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RESEARCH ARTICLE

High Velocity Low Amplitude Manipulation versus Sustained Apophyseal Glides on Pain and Range of Motion in Patients with Mechanical Neck Pain: An Immediate Effect.

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Abstract

Background: Mechanical neck pain (MNP) is a very common musculoskeletal disorder in which zygapophyseal joint dysfunction is a common source of disorder. Objective: To explore and compare effects of cervical high velocity low amplitude (HVLA) manipulation versus sustained natural apophyseal glides (SNAGs) on pain, intervertebral mobility and cervical range of motion (ROM). **Subjects:** Forty patients with chronic (MNP) participated in this study, their age ranged from 20 to 40 years with a mean 26.33 ± 5.45 years. **Methods:** Patients were randomly assigned into HVLA and SNAGs groups. Variables were evaluated pre and immediately after treatment, including pain intensity (by Visual Analogue Scale), X-Ray fluoroscopy was used to assess Intervertebral Mobility in Lateral bending to the Affected side "IVMLBAS" and Intervertebral Mobility in Lateral bending to the Contralateral Side "IVMLBCS" CROM device was used to assess Range of Motion of Lateral Bending to the Affected side “ROMLBAS” and Range of Motion of Lateral Bending to the Contralateral side "ROMLBCS". **Results:** Results showed that both techniques were effective in improving evaluated variables. Post-treatment evaluations revealed that mean values and pain intensity, IVMLBAS, IVMLBCS, IVMF, IVME, ROMLBAS, ROMLBCS, were (3.98 ± 1.47, 3.08 ± 1.19), (22.61± 1.81, 22.49 ± 2.16), (22.43± 2.19, 22.4± 2.3) , (37.15± 6.57, 35.8 ± 5.66), (36.9± 5.00, 36.85±5.47), for group-I and II respectively. **Conclusion:** Both cervical HVLA and SNAGs proved to be effective in improving pain intensity, IVMLBAS, IVMLBCS, ROMLBAS, ROMLBCS. SNAGs yielded more favorable effects on pain intensity than manipulation.

INTRODUCTION

Mechanical neck pain (MNP) is classically defined as a neck disorder characterized by generalized neck and/or shoulder pain secondary to cervical spine mechanical dysfunctions. (**Barry and Jenner, 1995**) Neck pain is a widespread disorder, the overall prevalence of neck pain in the general population with the overall mean of 23.1%. Prevalence is generally higher in high-income, urban countries compared with low- and middle-income, rural countries. **(Hoy et al., 2010)**

