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Effect of Mulligan Mobilization on Active Trigger Points in Cervical Radiculopathy

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Abstract:

Purpose: To evaluate mulligan sustained natural apophyseal glides technique of C4/5 in pressure pain threshold, rhomboids muscle activity and functional activity level in patients with cervical radiculopathy with active trigger point in rhomboids muscles.

Methods: Forty participants involved in current trial, their age range18-30 years old with body mass index between 18-25 kilogram/meter^2 of both genders, randomly allocated into 2 equal groups; Control 'B'; received conventional protocol in form of 20 minutes infrared, 10 minutes pulsed ultrasound therapy with 1.5 Watt/centimeter^2 and 1 Hertz, physical therapist deactivated active myofascial trigger points thought manual ischemic compression on rhomboids muscles for 10 minutes then muscle stretching 5 minutes and strengthening exercises for 15 minutes. Study 'A'**;** were applied in control B in combination with mulligan mobilization in form of sustained natural apophyseal glides (SNAGs) for cervical level at C4/5. Assessments were done using digital pressure algometer to assess pressure pain threshold, neck disability index to evaluate functional activity level, electromyography to measure rhomboids muscle activity and fatigue. Suggested protocol was applied 3 times weekly, measurements were conducted initially and by the end of suggested protocol.

Results: Results revealed obvious difference in all measured outcomes within groups. Statistically significant difference was also found in post-treatment values of all measured outcomes in-between two groups with superiority to Mulligan`s group.

Conclusion: Mulligan SNAGs technique of C4/5 combined with conventional physical therapy results in improvements in pressure pain threshold, increases EMG rhomboids muscle activity and functional activity level in patients with cervical radiculopathy and deactivates trigger point of rhomboids muscles.

Keywords: Active trigger points, Cervical radiculopathy, Mulligan mobilization

1.Introduction:

Almost cervical painful complains associated with disabilities, plus 40% of work absenteeism. In cervical radiculopathy during setting position due to compressed spinal nerve root thus rise pain sense that symptomatically could spread far distally along upper extremity and radiates to surrounding regions (1).

Cervical radiculopathy is a pathophysiolocal spinal nerve compressed roots due to herniated disc or arthritic spurs. Such typical impingement resulted in

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cervical and radiating painful numbness along upper limb, also altered senses and/ or upper extremities motor dysfunction (2).

Active trigger points (ATrPs) are often described as spreading or at rest radiating painful sense that while palpation is tender and sometimes presented in referred pattern look like original complaint, which not located at original trigger point, but remote away. Such referred pattern is a unique trigger point clinical feature, which differentiates from tender ones those are represent pain sensation at palpation site, only (3).

Numerous physical rehabilitation interventions have been stated previously to be effective in cervical radiculopathy management, such as therapeutic traction mainly automatic forms, manipulation, therapeutic training protocols, plus another physical approaches and modalities (4).

Almost, various physical therapy programs for cervical radiculopathy management were reported that 26 % of whom received surgical intervention continue reporting high pain levels up to a year postoperative (5). However, many reports had documented that conservative management could lead to better outcomes than surgical approaches (6).

Mulligan mobilization is a manual technique that recommended to gain straight dorsal spine through applying SNAGs. Mulligan SNAGs was reported to gain immediate benefits regarding spinal flexibility through correcting facet articulations faulty positions (7). In addition, combined weight-bearing mulligan mobilization with active movement reflected in better correcting of facets` articular surfaces malalignment (8).

Mulligan has offered a useful SNAGs approach for managing original spinal pain based on applying accessory passive vertebral glide where a simultaneous active movement of patient. Additionally, it is noted that gliding should be along facets joints` plane while performed in either standing or sitting weight-bearing positions (9).

Increasing pain pressure threshold (PPT) is a major goal for unilateral cervical radiculopathy patients, this goal never ever to be achieved without sufficient amount of releasing active trigger point to allow the patients to be independent on their ordinal day activities. The aim of this study was executed to detect whether or not that Mulligan mobilization with SNAGs technique would be effects on PPT in unilateral cervical radiculopathy patient with active trigger point.

2.Patients and Methods

2.1.: Design and Setting

Through current randomized controlled trial. Informed consent has been obtained from each participant and they were informed if any time were withdrawn no harm would be done. The consent form explaining nature, details and objective of current trial. The investigator conducted an initial demo to explain participants` demographic information and ensure they met research criteria. It was conducted between January 2021 to September 2021, and it was approved by Research Ethical Committee, Faculty of physical therapy, Cairo University, Egypt (P.T.REC/012/002504).

2.2. Patients:

Forty patients from both genders were recruited from Out-patient clinic, Department of Physical Therapy, Police Hospital, Alexandria, Egypt. Radom participants allocation into present trial equal groups number (20) for each one based on G*POWER statistical software (version 3.1.9.2; Franz Faul, Universität Kiel, Germany), where α was 0.05, β was 0.2 and effect size was 0.38 and allocation ratio N2/N1 was1.

