/manipulation and exercise therapy²:** This intervention group is also used in one study. It basically the combination of the two interventions above.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

This systematic review includes several outcomes measures used in the included studies and some of them doesn't pertain to the clinical questions proposed above. Therefore, only the targeted outcomes in the clinical questions will be described in detail and the other are just briefly summarized in the last of this section.

Primary outcomes pertaining to the proposed clinical question

1. **Headache frequency:** The number of headache days per week, the mean number of headache hours per day, and percent of days with headache
2. **Headache intensity:** Rated by visual analogue scale (0-10)
3. **Headache duration:** Total hours and average number of hours headache lasted in the past week
4. **Headache and neck pain intensity:** Scored by the modified Von Korff pain scale. For cervicogenic headache, the three outcomes (cervicogenic headache pain today, worst cervicogenic headache in the last 4 weeks, average cervicogenic pain in the last 4 weeks) are taken and average is calculated.
5. **Headache severity:** A headache questionnaire composing scores of headache, intensity, frequency, and duration

Secondary outcomes not necessarily associated with the proposed clinical question

- Disability (The Modified Von Korff disability scale), Flexion rotation test, Neck pain and disability (The Northwick Park Neck Pain Questionnaire), Analgesic use (the mean number of pain medications per day and percent of days requiring the medications), General health status (physical and mental components of SF-12), Missing school lessons secondary to headache

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

1. Manipulative/mobilization therapy; thrust and non-thrust

The outcomes of this intervention groups are **conflicting** among 6 studies; 4 studies report significant effectiveness, whereas the other two cannot provide either clinical or statistical significance. The table below summarizes the calculated effect size of the primary outcomes pertaining to the proposed clinical question. The other reported effect sized is described in parenthesis.

Cervical Thrust

There is **no statistically significant difference** between cervical manipulative therapy and sham cervical manipulative therapy in children and adolescents, aged 7-15 years. The effect sizes under "cervical thrust" in the table below reflect the result of this study and suggests a **small effect** on the outcome. In another study using high velocity, low amplitude cervical manipulation, there is **no statistically significant difference** in cervicogenic headache hours per day, intensity, and use of analgesics (effect size cannot be calculated). Additionally, in one another study with high velocity, low amplitude cervical manipulation, there is **statistically significant difference** in cervicogenic headache hours and intensity (effect size cannot be calculated).

Cervical and Upper Thoracic Thrust

There is **statistically significant difference** between cervical and upper thoracic manipulation and placebo in reduction of cervicogenic headache frequency, neck disability (-0.34), analgesic use (-0.25), but not in cervicogenic headache pain intensity, neck pain (-0.37), and cervicogenic headache disability (-0.39).

Non-Thrust Cervical SNAG

There is **statistically significant difference** between SNAG and placebo SNAG in cervigogenic headache intensity and increase in flexion rotation test ROM (0.57). The effect sizes under "non-thrust cervical SNAG" in the table below reflect the result of this study.

Combined Cervical Thrust and Non-Thrust

The combination of cervical manipulation and mobilization shows **statistically significant reductions** in cervicogenic headache, frequency, intensity, and neck pain (0.53), but not duration. This statistical improvement is maintained at month 12.

Outcome measures	Cervical Thrust (n=3)	Cervical and Upper Thoracic Thrust (n=1)	Non-Thrust Cervical SNAG (n=1)	Combined cervical thrust and non-thrust (n=1)
Frequency (%/days per wk)	-0.02	-	-	0.71
Frequency (# of headache)	-	-0.25	-	-
Intensity and Severity	-0.27	-0.39	-0.63 (at 4 wks) -0.67 (at 12 mos)	0.62
Duration (hrs)	0.10	-	-	0.33

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

2. Therapeutic exercise

The therapeutic exercise group shows **statistically significant improvement (p<0.001)** in **headache frequency, headache intensity, and neck pain** at 7 weeks of intervention when compared with the control group, but not in headache duration. This statistical improvement is maintained at month 12 compared with control group. The effect size (at 7 weeks) is described in the following table.