Chronic neck pain is the second musculoskeletal disorder associated with injury and disability after chronic low back pain. Approximately 10% of the population reports having neck pain on at least 7 days per month, and neck pain (of unspecified duration) occurs in at least 80% of the population at some time **(Bovim et al, 1994), (Côte et al, 1998**) with a 20–30% annual incidence of neck pain in population-based studies **(Croft et al, 2001)** that will cause psychological distress and socio-economic problems and disability (**Linton, 2000**).
Regardless of the origin of the MNP, it persists as a vicious circle, including pain, reflex muscle guarding, ischemia that further decreases range of motion and cervical dysfunction, resulting in cervical segment hypomobility**.** (**John and Triano, 2001; Fryer, 2004)** Patients suffer from MNP are generally coming with stiffness and/or pain felt mainly posteriorly in the cervical region, with referral contribution along myotomal pattern anteriorly to the chest, posteriorly to the dorsal spine, as well as the arm (**Bovim et al., 1994**).
Many treatment forms are prescribed for MNP including oral non-steroidal anti-inflammatory drugs, acupuncture, manipulation, massage, electrotherapy, therapeutic exercises **(Bogduk, 1999).** Manipulative therapy techniques are also commonly used to treat neck pain. Manual therapy was previously used as a separate therapeutic technique or in conjunction with other procedures as exercise and proved to be effective in treating patients suffering from acute and chronic neck pain as well as cervicogenic headaches **(Gross et al., 2002) (Bronfort et al., 2004).**
Many beneficial effects are reported regarding application of cervical manipulation in patients with neck problems of mechanical origin. The documented benefits involve improvement, range of motion, overall function and in reduction in pain score. (**Jim et al, 2005)** Beneficiary radiological changes were documented following application of cervical manipulation in patients with MNP **(Yeomans, 1992), (Fernández-de-las-Peñas, 2005).** Manipulation techniques increase the active range of motion (ROM) and reduce pain immediately post-treatment in patients with MNP **(Baltaci, 2001**).
Mulligan technique is a manual therapy procedure usually utilizing a joint glide manually induced, applied to a dysfunctional spinal motion segment (pain and hypomobility) and sustained is performed **(Exelby, 2002)**. A sustained natural apophyseal glide (SNAG) of the cervical spine was first introduced by Mulligan and was described in a number of clinical texts, has a respectable clinical acceptance **(Mercer 2004), (Chaitow and Wilson, 2002)**.
Many studies have reported the efficacy of various manual therapy techniques in treatment of patients with MNP. Despite HVLA manipulation and SNAGs are widely used techniques in clinics as a part of MNP treatment program; but the therapeutic superiority of either cervical HVLA manipulation or sustained apophyseal glides (SNAGs) is still controversial. Cervical SNAGs was described theoretically to produce greater accessory gliding motion than a similar but faster procedure such as a manipulation but there is a lack of clear evidence regarding the effectiveness of cervical HVLA manipulation versus SNAGs in patients with MNP **(Pérez et al., 2014)** and relating its effect to increase the intervertebral mobility (IVM) and radiological changes that may occur after manipulation. Thus we compared the immediate effects of cervical HVLA manipulation or SNAG techniques on measures of pain, IVM and ROM in patients with MNP to test the hypothesis of that both techniques have similar effects on evaluated variables.
Treatment with either cervical manipulation or SNAGs is an interesting approaches which has hypoalgesic, inhibitory effect for muscle spasm, and beneficiary mechanical effects. Although many studies have reported the efficacy of various manipulative procedures in the treatment of MNP; but the application of cervical manipulation or SNAGs is still controversial**.** Therefore, more researches are needed to explore the underlying mechanisms and therapeutic effects of cervical manipulation or SNAGs and then to justify the applicability of them for clinical practice.
Up to our knowledge and available literature, this is the first study comparing the changes of radiograghical findings IVM in response to the Cervical HVLA Manipulation versus SNAG technique.

Material and Methods

Subjects

Sixty eligible, volunteer, patients with (MNP) were recruited screened to be enrolled in this study. Of them; ten patients were excluded from the study because they respond negatively to pre-study lateral glide test, 4 patients were associated with significant X-Ray changes (spondylosis, instability), 2 Patients were suspected to have vertebrobasilar insufficiency, and additional 4 patients were initially excluded because of dissatisfaction with the program.
The remaining Forty patients (23 women and 17 men) fulfilled the inclusion criteria of the study, had no exclusion criteria, provided informed consent form giving agreement for participation and publication of the results of the study, they underwent the initial evaluation, completed the described treatment and underwent the final evaluation. This study protocol was reviewed and approved by the corresponding Institutional ethical committee.
Inclusion criteria: All patient were diagnosed by orthopedist as having non-specific (MNP) without radiculopathy for more than three months, age ranged between 20 and 40 years, patients with neck stiffness and hypomobility involvement, clinical presentation of inter-vertebral joint dysfunction at one side from any level of C4 till C6 confirmed by the lateral gliding test **(DeStefano, 2003) (Fernandez-de-la-penas et al., 2005)**.

Exclusion criteria: Any contraindication to manipulation (bone injuries, infections, neoplasm, rheumatoid arthritis, ankylosing spondylitis, vertebrobasilar insufficiency (VBI), and neurological diseases, no other vertebral disorder, no history of cervical spine surgery, any patient responded negatively to the lateral glide test, any patient responded positively to VBI test.

Prior to the start of the study, patients were completely informed about the purposes of the study. Concerning the methodology; participants were told that manual therapy procedure will be applied to cervical spine. The subjects had no knowledge of whether cervical HVLA manipulation or SNAGs was being received during the study.

A preliminary power analysis was performed to detect proper sample size required for this study in which (power (1-β error probability) = 0.8, $\alpha = 0.05$, effect size = 0.8); where number of groups=2 and number of measurements=2), resulting in a sample size of total 40 patients. The utilized effect size was used because it yielded a realistic sample size so as to clarify differences in the measured variables. To avoid bias; after medical counseling, patient were randomly allocated through computer-generated random numbers into either HVLA manipulation group **(group-I; n= 20)** or SNAGs group **(group-II; n= 20).**

