Original Article

Immediate Effects of Sub-Occipital Muscle Release combined with Sustained Natural Apophyseal Glides on Pain, Blood pressure, and Cervical range of motion in patients with chronic Tension-Type Headache": A Randomized Controlled Trial

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Abstract

Objective: This study aimed to determine the immediate effects of sub-occipital muscle release combined with and without sustained natural apophyseal glides on pain, blood pressure, and cervical ROM in the management of chronic tension-type headache.

Study Design: A Randomized Controlled Trial was conducted.

Place and duration of study: The study was conducted at Fauji Foundation Hospital, Rawalpindi.

Material and Methods: A randomized controlled trial was conducted at Fauji Foundation Hospital, Rawalpindi, comprising 48 patients randomized into two groups. The control group received conventional physical therapy with suboccipital muscle release, whereas the interventional group received additional sustained natural apophyseal glides. Numeric Pain Rating Scale (NPRS), blood pressure (mm Hg), and cervical range of motion (ROM) were used as outcome variables. All measurements were taken before and immediately after the intervention.

Results: The overall mean age of participants was 34.9 ± 11.0 years. Significant differences ($p<0.05$) were observed within the two groups at baseline and after treatment in all variables. Significant differences ($p<0.05$) were observed between the two groups at baseline, except for the Diastolic BP, and cervical right lateral flexion ($p>0.05$) in which no significant results were obtained. A significant difference ($p<0.05$) was observed between the two groups after treatment ($p<0.05$), except for right and left lateral rotation ($p>0.05$) in which no significant results were obtained.

Conclusion: Both conventional physical therapy with suboccipital muscle release and conventional physical therapy, along with suboccipital muscle release and sustained natural apophyseal glides, are effective. However, the latter approach is superior for managing chronic tension-type headaches, as it provides better results in terms of pain relief, blood pressure regulation, and cervical range of motion.

Keywords: Blood Pressure, Chronic Tension-Type Headache, Pain, Suboccipital Muscle release, Sustained Natural Apophyseal glides.

1. Introduction

One of the most reported types of headaches is Tension-type Headache, as it is projected to have an impact on every 2 in 3 individuals in the USA. (1) Headache is one of the most prevalent conditions worldwide, based on the 2019 Global Burden of Disease, and they estimated that tension-type headaches affect an average of 26% worldwide, among 27.1% are women and 23.4% are men suffering from TTH. (2) People who suffer from tension-type headaches explain that the pain is like steady, dull pain on both sides of the head or "a tight band around the forehead". In some cases, it ranges from an occasional mild headache to daily headaches. Psycho myogenic headache,

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, contraction headache, and stress headache are the other names for tension-type headache, while the most widely accepted term today is tension-type headache3. This type of headache has a peak prevalence in the age ranges from 30 to 39 years and declines slightly with age. In population-based studies, this type of headache is present in up to 78% of headache patients, and it is the least distinct of all types of headaches. [2] One of the frequently reported triggers for tension-type headaches is stress, while others are poor posture and inadequate sleep. The frequency of TTHs can be reduced by some relaxation techniques and regular exercise. But if headache pain is long-lasting or occurs frequently, then over-the-counter medications should be made necessary . [3] The pain of TTH does not get worse with routine physical activity and is generally mild to moderate. Vomiting or nausea does not co-exist with tension-type headaches, while it occurs with sensitivity to sound and light, but these two do not exist together. It means that people suffering from tension-type headaches can carry out normal daily activities despite experiencing headaches. But in chronic-type headache, mild nausea appears exclusively. [4] Patients who suffer from tension-type headaches face tenderness in the neck muscles and head, which particularly increases the frequency of attacks of tension-type headache. [2] Also, tension-type headaches and high blood pressure can coexist in individuals, but they are separate conditions with different underlying causes. Stress and anxiety, which are common triggers for tension-type headaches, can also temporarily raise blood pressure . [5] Non-pharmacological management of tension-type headaches includes psychological treatment and physical therapy. These management techniques are more attractive to patients who are reluctant to use drugs. However, ideally, all these methods should be tried in all patients' adjuncts to pharmacotherapy. [6] In addition to pain and musculoskeletal impairments, physiological parameters such as blood pressure may also be influenced in individuals with chronic tension-type headache (cTTH). Stress and anxiety, which are well-established triggers of tension-type headaches, are associated with increased sympathetic nervous system activity, potentially leading to transient elevations in blood pressure. Manual therapy interventions, including suboccipital muscle release and sustained natural apophyseal glides (SNAGs), may contribute to autonomic modulation by promoting relaxation, reducing muscle tension, and decreasing sympathetic overactivity. This may result in a reduction in blood pressure levels. Therefore, assessing blood pressure as an outcome measure provides insight into the broader physiological effects of manual therapy beyond pain relief and functional improvement.

