Research Report

Comparison of Mulligan Sustained Natural Apophyseal Glides and Maitland Mobilizations for Treatment of Cervicogenic Dizziness: A Randomized Controlled Trial

Susan A. Reid, Darren A. Rivett, Michael G. Katekar, Robin Callister

Background. There is short-term evidence for treatment of cervicogenic dizziness with Mulligan sustained natural apophyseal glides (SNAGs) but no evidence for treatment with Maitland mobilizations.

Objective. The purpose of this study was to compare the effectiveness of SNAGs and Maitland mobilizations for cervicogenic dizziness.

Design. A double-blind, parallel-arm randomized controlled trial was conducted.

Setting. The study was conducted at a university in Newcastle, Australia.

Participants. Eighty-six people with cervicogenic dizziness were the study participants.

Interventions. Included participants were randomly allocated to receive 1 of 3 interventions: Mulligan SNAGs (including self-administered SNAGs), Maitland mobilizations plus range-of-motion exercises, or placebo.

Measurements. The primary outcome measure was intensity of dizziness. Other outcome measures were: frequency of dizziness, the Dizziness Handicap Inventory (DHI), intensity of pain, and global perceived effect (GPE).

Results. Both manual therapy groups had reduced dizziness intensity and frequency posttreatment and at 12 weeks compared with baseline. There was no change in the placebo group. Both manual therapy groups had less dizziness intensity posttreatment (SNAGs: mean difference=−20.7, 95% confidence interval [95% CI]=−33.6, −7.7; mobilizations: mean difference=−15.2, 95% CI=−27.9, −2.4) and at 12 weeks (SNAGs: mean difference=−18.4, 95% CI=−31.3, −5.4; mobilizations: mean difference=−14.4, 95% CI=−27.4, −1.5) compared with the placebo group. Compared with the placebo group, both the SNAG and Maitland mobilization groups had less frequency of dizziness at 12 weeks. There were no differences between the 2 manual therapy interventions for these dizziness measures. For DHI and pain, all 3 groups improved posttreatment and at 12 weeks. Both manual therapy groups reported a higher GPE compared with the placebo group. There were no treatment-related adverse effects lasting longer than 24 hours.

Limitations. The therapist performing the interventions was not blind to group allocation.

Conclusions. Both SNAGs and Maitland mobilizations provide comparable immediate and sustained (12 weeks) reductions in intensity and frequency of chronic cervicogenic dizziness.

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The cervical spine should be considered a possible cause of dizziness when dizziness is described as imbalance, occurs with dysfunction in the cervical spine (pain or stiffness, or both), and is aggravated by movements or positions of the neck.[1–9] Mulligan sustained natural apophyseal glides (SNAGs) have been shown to have an immediate and sustained (for 12 weeks) effect in reducing dizziness, neck pain, and disability caused by cervical spine dysfunction.[2] Maitland mobilizations are a commonly used manual therapy technique for management of cervical pain[10–13]; however, there is no published evidence for their use in treating people with dizziness.

Cervicogenic dizziness is often related to upper cervical degeneration or a neck injury, such as whiplash.[5,14] It is thought to result from a perturbation in sensory information from the upper cervical spine.[5,8,15–18] Equilibrium and balance are maintained by an integration of signals from the vestibular system, the visual system, and proprioceptors in the neck, trunk, and lower limbs.[18–21] Normally, balance is controlled subconsciously; however, when a mismatch of afferent input from these systems occurs, a sensation of disequilibrium or dizziness is experienced.[22,23]

Poor balance and dizziness are common in the community, often with extremely disabling consequences.[24,25] The 2008 English Longitudinal Study of Ageing (ELSA), which assessed 2,925 participants aged over 65 years of age, demonstrated that 21.5% (n=619) of the participants had impaired balance and that 11.1% (n=375) experienced dizziness.[26] These conditions often lead to physical problems such as falls, as well as social, emotional, and financial problems.[24,27,28] The incidence of cervicogenic dizziness has been reported to be 7.5% of all dizziness,[29] with many patients having more than one reason for their dizziness.[29,30]

Although many people are affected by cervicogenic dizziness, a large proportion are not offered treatment. To date, the management of this disabling condition has not been widely studied, but there is a slowly growing body of evidence to support its treatment with manual therapy.[2,4,31–36] It is hypothesized that manual therapy applied to the upper cervical spine increases stimulation of proprioceptors in both joints and muscles of this area and normalizes afferent information.[2,37] Clinically, the treatment of cervicogenic dizziness is an emerging area of physical therapist practice.

Although SNAGs, as described by Mulligan,[38] have been shown to be an effective treatment for cervicogenic dizziness in the medium term (12 weeks),[2] the addition of self-administered SNAGs as a home exercise, which reflects clinical practice, has not been studied in treating cervicogenic dizziness. A self-administered SNAG targets cervical spine dysfunction by the patient performing an accessory glide on a vertebra while simultaneously undertaking the dysfunctional spinal active movement. Hall et al[39] provided evidence for the efficacy of the C1–C2 self-administered SNAG technique in the management of cervicogenic headache.

Passive joint mobilization has been described by Maitland as a manual therapy technique to treat people with cervical pain[40] and constitutes mainstream physical therapist practice, with 99.8% of physical therapists in one study using this approach.[11] A systematic review of manual therapy and exercise for neck pain showed that, of 17 randomized controlled trials, 15 used some form of joint mobilization.[12] Some manual therapists have reported anecdotally that this technique also can be used to treat people with cervicogenic dizziness, but to date there is no high-quality evidence for this claim.

