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Original Article

Combined use of cervical headache snag and cervical snag half rotation techniques in the treatment of cervicogenic headache

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Abstract. [Purpose] Cervicogenic headache is a major problem in patients with upper cervical dysfunction. However, its physical therapy management is a topic of debate. This study aims to determine the effect of C1-C2 Mulligan sustained natural apophyseal glide mobilizations on cervicogenic headache and associated dizziness. [Participants and Methods] This study included 48 patients with cervicogenic headache, who were randomly assigned to three equal groups: Group A (Headache SNAG), group B (C1-C2 SNAG rotation), and group C (combined). Neck Disability Index was used to examine neck pain intensity and cervicogenic headache symptoms. The 6-item Headache Impact Test scale was used to examine headache severity and its adverse effects on social life and functions. Flexion-Rotation Test was used to assess rotation range of motion at the level of C1-C2 and confirmed by a cervical range of motion device. Dizziness Handicap Inventory scale was used to evaluate dizziness. The evaluation was done pre- and post-treatment and compared between the groups. [Results] Group C showed significant improvement in all variables compared with groups A and B. [Conclusion] Sustained natural apophyseal glide mobilizations used in the study were effective in reducing cervicogenic headache and dizziness in all groups with a greater improvement in the combined group. The use of cervical SNAG mobilizations is encouraged as a noninvasive intervention depending on the therapist's assessment, findings, and clinical reasoning.
Key words: Cervicogenic headache, SNAG, Cervical snag half rotation

INTRODUCTION

A unilateral headache associated with signs and symptoms of cervical dysfunction worsening on neck movement, prolonged poor head position, or external pressure on painful occipital sites could be an indicator of cervicogenic headache (CGH)[1]. In 2004, the International Headache Society defined CGH as "pain, referred from a source in the neck and perceived in one or more regions of the head and/or face." Different components of the cervical spine, for instance, the zygoapophyseal joints, could contribute to CGH[2].

The mobility of the cervical spine should be evaluated by assessing the range of motion (ROM) of the upper cervical joints. Common clinical diagnostic methods include Flexion-Rotation Test (FRT), active cervical ROM, passive accessory inter-vertebral movement, physiological inter-vertebral movement (PPIM/PPIVM), active cervical flexion test, myofascial trigger points assessment, ischemic pressure tolerance test, and cervical proprioception assessment[3–5].

The "mobilization with movement" concept, known as the Mulligan concept, is entirely distinct from other forms of manual therapy. Mulligan described the sustained natural apophyseal glide (SNAG) on the joint with active movement done by the patient in the direction of the symptoms. This glide should be pain-free, with proper force applied by a trained person[6]. Efficacy of SNAG C1-C2 has been proven in patients experiencing acute to subacute CGH for both short and long-term periods[7, 8].

As a secondary complication of CGH, patients may report dizziness with prolonged neck positions or stiffness. As of today, the management of dizziness of cervical origin is an area of debate. A growing body of compelling evidence supports its treatment with manual therapy interventions[9]. Mulligan recommended that mobilization should be done towards the restricted site or in the direction of symptom reproduction, which is difficult to find in patients experiencing headache and dizziness in only one direction. There is evidence that mobilizing symptomatic and asymptomatic cervical levels results in immediate improvement of pain and segmental mobility at the same level as well as adjacent areas[10]. Therefore, we hypothesized that a combination of the two mobilization techniques might improve the segmental mobility, pain, headache, and associated symptoms on the targeted level and adjacent articular cervical areas.

The purpose of this study was to compare the effect of C2 headache SNAG and C1-C2 SNAG rotation separately as well as in combination in patients with cervicogenic headache regarding improvement of headache, dizziness, as well as overall function.

PARTICIPANTS AND METHODS

The study was conducted in the outpatient clinics of the Faculty of Physical Therapy and the Governmental New Cairo Medical Sector. The whole treatment time was approximately 6 month, from August 2017 to January 2018. The study implemented the principles of the Declaration of Helsinki and followed the Medical Research Involving Human Subjects Act (WMO). It was approved by the Institutional Review Board of the Faculty of Physical Therapy, Cairo University (Approval No.: P.T.REC/012/001616). The purpose, clinical benefits, expectations, and hazards of the study were clearly explained in Arabic to all participants before enrollment into the study and an informed consent form was obtained from those enrolled.