Outcome measures: Initial medical screening was performed for each patient by the physician; clinical history was documented for all participants. All participants underwent an identical battery of tests. Subjects were told to avoid extra-ordinary activities and heavy meals in the 2 hours prior to testing. The principal evaluated parameters were pain intensity, Intervertebral Mobility in Lateral bending to the Affected side "IVMLBAS", Intervertebral Mobility in Lateral bending to the Contralateral Side "IVMLBCS", Range of Motion of Lateral Bending to the Affected side "ROMLBAS", Range of Motion of Lateral Bending to the Contralateral side "ROMLBCS". Patients were closely monitored during both evaluation and treatment procedures to pick-up any abnormal signs that may affect patient's safety or study continuity. No adverse events were recorded during the study. All subjects' data were collected using standard procedures. All evaluations were conducted between 9- 11 am to minimize intraday variability, temperature effects, and biological rhythms.

Weight in kg; measured to the nearest 0.1 kg was evaluated from standing, weighting scale was calibrated with a weight of 50 g**.** Height was measured to the nearest 0.1 cm with the subject's standing in an erect position against a vertical scale of portable stadiometer (Detecto's ProMed® 6129 medical scale; a digital height and weight 225kg capacity scale, USA). BMI = weight kg / height^2).

Pain intensity evaluation:

Pain intensity was evaluated in accordance with previously standardized method **(Scrimshaw, 2001).** Every patient was informed to record his pain severity by visual analogue scale (VAS). The patient marked on the line the point that they felt represents their perception of their current state. The VAS score was determined by measuring in millimeters from the left hand end of the line to the point that the patient marks.

Intervertebral mobility (IVM) evaluation:

Intervertebral mobility IVM evaluation was performed in accordance with standardized method **(Fernandez-de-la-penas et al., 2005)** using Omni Diagnostic Fluoroscope (Phillips medical system, Netherlands). Each subject was seated upright in a chair. Patient was instructed to depress his shoulders to allow for clear visualization of the cervical spine. Patient was instructed to move his head in maximum pain-free range to the right side (without rotation, without forward flexion) till the end of the range, and then pause for an instant while anterior-posterior (AP) cervical spine radiograph was taken. This procedure then was repeated with the patient in cervical lateral flexion to the other side. The diagnostic Fluoroscopic procedure was repeated pre and post treatment for each patient, so IVM in lateral bending was evaluated to the affected side "IVMLBAS" and to the contralateral side "IVMLBCS".

The analysis of the inter-segmental motion of cervical lateral bending motion was performed after the images were taken by specialized radiologist using Kinovea software. To detect the IVM of the dysfunctional level, the distance was measured (in millimeters) between the transverse process of the vertebra making up the inferior joint surface of the dysfunctional segment and the transverse process of the vertebra making up the superior joint surface. The radiographic evaluation of IVM was performed twice for each patient. Post-treatment; the patient was rested in a sitting position for 5 min. then the post-treatment radiographs were obtained using the same procedure.

Range of motion (ROM) evaluation:

Range of motion evaluation was evaluated using cervical range of motion device (CROM) according to previously published procedure **(Nyland and Johnson, 2004), (Rheault et al., 1992), (Martınez-Segura et al., 2006).** The ROM was assessed while the patient in a relaxed seated position on a chair with back support. Then, the CROM device was mounted over the patient’s nose bridge, secured to the head by a Velcro strap. The subjects were instructed to move the head to the end point of active pain-free range of motion of lateral bending to the affected side

"ROMLBAS" then return to the neutral starting position. Range of motion of lateral bending to the contralateral side "ROMLBCS" was performed in the same manner. First, the correct movement sequence was demonstrated to the patient then the patient was instructed verbally to tilt the head as far as he can towards his shoulder until feeling tightness or pain, without lifting his shoulders or turning his head, after that, the patient return his head to the neutral position. The same procedures were repeated for the other side.

Interventions:
Each group adhered to the prescribed treatment regimen throughout the study. Participants were allowed to rest for period of 10 minutes in comfortable position before the commencement of treatment**.**

Cervical high velocity low amplitude manipulation (HVLA) for group-I:
Patient in the group-I assumed supine lying with the cervical spine in a neutral position. The index finger of the therapist was applied contact over the posterior-lateral aspect of the articular pillar (facet joints) at the dysfunctional side of the identified vertebra of the level of positively responded to lateral glide test. The therapist's other hand was cradle the patient's head. Gentle ipsilateral side flexion and contralateral rotation, was introduced from the restricted side until slight tension was palpated in the tissues at the contact point. HVLA thrust was directed upward and medially in the direction of the patient's contralateral eye. A specific popping sound, indicating joint cavitation, accompanied all manipulations.