The intervention of manual therapy for tension-type headaches is based on the improvement in the function of the craniocervical muscular skeleton with posture, active stabilization of the cervical spine, and mobilization, which will decrease sensitization, modulate pain perception, and positively impact the inhibitory system at certain spinal cord segments. With these techniques, blood flow to the affected areas increases due to which pain and discomfort. In a study, a greater number of active Trigger points on sub occipital muscle and forward head postures are observed in patients with cTTH as compared to healthy people. [7] Due to stress and poor posture, the suboccipital muscles become tense and tight, which results in headaches. To improve mobility and release tension, stretching and pressure are applied to sub occipital muscles by using the suboccipital muscle release technique. The goal of suboccipital muscle release is to reduce stress levels and promote relaxation. Immobility of joints and stiffness in the muscles of the shoulders and neck contribute to headache, which is then resolved by applying pressure to the specific areas of the spine that come under SNAGs. It is a Mulligan Technique, which is used throughout the spine, sacroiliac joint, and rib cage. SNAG aims to reduce headache symptoms by reducing muscle tension and increasing joint mobility.

For those with tension-type headaches, manual therapy procedures including spine manipulation and mobilization have been shown to be quite

effective, while the specific effects of SNAGs not combined with sub-occipital muscle release have not been extensively studied on tension-type headache patients.

Moreover, Chronic TTH is still unclear, while the pathophysiological theories of peripheral (myofascial nociception) pain mechanism and central (sensitization and inadequate endogenous pain control) will be discussed and described in the literature. [9] In recent research, it has been reported that there is a relationship between impairment of craniocervical musculoskeletal function and chronic tension-type headache. These functions include neck mobility, trigger points in the trapezius muscle, and forward head position. [10] But until now, in the treatment of cTTHs, there is a lack of evidence, so no definite conclusion regarding the use of manual therapy can be obtained. [11] Furthermore, as far as we are aware, no prior research has compared the effects of SNAGs and the sub-occipital muscle release technique in the treatment of chronic tension-type headaches, particularly with regard to systolic and diastolic blood pressure, which highlights the significance of the current study.

2. Materials & Methods

Ethical approval was obtained from the ethical review committee of "Foundation University School of Health Sciences (FUSH)" and is in accordance with the Declaration of Helsinki and CONSORT guidelines. The study was also prospectively registered at clinicaltrials.gov (National Institute of Health, US), ID: NCT05883813, as per CONSORT and ICMJE recommendations. This study was conducted in accordance with ethical standards and principles. Institutional Review Board (IRB) or Ethics Committee approval was obtained before the commencement of the research (Reference number: FF/FUMC/215-271-1 Phy/213). Informed consent was acquired from all participants involved in the study. The research was conducted with respect for participant privacy, confidentiality, and autonomy. Participants were briefed regarding the details of the study, confidentiality of the documentation, a brief explanation of Mulligan's SNAGs and suboccipital muscle release technique and exercises, and their role in reducing pain and improving functional ability.