Forty-eight patients with chronic mechanical CGH as confirmed by a neurologist participated in this study. Patients included in the study had experienced headache in the last three months and had unilateral neck pain and stiffness in addition to limited neck ROM of >10° as confirmed by positive FRT. The patients also had dizziness that was triggered by headache and neck extension. Patients were excluded from the study if they had other types of headaches, congenital conditions of the cervical spine, disc herniation, or fractures. Patients with contraindications to mobilization techniques and those with dizziness due to vertebrobasilar insufficiency or vestibular dysfunctions were also excluded.

Using systematic randomization, the participants were divided into three equal groups. Group A (n=16) was treated with cervical headache SNAG C2. Group B (n=16) received cervical SNAG C1-C2 half-rotation technique. Group C (n=16) were treated using a combination of both techniques.

Neck Disability Index (NDI) was used for evaluation of neck disability using information on pain intensity, ability for personal care, ability to lift things, ability to read books, headache, concentration, work and activities of daily living (ADLs)[11]. Dizziness Handicap Inventory (DHI) was used to assess the impact of dizziness on the quality of life. It quantifies the handicapping effect of dizziness imposed by vestibular system disease[12]. The 6-item Headache Impact Test (HIT-6) was used to examine the adverse impact of headache on social functioning, role functioning, vitality, cognitive functioning and psychological health[13]. Flexion rotation test was used to assess the amount of rotation in C1-C2 by passively flexing the head of the patient followed by passive rotation in either direction. The rotation is measured using a CROM device[14]. This method of assessment has been shown to have high intra- and inter-examiner reliability[15]. Two authors shared the baseline and post-treatment assessment; KB and AS. They made their measurements and checked the results with each other.

Baseline characteristics were measured before treatment. Headache intensity and neck pain were measured by NDI, while adverse social and psychological effects of headache were measured using the HIT-6 scale. Amount of rotation between C1-C2 was assessed by FRT and confirmed in degrees using a CROM device. Dizziness reported by patients was evaluated by interviewing patients using the DHI questionnaire.

Treatment protocol was as follows: In group A, the headache SNAG technique was performed with the patient sitting on a chair in the erect posture. The therapist handled C2 spinous process with the middle phalanx of one hand. With the other hand, he performed ventral gliding on C2 for 10 repetitions holding for 10 seconds in each glide with a rest time of 30 seconds in between In group (B), SNAG C1-C2 rotation technique was done according to the patient's restricted site. The therapist placed his thumb over thumb over the transverse process of C1. Then, he glided ventrally with active rotation of the restricted site for 10 repetitions with over pressure end of rotation with a rest time of 30 second between each repetition. In group (C), a combination of both techniques was used for 5 repetitions of each technique. Patients were managed by a certified Mulligan expert physiotherapist (AM) who was supervised by WS or MS.

Table 1. Age, gender, and body mass index of the three study groups

	Group A n=16	Group B n=16	Group C n=16
Age (years)	29.4 ± 2.6	29.3 ± 2.5	29.7 ± 2.7
Gender (male/female)	8/8	9/7	11/5
Weight (kg)	64.5 ± 2.1	66.4 ± 4.8	65.6 ± 4.7
Height (cm)	166 ± 8	170 ± 5	165 ± 10
Body mass index (kg/m^2)	23.1 ± 1.4	23.2 ± 1.4	23.2 ± 1.2

Data are expressed as mean ± SD.

Table 2. Neck Disability Index before and after treatment and its percentage of change in the three study groups

	Group A n=16	Group B n=16	Group C n=16
Neck Disability Index			
Before treatment	29.9 ± 1.7	29.1 ± 2.2	28.4 ± 2.2
After treatment	10.6 ± 2.2*†	11.4 ± 1.9‡	5.1 ± 1.1
% of change	64.7 ± 6.9*†	60.7 ± 7.3‡	82.0 ± 4.2

Data are expressed as mean ± SD.
*Significant difference between the three groups.
†Significant difference between Group A and Group C.
‡Significant difference between Group B and Group C.