Frequency (%/days per wk)	Intensity and Severity	Duration (hrs)	Neck pain
0.87	0.72	0.00	0.56

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

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

The combination of manipulative therapy and therapeutic exercise shows **statistically significant improvements** in all outcome measures at 7 weeks of intervention when compared with control group. This statistical improvement is maintained at month 12 compared with control group. The effect size (at 7 weeks) is described in the following table.

Frequency (%/days per wk)	Intensity and Severity	Duration (hrs)	Neck pain
0.68	0.76	0.53	0.64

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

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

Overall, this systematic review implies that conservative management of cervicogenic headache by physical therapy treatment is effective. It provides the effectiveness of different interventions between studies based on the calculated effect sizes. A combination of cervical manipulation and mobilization and therapeutic exercise are the most effective intervention for decreasing cervicogenic headache frequency, intensity, and duration.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

- **Risk of Bias/internal validity:** The AMSTAR scale is used for assessing the risk of bias of this systematic review. It is rated as 8/11 because of the lack of method to combine the findings or meta-analysis, of assessing likelihood of publication bias, and of notion about conflict of interest. They discuss that meta-analysis cannot be performed in this study because of heterogeneity of data. They also comment about potential bias during the article selection due to extensive literature search.
- **External validity:** As they discuss, the external validity of this study might not be good as they include the studies using variable intervention strategy and intervention providers with different skill, knowledge, and, experience especially when it comes to manipulation and manual therapy. As they report, the risk of bias of included studies assessed by PEDro is not great overall, this might also influence external validity.
- **Strength and weakness:** Except the risk of bias mentioned above, the study design of this systematic review is considered as strict and precise. However, due to lack of sufficient number of studies and data, the external validity becomes weak as shown that the main finding of this study is heavily on one randomized control study.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

As they overall conclude that conservative management of cervicogenic headache by physical therapy treatment is effective, this study provides some evidences supporting physical therapy intervention via different approach. The calculated effect sizes give insight how effective the each of intervention approach is. Some of manipulation/mobilization approaches, therapeutic exercise, and combination of both provide statistical improvement with regarding to headache symptom **more than moderate effect**. However, although the study using combination of manipulation/mobilization and therapeutic exercise provides strong results shown in statistical p-value and effect size, the interpretation of this result needs to be cautious given that this information comes from a single study.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

This systematic review is considered to be relevant and applicable to my clinical question. The combination of manipulation/mobilization and therapeutic exercise would be the first choice of treatment as this intervention approach is superior to the other based on the effect sizes. However, as the exercise-only group also shows statistical significance reducing headache frequency and intensity, I would be able to modify the management approach if my patient is not able to tolerate manipulation and mobilization as it is actually the case. In this systematic review, some of the included studies using manipulation and mobilization fail to show statistical and clinical significance to improve symptom of headache, so providing only therapeutic exercise is still considered as best available treatment option based on the evidences provided in this study. As I am familiar with all of the interventions used in the included studies, the feasibility of the interventions is considered good, but this might not be applicable to everyone as some of manipulation and mobilization requires skill and practice.

(2) Description and appraisal of "Manual Therapy for Cervicogenic Dizziness: Long-term Outcomes of A Randomised Trial." by Reid et al., 2015⁶

Aim/Objective of the Study/Systematic Review:

The purposes of this randomized control trial are to assess the effectiveness of two different interventions (1. Mulligan's Sustained Neutral Apophyseal Glides or SNAGs with self-administered SNAGs and 2. Maitland's passive joint mobilization) compared with placebo as well as to assess any differences of these interventions for the management of chronic cervicogenic dizziness in the long term (12-months post-treatment).

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

- **Study Design:** A randomized controlled trial
- **Randomization:** The subjects are randomized into one of the three groups: Mulligan's SNAGs together with self-SNAGs, Maitland's passive joint mobilizations with ROM exercises, or placebo intervention of detuned laser. Randomization is completed by computer generated sequence without stratification and providing opaque sealed envelopes.
- **Blinding:** The research assistances who collect baseline and follow-up data are blind to group allocation. The subjects are blind to which intervention they received. The treating therapist cannot be blind to group allocation due to the nature of intervention.
- **Time flow:** Either one of intervention is provided between 2 and 6 sessions over 6 weeks and outcome measures are captured at baseline, immediately post-treatment, at 12 weeks, and at 12 months.

