A Study to Compare the Effects of Sustained Natural Apophyseal Glides and Suboccipital Release Technique Combined with Conventional Exercises on Pain and Functional Disability Among Subjects with Mechanical Neck Pain in the Adult Population

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Abstract
Background: Among diverse neck pain, Mechanical neck pain is the most common type, with pain confined to the posterior aspect of the neck. The SNAG's basic principle of clinical management is the immediate cessation of pain and an increase in range of motion (ROM). In contrast, the Suboccipital release technique is proven to be effective in reducing functional disabilities and pain. Review of literature showed that there is a lack of evidence to allow conclusions to be drawn about the effectiveness of SNAGs when compared with the Suboccipital release technique for relieving mechanical neck pain and decreasing functional disability.
Methods: A minimum of 45 subjects, including both males and females, were selected for the study as per the inclusion and exclusion criteria between the age groups of 19-28 years. To assess pain intensity and functional disability, the Visual Analog Scale (VAS) and Neck disability index (NDI) were used, respectively.
Results: Results revealed a significant reduction in pain and functional disability across all groups; however, the SNAGs group exhibited the most substantial improvement. Statistical analysis confirmed that SNAGs produced greater reductions in both VAS and NDI Scores compared to the Suboccipital Release Technique and the control group ($p<0.05$).
Conclusion: SNAGs are superior to the Suboccipital Release Technique in reducing neck pain and associated disability. Integrating SNAGs into standard physiotherapy protocols may enhance clinical outcomes.

Keywords: Mechanical Neck Pain, SNAGs, Suboccipital Release

1. Introduction:

This generation is well known for its technology. The prolonged use of smartphones, laptops, and computers alters the posture of the neck, which results in nonspecific neck pain (1). Pain has been defined by the International Association for the Study of Pain (IASP) as: "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of damage" (2). It is more common in the adult population. Almost all individuals experience neck pain at some point in their lives, as it is a common musculoskeletal issue. It is the fourth leading cause of disability. Females report neck pain more frequently than males. The adult population (ages 15-74 years) shows a point of prevalence ranging from 5.9% to 38.7% (3). Among diverse neck pain, Mechanical neck pain is the most common type, with pain confined to the posterior aspect of the neck (4). Trigger points, which are most commonly located in the suboccipital, cervical, and shoulder muscles, can send pain to the head (5). Mechanical neck pain dysfunction is commonly referred to as simple or non-specific neck pain (NSNP) (6). It is a pain that radiates from the back of the skull to the shoulder and the lower cervical spine. As a result of this discomfort, the cervical spine and ribcage joints are unable to perform proper biomechanical movements, which results in reduced mobility and pain. Lack of physical activity and structural changes in the cervical spine's tissue can lead to a decrease in cervical range of motion and can increase connective tissue density, shortening of collagen tissue, and muscle fibrosis (7). Many different factors can contribute to neck pain, but the most common causes are poor ergonomic practices at work and prolonged periods of sitting with an unhealthy neck position, nervousness, and some destructive games and leisure activities (8).

The length of time that symptoms persist can determine the categorization of neck pain, which can be considered acute if it lasts for less than 6 weeks, subacute if it persists for 3 months or less, or chronic if it continues for more than 6 months. The length of time experiencing neck pain is linked to the overall prognosis for future outcomes. A shorter duration of neck pain suggests better long-term results (3). The treatment protocols that are used for Mechanical neck pain include pain killers, muscle relaxants, anti-inflammatory drugs, muscle relaxation training (YOGA), manipulation techniques, dry needling, and physical therapy management. Modalities give symptomatic relief, but manual therapy targets the source of the problem and corrects the faulty posture (1).

Manual therapy (MT) interventions in combination with exercises appear to be beneficial in chronic non-specific neck pain (NS-NP), for pain as well as functionality. The mobilization concept known as Mulligan with movement (MWM) is an essential aspect of the clinical practice among numerous manual physiotherapists. The effective treatment involves the combined efforts of both the therapist, who applies the necessary accessory movements, and the patient, who actively performs physiological movements. The Mulligan concept consists of three techniques for the spine: Natural Apophyseal Glides (NAGs), Sustained Natural Apophyseal Glides (SNAGs), and Mobilization with Movement (MWM). One of the fundamental principles of clinical management, according to SNAG, is to promptly alleviate or stop pain while enhancing the range of motion (4). The fundamental beliefs of Mulligan's concept are:

All techniques are carried out within a pain-free framework.

The accessory treatment force is applied along the facet planes of the spinal joints.

The techniques are developed to overcome joint 'positional fault'.

Repetitions of glide with active movement.

Pain-free over-pressure at the end of range.

Self-mobilization. SNAGs are defined as sustained repositioning of one articular surface on its neighbour while a movement or function is undertaken. SNAGs are always involved with the end range of joint movement. Sustained Natural Apophyseal Glides are very useful in the treatment of the cervical, thoracic, and lumbar spine. SNAG's technique was developed by Brian Mulligan, which is a combination of a sustained facet glide with movement applied at the facet joint between cervical C2-C7. It is usually done in a sitting or standing position. SNAGs mobilization is done on the facet where glides are sustained with active movement, followed by overpressure, and glides are maintained until the joint returns to its original position (9).

