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Original Article

Physiotherapy Section

Effectiveness of Mulligan's Sustained Natural Apophyseal Glide (SNAG) over First Rib in Reducing Pain and Improving Cervical Rotation in Individuals with Mechanical Neck Dysfunction

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ABSTRACT

Introduction: Mechanical Neck Pain (MNP) is any type of pain caused by placing abnormal stress and strain on the structures that constitute the vertebral column. Elevated first rib dysfunction is one potential somatic lesion that could lead to neck pain. Little information is available regarding this somatic lesion and its management.

Aim: To assess the impact of treating first rib dysfunction with Mulligan's Sustained Natural Apophyseal Glide (SNAG) among subjects with mechanical neck dysfunction.

Materials and Methods: A quasi-experimental-study with 40 patients with elevated first rib and neck pain were included in this study. After baseline evaluation comprising of history, pain intensity, Pressure Pain Threshold (PPT), Cervical Range of Motion (CROM) and Neck Disability Index (NDI), the subjects were divided into two groups (n=20). The Experimental group was treated with SNAG with neck isometrics and the control group was treated with interferential therapy with neck isometrics. After six sessions of treatment the PPT, CROM and NDI were measured. The results were tested using Paired t-test and Mann-Whitney U-tests with a statistical significance level set at $p<0.05$.

Results: Subjects in experimental group had clinically significant improvement post-treatment on Pain ($p<0.002$), Pressure Pain Threshold (PPT) ($p<0.009$), Cervical rotation range ($p<0.001$) and Neck disability ($p<0.001$) when compared to the control group.

Conclusion: Treating the first rib elevation dysfunction with Mulligan SNAG will improve cervical range of motion, decrease pain and related disability.

Keywords: Bubble inclinometer, First rib dysfunction, Mulligan therapy

INTRODUCTION

Neck problems are a common clinical presentation resulting in various degrees of functional limitation [1]. Mechanical Neck Pain (MNP) is a term used to describe pain that results from stress or strain on the structures of the vertebral column. Factors such as alteration in the anatomical structures, sprain or strain of the muscles or ligaments, and adaptation to a faulty posture can result in MNP [2].

First rib dysfunction has been identified as a potential cause for MNP [2]. Faulty dynamic, static, traumatic or congenital factors may contribute to the development of elevated first rib dysfunction [2]. The first rib is a relatively unstable structure, articulating with body of first thoracic vertebra via small round head and providing attachment for several muscles such as the anterior and middle scalene. The absence of superior ligamentous support at the first costotransverse joint and/or hypertonicity of scalene muscles may pull the rib upward contributing to superior subluxation/hypomobility. This may lead to referred pain over the neck, arm and shoulder and limitation of contralateral rotation and ipsilateral flexion of cervical spine [3]. It has been proposed that the main cause for the range of motion limitation is hitching of the first thoracic vertebra transverse process against the elevated first rib [3]. If this somatic lesion does not resolve spontaneously manual correction is warranted, which could indicate the need for implementing mobilisation or manipulation to improve the mobility of this rib [4].

Mulligan's SNAGs are recommended as a treatment for the cervical, thoracic and lumbar spine, where the mobilisation with active movement follows passive overpressure [5]. Whilst, SNAGs to improve the mobility of a dysfunctional first rib have been advocated by Mulligan, information on clinical usefulness of this technique is minimal, and therefore warrants further studies. Hence, this study aimed to test the effectiveness of first rib SNAGS in improving the first rib mobility and thereby improving the cervical mobility and reducing pain.

MATERIALS AND METHODS

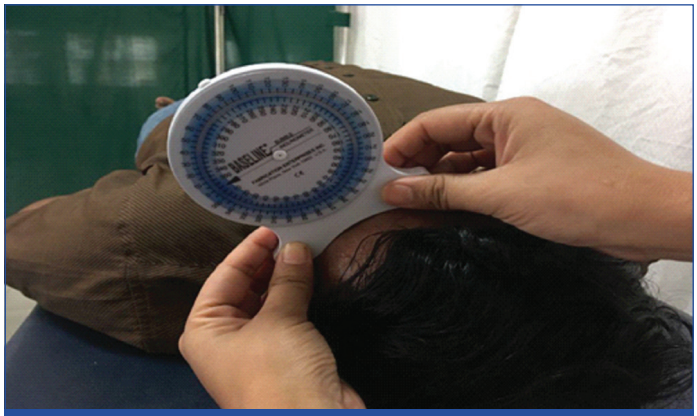
A quasi-experimental study with purposive sampling was conducted in the Physiotherapy Outpatient Department, Faculty of Physiotherapy. The study was approved by the Institutional Ethical Committee (REF: CSF/17/OCT/61/284).