<ul style="list-style-type: none"> • Statistical analysis: A sample size of 30 participants in each group is expected to provide 80% power for both primary and secondary outcomes. Statistical significance is pre-determined as a value of <0.05. Both t-tests and repeated measures analyses of variance (ANOVA) were used. A Linear Mixed Model ANOVA was used for assessing the difference between baseline to 12 months, between post-treatment to 12 months, and between groups at the 12-month follow-up. A repeated measures mixed effect model was used for GRE. An intention-to-treat analysis was used as well.
<p>Setting</p> <p>[e.g., locations such as hospital, community; rural; metropolitan; country]</p>
<ul style="list-style-type: none"> • The subjects of this study are recruited from local community via press release, advertisements in newspaper and letters to general practitioner and neurologists in Australia. • This research is conducted at physical therapy research laboratory in the University in Australia.
<p>Participants</p> <p>[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]</p> <p>Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.</p>
<ul style="list-style-type: none"> • The participants are recruited from local community and pre-screened by phone followed by clinical examination by a physical therapist and neurologist from April 2010 to December 2011. He follow-up period continued until December 2012. • The included subject should complain cervicogenic dizziness defined as non-rotary dizziness (described as unsteadiness) provoked by cervical spine movements together with a history of neck pain and/or stiffness for greater than 3 months. • The other types or causes of dizziness are excluded. • 86 participants entered this randomized control trial from 683 available volunteers; the excluded volunteers are either not meeting inclusion criteria (n=587) or declining the participation (n=10). 7 participants are dropped out (3 from the SNAG group, 3 from passive joint mobilization group, 1 from placebo group). • Subject demographics: average age: 62±12.7 (ranges 21-85) years, proportion of female: 50%, mean duration/chronicity of symptom: 7.2±6.8 years (ranges 3 months-30 years), no group difference in dizziness intensity (p=0.51) and DHI (p=0.44)
<p>Intervention Investigated</p> <p>[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]</p>
<p><i>Control</i></p>
<p>Placebo (n=28): A deactivated laser device is applied once per each session for 2 minutes at three sites on posterior neck. This group received 3.9±0.3 treatment sessions on average over 6 weeks.</p>
<p><i>Experimental</i></p>
<p>The following intervention is provided between 2 and 6 sessions over 6 weeks which the number of session is determined by clinical judgement of treating physical therapist.</p> <p>1. Mulligan’s Sustained Neutral Apophyseal Glides or SNAGs with self-administered SNAGs (n=29)</p> <ul style="list-style-type: none"> • If active cervical spine flexion or extension produced dizziness, a sustained anterior glide is given at C2, while the subject actively moves their head to symptomatic direction. • If active cervical spine rotation produces dizziness, a sustained anterior glide is given at ipsilateral articular pillar C2, while the subject actively rotates their head to symptomatic direction. • SNAG is repeated 6 times and over-pressure is applied at the end of active movement. • Self-SNAG starts after the second treatment for 6 repetitions once a day until the follow-up at 12 months. • This group received 4.2±0.6 treatment sessions on average over 6 weeks.

2. Maitland's passive joint mobilization (n=29)

- The mobilization is applied at up to three hypomobile and/or painful upper cervical spine segments and consists of three 20-45 seconds oscillatory movement in each spinal level.
- ROM exercises into symptom-free flexion, extension, left/right rotation, and left/right lateral flexion are also given after the second treatment. It should repeat 3 times in each direction, once a day, and continue until the follow-up at 12 months.
- This group received **4.1±0.5** treatment sessions on average over **6 weeks**.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

The following outcomes are measured at baseline, immediately post-treatment, at 12 weeks, and at 12 months after the intervention. This study is a sequel of the previous study reporting the outcome at post-treatment and at 12 weeks.^{5,7}