The Suboccipital region is present between the occipital and the spine of the axis vertebrae. the four muscular layers are represented as trapezius, splenius capitis, semispinalis, and longissimus. Suboccipital release is also known as cranial base release. The musculature in the neck and upper back often contains numerous overactive trigger points. Occipital release is another method that can be beneficial in the treatment of trigger points. It has also been called 'inhibitive cervical manual traction'. A gentle, slight pulling force to the muscles and ligaments at the back of the neck is applied. Pressure is exerted directly on the musculotendinous junction of the muscles in the neck to promote relaxation, particularly at the area near the base of the skull (10). A wide variety of treatment protocols for mechanical neck pain are available; however, the most effective management remains an area of debate. There is a lack of evidence to allow conclusions to be drawn about the effectiveness of SNAGs when compared with the Suboccipital release technique in combination with exercises for relieving mechanical neck pain. Therefore, this study will add to the growing body of knowledge that if these two techniques yield similar results, or if one technique is superior to the other, which should be the alternate choice of therapy.

2. Subjects & Methodology

2.1 Study Design: Quasi-experimental study, comparative in nature. Convenient sampling was done. The study was performed in the OPD of D.A.V. Institute of Physiotherapy and Rehabilitation, Jalandhar. The duration of the study was one and a half years. A total of 45 subjects (male and female) were enrolled in the study and divided into three groups: Group A, Group B, and Group C. Group A served as the Control group, while Groups B and C were the Experimental Groups (1 and 2). A minimum of 15 subjects were allocated in each group.

Inclusion criteria: Participants in the study were young adults aged 18–29 years who provided written informed consent before participation. They presented with mechanical neck pain persisting for at least six weeks (subacute) to several months (chronic) in duration, and experienced cervicogenic headache. Characteristic features included unilateral head pain referred from cervical structures (commonly from C1–C3 joints or soft tissues), exacerbated by neck movement or sustained postures, accompanied by reduced cervical range of motion, neck stiffness, and, in some cases, ipsilateral shoulder or arm discomfort.

Exclusion criteria: Participants were excluded if they had undergone recent spinal or proximal upper limb surgery, sustained fractures, or harboured metal implants in these regions. Serious pathologies, such as severe osteoporosis, infectious or inflammatory conditions (including whiplash or cervical stenosis), malignancy, or active infective skin disorders (for example, psoriasis, eczema, or urticaria), also disqualified subjects from participation. Additionally, individuals with structural abnormalities like torticollis or Sprengel's shoulder, vascular syndromes such as basilar artery insufficiency, or those unable or unwilling to cooperate with the study protocol were not eligible for inclusion

2.2 Procedure

All the subjects were selected based on the following inclusion and exclusion criteria. A written informed consent was obtained from all the subjects, and they were assessed for pain level with a visual analogue scale (VAS) and functional disability with the Neck Disability Index (NDI). Group A (Control group) subjects were treated with a moist heat pack, burst transcutaneous electrical nerve stimulation (burst mode of frequency 10-200 Hz and pulse width of $100\text{-}250_{us}$) for 15 minutes, and Conventional exercises (Neck isometrics and passive stretching), 5 repetitions with 30-second holds. Group B (Experimental group) was given Sustained Natural Apophyseal Glides (SNAGs 6 repetitions of 3 sets/ session, along with a Hot pack, TENS, and Conventional exercises (Neck isometrics and passive stretching). Group C (Experimental Group-2) was treated with Sub-occipital Release Technique for 5 minutes along with a Hot pack, TENS, and Conventional exercises (Neck isometrics and passive stretching). A total of 10 treatment sessions were given to each group, 5 sessions per week for 2 consecutive weeks.

2.3 Control Group

The intervention protocol consisted of a combination of electrotherapy, thermotherapy, and therapeutic exercises targeting the cervical spine. Burst-mode Transcutaneous Electrical Nerve Stimulation (TENS) was administered with the patient positioned either in a prone or a comfortable seated posture. The stimulation was applied for 15 minutes, using a frequency range of 10–200 Hz and a pulse width of 100–250 µs. The intensity was gradually increased according to the patient's tolerance to ensure a therapeutic yet comfortable level of stimulation.

In addition, superficial heat therapy was applied using a hydrocollator hot pack placed over the cervical region for 15 minutes. During the application, patients were seated with their heads supported by their forearms, which rested on a table, allowing for relaxation and effective heat penetration.

Following the modalities, participants were instructed in a set of conventional therapeutic exercises, which included both stretching and strengthening routines specifically targeting the cervical musculature. These exercises aimed to enhance muscular flexibility, strength, and overall neck function.