The subjects with the clinical presentation of unilateral elevated first rib dysfunction (either right/left side), including pain over the neck and trapezius area, restricted cervical rotation range of motion, and a positive manual spring test who presented to the outpatient department between December 2017 and April 2018 were included in the study. Individuals with a diagnosis of cervical radiculopathy, vertebrobasilar insufficiency, rib fracture, rib dislocation and/or history of shoulder surgery was excluded. The first rib was palpated lateral to the 1st thoracic transverse process through the trapezius muscle at the width of the mastoid process [6] and manual rib spring test was performed to identify the status of the dysfunction [7]. The sample size was derived by considering improvement of 10°-19° in cervical rotation (the identified minimal detectable change for cervical range of motion with inclinometer), error 5%, power of 80% with 10% attrition, a sample of 38 was obtained (19 per group).

Forty subjects who met the inclusion criteria and provided consent were divided into two groups; an experimental group and a control group.

A standardised musculoskeletal neck assessment and evaluation was completed prior to the treatment for obtaining baseline data about pain, PPT, range, and regional function. Pain intensity was measured using numeric pain rating scale, PPT was measured using pressure algometer, and cervical spine rotation was measured using a bubble inclinometer.

Active cervical rotation range was measured by placing the subject in supine position with the cervical spine in neutral [Table/Fig-1]. The bubble inclinometer was placed in the middle of the forehead and adjusted to zero. The subject was instructed to rotate the head one side and the difference of reading at the completion of range of motion was noted to record the degrees of rotation to that side. The head was repositioned to neutral and measurement for other side rotation was recorded [7]. The PPT was measured with the subjects seated in a low back supported chair and the probe of the algometer was placed on the most sensitive painful spot (Epicentre) over the upper trapezius muscle [Table/Fig-2] on the side of the rib dysfunction [8].



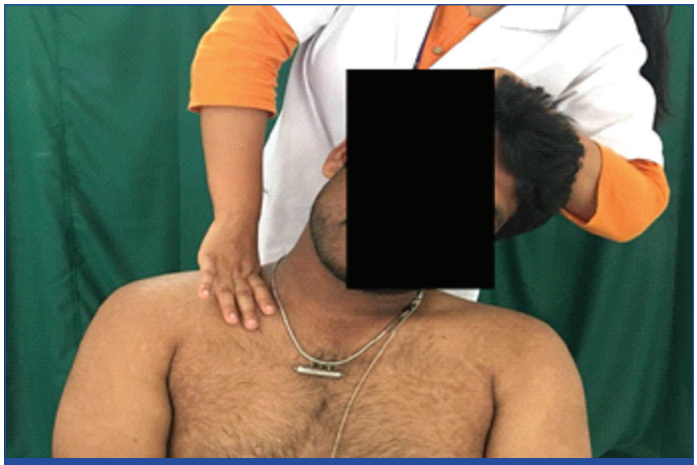
[Table/Fig-1]: Cervical rotation range measurement with bubble inclinometer.

[Table/Fig-2]: Pressure pain threshold measurement over trapezius muscle using pressure algometer.

The experimental group (n=20) received first rib SNAGS and neck isometrics exercises and the control group (n=20) received therapy to modulate pain (interferential therapy-nape of the neck and over-involved trapezius using bipolar method for 20 minutes) and isometrics neck exercises.

In the experimental group SNAGs technique over the first rib was performed with the patient seated comfortably in a low back supported chair, and the cervical spine in neutral. Standing behind the patient, the first rib was palpated and using the radial border of the second metacarpal of the hand over the first rib, an inferior and medial pain-free SNAGs was applied while the therapist used their other hand to laterally flex the cervical spine on the contralateral side of dysfunction with overpressure [5]. The procedure was repeated six times, in a single session [Table/Fig-3]. Subjects received 4-6 session of manual therapy and performed isometric exercise 3-5 sets per day for six days.

Subjects in both experimental and control groups received neck isometric exercises. The exercises were self-assisted where the



[Table/Fig-3]: Application of sustainted natural appophyseal glide (SNAG) over first rib.

patient was asked to hold the contraction for 10 seconds and perform three sets with 10 repetitions in a day. Participants were asked to perform exercises for 12 weeks and post-treatment measurement was taken on sixth day to know the effectiveness of the technique. Mulligan claims the effect will be immediate and could be reached within that time. Hence, this original recommendation from the author followed [5]. Both the pre and post-treatment measured data was subjected to statistical analysis.

STATISTICAL ANALYSIS

The data was analysed using SPSS© version 16 statistical software. To describe the descriptive, categorical and continuous variable ratio analysis, mean rank and mean standard deviation was used. To explore significant differences within group paired t-test and between experimental and control groups Mann-Whitney U tests were used.

RESULTS

The [Table/Fig-4] presents the baseline characteristics of participants with no significant differences between the groups noted. All of the 40 participants completed the study at the end of the sixth day with no reports of adverse effects following treatment. The [Table/Fig-5] presents the within, experimental and control between group comparisons, significance value ($p<0.05$) for cervical rotation, Numerical Pain Rating Scale (NPRS), PPT, and NDI. Whilst there was an improvement in both groups, it was noted that subjects belonging to the experimental group showed significantly greater differences in Cervical rotation range ($p<0.001$), Pain ($p<0.002$), PPT ($p<0.009$) and Neck disability ($p<0.001$) than control group by the end of the six days.