The Bottom Line

What do we already know about this topic?

Cervicogenic dizziness is a condition characterized by episodes of potentially disabling dizziness arising from dysfunction of the cervical spine. Mulligan sustained natural apophyseal glides applied to the cervical spine have been shown to help alleviate this dizziness in the short term.

What new information does this study offer?

This study shows that both Maitland mobilizations and Mulligan sustained natural apophyseal glides are beneficial in reducing the intensity of dizziness, dizziness frequency, and disability in people with chronic cervicogenic dizziness, and the effects of these interventions are maintained for 12 weeks after treatment.

If you're a patient, what might these findings mean for you?

This study provides evidence of successful treatment of cervicogenic dizziness with 2 to 6 sessions of physical therapist intervention and some simple home exercises.

The aim of the present study was to determine and compare the effectiveness of Mulligan SNAGs (including self-administered SNAGs) and Maitland mobilizations (plus range-of-motion exercises) on chronic cervicogenic dizziness symptoms immediately and at 12 weeks after treatment. Adverse effects and global perceived effect (GPE) also were assessed.

Method

Design Overview

This study was a 3-arm, double-blind, randomized controlled trial.[41] Participants with cervicogenic dizziness were randomly allocated to 1 of 3 groups: (1) a group that received Mulligan SNAGs (including self-administered SNAGs), (2) a group that received Maitland mobilizations plus range-of-motion exercises, or (3) a group that received a placebo intervention. Participants received 2 to 6 therapist-delivered treatments over 6 weeks at the discretion of the treating therapist, who used clinical judgment to determine the specific number of treatments based on the participant's response and consistent with previous research that used Mulligan SNAGs or Maitland mobilization to treat people with cervicogenic dizziness or neck pain.[2,12,13] An Australia-licensed physical therapist with formal postgraduate training in both the Maitland and Mulligan approaches and more than 30 years of clinical experience using both manual therapy approaches performed all of the interventions.

Setting and Participants

Over a period of 20 months, participants with dizziness were recruited via media releases, advertisements in local newspapers, and letters to general practitioners and neurologists in the Hunter region of New South Wales, Australia. A 3-step process was followed to identify people with cervicogenic dizziness and exclude those who did not have this condition. An initial telephone screening was conducted by a physical therapist asking about the type of dizziness and checking inclusion and exclusion criteria. To be included in the study, participants had to have dizziness described as imbalance (plus a history of neck pain or stiffness, or both) and a history of neck movement or positions provoking the cervicogenic dizziness. They had to be 18 to 90 years of age and have had dizziness symptoms for 3 months or longer. People were excluded if they had other types or causes of dizziness (eg, vertigo, light-headedness, psychogenic dizziness, vertebrobasilar insufficiency, migraines) or other causes of poor balance (eg, stroke, spinal cord pathology, cerebellar ataxia, Parkinson disease). People also were excluded if they had conditions for which manual therapy is contraindicated (eg, inflammatory joint disease, spinal cord pathology, cervical spine infection, marked osteoporosis, cervical spine cancer) or if they were pregnant, receiving workers' compensation payments, or unable to read English.

Potential participants underwent a physical examination by a physical therapist at The University of Newcastle. Palpation and passive accessory mobilizations of the upper cervical spine (occiput to C3) and cervical active range-of-motion measurements were performed to confirm the presence of dysfunction in the cervical spine. Balance also was tested because it has been identified as being impaired in people with cervical spine dysfunction.[4,5,15,42] Testing to exclude other causes of dizziness consisted of smooth visual pursuit movements,[43] the vestibulo-ocular reflex,[43] and blood pressure measurements. The Dix-Hallpike maneuver[43] was performed to identify and eliminate individuals with benign paroxysmal positional vertigo.

Finally, if not previously excluded, the potential participants underwent a clinical examination by an otoneurologist in Newcastle, which consisted of peripheral vestibular function testing to exclude other noncervical causes of dizziness. After these thorough examinations, the identified participants were considered to have a confirmed diagnosis of cervicogenic dizziness. All participants provided written informed consent.

Randomization and Interventions

Participants who met the inclusion criteria were randomly allocated to 1 of 3 intervention groups: (1) a group that received Mulligan SNAGs (including self-administered SNAGs), (2) a group that received Maitland mobilizations plus range-of-motion exercises, or (3) a group that received a placebo intervention. An independent statistician generated a randomization sequence, which was placed in sequentially numbered, opaque, sealed envelopes. Participants were blinded as to whether they received a placebo or active intervention.

One group of participants received SNAGs as described by Mulligan.[44] Each participant, in a seated position, was asked to move his or her head in the direction that produced the dizziness. As the participant moved his or her head, the physical therapist performed a sustained gliding movement to the C1 or C2 vertebra (Fig. 1A). If the provocative direction was flexion or extension, an anterior glide was applied to the C2 spinous process. If rotation produced dizziness, an anterior glide was applied to the C1 transverse process. This movement was repeated 6 times at the first treatment session and had to be symptom-free. At subsequent treatments, gentle overpressure was applied. A second SNAG in another implicated direction was added when clinically justified. After the second treatment, the participant was advised how to self-administer the SNAG using his or her fingers or a strap (6 repetitions) into

the provocative direction as a home exercise once daily (Fig. 1B).