Statistical analysis was performed using IBM© SPSS© Statistics version 22 (IBM© Corp., Armonk, NY, USA). Numerical data were expressed as mean and standard deviation. Qualitative data were expressed as frequency and percentage. χ^2 test or Fisher's exact test were used to examine the relationship between qualitative variables. For quantitative data, the comparison between the three groups was made using ANOVA test; then the post-hoc Scheffe test was used for pair-wise comparison. The variables NDI, FRT, HIT-6, and DHI, were not normally distributed; therefore, the post-treatment values and percentage of change were compared using Kruskal-Wallis test. Repeated measures of NDI, FRT, HIT-6, and DHI were compared using Wilcoxon-signed ranks test. All p values were corrected for the repeated analyses. All tests were two-tailed. A p-value<0.05 was considered significant.

RESULTS

There was no significant difference between the three groups regarding age (p=0.909), gender (p=0.549), and body mass index (p=0.983, Table 1). Before treatment, NDI was comparable in the three groups (p=0.095). NDI decreased significantly after treatment in the three groups (p<0.001 for all comparisons). Post-treatment NDI was significantly lower in Group C compared to the other two groups (p<0.001) and was comparable in groups A and B (p=1.000). The percentage drop of NDI was significantly higher in Group C compared to the other two groups (p<0.874), but the magnitude of NDI drop was comparable between Groups A and B (p=1.000, Table 2).

As shown in Table 3, FRT was comparable before treatment in the three groups (p=0.552) and increased significantly after treatment in all the three groups (p<0.001 for all comparisons). After treatment, it was significantly higher in group C compared to the other two groups (p<0.001) and was comparable in groups A and B (p=0.508). The percentage increase of FRT was significantly higher in group C compared to groups A (p=0.044) and B (p=0.001), while it was comparable between groups A and B (p=0.824).

Table 4 shows that before treatment, HIT-6 was comparable in the three groups (p=0.936), and decreased significantly after treatment in all the three groups (p<0.001 for all comparisons). After treatment, it became significantly lower in group C compared to the other two groups (p<0.001) and was comparable in groups A and B (p=1.000). The percentage decrease of HIT-6 was significantly higher in group C compared to the other two groups (p<0.001), while it was comparable between Groups A and B (p=1.000).

Before treatment, DHI was comparable in the three groups (p=0.501) and decreased significantly after treatment in the three groups (p<0.001 for all comparisons). After treatment, it became significantly lower in group B compared to group A (p=0.018). It was comparable between groups B and C (p=0.869) and between groups A and C (p=0.269). The percentage decrease of DHI was significantly higher in group B compared to group A (p=0.035). It was comparable between groups B and C (p=0.720) and between groups A and C (p=0.533, Table 5).

J. Phys. Ther. Sci. Vol. 31, No. 4, 2019

378

Table 3. Flexion Rotation Test before and after treatment and its percentage of change in the three study groups

	Group A n=16	Group B n=16	Group C n=16
Flexion Rotation Test			
Before treatment	24.4 ± 2.7	23.8 ± 2.9	23.3 ± 2.7
After treatment	38.1 ± 1.1*†	39.1 ± 1.7‡	43.1 ± 0.9
% of change	35.9 ± 7.3*†	39.3 ± 7.4‡	45.9 ± 6.4

Data are expressed as mean ± SD.
*Significant difference between the three groups.
†Significant difference between Group A and Group C.
‡Significant difference between Group B and Group C.

Table 4. The 6-Item Headache Impact Test before and after treatment and its percentage of change in the three study groups

	Group A n=16	Group B n=16	Group C n=16
6-Item Headache Impact Test			
Before treatment	67.5 ± 3.4	67.4 ± 3.4	67.1 ± 3.6
After treatment	44.1 ± 2.1*†	43.7 ± 2.2‡	37.8 ± 1.4
% of change	34.4 ± 5.1*†	35.0 ± 3.8‡	43.6 ± 3.7

Data are expressed as mean ± SD.
*Significant difference between the three groups
†Significant difference between Group A and Group C.
‡Significant difference between Group B and Group C.