Isometric Exercises: In a seated position, the subject performed an isometric push against the hand to strengthen the neck. The subject was instructed to hold the left palm against the left side of the head and push the left hand against the head while simultaneously pushing the head toward the left hand with approximately half strength. This position was held for 30 seconds. The same procedure was repeated with the right hand on the right side of the head, as well as using either hand at the back of the head and the forehead. This exercise was performed five times per set.

Figure: 1(a) **Figure: 1(b)**


Figure: 1(c) **Figure: 1(d)**

Figure 1 a, b, c and d representing Cervical isometrics

Active Stretchings:

Upper Trapezius: The subject, seated, was instructed to reach the right arm over the head so that the palm rested on top of the skull with fingers positioned just above the left ear. With light fingertip pressure, the weight of the arm gently bends the head toward the right shoulder while keeping the shoulders relaxed. The subject maintained a forward gaze. This position was held for 30 seconds and repeated five times per set.

Figure: 2 representing active stretching of upper trapezius

Levator Scapulae: The subject either sat or stood with relaxed shoulders. The head was turned 45 degrees to one side while looking down, tucking the chin into the chest. To enhance the stretch, the subject used the hand on the same side to apply light pressure on the head. The stretch was held for 30 seconds while maintaining deep breathing and was repeated five times.

Figure: 3 representing active stretching of levator scapulae

2.4 Experimental Group 1 (Sustained Natural Apophyseal Glides)

Position of the subject: The subjects were seated in a supportive low-back chair.

Position of the therapist: The therapist stood behind the patient, placing the medial border of the thumb of the stabilizing hand on the posterior aspect of the spinous process. The pulp of the thumb of the mobilizing hand reinforced the lateral side of the stabilizing thumb. The fingers of both hands were positioned comfortably on the mandible. The subject was instructed to actively perform the painful or restricted movement. The therapist applied an anterior glide to the spinous process of the targeted cervical vertebrae, directed toward the Mulligan SNAGs were administered for each cervical movement in sets of 3, with 6 repetitions per session.

Figure: 4(a) Starting position **figure: 4(b) ending position**

Figure 4 showing application of SNAGs

2.5 Experimental Group 2 (Suboccipital Release technique)

Position of the subject: The subject was positioned in the supine position with both arms extended straight at the sides, maintaining external rotation of both shoulders and supination of the lower arms and hands.

Position of the therapist: The therapist sat in the direction of the subject's head, with the subject's head resting on both of the therapist's hands. The tips of the fingers, excluding the thumbs, were used to support the suboccipital muscles, applying consistent pressure between the fingers and the suboccipital muscles. This pressure was maintained for five minutes while simultaneously applying slight traction in the direction of the head.

Figure: 5 representing Suboccipital Release Technique

3. Results

The present study compares the effects of sustained natural apophyseal glides (SNAGs) and suboccipital release technique (SRT) combined with conventional exercises on pain, range of motion (ROM), and functional disability among subjects with mechanical neck pain in the young adult population. The statistical analysis was performed using SPSS software version 22.0. A level of significance of 0.05 was used to determine the statistical significance. Both within-group and between-group analysis was done to analyse dependent variables [Score of Visual Analogue Scale (VAS) for pain, Score of Neck Disability Index (NDI) for functional disability]. Group were compared by one factor analysis of variance (ANOVA) or two factor (period x group) repeated measures ANOVA (RM ANOVA) and the significance of mean difference within (intra) and between (inter) the groups were done by Tukey's HSD post hoc test after ascertaining normality by Shapiro-Wilk's test and homogeneity of variance between groups by Levene's test. The baseline data were recorded on the first day before treatment, and then readings were taken on the 5^{th} day post-treatment and then on the 10^{th} day post-treatment for pain and functional disability.

The pre (day 1) and post (day 5 and day 10) VAS score of three groups (Group A, Group B and Group C) is summarised in Table 2 and also shown in Fig. 3. In all groups, the mean VAS score decreased comparatively after the treatment and the decrease was highest in Group B followed by Group C and Group A, the least (Group A < Group C < Group B).

For each group, comparing the difference in mean VAS score between periods (i.e. intra group), Tukey test showed significant ($P < 0.001$) decrease in VAS score at both day 5 and day 10 as compared to day 1 in all groups (Table 3 and Fig. 4). Further, in all three groups, it also showed significant ($P < 0.05$ or $P < 0.01$ or $P < 0.001$) decrease at day 10 as compared to day 5.

Similarly, for each period, comparing the difference in mean VAS score between groups (i.e. inter group), Tukey test showed similar ($P > 0.05$) VAS score between groups at day 1 suggesting it comparable among the groups (Table 4 and Fig. 5). However, at both day 5 and day 10, it showed significant ($P < 0.05$ or $P < 0.001$) decrease in both Group B and Group C as compared to Group A. Further, at day 10, it also showed a significant ($P < 0.001$) decrease in Group B as compared to Group C.

At final evaluation (i.e. after day 10), the net mean decrease (i.e. mean change from day 1 to day 10) or improvement in pain of Group B (83.2%) was found 48.5 and 28.2% higher respectively as compared to Group A (34.7%) and Group C (55.0%).