The second group received passive joint mobilizations applied to up to 3 stiff or painful joints in the upper cervical spine based on the clinical judgment of the physical therapist as described by Maitland et al[45] (Fig. 1C). The degree of vigor (grade according to Maitland) and duration of the application were determined by clinical judgment but usually consisted of three 30-second applications at each spinal level treated.[10] After the second treatment, the participant was advised to perform range-of-motion exercises into flexion, extension, rotation, and lateral flexion, 3 times in each direction, once a day.

The third group of participants received a placebo intervention consisting of application of a laser, which had been deactivated by the manufacturer. To the participant, the placebo laser (a Therapower 40-mW laser, Meyer Medical Electronics, Mordialloc, Australia) appeared to operate normally, with a light flashing and a beeping sound, but it did not produce any emission. The deactivated laser was applied for 2 minutes to 3 sites on the neck, with the probe at a distance of 0.5 to 1 cm from the skin. This placebo intervention has been used effectively in previous studies.[2,46]

Outcomes and Follow-up

Demographic data were collected at baseline (Tab. 1). Outcome measurements were obtained at baseline, following the final therapist treatment, and at 12 weeks after the final treatment. All outcome assessments and data entry were performed by a research assistant blinded to group allocation.

The primary outcome measure was intensity of dizziness (averaged over the previous few days), which was measured with a 100-mm visual analog scale (VAS) as in previous studies of cervicogenic dizziness.[2,34,47]

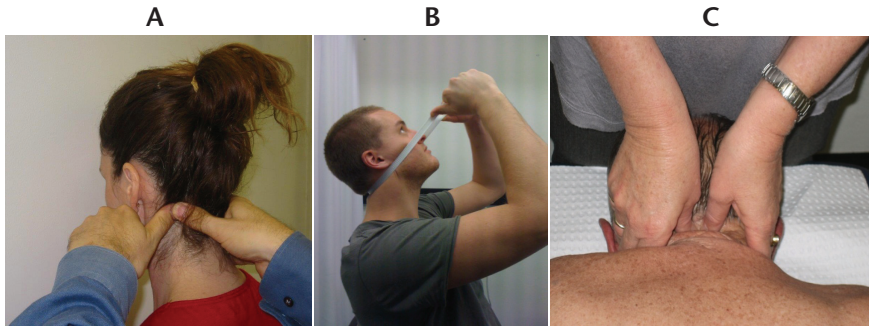

Figure 1.
The manual therapy interventions used in the study: (A) Sustained natural apophyseal glide (SNAG) into left rotation. The physical therapist performs a sustained anterior glide to the left C1 transverse process. The participant turns his or her head to the left as the SNAG is sustained. (B) Self-administered SNAG into extension. The participant uses a strap or his or her fingers to perform a sustained anterior glide to the C2 spinous process while looking up. The glide is maintained until the head returns to the neutral starting position. (C) Maitland central posterior-anterior passive joint mobilization on C2.

Secondary outcome measures were:

1. Frequency of dizziness (0=no dizziness, 1=dizziness less often than once a month, 2=1–4 episodes per month, 3=1–4 episodes per week, 4=dizziness once daily, 5=dizziness more often than once daily or constant dizziness).[2,33,48]

2. Dizziness Handicap Inventory (DHI), a measure of handicap related to dizziness and its impact on daily life.[49] A total score of 0 to 30 indicates mild handicap, of 31 to 60 indicates moderate handicap, and of 61 to 100 indicates severe handicap.[50] It has been suggested that a change in the score of 10% or more is clinically relevant.[17] Also, Tamber et al[51] have suggested that 11 points is the value of the minimal important change (MIC). The DHI was designed for use with patients with vestibular disorders, and its use in studies of cervicogenic dizziness is not well established.

Table 1.
Comparison of Participant Characteristics of the 3 Treatment Groups at Baseline[a]

Characteristic	SNAG Group (n=29)	MM Group (n=29)	Placebo Group (n=28)	P[b]
Sex, female, n (%)	15 (52%)	18 (62%)	10 (36%)	.13
Age (y)	60.0 (10.1)	61.0 (15.7)	65.6 (11.0)	.17
Dizziness duration (mo)	70.3 (61.9)	91.6 (91.0)	91.4 (87.0)	.52
VAS for dizziness	43.3 (21.9)	50.3 (21.2)	47.5 (24.9)	.51
Dizziness frequency	3.1 (1.5)	3.4 (0.9)	3.4 (1.0)	.46
DHI	38.4 (16.3)	44.1 (19.8)	42.8 (16.4)	.44
VAS for pain	41.2 (26.5)	50.9 (22.3)	57.4 (28.1)	.06

[a] Data are mean (SD) unless stated otherwise. SNAG=sustained natural apophyseal glide, MM=Maitland mobilization, VAS=visual analog scale, DHI=Dizziness Handicap Inventory.
[b] Comparison of means among groups (significant at $P<.05$).

3. Intensity of cervical pain, as measured with a 100-mm VAS.[47,52]

4. Global perceived effect, which was used to assess the participant's perceived benefit of the treatment and measured on a rating scale (0=no benefit, 1=minimal benefit, 2=some benefit, 3=a lot of benefit, 4=great benefit, 5=maximal benefit).[2,53,54]

5. Adverse effects, which were identified by asking the participant about any new symptoms after the interventions and if the symptoms persisted for more than 24 hours.