Table 5. Dizziness Handicap Inventory before and after treatment and its percentage of change in the three study groups

	Group A n=16	Group B n=16	Group C n=16
Dizziness Handicap Inventory			
Before treatment	32.9 ± 1.6	32.5 ± 1.4	32.1 ± 1.9
After treatment	7.3 ± 1.6*#	5.5 ± 1.5	6.1 ± 1.7
% of change	77.9 ± 5.0*#	83.0 ± 4.9	81.0 ± 5.0

Data are expressed as mean ± SD.
*Significant difference between the three groups.
#Significant difference between Group A and Group B.

DISCUSSION

The purpose of the study was to identify the effect of C2 headache SNAG and C1-C2 SNAG rotation as two separate techniques and in combination on CGH with dizziness related to neck pain and stiffness. Till date, no published study has investigated the effect of combining the two SNAG mobilization techniques on headache and dizziness. In our study, patients were assigned to three equal groups and had SNAG mobilizations as two separate interventions in group A and B, and in combination in Group C for three sessions per week for one month under a qualified Mulligan practitioner. Results of the study showed a significant improvement in post-treatment scores of all measured variables within groups and among the groups with the combined groups showing the greatest improvement.

SNAG Mulligan mobilizations are one of the most popular manual therapy techniques found to be effective in treating CGH as mentioned in the "Neck Pain Guidelines 2017" recommended by American Physical Therapy Association (APTA), which reported that patients with neck pain and CGH had significant improvement with self-SNAG C1-C2 for both short and long-term periods[16].

The findings regarding cervical SNAG mobilizations in the current study were in agreement with those of Zito et al.[17] who found that the presence of upper cervical joint dysfunction differentiated patients with CGH from those having migraine

with aura. It also limited the upper cervical ROM in cranio-cervical flexion and rotation, which were not common in the migraine group. They concluded that this treatment for CGH is justified by the fact that the clinical features are due to impairment of the musculoskeletal system[17].

The results reported by Hall et al.[14] and Youssef and Shanb[18] were in line with ours. Hall studied the effect of SNAG C1-C2 on 32 CGH patients with limited FRT who were assigned to two groups. They found a significant reduction in headache intensity and increase in neck ROM in the experimental SNAG group[14]. Youssef and Shanb compared the effect of mobilizations and massage on CGH and reported superior results in the mobilization group[18].

In the current study, significant improvement of the cervical dizziness associated with headache was observed. These results are supported by those of Reid et al.[19] who showed that SNAG had immediate and sustained (for 12 weeks) effect in reducing dizziness, neck pain, and disability caused by cervical spine dysfunction. In 2014, the same research group compared the effectiveness of SNAG with Maitland mobilizations on cervicogenic dizziness and found a reduction of dizziness intensity and frequency after treatment that lasted for 12 weeks compared to baseline with no side effects reported as later as 24 weeks post-treatment.

Recommendations of Mulligan state that if cervical spine extension or flexion is the symptomatic direction, then the glide should be applied ventrally to C2 spinous process while the patient slowly extends or flexes his neck. If rotation is symptomatic then the anterior glide should be applied to the C1 transverse process while the patient rotates his neck slowly in the symptomatic direction[20].

Since it was hard to enroll patients with such specifications as well as to avoid being biased by one technique, we assigned patients randomly to the three groups. In line with previous recommendations, Maitland[21] suggested that mobilization techniques should be selected according to pain site localization, the direction of symptoms reproduction, and the vertebral level producing symptoms.

However, previous studies of Vicenzino et al.[22], Chiradejnant et al.[23], and Cleland et al.[24] demonstrated the opposite, that is, spinal mobilization of even asymptomatic areas results in symptom reduction and increase in segmental mobility at the same level as well as adjacent regions.

Similarly, Aquino et al.[25] who investigated the effect of different levels of mobilizations on symptomatic and asymptomatic cervical levels in patients with chronic nonspecific cervical pain, found significant immediate pain relief in both groups and increase in segmental mobility on different levels. Our results were consistent with those of previous studies in that patients with symptoms and restricted movements, either on rotation around C1-C2 or extension around C2, experienced improvement in symptoms when SNAG C2 or SNAG C1-C2 rotation techniques were used separately. However, greater improvements were observed in group C, which received combined treatment. Improvement in the variables measured in this study demonstrates that the efficacy of SNAG mobilizations is possibly due to the direct stimulation of mechanoreceptors in cervical facet joints that inhibit pain in accordance to the gate control theory[26].