Sustained natural apophyseal glides ((SNAGs) for group-II:
Patient in the SNAGs group was seated comfortably in a supportive low back chair facing a mirror, thus the cervical spine was in a vertical position (i.e. weight bearing position) while the therapist standing behind the patient using the medial border of his thumb's distal phalanx, reinforced by the pad of the other thumb to apply an antero-superior accessory glide through the superior spinous process (articular pillar) of the involved motion segment (i.e. the vertebra above the suspected site of the problem). The force was delivered through therapist's thumb in a slope at approximately 45 degrees. The therapist's other fingers are comfortably placed laterally on each side of the neck to give some lift and prevent the neck from coming in flexion.
The therapist moves the spinous process up in the direction that must follow the plane described by the surfaces of the apophyseal joints under treatment i.e. toward the eyeball. While sustaining this pain-free accessory glide, the patient was instructed to actively move his head through full range. As the patient progressed through the increasing physiological range, the therapist "tracked" with the spinous process to maintain his/her glide. The end range physiological movement was sustained for several seconds. Gentle pressure was given at the end of range by the therapist to enhance the effect. Patient then actively returned his head to the starting position while the therapist maintained the gliding. The procedure was repeated in sets of six to ten.

Statistical analysis:
Statistical analyses were performed using SPSS software (version 16.0). Descriptive statistical analysis was performed for the pre and post treatment variables and data was expressed as mean ± SD. Changes in mean values of pain intensity, intervertebral mobility, and range of motion within and between groups were analyzed to test hypothesis within (Paired t-test) and between (Unpaired t-test) groups. Percentage of change was also calculated for each variable. The level of significance was set at $p < 0.05$.

Result

At the evaluation-1, there were non-significant differences in age, height and weight between the two groups ($p > 0.05$) **(Table 1).**

Table 1: The demographic characteristics of participants in both cervical high velocity low amplitude (HVLA) manipulation and sustained natural apophyseal glides (SNAGs) groups (Mean ± SD)

Variables	HVLA Group (N=20)	SNAGs Group (N=20)	T value	P value☼
Age (year)	26.2 ± 4.50	25.45± 3.47	2.021	0.06 **
Height (Ht; m)	1.7 ± 0.071	1.73 ± 0.055	-1.521-	0.137 **
Weight (Wt.; kg)	76.2 ± 7.04	73.93 ± 5.63	1.129	0.266 **

☼= Level of significance at P<0.05. * = significant **= non-significant

Pre-training results revealed that there were non-significant differences between the 2 groups in pain intensity, Intervertebral Mobility in Lateral bending to the Affected side "IVMLBAS", Intervertebral Mobility in Lateral bending to the Contralateral Side "IVMLBCS", Range of Motion of Lateral Bending to the Affected side “ROMLBAS” and Range of Motion of Lateral Bending to the Contralateral side "ROMLBCS". Pre and post study data collected from both groups were compared within and between groups.

Within-group comparison:

Within-group comparison revealed that in group-I and II; there were significant decrease in pain intensity mean value between the (evaluation-1) and (evaluation-2) (P< 0.05). Also, there were significant increase in IVMLBAS, ROMLBAS and ROMLBCS mean value between the (evaluation-1) and (evaluation-2) (P< 0.05), while there was non-significant increase in IVMLBCS mean value between the same evaluation points (P> 0.05). **(Tables 2 and Figures 1, 2 and 3).**

Between-groups comparison:

Between-groups comparison revealed that there were statistically significant differences in mean values of pain intensity between groups at (evaluation-2); but in favor of the SNAGs group (p= 3.11^{-10}). Furthermore; there were statistically non-significant differences in mean values of IVMLBAS, IVMLBCS, ROMLBAS and ROMLBCS between groups at (evaluation-2) (P> 0.05). **(Tables 2 and Figures 1, 2 and 3).**

Table 2. Pain, IVMLBAS. IVMLBCS, ROMLBAS and ROMLBCS (within and between groups).