Primary outcome

1. **Intensity of dizziness:** measured with a 100mm VAS

Secondary outcomes

2. **Frequency of dizziness:** A 6-point categorical rating scale (0="no dizziness", 1="dizziness < once per month", 2="1-4 episodes per month", 3="1-4 episodes per week", 4="dizziness once daily", 5="dizziness > once a day or constant").
3. **Dizziness Handicap Inventory (DHI):** (0-100; 0=no handicap, 100=maximum handicap)
4. **Cervical spine ROM:** measured in flexion, extension, left/right rotation, left/right lateral flexion with cervical ROM device
5. **Head repositioning accuracy:** measured in left and right rotation as described in the Revel's study
6. **Balance measures:** 15 seconds of the trial under 6 conditions are measured: 1. standing on a stationary platform with the neck in the neutral position with eyes open, 2. standing on a stationary platform with the neck in the neutral position with eyes closed, 3. standing on a stationary platform with the neck extended with eyes open, 4. standing on a stationary platform with the neck in left rotation with eyes closed, 5. standing on a stationary platform with the neck in right rotation with eyes open, standing on a moving platform with eyes open.
7. **Global perceived effect:** rated by a 5-point scale (0="no benefit", 1="minimal benefit", 2="some benefit", 3="a lot of benefit", 4="great benefit", 5="maximal benefit")

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

As this study includes several outcome measures which include ones not necessarily associated with the proposed question, this section focuses on only the first three outcome measures (intensity of dizziness, frequency of dizziness, and DHI score) to summarize.

a. **Between groups difference** (described in the table below)

Intensity of dizziness: There are **no statistically significant group differences** between group at the 12-months follow-up, though scores of the two manual therapy groups are in mild range (< 30mm) compared with placebo in moderate range (30-54mm).

Frequency of dizziness: There are **statistically significant group differences** in frequency of dizziness at the 12-months of follow up in both SNAG and PJM groups compared with placebo, but **no statistically significant difference** between manual therapy groups.

DHI: There are **statistically significant group differences** in the DHI score at the 12-months of follow up in both SNAG and PJM groups compared with placebo, but **no statistically significant difference** between manual therapy groups.

	Dizziness Intensity		Dizziness Frequency		DHI	
	Mean diff (95% CI)	p	Mean diff (95% CI)	p	Mean diff (95% CI)	p
SNAG vs placebo	-9.6 (-22.8, 3.6)	0.15	-0.7 (-1.3, -0.2)	0.01*	-8.9 (-16.3, -1.6)	0.02*
PJM vs placebo	-10.8 (-23.8, 2.2)	0.1	-0.7 (-1.2, -0.1)	0.02*	-13.6 (-20.8, -6.4)	<0.001*
PJM vs SNAG	-1.2 (-14.5, 12.0)	0.85	0.1 (-0.5, 0.7)	0.77	-4.7 (-12.0, 2.7)	0.21

b. Within group difference/time effect (described in the table below)

Intensity of dizziness: There are **statistically significant reductions** in intensity of dizziness at the 12-months of follow up compared with baseline in all three groups; The amount of reduction is **43%** in SNAG, **53%** in PJM, 28% in placebo respectively. However, there is **no statistically significant change** of intensity of dizziness between at post-treatment and at 12 months in any groups, though the amount of change in placebo group during this period of time is **67%**.

Frequency of dizziness: There are **statistically significant reductions** in the frequency of dizziness at 12-month of follow up compared with baseline in all three groups. There are also **statistically significant changes** of frequency of dizziness between at post-treatment and at 12 month in both manual therapy groups.

DHI: There are **statistically significant improvement** in the DHI score at the 12-month of follow up compared with baseline in all three groups; The amount of reduction is **38%** in SNAG, **46%** in PJM, **15%** in placebo respectively. There are also statistically significant changes of frequency of dizziness between at post-treatment and at 12 month in both manual therapy groups. The scores at 12 months are indicated mild handicap in both manual therapy groups, whereas the placebo group still shows moderate handicap as same as at baseline.