Intra-group analysis:

Time Period	Group A (n=15)	Group B (n=15)	Group C (n=15)
day 1	6.53 ± 0.92	6.73 ± 1.10	6.67 ± 0.90
day 5	5.27 ± 1.16	2.87 ± 1.06	3.93 ± 0.96
day 10	4.27 ± 1.49	1.13 ± 0.83	3.00 ± 1.07

Table 1: VAS (score) of three groups over the periods

The VAS scores of the three groups were summarised as Mean ± SD.

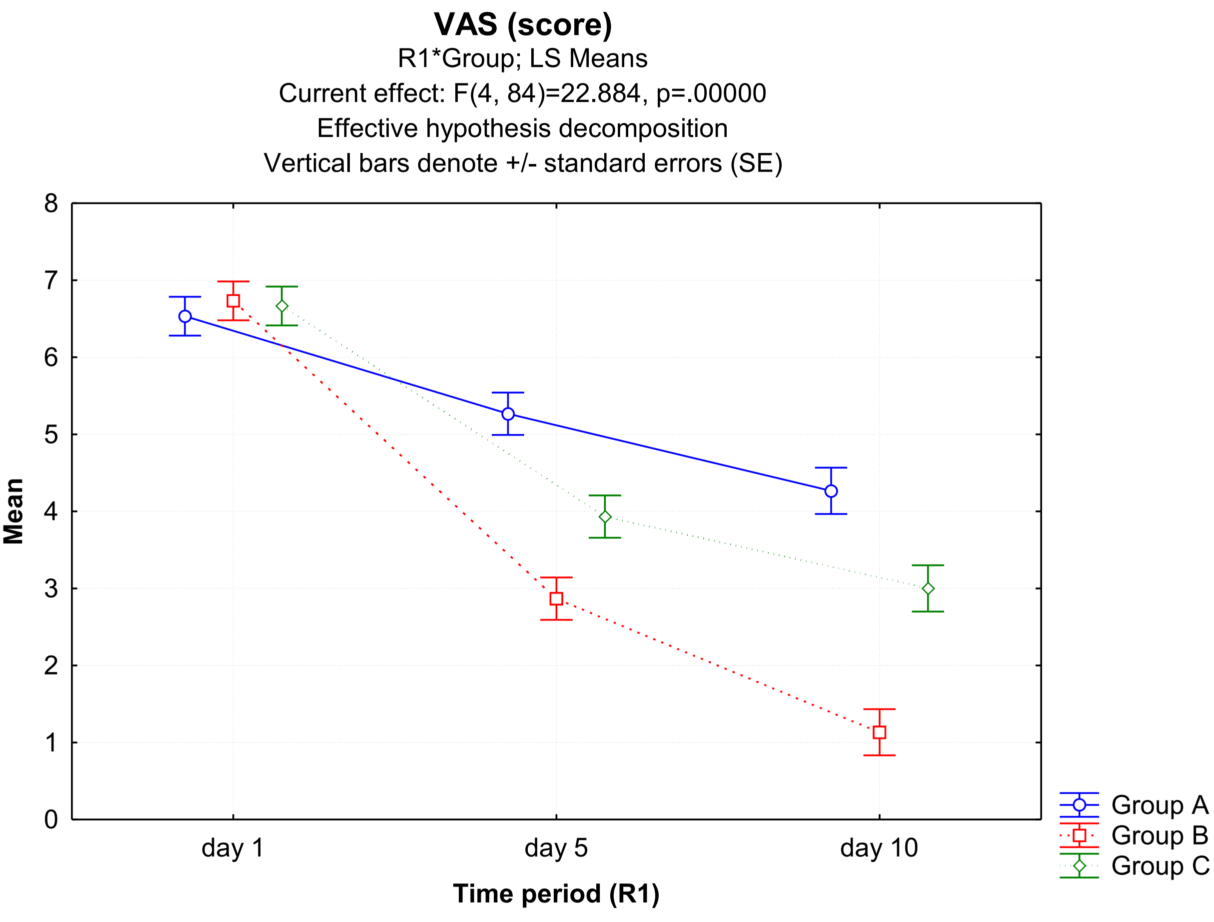
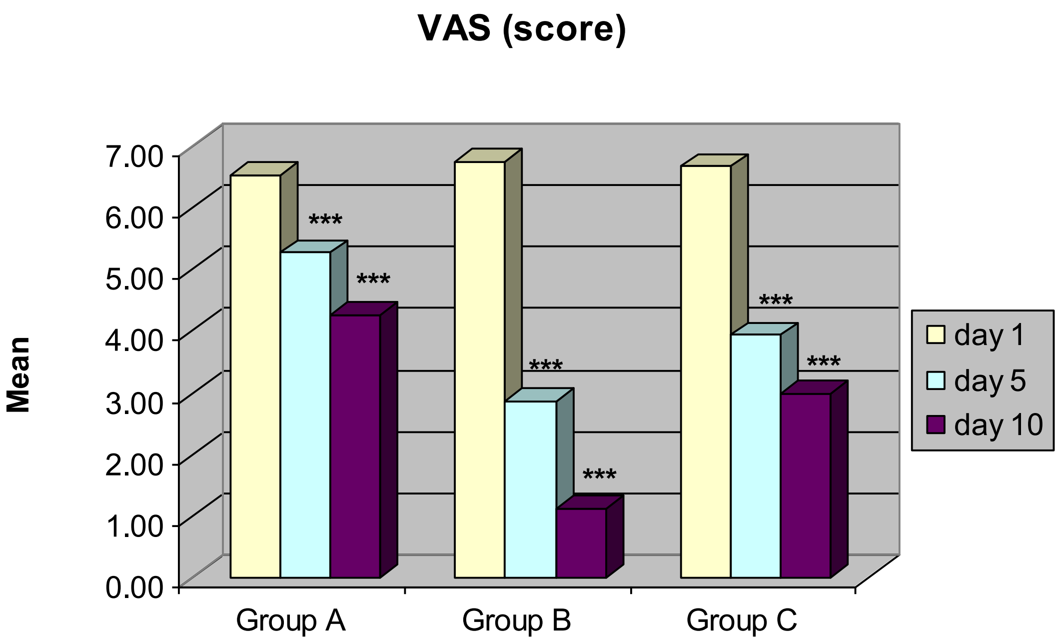