Variable		Pre	Post	T-Value	P-value
Pain (VAS)	**G-I**	5.38 ± 1.194	3.98 ± 1.47	**6.11**	**7.14^{-6} ***
	G-II	5.06 ± 1.29	3.08 ± 1.19	**11.87**	**3.11^{-10} ***
	T-Value	**0.827**	**2.145**		
	P-Value	**0.413 ****	**0.038 ***		
IVMLBAS	**G-I**	18.77± 1.72	22.61± 1.81	**-17.166-**	**5.2^{-11}***
	G-II	18.7± 2.33	22.49 ± 2.16	**-14.882-**	**6.32^{-12} ***
	T-Value	**0.116**	**0.182**		
	P-Value	**0.91****	**0.856****		
IVMLBCS)	**G-I**	21.27± 2.64	22.43± 2.19	**-6.809-**	**1.68^{-6} ****
	G-II	21.1± 2.22	22.4± 2.3	**-6.106-**	**7.17^{-6} ****
	T-Value	**0.219**	**0.042**		
	P-Value	**0.828****	**0.967****		
ROMLBAS	**G-I**	31.25 ± 5.37	37.15± 6.57	**-13.388-**	**3.99^{-11} ***
	G-II	30.79± 5.98	35.8± 5.66	**-7.727-**	**2.8^{-7} ***
	T-Value	**0.259**	**0.696**		
	P-Value	**0.797****	**0.491****		
ROMLBCS	**G-I**	32.35± 5.89	36.9± 5.00	**-12.945-**	**7.13^{-11} ***
	G-II	32± 5.30	36.85±5.47	**-11.954-**	**2.67^{-10} ***
	T-Value	**0.198**	**0.03**		
	P-Value	**0.844****	**0.976****		

G-I: cervical high velocity low amplitude (HVLA) manipulation group**, G-II:** sustained natural apophyseal glides (SNAGs) group**, VAS:** Visual Analogue Scale, **VMLBAS:** Intervertebral Mobility in Lateral bending to the Affected side, **IVMLBCS:** Intervertebral Mobility in Lateral bending to the Contralateral Side, ROMLBAS**:** Range of Motion of Lateral Bending to the Affected side, and **ROMLBCS:** Range of Motion of Lateral Bending to the Contralateral side.

☼**=** Level of significance at P<0.05. * = significant **= non-significan

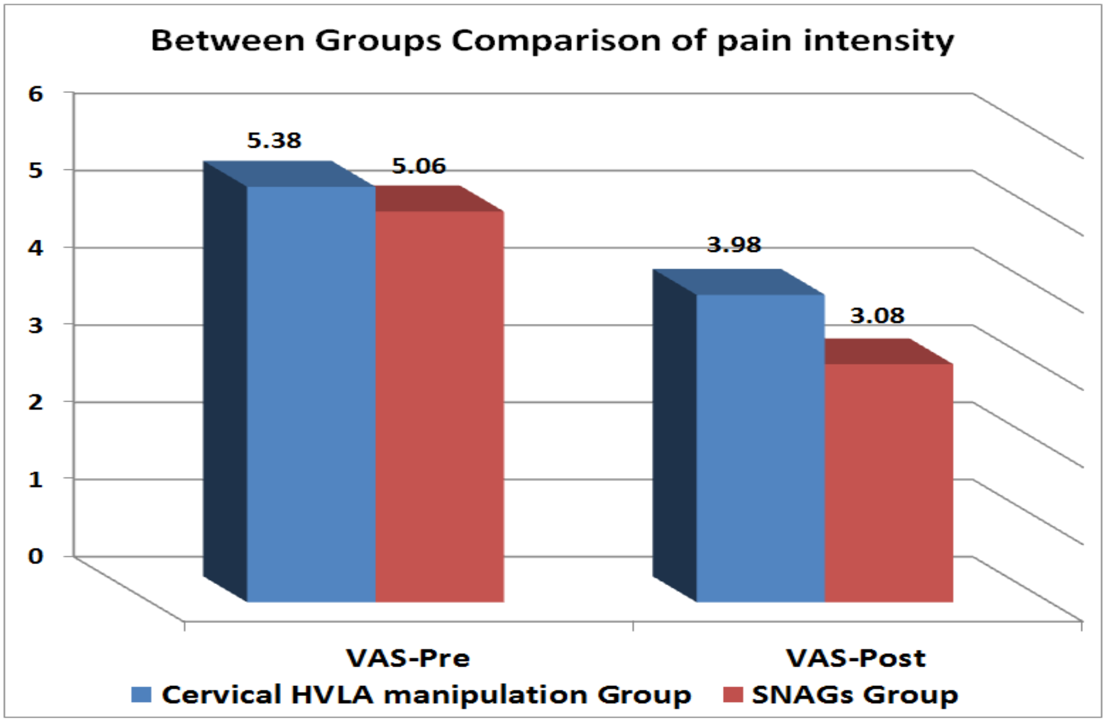

Figure 1: Comparison between pre-study and post-study values of pain intensity in both cervical high velocity low amplitude (HVLA) manipulation and sustained natural apophyseal glides (SNAGs) groups.

