ORIGINAL RESEARCH PAPER

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EFFECTIVENESS OF C1-C2 SNAG MOBILIZATION AND DEEP CERVICAL FLEXOR STRENGTHENING IN A PATIENT WITH CERVICOGENIC HEADACHE: A CASE REPORT.

KEY WORDS: SNAG, Deep cervical flexor, Cervicogenic headache, Mulligan mobilization.

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ABSTRACT

Background- Cervicogenic headache is a unilateral headache felt in the occipital, temporal or orbital region and is a common finding in patients suffering from neck pain, ranging from mild to severe in intensity. Several interventions are effective in treating neck pain with headaches that focus on the muscles and joints of the posterior neck. The purpose of this case report is to describe the efficacy of C1-C2 SNAG mobilization and deep cervical flexor muscle (DCFM) strengthening in reducing cervicogenic headache. **Case Description:** This case report describes the effect of training DCFM using a pressure biofeedback unit in addition to SNAG mobilization at C1-C2 in a 46-year-old female patient who presented with cervicogenic headache post neck pain. Upon referral to physical therapy, she was treated for 6 sessions, two sessions per week focusing on pain reduction, posture re-education, improving cervical range of motion, and muscle strength. **Outcome:** Physical therapy intervention targeting DCFM using pressure biofeedback unit along with manual therapy significantly reduced the patient's NPRS score from 8/10 to 3/10 within three weeks and further reduced it to 1/10 at three months and six months follow-up. Her headache duration changed from being constant to intermittent, lasting only few minutes. Neck Disability Index changed from 40 to 18. **Discussion & Coclusion:** Combined intervention of SNAG mobilization and DCFM training is effective in reducing pain in cervicogenic headache. This case report concluded that both treatment intervention when used in combination can be employed as the mainstay treatment in reducing frequency, intensity and duration of this condition.

INTRODUCTION

Cervicogenic headache (CGH) is commonly seen in patients suffering from neck pain. The global prevalence of CGH is estimated to be in the range of 1%- 4% and around 15-20% among the other types of headaches.[1,2] The International Headache Society (IHS) has described CGH as a secondary type of headache classifying it under section 11.2, which describes it as 'headache or facial pain attributed to disorder of the cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cervical structure'.[3]

Although CGH is a commonly encountered condition, it is often reported as a secondary complaint and if left unaddressed, it can progress to becoming chronic.[1] Hence, identifying the type of headache and treating it accordingly can help resolve the pain in time and in the long term. Several studies have been conducted to determine the efficacy of various treatment techniques to treat CGH, of which a combination of manual therapy and exercise therapy has been proven to be the most effective.[4,5] This case report describes the results of combining C1-C2 SNAG mobilization and deep cervical flexor muscles training in effectively reducing a 46-year-old female's CGH.

Patient Description

46-year-old female was referred with complaints of neck pain and right-sided headache, extending from the right occipital region to the right temporal region. Her symptoms began as a result of spending long hours working from home in awkward positions. She reported taking 5 sessions of traditional PT for neck pain, a year ago that did not resolve completely and led to the development of a right-sided headache over a course of four months. The patient did not report any incidents of trauma or injury before developing these symptoms. She performed a home exercise program that included stretching, applying hot packs, and taking over-the-counter pain medications. Her symptoms were aggravated by weight training, working on the computer for extended periods and texting on her mobile phone. When the headache increased in severity and started interfering with her daily activities, she consulted her orthopedic physician who prescribed Mydocalm (tolperisone, a centrally-acting skeletal muscle relaxant) and Tylenol for pain relief.

Medical history was non-significant.

Goals- The patient wanted to resume weight training in the gym 4 times a week, use her mobile phone and laptop for work with no headache, and stop using any pain medication.

Clinical Impression #1:

The most prominent feature of this condition is headache brought on by neck movements or sustained awkward neck positions. The patient's symptoms satisfy the criterion given by the International Headache Society (IHS), i.e., headache caused by neck dysfunction. Migraine and tension-type headaches are two types of headaches that present with overlapping areas of pain such as the occipital, orbital, temporal, and frontal regions, similar to CGH, making it difficult for the clinician to make a clear diagnosis. This can lead to a misdiagnosed condition and render the wrong type of treatment. The IHS and Cervicogenic Headache International Study Group (CHISG) suggest the reduction in cervical range of motion (ROM) as a clinical sign of CGH and recommend diagnostic nerve or joint block to rule in the role of the cervical region in CGH[6]. According to a study done by Getsoian et al., utilizing a cluster of clinical signs such as decreased ROM, painful joint dysfunction, and impaired muscle function can be helpful in the differential diagnosis of CGH[6]. The distinguishing factor in this patient's case is the reduced cervical ROM, neck pain, and pain induced by sustained neck postures. In addition, the patient's X-ray and MRI for the cervical region results were normal. The most involved cervical segment known to disperse pain to the head has been found at the C1-C2 level. Flexion-rotation test (FRT) is a test used to determine the rotation range in the upper cervical region, specifically at the C1-C2 level, performed on days when a patient does not have a headache.[7] The FRT has intra-rater reliability ICC=0.84-0.89 and inter-rater reliability ICC=0.93.[8] The positive likelihood range for the FRT is between 2.33-10.65 and the diagnostic accuracy is between 89 and 90%. Some studies have also found that this test can be utilized by all clinicians, irrespective of their experience level.[9,10] The cut-off value for FRT is 44°, a deduction of more than 10° from this value towards any side of rotation is assumed as a positive test for CGH.[11]

Cranio-cervical flexion test (CCFT) is a low-load test used to evaluate the activity of the deep neck flexor muscles in patients suffering from neck pain. This test has been found to have good inter-rater (ICC>- 0.85-0.86) and intra-rater reliability (ICC>- 0.69-0.81).[8] Positive findings in these tests will further strengthen the need for the above-mentioned intervention.

Examination

On observation, the patient appeared alert with no signs of distress. In sitting and standing, she exhibited a forward head posture with rounded shoulders and thoracic kyphosis. No deviation of head noted. No red flags were identified.

On examination, active ROM for the cervical region was painfully restricted in ranges of flexion, extension, and rotation (right>left). Passive ROM was found to be restricted and triggered her headache with extension and right rotation. The ROM measurements for the cervical region are mentioned in table 1. No reduction of motion was noted in bilateral shoulders. No signs or symptoms of vertebrobasilar artery dysfunction were noted with sustained extension or rotation. The FRT revealed decreased rotation to the right, around 30°.

Assessment of muscle length revealed tightness of bilateral pectoralis major and right upper trapezius muscles. Manual muscle testing was 4+/5 for bilateral upper limbs. The patient was unable to recruit deep flexor muscles, longus capitis and longus colli, at levels of 26 mmHg and higher, evidenced by the increased recruitment of sternocleidomastoid (SCM) muscles. On palpation, tenderness was noted over the right suboccipital muscles, right upper trapezius, bilateral SCM (right > left), and right C1 and C2 articular processes. Point pressure on the suboccipital muscles and right upper trapezius as well as sustained upper cervical extension triggered the patient's headache.

Table 1

Cervical movements	ROM
1. Flexion	60° (Painfully restricted)
2. Extension	50° (painfully restricted)
3. Side flexion	40° bilaterally
4. Rotation	Right- 30o(painfully restricted), Left-45°

Exam procedure	ICF category	Findings
1. Pain (Headache)	Body structure and function	8/10 on Numeric Pain Rating Scale (NPRS)
2. Flexion rotation test	Body structure and function	Painfully restricted at 30 degrees to the right.
3. Cranio-cervical flexion test	Body structure and function	Abnormal at 26 mmHg, as noted by reduced activity of deep neck flexors and increased activity of SCM and anterior scaleni
4. MMT for bilateral upper limb	Body structure and function	4+/5

Clinical Impression-2

On examination, the FRT was found to be approximately 30°, (measured visually), 14° less than the expected 44°. In addition, CCFT revealed decreased activity in the deep flexor muscles and increased activity in the SCM muscle at 26 mmHg and higher. As discussed earlier, reductions in these two parameters have been recurrent findings in patients with CGH. The correction of these dysfunctions using manual therapy and an exercise program may result in a favorable outcome, i.e., reduction in the headache intensity, duration, and frequency, resolution of neck pain, and improved cervical ROM. The outcome measures utilized for this patient were neck disability index (NDI), headache intensity on the NPRS, and headache duration and frequency. The outcomes were recorded on the 1st, 3rd, and 6th sessions and at 3- and 6-month follow-ups. If the interventions were to be successful in mitigating the headache, these would be reflected as reduced scores for each of the outcome measures.

Intervention

The patient attended 6 sessions over a period of three weeks with each session lasting 30 minutes. The sessions aimed to improve her range of motion at the C1-C2 level and the muscular impairment of the deep cervical flexor muscles.