Fig. 6. Mean VAS score of three groups over the periods.

Comparison	Group A		Group B		Group C	
	Mean diff	*P* value	Mean diff	*P* value	Mean diff	*P* value
day 1 vs. day 5	1.27	< 0.001	3.87	< 0.001	2.73	< 0.001
day 1 vs. day 10	2.27	< 0.001	5.60	< 0.001	3.67	< 0.001
day 5 vs. day 10	1.00	0.007	1.73	< 0.001	0.93	0.017

Table 2: For each group, comparison (*P* value) of the difference in mean VAS (score) between periods by the Tukey test.

Diff: difference.



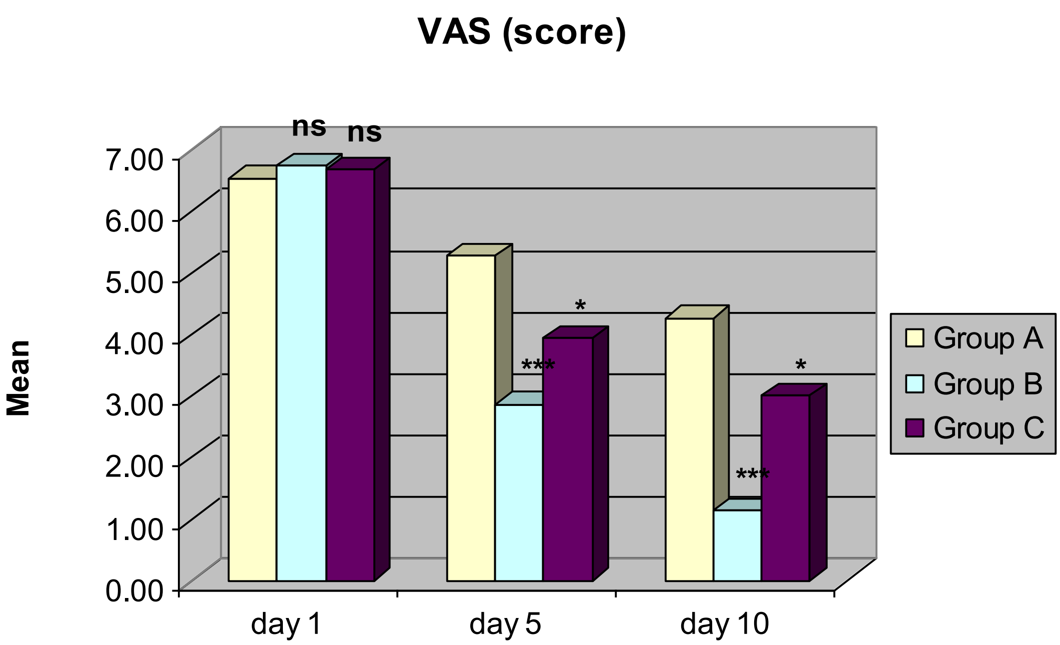
***$P < 0.001$- as compared to day 1

Fig. 7. For each group, comparisons of the difference in mean VAS score between periods.

Comparison	day 1		day 5		day 10	
	Mean diff	*P* value	Mean diff	*P* value	Mean diff	*P* value
Group A vs. Group B	0.20	1.000	2.40	< 0.001	3.13	< 0.001
Group A vs. Group C	0.13	1.000	1.33	0.027	1.27	0.044
Group B vs. Group C	0.07	1.000	1.07	0.154	1.87	< 0.001

Table 3: For each period, comparison (*P* value) of the difference in mean VAS (score) between groups by the Tukey test

Diff: difference.