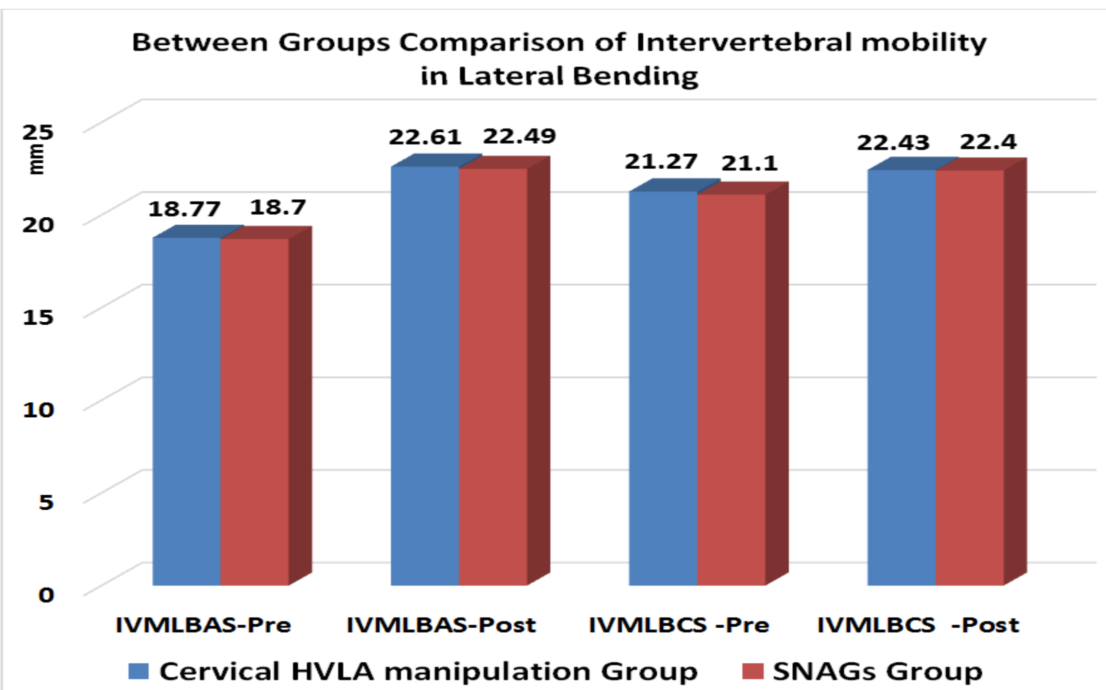

Figure 2: Comparison between pre-study and post-study values of Intervertebral Mobility in Lateral bending to the affected side **"IVMLBAS"**, Intervertebral Mobility in Lateral bending to the Contralateral Side **"IVMLBCS"** in both cervical high velocity low amplitude (HVLA) manipulation and sustained natural apophyseal glides (SNAGs) groups.