	Post-treatment - baseline		12 months - baseline		12 months - post-treatment	
	Mean diff (95% CI)	p	Mean diff (95% CI)	p	Mean diff (95% CI)	p
Dizziness Intensity						
SNAG	22.5 (13.0, 32.1)	0.001*	20.0 (10.3, 29.7)	0.001*	-2.6 (-12.6, 7.4)	0.61
PJM	20.8 (11.5, 30.1)	0.001*	25.3 (15.8, 34.7)	0.001*	4.5 (-5.1, 14.0)	0.36
placebo	4,2 (-5.1, 13.4)	0.38	12.8 (3.3, 22.2)	0.008*	8.6 (-0.9, 18.1)	0.08
Dizziness Frequency						
SNAG	0.5 (0.1, 1.0)	0.02*	1.3 (0.9, 1.8)	0.001*	0.8 (0.3, 1.3)	<0.001*
PJM	0.5 (0.0, 0.9)	0.03*	1.4 (1.9, 1.9)	0.001*	0.9 (0.5, 1.4)	<0.001*
placebo	0.4 (0.1, 0.8)	0.11	0.8 (0.3, 1.2)	0.001*	0.4 (-0.1, 0.9)	0.08
DHI						
SNAG	8.6 (4.0, 13.2)	0.001*	14.6 (9.8, 19.3)	0.001*	5.9 (1.2, 10.7)	0.01*
PJM	15,2 (10.5, 19.8)	0.001*	20.4 (15.8, 25.1)	0.001*	5.3 (0.6, 10.0)	0.02*
placebo	4.6 (0.1, 9.2)	0.05*	6.6 (1.9, 11.3)	0.006*	2.0 (-2.7, 6.6)	0,41

c. Adverse effects

There is no adverse effect which lasts more than 24 hours after the intervention reported.

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

- This randomized controlled trial provides the evidence that both manual therapy interventions (SNAG and passive joint mobilization) have favourable effect in long-term (12 months post-intervention) for the management of chronic cervicogenic dizziness.
- Manual therapy treatment offers immediate reduction of intensity of dizziness which improvement is maintained 12 months later. The frequency of dizziness and handicap continue to improve even after the intervention.
- There are no differences between manual therapy groups in the outcome measures associated with dizziness.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

- **Risk of Bias/internal validity:** The PEDro scale is used for assessing the risk of bias of this randomized controlled trial. It is rated as 10/11 with missing point in the question of blinding of therapists who administer intervention. Given the nature of intervention (i.e. manual therapy and exercises), potential risk of bias is not avoided in this type of research in physical therapy, so this score is considered as relatively high.
- **External validity:** The use of this study result needs cautious because of two reasons. First, this study is done in a single place from local community, so the outcome in a different group of population might not be the same. Second, the intervention is provided by a single PT is experienced with completion of the Maitland and Mulligan techniques and a title member of Australian Physiotherapy Association for 25 years. Because of that, external validity might not be good.
- **Strength and weakness:** As scored by the PEDro and description of study process, this randomized control trial is considered as strict and precise. Although the potential influence on external validity is mentioned above, they discuss that generalizability of this study is good based on how they recruit participants. The weakness of this study is difficulty of justifying the effectiveness of home exercise program as only low portion of participants recoded dailies as requested.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

This randomized controlled trial provides additional evidenced information of physical therapy intervention for chronic cervical dizziness synthesizing previous studies^{5,7}. For the management of this population, the application of combination of manual therapy and therapeutic exercise is recommended based on this study's results. Both SNAG and PJM provides statistically significant improvement in the intensity of dizziness, frequency of dizziness, and DHI for long-term. Although placebo group shows symptom reduction at 12 months, the group difference between 2 manual therapy interventions and placebo supports the superiority of its effectiveness. Especially, according to Yorke et al., the minimal detectable change (MDC) and the minimal clinically important difference (MCID) of DHI in the population of vestibular dysfunction are 17.18 and 18 respectively.⁹ Only the change in the group of passive joint mobilization between baseline and at 12 months exceeds these values, but not SNAG and placebo. The confidence interval of the passive joint mobilization intervention are relatively narrow and greater scores (CIs: 15.8-25.1). Differed from SNAG, the lowest CI of passive joint intervention (15.8) is still higher than the highest CI of placebo (11.3). Although MDC or MCID of frequency of dizziness have nor reported, the difference more than 1 point is considered as meaningful as change from "3" to "2" are identical to "1-4 episodes per week" to "1-4 episodes per month". Both manual therapy groups show more than 1 point improvement from baseline to 12 months and CI of passive joint mobilization groups is really narrow (CIs: 1.9-1.9). Based on these analysis, both manual therapy groups are superior to placebo to reduce dizziness intensity and frequency and DHI. Additionally, the outcome of passive joint mobilization is more reliable, even though there is no statistical group difference between manual therapy groups.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