$^{ns}P > 0.05$ or $^{*}P < 0.05$ or $^{***}P < 0.001$- as compared to Group A

Fig. 8. For each period, comparisons of the difference in mean VAS score between groups.

Neck disability index

The pre (day 1) and post (day 5 and day 10) NDI score of three groups (Group A, Group B and Group C) is summarised in Table 5 and Fig. 6. Like VAS score, the mean NDI score also showed marked decreased after the treatment in all groups and the decrease was highest in Group B followed by Group C and Group A, the least (Group A < Group C < Group B).

For each group, comparing the difference in mean NDI score between periods (i.e. intra group), Tukey test showed significant ($P < 0.05$ or $P < 0.001$) decrease in NDI score at both day 5 and day 10 as compared to day 1 in all groups (Table 6 and Fig. 7). Further, in both Group B and Group C, it also showed significant ($P < 0.05$ or $P < 0.001$) decrease at day 10 as compared to day 5.

Similarly, for each period, comparing the difference in mean NDI score between groups (i.e. inter group), Tukey test showed similar ($P > 0.05$) NDI score between groups at day 1 suggesting it comparable among the groups (Table 7 and Fig. 8). Further, it also not differ ($P > 0.05$) between the groups at day 5 i.e. found to be statistically the same. However, at day 10, it showed a significant ($P < 0.05$ or $P < 0.001$) decrease in Group B as compared to both Group A and Group C, but found statistically similar ($P > 0.05$) between Group A and Group C.

At final evaluation (i.e. after day 10), the net mean decrease (i.e. mean change from day 1 to day 10) or improvement in neck disability of Group B (65.6%) was found 49.5 and 32.0% higher respectively as compared to Group A (16.0%) and Group C (33.6%).

Intra-group analysis:

Time Period	**Group A (n=15)**	**Group B (n=15)**	**Group C (n=15)**
day 1	46.13 ± 10.60	44.13 ± 13.74	47.27 ± 11.13

day 5	40.27 ± 12.32	27.33 ± 11.87	37.13 ± 12.05
day 10	38.73 ± 12.63	15.20 ± 8.06	31.40 ± 12.25

Table 4: NDI (score) of three groups over the periods

The NDI scores of the three groups were summarised as Mean ± SD.