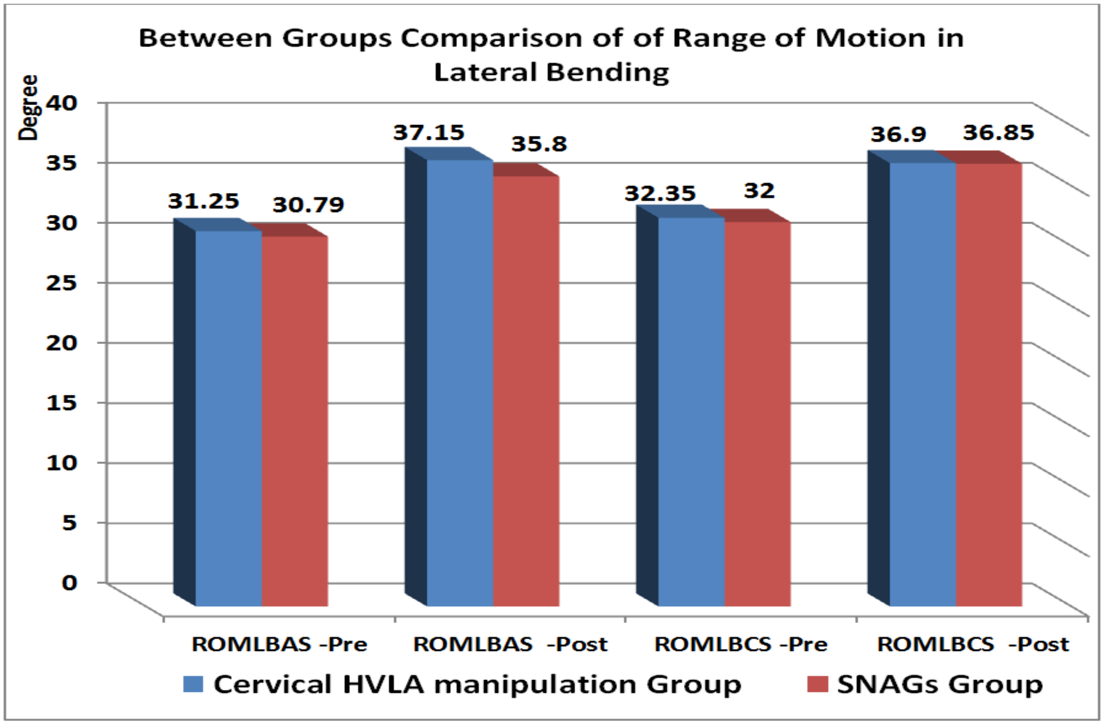

Figure 3: Comparison between pre-study and post-study values of Range of Motion of Lateral Bending to the Affected side **"ROMLBAS"** and Range of Motion of Lateral Bending to the Contralateral side **"ROMLBCS"** in both cervical high velocity low amplitude **(HVLA)** manipulation group and sustained natural apophyseal glides **(SNAGs)** group.

Discussion

The purpose of this study was to investigate the immediate post-treatment effect of Cervical high velocity low amplitude (HVLA) manipulation or Sustained natural apophyseal glides (SNAGs) on pain intensity, IVM and range of motion (ROM) in frontal plan in patients with MNP. The results of this study revealed that there were significant improvement in pain intensity, IVM, and ROM mean values in response to either HVLA or SNAGs treatments. Results revealed that there were non-significant differences between groups' post-treatment outcomes except for pain intensity; there was significant post-treatment difference in pain intensity, but in favor of group-II.

Mechanical neck pain is a common disorder associated with pain, hypomobility in zygapophyseal joints and limited spinal ROM **(John and Triano, 2001)**. In cases of MNP, the spinal pain can arise without degeneration as changes in posture affects the relative orientation of adjacent vertebra, and profoundly alter stress distribution within the zygapophyseal joint and pain perception from the innervated tissues, even if the stress concentration insufficient to cause detectable injury or other pathology **(Adams and Dolan., 2005)**; the concept that supports the idea of pain relief after manipulation of zygapophyseal joints can be due to stress relief or redistribution by manipulation distracting forces.

During the pathophysiologic conditions of joint pain, the ligamento-muscular reflex mediates the "pain-spasm cycle" to protect the painful joint from excessive movement and loading. Viscous cycle may arise within the pathway of this reflex that would augment muscular spasm response to pain and that would then be enhanced by subsequent ischemic muscular pain, producing increased and sustained spasm. Manipulation decreases the spasm and pain and altering the viscious cycle **(Solomonow et al., 1998)**.

Cervical HVLA manipulation and SNAGs are two manual therapy techniques utilized in the treatment of mechanical spinal disorders. The results of the current study reinforce and support that manual therapy techniques are effective on pain reduction in chronic MNP. The magnitude of improvement in pain met the pain reduction criterion established by **Emshoff et al.,** immediately after the first session **(Emshoff et al., 2011)**. The immediate reduction of pain in HVLA manipulation group supports that spinal manipulation has a positive hypoalgesic effect that similar to those reported by Martı´nez-Segura et al., and Maduro de Camargo et al., **(Martı´nez-Segura et al., 2006), (Maduro de Camargo et al., 2011).**

The observed functional improvement in response to either cervical HVLA manipulation or SNAGs can be explained in light of previously published studies' outcomes in which HVLA manipulation or SNAGs was proved to have the ability to produce sedative effect. Although the exact neurophysiologic mechanisms by which manual therapy in reducing pain are not fully understood, but multiple explanations are proposed; possibly the mechanical hypoalgesia induced by the spinal manipulation and mobilization techniques produce stimulation of proprioceptors in joint capsule and muscle spindles, that may cause a reflex pain inhibition, muscle relaxation, and improve ROM **(Buerger, 1983), (Terrett, 1984)**.