Session 1: A rotational sustained natural apophyseal glide (SNAG) mobilization was performed in sitting at the C1-C2 level. A posterior-anterior (PA) pressure was applied and maintained on the left posterior arch of C1 while the patient actively turned her head towards the right side and returned to the starting position.[13] The end range of rotation was maintained for 10 seconds and the mobilization was performed 8 times. She did not report any pain during the mobilization. On reassessment, the FRT improved by 5° although the patient still complained of pain with movement, following which two more sets of 8 repetitions were completed. After the completion of the two sets, the FRT was measured as 35° with pain at the end range. As a home exercise program (HEP), the patient was taught self-SNAG mobilization with the help of a towel and was advised to perform 3 sets of 8 repetitions, thrice a day.

The patient was taught to perform craniocervical flexion (CCF) by gently nodding her head while sliding the top of her head on the bed and with minimal SCM/ anterior scalenus recruitment. Once, she demonstrated this movement correctly, she was trained progressively with the help of a PBU. The PBU is a commonly used device to provide feedback while performing stabilization exercises of the spine. This equipment consists of a manometer and a balloon connected to a pressure cell which gauges any changes in pressure while the patient performs the exercises, thus guiding the patient to control unwanted movements during exercises. The DCFM activation exercise was performed in a hook-lying position and a small towel was placed under the head to maintain the neck in a neutral position.[14] The pressure sensor was placed under her neck and inflated to 20 mmHg and the patient was asked to perform CCF increasing the pressure by 2 mm Hg and 4 mm Hg above the baseline pressure. She performed 10 repetitions, holding each contraction for 5 seconds with 10 seconds rest.

In addition, she was also taught active ROM neck exercises, and scapular retraction exercises with stretches for the upper trapezius and pectoralis major muscles. She was advised to take frequent breaks and follow proper ergonomics while working and avoid activities that aggravated her symptoms.

Session 2- The patient stated feeling better after the first session and noticed a reduction in her pain. She, however, was not compliant with the home exercise program (HEP) citing her busy schedule. The patient was educated on the importance of following the HEP. SNAG mobilization was continued the same as the last session, (3x8). DCFM training exercises were done using the PBU (3x10) at 26 mm Hg.

Session 3- The patient followed her HEP sincerely and noted a decrease in the duration of the headaches. This session continued as the previous one with SNAG mobilization and DCFM training at 26 mm Hg. Her NPRS score was reduced by 3 points, NDI by 15 points, and headache duration and frequency scores were measured and documented.

Session 4- The patient reported a slight increase in headache intensity after spending long hours working on her laptop without breaks as well as lifting heavy weights in the gym. She was educated on the importance of taking frequent breaks at work, increasing HEP frequency throughout the day, and avoiding symptom-aggravating activities. Session 4 concluded with the same treatment as session 3.

Session 5- The patient reported a reduction in her symptoms and that she was able to perform most of her daily activities without headaches. She was compliant with the exercises and mobilization at home. Her FRT score had improved by 10° since the first session and was mildly painful at the end of the available range. Hence, SNAG mobilization was continued with overpressure applied at the end range by the patient. The patient also showed improvements in her DCFM score depicted by her ability to maintain the pressure at 30 mm Hg on the PBU with minimal activation of the SCM. In this session, she progressed to advanced DCFM exercises in all four positions. She was also advised to start lifting light weights in the gym.

Session 6- The patient's NPRS, FRT, and DCFM scores were measured which showed improvements as they all reduced. SNAG mobilization continued along with thoracic extension exercises, and retraction exercises to address thoracic kyphosis. She was advised to continue with the exercises at home.

Treatment Summary

Session	NPRS	FRT (rt)	DCFM exercises	SNAG mobilization	Post-intervention
Session 1	No headache	30o (pain-ful)	22 and 24 mmHg	PA pressure on the left posterior arch of C1	FRT = 35o still painful

Session 2	6/10	35o (less painful)	26 mm Hg	Same as session 1	FRT 35o pain-free
Session 3	5/10	35o pain-free	26 mm Hg	PA pressure with overpressure at the end range	FRT 40o painful with end range
Session 4	6/10	40o painful	28 mm Hg	Same as session 3	FRT 45o mild pain at the end range
Session 5	5/10	45o pain-free	30 mm Hg	Same as session 3	45o pain-free
Session 6	3/10	45o pain-free	30 mm Hg	NA	45o pain-free

Outcome Measures

The patient's progress was measured using the NPRS, NDI, and the patient's account of the duration and frequency of her headache. The patient's headache duration changed from being constant (>8 hours) in 1st session to 4 hours by 3rd session and <1 hour by the 6th session. The frequency of her headache became infrequent, once a week by the 6th session.