Data Analysis

Sample size calculation. Sample size calculations were based on a difference among the groups that would be clinically significant for the main outcome measures and supported by the results of previous research where applicable data existed and on clinical expectations for those factors for which no previous data existed.[55] The sample size was estimated by biostatisticians from The University of Newcastle using previous studies with VAS (for main complaint) and DHI as outcome measures.[49,54,56–59] Visual analog scales have been used in previous studies to measure dizziness, pain, or the main complaint[2,54,58–60] and have been shown to have high reliability and validity; therefore, a calculation of sample size was based on VAS intensity of main complaint data. It was calculated that a sample size of 30 participants would be required for each group to detect a clinically significant difference of 2 units on a 0–10 VAS between 2 groups, with a power of 80%, a 5% confidence level, and a standard deviation of 2.4.[2,58,60] To allow the study to be adequately powered for secondary outcomes, the DHI also was used for sample size calculations, as it is a widely reported measure of self-perceived disability and effect of dizziness on function. The DHI has been shown to have short-term test-retest reliability and good internal consistency.[61] Assuming that the standard deviation of DHI scores is 15, 30 participants per group would provide 80% power to detect a difference of 11 units between groups for each comparison.[49,56,57]

Statistical methods. Biostatisticians from The University of Newcastle assisted with the statistical analyses. The response variables were found to be consistent with a normal distribution, so parametric statistics were used. Means, standard deviations, and 95% confidence intervals were calculated for all outcome measures. Comparisons of groups at baseline were conducted with one-way analysis of variance (ANOVA). For the main analyses, an intention-to-treat approach using a linear mixed model with repeated-measures ANOVA was used. For missing data, a participant's last observation for each outcome measure was carried forward. Pearson correlation analyses also were performed.

Role of the Funding Source

This study was financially supported by the Mulligan Concept Teachers Association Research Award and The University of Newcastle.

Results

Participants

Six hundred eighty-three people responded to the recruitment strategies between April 2010 and December 2011 (Fig. 2). Most people (n=482; 71%) were excluded because they did not meet the telephone screening inclusion criteria regarding symptoms consistent with cervicogenic dizziness. A further 54 people (8%) were excluded after the physical examinations by the physical therapist, and another 51 people (7%) were excluded after examination by the neurologist, which included vestibular function testing. The most common reasons for being excluded were having rotatory dizziness, central or cardiovascular causes of dizziness, or migraines or not having a related neck problem. Ten individuals (1%) declined to participate. Following screening, 86 people (13%) were identified as having cervicogenic dizziness and entered the study. Twenty-nine participants were allocated to each of the SNAG and Maitland mobilization groups, and 28 participants were allocated to the placebo group. Table 1 presents baseline demographic, dizziness, and pain characteristics. The average age of the participants was 62 years (range=21–85), and 50% of the participants were female. The average time that participants had experienced dizziness before entering the study was 7 years 2 months (range=3 months–30 years). There was a tendency for all measurements (dizziness duration, VAS for dizziness, dizziness frequency, DHI, and VAS for pain) to be lower in the SNAG group at baseline, and the measurements for the VAS for pain approached significance ($P=.06$) (Tab. 1). During the study, 3 participants withdrew due to unrelated medical problems, and 2 dropped out due to moving and were unable to be contacted.

Responses to Interventions

Intensity of dizziness. Analysis of changes in intensity of dizziness over time showed that dizziness intensity was reduced immediately after both manual therapy interventions, and the effects were maintained for 12 weeks (Tab. 2, Fig. 3). There was no reduction in dizziness in the placebo group. Both the SNAG and Maitland mobilization groups had less ($P<.05$) dizziness intensity than the placebo group posttreatment and at the 12-week follow-up (Tab. 3).