The dense fibro-adipose apex of the facet joint (meniscoid) becomes trapped in a recess created by deformation of the articular cartilage. Any movement results in traction on the rich innervated facet joint capsule through the base of the meniscoid , that can be itself a focal point of fibrous tissue accumulation and adhesion formation, resulting in pain and reflex muscle spasm (entrapment theory) and release **(Mercer 1994) , (Mercer and Bogduk 1993)**, the distraction of joint surfaces cause release of the entrapped joint capsule and break down of adhesions that will improve ROM and relief pain and dysfunction **(Hearn and Rivett, 2002)**.

Both HVLA manipulation and SNAGs yielded post-treatment favorable effects on reducing pain intensity in patients with MNP. These findings came in accordance with Sterling et al., Vicenzino et al. and Wright, who reported that improvement of neck pain is secondary to direct neural inhibition **(Sterling et al., 2001), (Vicenzino et al., 1996, 1998b), (Wright, 1995)**. Manual therapy procedures proved to cause presynaptic inhibition of segmental pain pathways and hence activate the endogenous opiate system **(Pickar, 1999).** Additionally; spinal release of neuronal noradrenaline and serotonin may have contribution in pain modulation due to manual therapy **(Skyba et al., 2003)**. Immediate post-treatment response of pain intensity to cervical HVLA manipulation in patients with neck pain secondary to spondylosis without radiculopathy was evaluated **by Tseng et al.,** who found significant improvement in pain after cervical HVLA manipulation **(Tseng et al., 2005)**.

Successful application of SNAGs mobilizations to the correct segment allows the therapist to directly "attack" the painfully restricted movement by using pain-free movement to centralize the pain; a well-recognized phenomenon as a positive prognostic change **(Miller et al. 1999)**.

Results of this this study clarified that SNAGs had more pronounced effect on pain reduction than HVLA manipulation and this came in accordance with Vicenzino et al, who reported that the predominant explanation provided for this rapid pain relieving effect is mechanical in nature and based on the proposed existence of bony positional faults and the ability of mobilization with movement to correct these faults **(Vicenzino et al., 2007)**. The Mulligan's SNAG technique involves passive accessory joint play combines simultaneously with active physiological neck movement in loaded position, repeated multiple times, that may cause further sedation and nociceptive pain receptors inhibition **(Exelby, 2002), (Pickar, 1999)**. The findings of pain reduction in response to SNAGs technique were also consistent with the findings of **McNair et al.,** who reported that cervical SNAGs has sympathoexcitatory effect that induces analgesia even in a symptomatic subjects **(McNair et al., 2007)**. One can concluded that SNAG technique is effective as an alternative to HVLA manipulation, which can lessen the complications of cervical manipulation like the risk of vascular accident **(Chakraverty et al., 2011).**

The hypomobility of the motion segments in subjects with spinal pain have an exaggerated paraspinal muscular electromyographic amplitude response to the mechanical painful stimulus (**Lehman et al., 2001)**. Cervical manipulation was reported to improve the zygapophyseal joint mobility **(Cassidy, 1992; Pikula, 1999)**.

Cervical HVLA manipulation and SNAGs significantly improved segmental mobility and ROM in patients with MNP. These results came in line with previously published results of Fernandez-de-las-Penas et al., who documented that cervical HVLA manipulation causes increased intervertebral motion at the hypomobile affected cervical facet joint; assessed by radiographs during cervical side bending to the contralateral side (**Fernandez-de-las-Penas et al., 2005)**. The obvious increase in cervical ROM and facet joint mobility after spinal manipulation were attributed in part to greater decrease in neck pain **(Cassidy et al.1992, Pikula 1999, Vernon et al, 1990)**. Furthermore; immediate post-treatment increase in active cervical ROM was also reported by Martinez-Segure et al., who investigated the effect of single HVLA in patients with MNP (**Martinez-Segure et al., 2006**).

Conclusion

Cervical HVLA manipulation or SNAGs can produce beneficial effects on pain, IVM and ROM in patients with MNP. SNAGs yielded more favorable effects on pain compared with cervical HVLA, while cervical HVLA and SNAGs are comparable in their effects on IVM and ROM. According to priorities and physician recommendations to maximize health benefits; when the primary goal is to control pain; SNAGS is the intervention of choice, but when the goal is to increase IVM and ROM; then the cervical HVLA is the recommended approache.

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