The NPRS and NDI have strong construct validity in the CGH population. The Numeric Pain Rating Scale is the most widely and commonly used patient-reported outcome measure for pain. It is an 11-point scale scored from 0-10, where '0' denotes no pain and '10' denotes the worst pain imaginable.[15] According to a study by Young et. al., the reliability for NPRS in this population has been found to be moderate at 1 week (ICC-0.62) and 4 weeks (ICC-0.72) and fair (0.48) at 3 months follow-up.[16] The MDC and MCID for NPRS for patients with CGH at 4 weeks are 2.4 points and 2.5 points, respectively. The patient's baseline NPRS score in the 1st session was recorded as 8/10, in the 3rd session as 5/10, and in the 6th session as 1/10. As the patient's score is clearly more than the recommended MDC and MCID, we can conclude that the patient made significant progress.

Numeric Pain Rating Scale

1st session	3rd session	4th session	3 and 6-month follow-up
8/10	5/10	3/10	1/10

The NDI is a self-report questionnaire consisting of 10 items, that evaluates the impact of neck pain on a patient's day-to-day activities such as 'personal care, lifting, reading, headaches, concentration, driving, work, sleeping, and recreation.' The patient scores each question on a 6-point scale from 0 (no disability) to 5 (complete disability). The total score is out of 50, with the higher numbers indicating higher disability. The NDI for patients with CGH has been found to have excellent reliability at 1 week (ICC- 0.94), 4 weeks (ICC 0.92), and 3 months follow-up (ICC-0.95). The MCID for NDI at the 4-week follow-up is a change of 5.9-point score. [16] The patient's NDI score also reduced with each session as shown in the following table.

Neck Disability Index

	Baseline (T0)	3rd session (T1)	6th session (T2)
Section 1	5	2	1
Section 2	2	1	0
Section 3	3	2	2
Section 4	4	2	2
Section 5	5	3	1
Section 6	5	4	3
Section 7	4	3	2
Section 8	4	3	3
Section 9	4	3	2
Section 10	4	2	2
Total score	40	25	18

DISCUSSION

This case report showed that a combination of SNAG mobilization and DCFM training when administered together improves the clinical signs of CGH in short term and in 6 months follow-up. The patient's symptoms in this case report satisfy the criterion for the clinical diagnosis of CGH given by IHS and CHISG and her examination revealed a reduced FRT score, reduced cervical ROM, and deep cervical flexor muscle function impairment. The goals of the session were to improve the FRT score through manual therapy and decrease the muscular impairment of the DCF with activation exercises. Various studies have deduced that manual therapy (MT) is more effective than other interventions aimed at reducing CGH.[13,5,4] In this case, SNAG and self-SNAG mobilization at the C1-C2 level was utilized to increase the reduced FRT score. It was noted that with a consecutive increase in the FRT score, the patient's headache intensity and frequency as well as the tenderness over the right C1-C2 articular process were reduced. There was also marked improvement in the cervical ROM in all ranges with each session.

Activation exercises for the DCFM were introduced to address the patient's impaired ability to maintain increasing degrees of CCF. A study by Ahmed et. al. showed similar results and proved the efficacy of training DCFM in reducing headaches. Although this study did not improve FRT score, however, DCFM training reduced headaches. The patient's ability to hold CCF at higher pressures improved significantly with each week corresponding with a decrease in her symptoms.

At the 3-month and 6 months follow-up, the patient did not have any aggravation of the symptoms and had returned to her daily activities without any pain. The result found in this case report is in unison with the results of several studies indicating that MT and exercise therapy should be administered together for positive outcomes in the short and long term.

CONCLUSION

This case report suggests applying the Mulligan method of SNAG mobilization to successfully improve the FRT score and teaching patients activation exercises for the DCFM impairment.