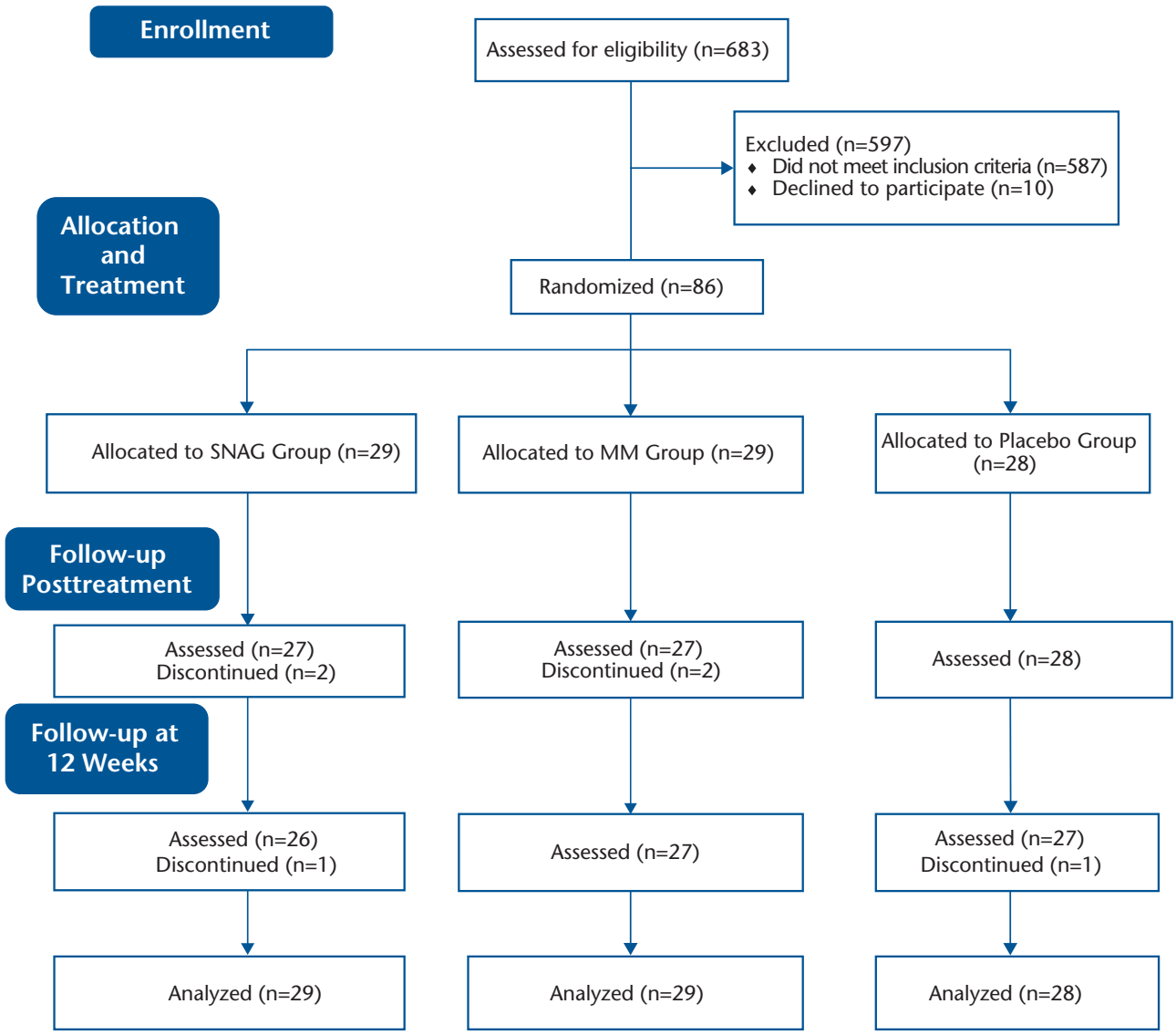

Figure 2.
Flow diagram of participants in the study. An intention-to-treat analysis was performed; therefore, all participants were analyzed at all time points. SNAG=sustained natural apophyseal glide, MM=Maitland mobilizations.

There was no significant difference in dizziness intensity between the SNAG and Maitland mobilization groups after the interventions.

Frequency of dizziness. There were significant reductions in frequency of dizziness after treatment and at 12 weeks in both manual therapy groups compared with baseline but no change in the placebo group (Tab. 2). There were statistically significant lower scores for frequency of dizziness in both the SNAG and Maitland mobilization groups compared with the placebo group at the 12-week follow-up (Tab. 3), but there was no difference between the SNAG and Maitland mobilization groups. The clinical change for the SNAG and Maitland mobilization groups was a reduction in dizziness frequency from dizziness experienced daily or 1 to 4 episodes a week at baseline to dizziness experienced 1 to 4 episodes a month after treatment. For the placebo group, frequency remained at 1 to 4 episodes a week after treatment.

Dizziness Handicap Inventory. At baseline, the DHI scores indicated that dizziness was having a moderate effect on the emotional, social, and physical aspects of the participants' lives in all 3 intervention groups (DHI scores=31–60).[50] There was a significant reduction in DHI scores in all 3 groups posttreatment and at the

Table 2.
Comparison of Changes in Outcome Measures Over Time for Each Treatment Group[a]

Measure	Group	Baseline Mean (SD)	Posttreatment Mean (95% CI)	12 Weeks Mean (95% CI)	Posttreatment vs Baseline		12 Weeks vs Baseline	
					Mean Diff[b] (95% CI)	*P*	Mean Diff[b] (95% CI)	*P*
VAS dizziness	SNAG	43.3 (21.9)	22.3 (12.9, 31.6)	21.7 (12.5, 31.0)	22.5 (13.0, 32.1)	.001*	23.1 (13.7, 32.6)	.001*
	MM	50.3 (21.2)	27.8 (18.6, 36.9)	25.7 (16.4, 34.9)	20.8 (11.5, 30.1	.001*	23.2 (13.7, 32.6)	.001*
	Placebo	47.5 (24.9)	42.9 (34.0, 51.8)	40.1 (31.0, 49.1)	4.2 (−5.1, 13.4)	.38	7.1 (−2.3, 16.4)	.14
Dizziness frequency	SNAG	3.1 (1.5)	2.7 (2.3, 3.1)	2.1 (1.7, 2.5)	0.5 (0.1, 1.0)	.02*	1.0 (0.6, 1.5)	.001*
	MM	3.4 (0.9)	2.9 (2.5, 3.3)	2.3 (1.9, 2.7)	0.5 (0.0, 0.9)	.03*	1.1 (0.7, 1.6)	.001*
	Placebo	3.4 (1.0)	3.0 (2.6, 3.4)	3.0 (2.6, 3.4)	0.4 (0.1, 0.8)	.11	0.4 (−0.1, 0.8)	.11
DHI	SNAG	38.4 (16.3)	32.1 (27.0, 37.2)	30.5 (25.3, 35.7)	8.6 (4.0, 13.2)	.001*	10.2 (5.5, 14.9)	.001*
	MM	44.1 (19.8)	26.7 (21.6, 31.8)	22.9 (17.7, 28.0)	15.2 (10.5, 19.8)	.001*	19.0 (14.3, 23.7)	.001*
	Placebo	42.8 (16.4)	36.9 (31.9, 41.9)	35.2 (30.1, 40.2)	4.6 (0.1, 9.2)	.05*	6.4 (1.8, 11.1)	.006*
VAS pain	SNAG	41.2 (26.5)	28.4 (18.9, 38.0)	31.4 (21.8, 41.1)	15.9 (5.6, 26.2)	.003*	12.7 (2.2, 23.1)	.02*
	MM	50.9 (22.3)	32.7 (23.3, 42.1)	26.2 (16.8, 35.6)	17.9 (7.6, 28.2)	.001*	24.4 (14.1, 34.7)	.001*
	Placebo	57.4 (28.1)	37.8 (28.5, 47.1)	40.5 (31.0, 49.9)	16.7 (6.5, 26.9)	.0001*	13.9 (3.6, 24.3)	.01*