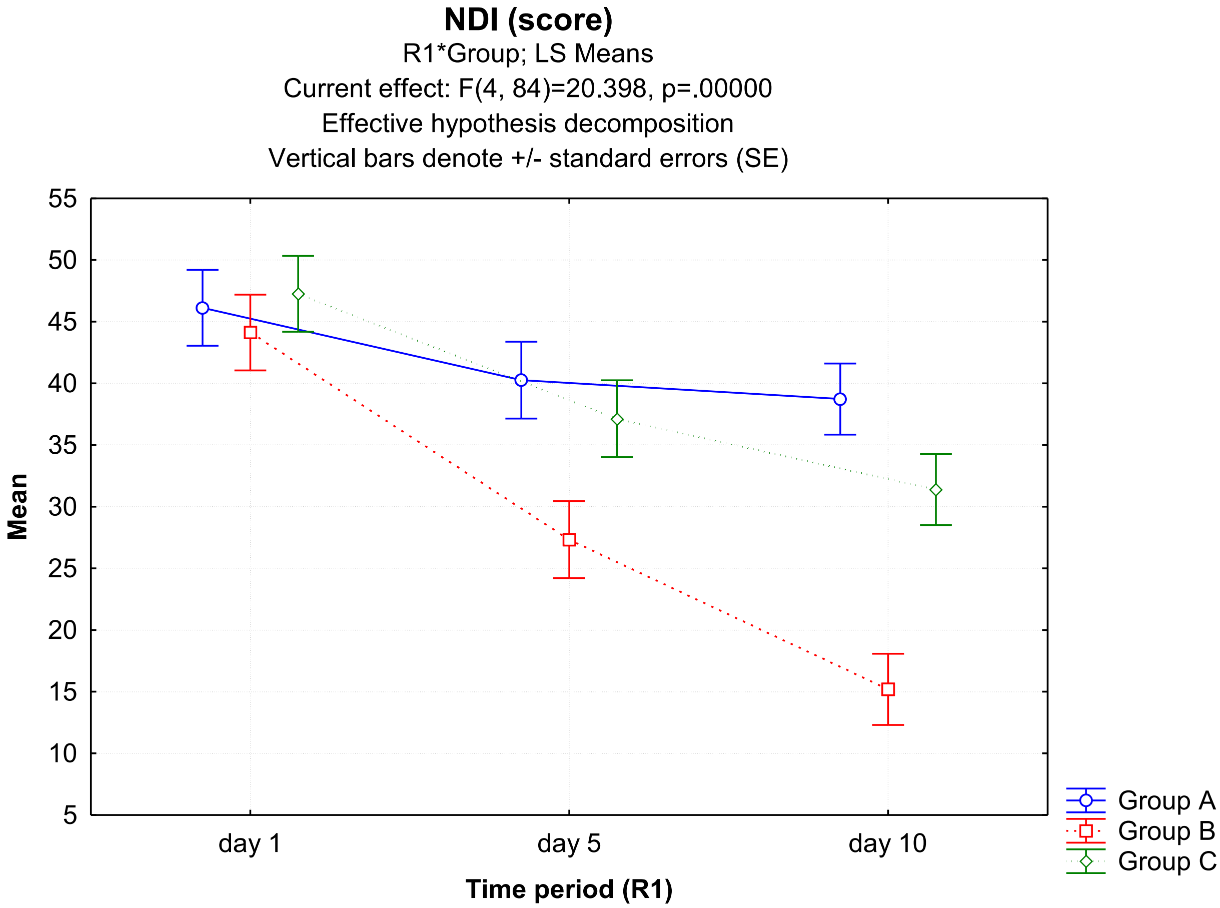
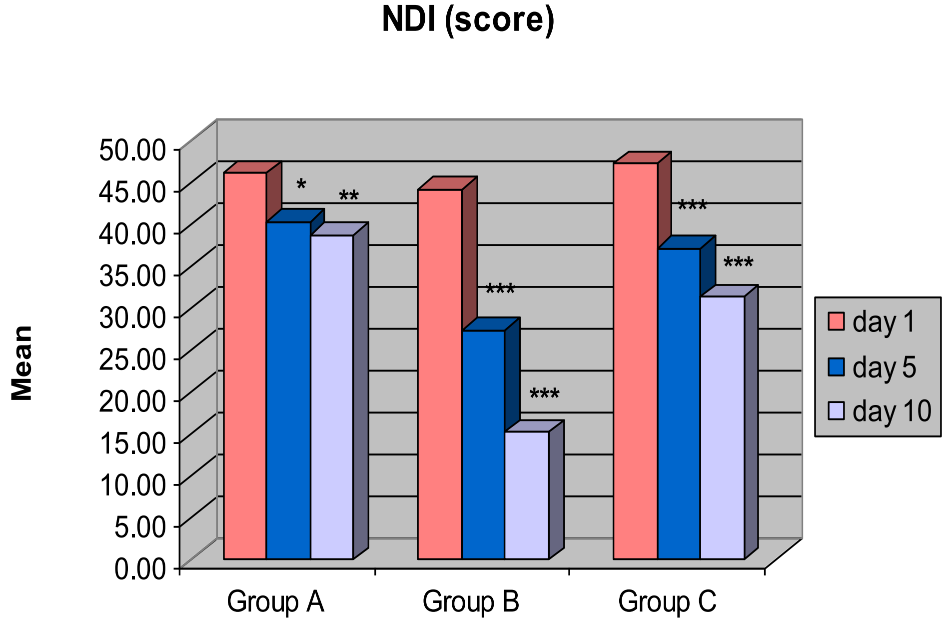


Fig. 9. Mean NDI score of three groups over the periods.

Comparison	Group A		Group B		Group C	
	Mean diff	*P* value	Mean diff	*P* value	Mean diff	*P* value
day 1 vs. day 5	5.87	0.023	16.80	< 0.001	10.13	< 0.001
day 1 vs. day 10	7.40	0.001	28.93	< 0.001	15.87	< 0.001
day 5 vs. day 10	1.53	0.992	12.13	< 0.001	5.73	0.029

Table 5: For each group, comparison (*P* value) of the difference in mean NDI (score) between periods by the Tukey test

Diff: difference.



$^{*}P < 0.05$ or $^{**}P < 0.01$ or $^{***}P < 0.001$- as compared to day 1

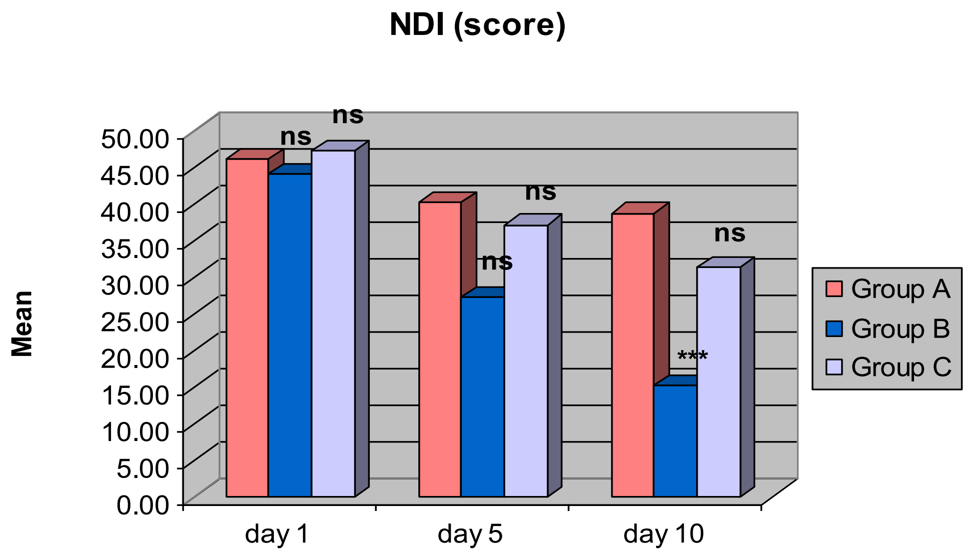
Fig. 10. For each group, comparisons of the difference in mean NDI score between periods.