REFERENCES

1. Antonaci, F., & Inan, L. E. (2021). Headache and neck. Cephalalgia : an international journal of headache, 41(4), 438–442. https://doi.org/10.1177/0333102420944878
2. Yang, D. J., & Kang, D. H. (2017). Comparison of muscular fatigue and tone of neck according to craniocervical flexion exercise and suboccipital relaxation in cervicogenic headache patients. Journal of physical therapy science, 29(5), 869–873. https://doi.org/10.1589/jpts.29.869
3. International Headache Society. https://ihs-headache.org/en/resources/guidelines/ Accessed on February 2, 2023.
4. Bini, P., Hohenschurz-Schmidt, D., Masullo, V., Pitt, D., & Draper-Rodi, J. (2022). The effectiveness of manual and exercise therapy on headache intensity and frequency among patients with cervicogenic headache: a systematic review and meta-analysis. Chiropractic & manual therapies, 30(1), 49. https://doi.org/10.1186/s12998-022-00459-9
5. Rodríguez-Sanz, J., Malo-Urriés, M., Lucha-López, M. O., López-de-Celis, C., Pérez-Bellmunt, A., Corral-de-Toro, J., & Hidalgo-García, C. (2021). Comparison of an exercise program with and without manual therapy for patients with chronic neck pain and upper cervical rotation restriction. Randomized controlled trial. PeerJ, 9, e12546. https://doi.org/10.7717/peerj.12546
6. Anarte-Lazo, E., Carvalho, G. F., Schwarz, A., Luedtke, K., & Falla, D. (2021). Differentiating migraine, cervicogenic headache and asymptomatic individuals based on physical examination findings: a systematic review and meta-analysis. BMC musculoskeletal disorders, 22, 1-18.
7. Paquin, J. P., Dumas, J. P., Gérard, T., & Tousignant-Laflamme, Y. (2022). A perspective on the use of the cervical flexion rotation test in the physical therapy management of cervicogenic headaches. Archives of Physiotherapy, 12(1), 1-4.
8. Getsoian, S. L., Gulati, S. M., Okpareke, I., Nee, R. J., & Jull, G. A. (2020). Validation of a clinical examination to differentiate a cervicogenic source of headache: a diagnostic prediction model using controlled diagnostic blocks. BMJ open, 10(5), e035245. https://doi.org/10.1136/bmjopen-2019-035245
9. Blandpied, P. R., Gross, A. R., Elliott, J. M., Devaney, L. L., Clewley, D., Walton, D. M., ... & Robertson, E. K. (2017). Neck Pain: Revision 2017. Clinical practice guidelines linked to the international classification of functioning, disability and health from the orthopaedic section of the American Physical Therapy Association. Journal of Orthopaedic and Sports Physical Therapy, 47, A1-A83.
10. Elizagaray-García, I., Perez-Garcia, L., Párraga-Delgado, R., Javier-Valverde, F., Luedtke, K., & Gil-Martínez, A. (2022). Flexion-rotation test and C0-C2 axial rotation test. Are they equally reliable for novice clinicians?. Musculoskeletal science & practice, 62, 102625. https://doi.org/10.1016/j.msksp.2022.102625
11. Howard, P. D., Behrns, W., Martino, M. D., DiMambro, A., McIntyre, K., & Shurer, C. (2015). Manual examination in the diagnosis of cervicogenic headache: a systematic literature review. The Journal of manual & manipulative therapy, 23(4), 210–218. https://doi.org/10.1179/2042618614Y.0000000097
12. Araujo, F. X., Ferreira, G. E., Scholl Schell, M., Castro, M. P., Ribeiro, D. C., & Silva, M. F. (2020). Measurement Properties of the Craniocervical Flexion Test: A Systematic Review. Physical therapy, 100(7), 1094–1117. https://doi.org/10.1093/ptj/pzaa072
13. Paquin, J. P., Tousignant-Laflamme, Y., & Dumas, J. P. (2021). Effects of SNAG mobilization combined with a self-SNAG home-exercise for the treatment of cervicogenic headache: a pilot study. The Journal of manual & manipulative therapy, 29(4), 244–254. https://doi.org/10.1080/10669817.2020.1864960
14. Salwa, F., AHMED, M. M., & SAWEERES, E. S. (2019). Efficacy of biofeedback exercise of deep neck flexors on cervicogenic headache. The Medical Journal of Cairo University, 87(March), 967-980.
15. https://www.sralab.org/rehabilitation-measures/numeric-pain-rating-scale. Accessed March 17, 2023.
16. Young, I. A., Dunning, J., Butts, R., Cleland, J. A., & Fernández-de-Las-Peñas, C. (2019). Psychometric properties of the Numeric Pain Rating Scale and Neck Disability Index in patients with cervicogenic headache. Cephalalgia : an international journal of headache, 39(1), 44–51. https://doi.org/10.1177/0333102418772584