A parallel design randomized controlled trial was conducted at the Neurological Department of Fauji Foundation Hospital from July 2022 to July 2023. A total of 48 patients were included via non-probability purposive sampling and randomized into two groups, namely the Control (conventional physical therapy with suboccipital muscle release) and Interventional (conventional physical therapy, suboccipital muscle release along with sustained natural apophyseal glides) groups, via a lottery method. No dropouts were reported, and all 48 patients were analyzed after the study (Fig. 1). It was a single-blind study in which patients were unaware of which group they were assigned. The Numeric Pain Rating Scale (NPRS), blood pressure (mm Hg), and cervical range of motion (ROM) were used as outcome measurement tools. Cervical range of motion (ROM) was assessed using a universal goniometer, a reliable and widely used clinical instrument. ROM measurements included cervical flexion, extension, bilateral lateral flexion, and rotation, and were recorded in a standardized manner pre- and post-intervention to ensure consistency and accuracy. The alternate hypothesis for the current study was that a significant difference exists between the immediate effects of suboccipital muscle release with and without SNAGS in the management of chronic tension-type headaches.

Patients aged 18–64 years of both genders diagnosed with chronic tension-type headache

(cTTH) according to the International Classification of Headache Disorders-3 (ICHD-3) criteria were included in the study.Inclusion criteria were as follows: Headache occurring on ≥15 days/month on average for >3 months (≥180 days/year), Headache lasting hours to days or unremitting, At least two of the following characteristics: Bilateral location, Pressing or tightening (non-pulsating) quality, Mild to moderate intensity, Not aggravated by routine physical activity (e.g., walking or climbing stairs). Both of the following: No more than one of photophobia, phonophobia, or mild nausea, Neither moderate nor severe nausea or vomiting , Not better accounted for by another ICHD-3 diagnosis. [12] Patients with other types of primary or secondary headache, like cervicogenic headache, history of trauma to the cervical spine, vertigo, dizziness, uncompensated neck tension, spurling test positive, flexion or extension compression test positive, cervical flexion rotation test positive, and pregnancy were excluded from the study.

The intervention was given by a manual physical therapist with clinical experience. Both groups received heat therapy and transcutaneous electric nerve stimulation (TENS) for 10 minutes each before muscle release. Stretching exercises for muscles, including trapezius and levator scapulae with 1 set of 5 repetitions, with 3 seconds hold in each position. The Control (conventional physical therapy with suboccipital muscle release) group received 5 min of general warm-up exercises, suboccipital muscle release with the patient in the supine position, with the eyes closed and the physiotherapist's hands placed under the patient's head, in contact with the suboccipital muscles. The physiotherapist progressively increased the pressure exerted during the 10 minutes of treatment. [13] The Interventional (conventional physical therapy, suboccipital muscle release along with sustained natural apophyseal glides group, on the other hand, received additional headache SNAGs in a sitting position, therapist stabilizes the patient's head against their body while his middle phalanx of the little finger contacts the posterior aspect of patient's C2 spinous process and thenar eminence of non-contact hand presses anteriorly in the horizontal plane against the little finger of opposite hand. 3 repetitions of each glide were given and maintained for 10 seconds each. The glides were tapered as per individual needs and the progression of the condition. [14] Both groups received a single treatment session as we were studying the immediate effects of treatment.

The sample was calculated using the OpenEpi Version 3 sample size calculator, keeping the confidence interval at 95%, a power of 80%, a ratio of sample size 1, entering the mean and standard deviation of the primary outcome variable, i.e., pain of both groups (experimental and control), and a resultant sample of 48 was calculated. [15]

The data was assessed for normality using the Shapiro-Wilk test of normality, showing $P<0.05$, indicating asymmetrical distribution of data; non-parametric tests of significance were used for the analysis of data. The Mann-Whitney U test was used for between-group analysis, while the Wilcoxon Signed Rank test was used for within-group analysis.

3. Results

Of the 56 subjects initially assessed, 48 (85.7%) were included. Of them, no one was lost to follow-up, and 48 (100%) completed the study. The overall mean age of participants was 34.90 ± 11.00 years. There were 17 (35.4%) males and 31 (64.5%) females. The interventional group consisted of 7 (29.2%) males and 17 (70%)

females, whereas the control group had 10 (41%) males and 14 (58.3%) females (Table I).