Inter-group analysis:

Comparison	**day 1**		**day 5**		**day 10**	
	Mean diff	***P* value**	**Mean diff**	***P* value**	**Mean diff**	***P* value**
Group A vs. Group B	2.00	1.000	12.93	0.085	23.53	< 0.001
Group A vs. Group C	1.13	1.000	3.13	0.998	7.33	0.736
Group B vs. Group C	3.13	0.998	9.80	0.368	16.20	0.011

Table 6: For each period, comparison (*P* value) of the difference in mean NDI (score) between groups by the Tukey test

Diff: difference.



$^{ns}P > 0.05$ or $^{***}P < 0.001$- as compared to Group A

Fig.11. For each period, comparisons of the difference in mean NDI score between groups.

Analysis showed that Group A experienced a 34.7% reduction in VAS scores and a 16.0% improvement in NDI. Although the improvements were significant, they were substantially lower than those observed in the experimental groups. Group B exhibited an 83.2% reduction in pain scores (VAS), a 65.6% improvement in NDI. In our study findings of Group C demonstrated a 55.0% decrease in visual analog scale (VAS) scores and a 33.6% reduction in the Neck Disability Index (NDI).

4. Discussion

This study compared the effectiveness of Sustained Natural Apophyseal Glides (SNAGs) and the Suboccipital Release Technique (SRT), combined with conventional exercises, on pain and functional disability in adults with mechanical neck pain. The findings revealed significant improvements in pain and functional outcomes across both intervention groups. These results are consistent with previous studies supporting the use of manual therapy and multimodal interventions in the management of neck pain.

Thermotherapy was one component of the intervention. Lehmann and de Lateur (2022) (13) noted that superficial heat reduces connective tissue viscosity and enhances muscle flexibility, while Benjaboonyanupap et al. (2015) (14) demonstrated that hot pack application promotes circulation and reduces pain through thermal effects. These findings reinforce the physiological basis for using heat to prepare tissues for further treatment.

The role of Burst-mode TENS is also supported by Rodríguez-Fernández et al. (2011) (15), who found that it improved cervical ROM and pressure pain thresholds at myofascial trigger points.

Exercise interventions, particularly cervical extensor strengthening, have shown significant benefits. Zhang et al. (2024) (16) reported improvements in pain, ROM, muscle mass, and posture following a long-term cervical exercise program. Similarly, Amjad et al. (2024) (17) found both isometric and isotonic exercises effective for reducing pain and improving function.

Similarly, the benefits of stretching are also supported by prior research. Ylinen et al. (2007) (18) and Shariat et al. (2018) (19) demonstrated that regular stretching improves flexibility and reduces neck pain. The efficacy of SNAGs in improving cervical mobility and reducing pain is reinforced by Shajahan et al. (2024) (20) and Reid et al. (2008) (21), who found SNAGs beneficial for pain, disability, and posture correction. Likewise, the use of suboccipital release is supported by Aggarwal et al. (2024) (22) and Hasaneen et al. (2018) (23), who reported enhanced pain relief and mobility when it was added to conventional care.

Rezkallah and Abdullah (2018) (4) further support the combined use of manual therapy and exercise, showing that SNAGs and myofascial release yielded greater improvements compared to exercise alone; however, the SNAGs group benefited the greatest. Their findings echo the current study's conclusion that integrating manual techniques with exercise provides superior outcomes in managing mechanical neck pain.

5. Limitations and Future Scope

One limitation of this study is the use of the Visual Analogue Scale (VAS) for assessing pain, which relies on patients' perception and can lead to differences in how pain is reported. The short duration of the intervention also limits the ability to understand the long-term effects of the treatments. Additionally, the study involved only a small number of young adults, which makes it harder to apply the findings to older individuals or the general population. Another limitation is the lack of follow-up.

Future studies should include larger and more diverse groups of participants to improve the accuracy and generalizability of results. Research conducted over a longer period, with follow-up assessments, would help in understanding the lasting effects of treatment. Combining manual therapy with other rehabilitation techniques may offer added benefits and should be explored. It is also recommended that future research include broader outcome measures such as patient satisfaction, mental well-being, and quality of life for a more complete view of treatment success.

6. Conclusions

The present study concluded that Sustained Natural Apophyseal Glides (SNAGS) are significantly more effective than the Suboccipital Release Technique (SRT) when combined with conventional exercises in improving pain and functional disability among individuals with mechanical neck pain. Therefore, SNAGs, along with conventional therapy, can be recommended as a superior manual therapy technique for managing mechanical neck pain in the young adult population.

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