In addition, immediate FRT improvement points to the descending inhibitory pain mechanism that could be activated and mediated by areas of periaqueductal gray of the midbrain as Sterling et al.[27] claimed. Moreover, post-mobilization physiological effects like increased blood circulation and elevated skin temperature can also reduce pain and increase ROM.

Wrisley et al.[28] agreed that dizziness might be caused by dysfunction of cervical mechanoreceptors and deep muscular proprioceptors affecting their input to vestibular nuclei.

In line with the previous studies, Treleaven et al.[29] conducted a study on patients with dizziness and found that significantly greater joint position errors and a higher neck pain index were likely to be present in the experimental group than in the control group, which is consistent with cervical mechanoreceptor dysfunction being a likely cause of the symptoms.

Therefore, SNAG mobilizations for upper cervical spine were found to be an effective method in reduction of dizziness. This is because mobilization applied to the upper cervical spine increases stimulation of proprioceptors in both joints and muscles of this area and normalizes afferent information to the vestibular nuclei. This explanation is supported by previous studies[19, 30].

Limitations of this study can be summarized as follows: the relatively small sample size that limits generalization of results, relative subjectivity of a scale like dizziness handicap inventory which might differ with personality, mood, and psychological support, and lastly some difficulties related to making patients adapted and familiar with the questions of different scales.

Results of this study indicate an objective and promising effect of SNAG mobilization on CGH symptoms with associated dizziness by stimulation of mechanoreceptors of the cervical joints and muscle proprioceptors and by modulation of abnormal afferent signals originating from the upper cervical spine. This study encourages the use of cervical SNAGs as a noninvasive intervention depending on the therapist's assessment, findings, and clinical reasoning.

Conflict of interest

None to declare.

J. Phys. Ther. Sci. Vol. 31, No. 4, 2019

380

REFERENCES

1) Chaibi A, Russell MB: Manual therapies for cervicogenic headache: a systematic review. J Headache Pain, 2012, 13: 351–359. [Medline] [CrossRef]

2) Headache Classification Subcommittee of the International Headache Society: The International Classification of Headache Disorders: 2nd edition. Cephalalgia, 2004, 24: 9–160. [Medline]

3) Ogince M, Hall T, Robinson K, et al.: The diagnostic validity of the cervical flexion-rotation test in C1/2-related cervicogenic headache. Man Ther, 2007, 12: 256–262. [Medline] [CrossRef]

4) Uthaikhup S, Sterling M, Jull G: Cervical musculoskeletal impairment is common in elders with headache. Man Ther, 2009, 14: 636–641. [Medline] [CrossRef]

5) Huber J, Lisiński P, Polowczyk A: Reinvestigation of the dysfunction in neck and shoulder girdle muscles as the reason of cervicogenic headache among office workers. Disabil Rehabil, 2013, 35: 793–802. [Medline] [CrossRef]

6) Teys P, Bisset L, Vicenzino B: The initial effects of a Mulligan's mobilization with movement technique on range of movement and pressure pain threshold in pain-limited shoulders. Man Ther, 2008, 13: 37–42. [Medline] [CrossRef]

7) Racicki S, Gerwin S, Diclaudio S, et al.: Conservative physical therapy management for the treatment of cervicogenic headache: a systematic review. J Manual Manip Ther, 2013, 21: 113–124. [Medline] [CrossRef]

8) Gross A, Kay TM, Paquin JP, et al. Cervical Overview Group: Exercises for mechanical neck disorders. Cochrane Database Syst Rev, 2015, 1: CD004250. [Medline]

9) Lystad RP, Bell G, Bonnevie-Svendsen M, et al.: Manual therapy with and without vestibular rehabilitation for cervicogenic dizziness: a systematic review. Chiropr Man Therap, 2011, 19: 21. [Medline] [CrossRef]

10) Slaven EJ, Goode AP, Coronado RA, et al.: The relative effectiveness of segment specific level and non-specific level spinal joint mobilization on pain and range of motion: results of a systematic review and meta-analysis. J Manual Manip Ther, 2013, 21: 7–17. [Medline] [CrossRef]