Table I: Demographic Data of participants

Descriptive Statistics		Interventional Group(conventional PT+suboccipital MR+SNAG's)	Control Group(conventional PT+suboccipital MR)	p-value
		(n=24)	(n=24)	
Age (years)	Mean ± SD	35.2±11.80	34.5±10.40	0.87
Gender	Male[n(%)]	7(29.2%)	10(41%)	
	Female[n(%)]	17(70%)	14(58.3%)	

n(%): number (%), SD: Standard Deviation, SNAGs: Sustained Natural Apophyseal Glides, PT= Physical Therapy, MR= Muscle Release

At baseline, there were significant differences ($p<0.05$) between the two groups, except for the Diastolic BP, cervical right lateral flexion ($p>0.05$), in which no significant results were obtained. A significant difference ($p<0.05$) was observed between two groups after treatment ($p<0.05$) except for right and left lateral rotation ($p>0.05$) in which no significant results were obtained, concluding SNAGs in addition to suboccipital muscle release and conventional physical therapy to be more effective than suboccipital muscle release and conventional physical therapy in the management of chronic tension type headache except for the outcomes of right and left lateral rotation (Table II).

Table II: Inter-Group comparison in terms of Pain, Blood Pressure, and Cervical Range of Motion

Variable		Time	Interventional Group		Control Group		p-Value
			Median (IQR)	Mean Rank	Median (IQR)	Mean Rank	
Pain		Pre	7(1)	20.04	7(1)	28.96	0.01
		Post	4(1)	20.04	5(0)	28.96	**0.01***
Diastolic Blood Pressure		Pre	80(20)	23.98	90(20)	25.02	0.07
		Post	80(10)	26.75	80(15)	22.25	**0.02***
Systolic Blood Pressure		Pre	120(20)	25.79	120(16)	23.21	0.05
		Post	120(10)	28.29	120(10)	20.71	**0.00***
Cervical Range of Motion	Flexion	Pre	45(12)	17.79	50(5)	31.21	0.00
		Post	52(10)	18.63	55(5)	30.38	**0.00***
	Extension	Pre	45(10)	30.24	40(3)	18.58	0.00
		Post	50(5)	28.73	50(5)	20.27	**0.02***
	Right Rotation	Pre	70(5)	23.04	70(8)	25.96	0.04
		Post	80(5)	26.79	75(5)	22.21	**0.02***
	Left Rotation	Pre	70(5)	22.69	70(7)	26.31	0.03
		Post	80(5)	26.33	75(5)	22.67	**0.03***
	Right Lateral Flexion	Pre	35(8)	25.56	35(10)	23.44	0.57
		Post	45(5)	25.27	45(5)	23.73	0.06
	Left Lateral Flexion	Pre	35(5)	25.90	35(10)	23.10	0.04
		Post	45(5)	25.29	45(5)	23.71	0.06

IQR: Inter Quartile Range, *p-value significant at <0.05

A comparison of the two groups' before and after intervention ratings revealed substantial changes ($P < 0.05$) for every category, indicating that both treatment approaches, SNAGs in addition to suboccipital muscle release with conventional physical therapy, and suboccipital muscle release with conventional physical therapy, are effective in the treatment for chronic tension-type headaches (Table III).

Table III: Intra-Group comparison in terms of Pain, Blood Pressure, and Cervical Range of Motion

Variable		Time	Interventional Group		Control Group	
			Median (IQR)	P-Value	Median (IQR)	p- Value
Pain		Baseline	7(1)	0.00*	7(1)	0.00*
		Post Rx	4(1)		5(1)	
Diastolic Blood Pressure		Baseline	80(20)	0.00*	90(20)	0.00*
		Post Rx	80(10)		80(15)	
Systolic Blood Pressure		Baseline	120(20)	0.00*	120(16)	0.00*
		Post Rx	120(10)		120(10)	
Cervical Range of Motion	Flexion	Baseline	45(12)		50(5)	
		Post Rx	52.5(10)	0.00*	55(5)	0.00*
	Extension	Baseline	45(10)		40(3)	
		Post Rx	50(15)	0.00*	50(5)	0.00*
	Right Rotation	Baseline	70(5)		70(8)	
		Post Rx	80(5)	0.00*	75(5)	0.00*
	Left Rotation	Baseline	70(5)		70(7)	
		Post Rx	80(5)	0.00*	75(5)	0.00*
	Right Lateral Flexion	Baseline	35(9)		35(10)	
		Post Rx	45(5)	0.00*	45(5)	0.00*
	Left Lateral Flexion	Baseline	35(10)		35(5)	
		Post Rx	45(5)	0.00*	45(5)	0.00*