[a] VAS=visual analog scale, SNAG=sustained natural apophyseal glide, MM=Maitland mobilization, DHI=Dizziness Handicap Inventory, 95% CI=95% confidence interval. *$P<.05$.
[b] Mean diff=difference among groups for the least squares mean (adjusted for baseline and missing data).

12-week follow-up compared with baseline (Tab. 2). After treatment and at 12 weeks, the Maitland mobilization group's scores had decreased to indicate mild handicap (DHI scores=1–30),[50] whereas the other 2 groups remained in the moderate range. The reduction in DHI scores reached the MIC of 11 points posttreatment and at 12 weeks for the Maitland mobilization group but not for the other 2 groups. The DHI scores were significantly lower for the Maitland mobilization group compared with the placebo group posttreatment and at 12 weeks and compared with the SNAG group at 12 weeks (Tab. 3). There was no significant difference in DHI scores between the SNAG and placebo groups at any time point (Tab. 3). At baseline, correlations with the DHI scores were as follows: VAS for dizziness intensity, $r=.391$; VAS for frequency of dizziness, $r=.346$; and VAS for pain intensity, $r=.303$.

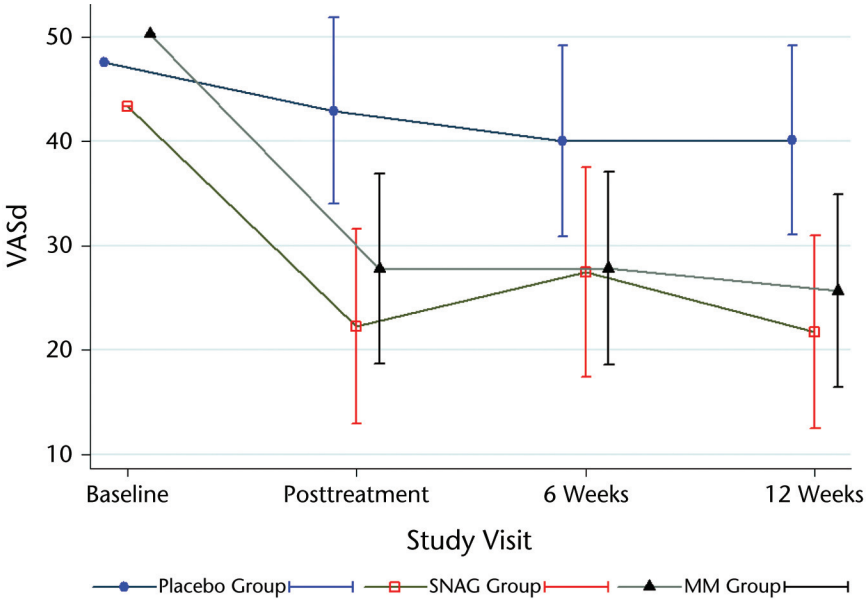

Figure 3.
Changes in mean values for intensity of dizziness (measured on a visual analog scale) over time for each treatment group. The SNAG group received Mulligan sustained natural apophyseal glides, the MM group received Maitland passive joint mobilizations, and the placebo group received deactivated laser. VASd=visual analog scale for intensity of dizziness, 95% CI=95% confidence interval.

Intensity of cervical pain. At baseline, the mean intensity of cervical pain reported by the SNAG and

Table 3.
Differences Among Treatment Groups on Each Outcome Measure Immediately Posttreatment and at 12 Weeks Posttreatment[a]