Variables	Experimental group	Control group	p-value
Age in years (mean±SD)	28.8 (4.81)	32.2 (5.75)	
Male: Female	08:12	08:12	
Symptom duration mean (months, SD)	1.6 (0.51)	1.85 (0.36)	
NPRS (mean rank)	21.95	19.05	<0.413
PPT in kg (mean rank)	19.73	21.28	<0.670
NDI (mean rank)	21.4	19.6	<0.624
Cervical rotation ROM in degrees (mean rank)	20.55	20.45	<0.978

[Table/Fig-4]: Baseline characteristics of participants.
NPRS: Numeric pain rating scale; PPT: Pressure pain thereshold; NDI: Neck disability index. p<0.05

DISCUSSION

The range of possible conservative management techniques that could be done for dysfunction of the first rib includes muscle energy techniques, joint mobilisation, isometric neck exercises, therapeutic modalities and immobilisation [2]. The effectiveness

Measure		N	Pre (mean±SD)	Post (mean±SD)	p-value*	Between Group Post Mean Rank	U	p-value**
Cervical Rom-Rotation (degree)	EG	20	46.25 (16.13)	66.25 (7.41)	<0.001*	27.25	65.000	<0.001**
	CG	20	47.50 (11.30)	53.75 (9.72)	<0.001*	13.75		
NPRS (scale)	EG	20	6.47 (1.02)	2.85 (1.23)	<0.001*	14.8	86.000	<0.002**
	CG	20	6.22 (0.86)	4.25 (1.21)	<0.001*	26.2		
PPT (kg)	EG	20	0.75 (0.21)	1.69 (0.54)	<0.001*	25.33	103.500	<0.009**
	CG	20	0.80 (0.22)	1.25 (0.30)	<0.001*	15.68		
NDI (scale)	EG	20	27.25 (10.67)	5.80 (2.62)	<0.001*	10.6	200.000	<0.001**
	CG	20	27.15 (8.25)	22.60 (7.14)	<0.001*	30.4		

[Table/Fig-5]: Within and between group comparison of cervical rotation range, pain intensity, pressure pain threshold and disability score.
p<0.05 is significance *Paired t-test **Mann-Whitney U tests, significant between EG and CG.
EG: Experimental group; CG: Control group; NPRS: Numeric pain rating scale; PPT: Pressure pain thereshold, NDI: Neck disability index

of these treatments, however, has not been verified by clinical research. The lack of literature regarding the management of first rib dysfunction related to mechanical neck pain substantiated the need for this study.

Whilst changes in NPRS values with both the groups exceeded the MCD value of two over the six days, the experimental group showed a significantly greater reduction in pain levels compared to control groups (NPRS: Experimental group:14.8 Vs. control group: 26.2; p<0.002). This pain reduction could be due to the effect of SNAG application resolving the somatic lesion.

Subjects in both the groups showed a statistically significant change in PPT (PPT: Experimental group: 25.33 Vs. control group: 15.68), indicating an increased pressure pain threshold following manual therapy (p=0.009). This finding supports the fact that mobilisation over the first rib using a Mulligan SNAG technique could induce changes in PPT among first rib dysfunction subjects. The present finding goes in accordance to few studies were they have noted changes in PPT following administering manual therapy to cervicothoracic region. The possible cause for increase in PPT could be due to stimulation of central, peripheral inhibitory mechanisms and local mechanoreceptor stimulation. This effect was observed following manual therapy in many studies and is also applicable to the current findings [9-11].

There was significantly greater increase in cervical rotation range of motion over six days observed for subjects in the experimental group than those in control group (27.25° vs 13.75°; p<0.001) [Table/Fig-5]. These results are similar to the findings that patients with mechanical neck pain reported an increase in function immediately following treatment with Mulligan's Concept Positional SNAG directed over the cervicothoracic region [12]. A 10°-19° degree of improvement in range is considered to be the Minimal Detectable Change (MDC) for cervical rotation mobility measured with inclinometer [13] and in this study the improvement in cervical rotation exceeded this limit suggesting clinical significance.

Subjects in both the groups exceeded the MDC value of 7.5 for NDI [14] with a statistically significant difference found between the control and experimental groups (NDI: 10.6 vs 30.4; p=0.001). The combined effect of manual and exercise therapy with correction of somatic lesion may have led to improved regional function as identified with spinal disorders [15,16]. SNAG mobilisation to be more beneficial in subjects with neck pain secondary to first rib dysfunction [17,18].

Post-hoc power analysis for each of the outcome measures identified that all measures returned power of >80% (beta), with a significance of 0.05 (alpha), indicating that the subject numbers were adequate to minimise the potential for chance findings.

LIMITATION

This study focused only on the immediate effects of SNAG with only cervical rotation measurement, pain and disability over a six day treatment period. Long-term follow-up, including measurement of lateral flexion along with cervical rotation can be done in future studies to know the extended effects of first rib SNAG.

CONCLUSION

Elevated first rib could be suspected for limited cervical range among subjects with mechanical neck pain. SNAGs over first rib was effective in bringing short-term effects and can be clinically used as a lesion specific management.

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