IQR: Inter Quartile Range, *p-value significant at <0.05

4. Discussion

The focus of the present study was to compare suboccipital muscle release with conventional physical therapy versus SNAGs, in addition to suboccipital muscle release with conventional physical therapy on pain, blood pressure, and cervical range of motion in chronic tension-type headache. Both of the groups reported improvement in blood pressure, pain, and cervical range of motion after intervention, with P <0.05. When comparing between groups, SNAGs, in addition to suboccipital muscle release and conventional physical therapy, yielded greater improvements than suboccipital muscle release with conventional physical therapy. There is little research on how suboccipital muscle release and SNAGs, either separately or combined, affect systolic and diastolic blood pressure and all components of cervical range of motion in subjects with chronic tension-type headache.

It is important to note that the current study evaluated the immediate effects of a single treatment session, reflecting the short-term neurophysiological and mechanical responses to manual therapy interventions. Immediate improvements observed in pain and cervical mobility may be attributed to mechanisms such as reduction in muscle tension, improved joint mobility, modulation of nociceptive input, and activation of descending pain inhibitory pathways. These findings are clinically relevant, as early symptom relief may enhance patient compliance, reduce distress, and support the initiation of longer-term rehabilitation programs.

Although chronic tension-type headache is a long-standing condition, the assessment of immediate effects provides valuable insight into the initial therapeutic response, which is often used by clinicians to guide treatment selection and progression. In clinical practice, early improvement following manual therapy techniques such as SNAGs may serve as an indicator of treatment responsiveness and help in individualized patient management.

The results of the current study are in accordance with those of R. Tachii. et al (2015). They found that SNAGs, in addition to neck isometric exercises and a hot pack, showed that individuals with persistent nonspecific neck pain saw a substantial improvement in cervical joint position sense (CJPE), pain (NPRS), and neck disability (NDI). [16] However, there was no systolic and diastolic blood pressure included in R. Tachii. et al's study, and all movement components of cervical range of motion were not observed either. On the contrary, a study by Krupa D. Tank (2018) showed that Because both groups shown equivalent efficacy in terms of VAS, NDI, and cervical range of motion, Muscle Energy Technique and Mulligan SNAGS can be utilized as an alternative treatment in addition to traditional therapy for mechanical neck discomfort. [17] Moreover, a comparative study demonstrated no significant difference between myofascial release (MFR) and Mulligan Sustained Natural Apophyseal Glides (SNAGs) on pain, restricted ROM, and disability in non-specific low back pain. [18]

In our study, SNAGs, in addition to suboccipital muscle release with conventional physical therapy, showed improvement in pain. The results are consistent with a Muhammad Khan-led inquiry. et al. (2014), who found that in individuals with cervicogenic headaches, SNAGs mobilization has been more successful in lowering pain than Posterior Anterior Vertebral Mobilization (PAVMs). [19] These findings emphasize the potential advantages of SNAGs in reducing pain. Furthermore, a study by EJ Shin et al. (2014) has also reported that Middle-aged female patients with cervicogenic headaches can benefit from the SNAGs approach, which relieves both headache and cervical discomfort. It can also be applied to headaches in physiotherapy. [20]

Between-group analysis of the current study showed that systolic and diastolic blood pressure showed significant improvement in the interventional group. These findings may reflect autonomic nervous system modulation, particularly a reduction in sympathetic activity and enhanced parasympathetic response following manual therapy interventions. However, the literature on this outcome remains limited and inconsistent, highlighting the need for further investigation. But according to normality analysis, baseline data were non-normally distributed for systolic blood pressure, and this could be because some patients had slightly high but within range systolic blood pressure, whereas other patients had at low in range systolic blood pressure, so eventually all of them had different systolic blood pressure at baseline. The results are in contrast to that, a study by Z Mehmood et al. (2022) reported they did not observe any significant difference in systolic and diastolic blood pressure after treatment with sustained natural apophyseal glide with traction and traction alone. [21] And there is no study present in the literature to investigate the outcomes of blood pressure after performing either SNAGs or suboccipital muscle release on any of the patients.