Measure	Groups	Posttreatment			12 Weeks		
		Mean Diff[b]	95% CI	*P*	Mean Diff[b]	95% CI	*P*
VAS dizziness	SNAG vs Placebo	−20.7	−33.6, −7.7	<.001*	−18.4	−31.3, −5.4	.01*
	MM vs Placebo	−15.2	−27.9, −2.4	.02*	−14.4	−27.4, −1.5	.03*
	MM vs SNAG	5.5	−7.6, 18.6	.41	3.9	−9.2, 17.0	.56
Dizziness frequency	SNAG vs Placebo	−0.4	−0.9, 0.2	.21	−0.9	−1.4, −0.3	<.001*
	MM vs Placebo	−0.1	−0.7, 0.4	.67	−0.7	−1.3, −.0.2	.01*
	MM vs SNAG	0.2	−0.3, 0.8	.41	0.1	0.04, 0.7	.68
DHI	SNAG vs Placebo	−4.8	−12.0, 2.3	.18	−4.7	−11.9, 2.6	.2
	MM vs Placebo	−10.3	−17.4, −3.1	.01*	−12.3	−19.5, −5.1	.01*
	MM vs SNAG	−5.4	−12.7, 1.8	.14	−7.6	−14.9, −0.3	.04*
VAS pain	SNAG vs Placebo	−9.3	−22.8, 4.2	.17	−9.0	−22.7, 4.7	.2
	MM vs Placebo	−5.0	−18.2, 8.1	.45	−14.2	−27.5, −1.0	.04*
	MM vs SNAG	4.3	−9.2, 17.7	.53	−5.2	−18.8, 8.3	.45

[a] VAS=visual analog scale, SNAG=sustained natural apophyseal glide, MM=Maitland mobilization, DHI=Dizziness Handicap Inventory, 95% CI=95% confidence interval. *$P<.05$.
[b] Mean diff=difference among groups for the least squares mean (adjusted for baseline and missing data).

Maitland mobilization groups was moderate (pain of 30–54 mm on the VAS), whereas the mean severity of pain reported by the placebo group was severe (pain greater than 54 mm on the VAS).[62] There was a significant ($P<.05$) decrease in pain in all 3 groups after the interventions, and this effect was maintained for 12 weeks (Tab. 2). The Maitland mobilization group had significantly lower pain scores than the placebo group at 12 weeks (Tab. 3). There was a large number of participants (n=10) in the SNAG group with VAS pain scores of less than 20 mm at baseline but only a small number (n=3) in the other 2 groups. There is some thought that participants with VAS pain scores of less than 20 mm should not be included in pain trials, as this low score could be called neck discomfort and not actual pain.[13] When a statistical analysis of changes in pain scores was performed after excluding participants with pain scores of less than 20 mm at baseline, there was a trend for a decrease in pain scores for the SNAG group compared with the placebo group ($P=.06$) at 12 weeks after the interventions. The clinical change for the manual therapy groups was a reduction in pain intensity from moderate (30–54 mm on the VAS) at baseline to mild (<30 mm on the VAS) posttreatment for the SNAG group and at 12 weeks for the mobilization group (Tab. 2). It remained in the moderate range for the placebo group posttreatment and at 12 weeks (Tab. 2).

GPE. The SNAG and Maitland mobilization treatments were perceived by the participants to be of more benefit than the placebo intervention. The results show that both manual therapy groups had significantly ($P<.05$) higher GPE ratings compared with the placebo group posttreatment and at 12 weeks. The median GPE score for both the SNAG and Maitland mobilization groups immediately posttreatment and at the 12-week follow-up was 4, indicating "great" benefit. The median score for the placebo group at both time points was 3, indicating "a lot" of benefit.

Adverse effects. Four participants reported mild transient pain in their lower cervical spine or upper arm after SNAGs or self-administered SNAGs. None of the symptoms lasted longer than 24 hours. There were no adverse effects in the Maitland mobilization or placebo groups.

Discussion

This study demonstrated that both SNAGs and Maitland passive joint mobilizations are safe and effective manual therapy interventions for the treatment of cervicogenic dizziness. Both manual therapy treatments reduced the intensity and frequency of dizziness, whereas the placebo intervention had no effect. These reductions in dizziness symptoms were of similar magnitude with both of these manual therapies. The DHI scores and pain intensity ratings also were reduced over time with all of the interventions, although the magnitude of these improvements was greater for Maitland mobilizations. These findings indicate that SNAGs and Maitland mobilizations are effective for the treatment of cervicogenic dizziness,

with more variable effects on any associated handicap or pain.

The effects of the 2 manual therapy treatments on cervicogenic dizziness in this study are consistent with the findings of our previous study,[2] which showed reductions in frequency and intensity of dizziness with treatment using SNAGs manual therapy. Similarly, Karlberg et al[33] found improvements in dizziness after manual therapy, and this effect was maintained for 2 years after treatment.[4] Both Du et al[35] and Fang[36] also reported improvements in dizziness after spinal manipulation and soft tissue therapy. Because these findings show that manual therapy applied to the cervical spine is an effective treatment for cervicogenic dizziness, our study provides indirect evidence that the symptoms can be attributed to cervical structures.

Unlike the changes in dizziness intensity and frequency, which were specific to the intervention groups, all 3 groups had reductions in DHI and pain intensity scores. These findings suggest that the handicap measured by the DHI in this population may not be specific to changes in dizziness symptoms. The DHI was designed for use in people with vestibular pathology and has rarely been used in those with cervicogenic dizziness. The cervicogenic dizziness population tends to be older and have a number of comorbidities, in particular pain, which may influence responses on the DHI, as a number of the items relate to disability and may not be specific to dizziness. The correlations with the DHI at baseline were similar for dizziness intensity, frequency of dizziness, and VAS for pain intensity. This finding suggests that the DHI scores in this population are almost as well correlated with pain ratings as with the dizziness ratings, which may not be surprising given the effects of pain on disability. The reductions in DHI in all 3 groups are consistent with the reductions in pain intensity observed in all 3 groups. In contrast, only the manual therapy interventions resulted in significant improvements in VAS scores for dizziness intensity and frequency of dizziness. Therefore, these dizziness measures are the more appropriate outcomes on which to base conclusions regarding the effects of manual therapy on dizziness symptoms. The DHI was not used as an outcome measure in the studies by Malmström et al,[4] Karlberg et al,[33] Du et al,[35] or Fang,[36] thus precluding any comparison with our results. Further investigation of the DHI in patients with cervicogenic dizziness may be warranted.