11) Vernon H: The Neck Disability Index: state-of-the-art, 1991–2008. J Manipulative Physiol Ther, 2008, 31: 491–502. [Medline] [CrossRef]

12) Kaufman KR, Brey RH, Chou LS, et al.: Comparison of subjective and objective measurements of balance disorders following traumatic brain injury. Med Eng Phys, 2006, 28: 234–239. [Medline] [CrossRef]

13) Kosinski M, Bayliss MS, Bjorner JB, et al.: A six-item short-form survey for measuring headache impact: the HIT-6. Qual Life Res, 2003, 12: 963–974. [Medline] [CrossRef]

14) Hall T, Chan HT, Christensen L, et al.: Efficacy of a C1-C2 self-sustained natural apophyseal glide (SNAG) in the management of cervicogenic headache. J Orthop Sports Phys Ther, 2007, 37: 100–107. [Medline] [CrossRef]

15) Hall T, Robinson K: The flexion-rotation test and active cervical mobility—a comparative measurement study in cervicogenic headache. Man Ther, 2004, 9: 197–202. [Medline] [CrossRef]

16) Blanpied PR, Gross AR, Elliott JM, et al.: Neck pain: revision 2017. J Orthop Sports Phys Ther, 2017, 47: A1–A83. [Medline] [CrossRef]

17) Zito G, Jull G, Story I: Clinical tests of musculoskeletal dysfunction in the diagnosis of cervicogenic headache. Man Ther, 2006, 11: 118–129. [Medline] [CrossRef]

18) Youssef EF, Shanb AS: Mobilization versus massage therapy in the treatment of cervicogenic headache: a clinical study. J Back Musculoskeletal Rehabil, 2013, 26: 17–24. [Medline] [CrossRef]

19) Reid SA, Rivett DA, Katekar MG, et al.: Sustained natural apophyseal glides (SNAGs) are an effective treatment for cervicogenic dizziness. Man Ther, 2008, 13: 357–366. [Medline] [CrossRef]

20) Mulligan BR: Mobilisations with movement and other techniques, 4th ed. Brühl: H. Müller-Frank, 1999, p 114.

21) Maitland GD: Maitland's vertebral manipulation, Oxford: Butterworth-Heinemann, 2002.

22) Vicenzino B, Paungmali A, Buratowski S, et al.: Specific manipulative therapy treatment for chronic lateral epicondylalgia produces uniquely characteristic hypoalgesia. Man Ther, 2001, 6: 205–212. [Medline] [CrossRef]

23) Chiradejnant A, Maher CG, Latimer J, et al.: Efficacy of "therapist-selected" versus "randomly selected" mobilisation techniques for the treatment of low back pain: a randomised controlled trial. Aust J Physiother, 2003, 49: 233–241. [Medline] [CrossRef]

24) Cleland JA, Childs JD, McRae M, et al.: Immediate effects of thoracic manipulation in patients with neck pain: a randomized clinical trial. Man Ther, 2005, 10: 127–135. [Medline] [CrossRef]

25) Aquino RL, Caires PM, Furtado FC, et al.: Applying joint mobilization at different cervical vertebral levels does not influence immediate pain reduction in patients with chronic neck pain: a randomized clinical trial. J Manual Manip Ther, 2009, 17: 95–100. [Medline] [CrossRef]

26) Wright A: Hypoalgesia post-manipulative therapy: a review of a potential neurophysiological mechanism. Man Ther, 1995, 1: 11–16. [Medline] [CrossRef]

27) Sterling M, Jull G, Wright A: Cervical mobilisation: concurrent effects on pain, sympathetic nervous system activity and motor activity. Man Ther, 2001, 6: 72–81. [Medline] [CrossRef]

28) Wrisley DM, Sparto PJ, Whitney SL, et al.: Cervicogenic dizziness: a review of diagnosis and treatment. J Orthop Sports Phys Ther, 2000, 30: 755–766. [Medline] [CrossRef]

29) Treleaven J, Jull G, Sterling M: Dizziness and unsteadiness following whiplash injury: characteristic features and relationship with cervical joint position error. J Rehabil Med, 2003, 35: 36–43. [Medline] [CrossRef]

30) Grieve's modern manual therapy: the vertebral column, 3rd ed., repr. Edinburgh: Churchill Livingstone, 2006, p 643.