In the current study, while observing the effects of these treatments on cervical range of motion, we found that all components of range of motion showed significant improvement immediately in between-group analysis, with superiority of the interventional group as compared to the control group, whereas right and left lateral rotation showed p value >0.05 indicates no statistically significant difference. Overall, while the findings demonstrate the effectiveness of both interventions in the short term, caution should be exercised in generalizing these results to long-term clinical outcomes. Future studies incorporating multiple treatment sessions and follow-up assessments are warranted to establish sustained effects and long-term clinical benefits in patients with chronic tension-type headache. And according to normality analysis, baseline data were non-normally distributed for all the components of cervical range of motion except for cervical right lateral flexion. This could be because every patient could have a different intensity of chronic tension-type headache, with some having the least limitations and others having extreme limitations in range. The results are in line with the findings of a study by K Vijayan et al. (2022), which showed that In patients with non-specific neck discomfort, the short-term use of Mulligan SNAGs in conjunction with traditional physiotherapy is effective in lowering pain, enhancing cervical range of motion, and restoring the lowered CV angle. [22] Whereas, a study by Krupa D. Tank (2018) showed that for mechanical neck pain, the Muscle Energy Technique and Mulligan SNAGS all groups shown equivalent efficacy in terms of VAS, NDI, and cervical range of motion. [17]

And as in our within-group analysis, we found that both groups reported improvement in all outcomes immediately, and both groups had manual therapy techniques incorporated in it, control group had the suboccipital muscle release technique, and the interventional group had suboccipital muscle release and SNAGs both. So our within-group results are also in accordance with the study by JA Mesa-Jimenez et al. (2015), They found that manual treatments were somewhat more successful than pharmaceutical medical medication therapy in the short term in lowering the frequency, severity, and duration of tension-type headaches. [23]

Despite the fact that our study is the only one that has examined this subject, no other research has evaluated the effects of SNAGs and suboccipital muscle release, either together or individually, in the treatment of chronic tension-type headaches. Systolic and diastolic blood pressure in individuals with persistent tension-type headaches is being examined for the first time in this study.

Conclusion:

Both suboccipital muscle release with conventional physical therapy and SNAGs, in addition to suboccipital muscle release with conventional physical therapy, are found to be effective in the management of chronic tension-type headache in terms of pain, range, and blood pressure. However, SNAGs, in addition to suboccipital muscle release with conventional physical therapy is found to be superior to suboccipital muscle release with conventional physical therapy only in terms of pain, systolic and diastolic blood pressure, and improvement in cervical range of motion; however, there were no discernible variations between the cervical right and left lateral rotation ranges of motion. These findings highlight the potential role of SNAGs as an effective adjunct in the early management phase of chronic tension-type headache. Nevertheless, as this study evaluated only immediate effects, further research is required to determine the long-term efficacy and clinical applicability of these interventions.

Limitations

The present study has several limitations. Firstly, the outcomes were assessed immediately after a single treatment session; therefore, the long-term effects and sustainability of improvements could not be determined. Given that chronic tension-type headache is a persistent condition, future studies should include longer follow-up periods and multiple treatment sessions to evaluate sustained clinical benefits. Despite these limitations, the study provides important preliminary evidence regarding the immediate clinical effects of manual therapy interventions, which may assist clinicians in early-stage decision-making and treatment planning.

Future Recommendations

Multicenter/longitudinal studies across KPK., Pre-post CPD intervention trials., Qualitative exploration of barriers (e.g., focus groups).

Disclosure /Conflict of interest:

Authors declare no conflict of interest.

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