For intensity of neck pain, there were no significant differences between the SNAG group and the placebo group at any time point, but there were significant differences for the Maitland mobilization group at 12 weeks. In our previous study, there was a significant difference in pain scores for the SNAG group compared with the placebo group.[2] Karlberg et al[33] and Fang[36] also reported pain reductions after treatment. A potential criticism of the current study is that some participants had very low pain scores (as people were included based on reports of dizziness and either neck pain or stiffness). Ten participants in the SNAG group and 3 participants in the other 2 groups had VAS pain scores of less than 20 mm. It is recognized in pain trials that adequate sensitivity is achieved only if patients experience at least moderate pain (ie, greater than 30 mm on the VAS) before treatment.[62] In the current study, despite randomization, participants in the placebo group tended to have greater pain at baseline compared with the other groups, meaning there was potentially greater scope for improvement in the placebo group. It has been shown that people who had the greatest VAS pain scores at baseline showed the greatest reductions after therapy.[60] Furthermore, the current study was designed to treat only the upper cervical spine. As the average age of the participants was 62 years, they may have had degeneration in the lower cervical spine that remained untreated, resulting in continued pain. This possibility also could explain some of the adverse effects after SNAGs. In clinical practice, the lower cervical spine also may be treated to address pain from lower cervical levels.

To enable the study to better reflect clinical practice, a self-management component was included. The Mulligan concept incorporates self-administered SNAGs for self-management, and evidence for the efficacy of this technique has been demonstrated in the management of cervicogenic headache.[39] Self-administered SNAGs may assist in restoring normal movement by creating desirable movement templates, which are believed to "resculpt" or "retune" the brain with repetition.[63] Interestingly, Jull et al[64] evaluated cervical mobilization and specific exercise for the treatment of patients with cervicogenic headache and found there was a clinically meaningful 10% better response for the participants who received the combined therapy compared with either intervention alone. In a study evaluating the treatment of patients with cervicogenic dizziness, Malmström et al[4] also reported on the use of a home exercise program following the treatment phase.

A major strength of this study was that recruitment was via press release and advertisements in newspapers in the Hunter region, Australia. Hence, the study sample is likely representative of the general population with cervicogenic dizziness in terms of age, sex, intensity of symptoms, and duration of illness, and thus the results of this study are appropriate to translate to people

with this problem in the wider community. Moreover, although the study took place at a university, the study setting was designed to reflect normal physical therapy clinical conditions, further enhancing the generalizability of the findings. The trial design was further strengthened by incorporating several methodological features that minimize bias, including blinded outcome assessment, blinding of participants, intention-to-treat analysis, randomization, and concealed allocation. A further strength of the study design was the use of a convincing placebo intervention, as evidenced by the fact that the placebo group felt this intervention was of "some benefit" and the lack of difference in dropouts between the manual therapy groups and the placebo group.

We acknowledge limitations of the study. The physical therapist performing the treatments was equally trained and experienced in both manual therapy methods but was not blind to group allocation. In an attempt to minimize associated performance bias, the therapist attempted to provide the same amount of attention to all participants. Despite randomization, there was a trend for a difference in pain scores ($P=.06$) at baseline. There was also a tendency for imbalances at baseline among the 3 groups for sex, age, intensity of dizziness, duration of dizziness, and DHI scores. Better allocation balance could be achieved in future studies by stratifying participants before randomization.

It is important to acknowledge that this clinical trial focused only on one aspect of management of cervicogenic dizziness. Many of the participants in the study had experienced dizziness for many years (mean time=7 years), and we recognize that chronic dizziness, pain, and disability are complex problems that clinically might require a wider approach.[63,65,66] Dizziness and cervical pain are very common problems in the community, and the findings of this study have the potential to benefit many people.[15,42] Considering that the participants had experienced dizziness for many years, the fact they could be effectively treated with 2 to 6 sessions indicates that SNAGs and Maitland mobilization are very potent interventions for this condition.

Conclusion

The results of this study provide strong evidence for the effectiveness of 2 common manual therapy treatments for patients with cervicogenic dizziness. There was no difference in effectiveness between the 2 manual therapy interventions, as measured by the changes in intensity and frequency of dizziness. The results provide the first documented evidence for the benefits of Maitland mobilization for cervicogenic dizziness.

All authors provided concept/idea/research design, facilities/equipment, and consultation (including review of manuscript before submission). Ms Reid, Dr Rivett, and Dr Callister provided writing and fund procurement. Ms Reid and Dr Katekar provided data collection and study participants. Ms Reid provided data analysis. Ms Reid and Dr Rivett provided institutional liaisons. This project was conducted with the assistance of Calum Bolton, Andrew Makaroff, and Jane Hake as research assistants.

This study was approved by The University of Newcastle Human Research Ethics Committee (No. H-2009-0377).

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