Despite that this randomized controlled trial doesn't compare between active and passive intervention as proposed in the clinical question, it is still considered to be relevant and applicable to my clinical question. The manual therapy technique is of interest in this study, but both manual therapy intervention groups include self exercises as part of regimen; SNAG group performed self-SNAG exercise and passive mobilization group did ROM exercise as home exercise program. Therefore, when it comes to the outcome at 12 months, the interventions provided are considered as combination of manual therapy and self-exercises. When ROM deficits are concerned, SNAG might be superior intervention as reported in this study (not part of this CAT), otherwise there are no difference between selection of intervention in symptom reduction related to dizziness. Both manual therapy interventions are commonly used in my practice, so the feasibility of the interventions is considered good, though again the treating PT in this study is experienced in these skills which would not be comparable to what I can provide.

SYNTHESIS AND CLINICAL IMPLICATIONS

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

Evidence Synthesis/ Implications for Clinical Practice

The evidence reviewed in this analysis supports the effectiveness of combination of manual therapy intervention and exercises in reduction of both symptoms of headache and dizziness. The systematic review by Racicki et al (2013) found that some types of manipulation/mobilization approaches, therapeutic exercise, and combination of both provide more than moderate effect in reduction of headache.⁴ This study directly compares between manipulation/mobilization (passive treatment), therapeutic exercise (active exercise), and combination of them as proposed in the clinical question of this CAT. Given that manual therapy-only is not superior to exercise-only, they conclude that the combination of manual therapy and therapeutic exercise might be the best option of treatment strategy. This systematic review actually refers only one randomized controlled trial conducted by Jull et al (2002) when it comes to the effect of combination of manual therapy and therapeutic exercise.² In this study, the direct comparison between combination of manual therapy and therapeutic exercise and exercise-only is performed by ANOVA and it results in no statistical difference. They further investigate how much proportion of participants had achieved reduction of headache frequency more than 50% or 100% given that more than 50% reduction in headache frequency is considered as clinically meaningful based on His report.² As a result, proportion of participants in combined therapies group who achieved more than 50% reduction of headache frequency is up to 10% more than manual therapy-only or exercise only group at 12 months.² Therefore, combination of manual therapy and therapeutic exercise appears to be more effective with clinically important superior outcome, but this tendency is not confirmed by statistical analysis. Additionally, the randomized controlled trial by Reid et al (2015) found that combination of manual therapy and self-exercise is more effective than control group in improvement of dizziness intensity, frequency, and DHI regardless of types of manual therapy technique.⁶ Although there is no group difference observed by statistical analysis, the outcome achieved by passive mobilization together with active ROM exercise appears to be more clinically importance as described above. On the other hand, SNAG technique together with self-SNAG provides greater in ROM. Therefore, both intervention strategy is effective for the management of cervicogenic dizziness and therapists can choose either one or both intervention approach based on their clinical judgement and patient's tolerance. Overall, multimodal interventions consisting manual therapy and exercise is considered to be the best approach to treat patient who complains headache and dizziness originating from cervical spine. Therapists can replace it with another manual therapy intervention or exercise-only when the multimodal approach didn't work given that such single intervention approach is still similarly effective as multimodal approach.

Implication for Future Research

Future research needs more emphasis on the effectiveness of therapeutic exercise, self-exercise, and combination of manual therapy and exercises. Among all the included study in this review, there is only one study which uses exercise-only group or combination of manual therapy group each in the study assessing headache and dizziness. This result is primarily because manual therapy has considered as best treatment strategy for the management of cervicogenic headache and dizziness and that's why the reach on manual therapy has heavily done. As the systematic review and this CAT review shows, the effectiveness of manual therapy intervention might be associated with which technique is used and who provides the intervention. On the other hands, this CAT review provides potentiality of multimodal approach to provide stronger and more consistent outcomes between different providers or groups. As more future research focuses on the multimodal approach or therapeutic approach is published, such evidences will help not only conducting another systematic review but also clinicians to determine how therapeutic approach should be made in this type of population.

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