The inclusion criteria: 1) Unilateral active rhomboids trigger points with cervical radiculopathy. 2) Number of trigger points from 2 to 4. 3) Age ranged between 18 to 30 years (10). 4) Their BMI was 18-25 kg/m^2 (10). 5) Male and female involved. The exclusion criteria: participant will be excluded from the study if: 1) They had musculoskeletal disorders other than cervical radiculopathy 2) They had previous cervical or thoracic surgery. 3) They had a skin infection.

Following patients' collection then random allocation into.

Control A was treated by conventional physical therapy: Infrared therapy, Ultrasound therapy, Manual ischemic compression, Muscle stretching and Strengthening exercises.

Study B was treated by the same conventional physical therapy as in control group combined with mulligan mobilization in form of sustained natural apophyseal glides for cervical level C4/5.

2.3. Instruments:

Instrument for measurement

They include digital pressure algometer (DPA), neuro-EMG-Micro-2 (surface EMG) and neck disability index (NDI).

1- Digital pressure algometer (DPA) to assess PPT level at rhomboids active trigger point (11).

It is a device that could provide identification of pressure plus eliciting PPT force. Based on prior clinical trials, applied force supposed to be consistent manually to elicit PPT to ensure greatest reliability. Earlier trial stated that DPA both reliability and construct validity (1000-Hz sampling rate) manually on a force plate (500-Hz): 10 sets of 5 sets to 80 newtons, also 1 set of 5 applications to

each force level: 20, 30, 40, 50, 60, 70, 80, 90, 100 and 110 N. clinician should be familiar with DPA then use it (12).

2- Neuro-EMG-Micro-2 (surface EMG) to measure rhomboids muscles activity while retracting shoulders in prone on an adjustable weight bench with examined upper limb hung freely with extended elbow over edge (13).

Surface electromyography (sEMG) showed valid and reliable method for measuring muscle activity during voluntary and evoked contractions (14).

3- Neck disability index (NDI) to evaluate functional activity level (FA). It is a unidimensional questionnaire designed to measure the patient self-reported disability level and clarify influence of pain on daily capabilities of the patient. Prior trials ensure that NDI provides required clinical evaluation in form of self-report outcome for cervical pain (15). NDI is simple to use and does not require physical measurement. Also has an internal consistent with good construct validity, and good responsiveness that deals specifically with high sensitivity to varying chronic neck pain and disabilities (16).

Instrument for treatment:

They include Quartz infrared lamp and Ultrasound equipment.

1-Quartz Infrared lamp made in China provides 760-100 thousand nm output light.

2-Combined 2200 Electrotherapy and Ultrasound, Germany.

2.4. Procedures:

Measurement Procedure

1- Pressure pain threshold was assessed using DPA at active trigger point of rhomboids muscles for seated participant with relaxed arm alongside. PPT was evaluated by researcher, only for all participants. PDA was adjusted at its peak value, so could be blinded to suspect score while evaluating PPT. Participant was informed to immediately state when sense any felt variation in pain sense that means ideal score, which noted (11).

2- Rhomboids muscle activity (RMA) and fatigue (RMF) were assessed using Neuro-EMG-Micro-2 (surface EMG) while patient doing the standardized scapular retraction. The subject was asked to produce a movement which moved the scapula medial rotation. Participants should be relaxed in comfortable place. The investigator measure root mean square of Rhomboids muscles to obtain muscles activities. Therefore, to analysis, each workload was adjusted to be zero effectively (13).

To record EMG signals for each rhomboid or its portions while doing retraction, the electrodes were allocated unilaterally in a standardized position (13).

3-Functional activity (FA) level was assessed using Neck disability index (NDI) that requires from 3 to 8 minutes scored as a raw score, where each section on a 0- 5 rating scale, zero refers to “no pain” and 5 refers to “worse imaginable pain” (15) NDI used at baseline and by the end of program. NDI higher score indicates more rated disability without stating how to handle missing data (16).

Treatment Procedures

1) Conventional Physical Therapy

1-Infrared Therapy; the patient had a relaxed setting position where patients` head rested on crossing patients` hands and infrared therapy were sequentially adjusted at 30-50 cm perpendicular away to active trigger point of rhomboids, thus permitting to be framed the duration of application was 20 min per session (17).

2-Ultrasound Therapy; the patient had a relaxed setting position with both hands beside the body and the intensity of pulsed ultrasound therapy with 0.8 W/cm^2 and 1 Hz. Device head had been placed in contact to treated site before turned on. The coupling media (medical gel) was applied to minimize losses and reduce reflection while conducted therapeutic slow circular movements over the myofascial trigger point on cervical muscles, the duration of application was 10 min. per session (18).

3-Manual ischemic compression; it was applied while participant relaxed setting position, hands beside the body and manual ischemic compression was applied perpendicular on active trigger point of rhomboids muscles by using thumb compression and the duration of application lasts for 10 min. per session (19).

4-Stretching exercises were applied for 5 min; 30 sec. stretching exercises followed by 30 sec. relaxation as the following: *a)* Trapezius (upper fibres), *b)* Levator scapulae, *c)* Infraspinatus and *d)* Rhomboids muscles (18).

5-Strengthening exercises were applied for 15 min.; 30 sec. strengthening exercises followed by 30 sec. relaxation as the following: *a)* Trapezius (upper fibres), *b)* Levator scapulae, *c)* Infraspinatus and *d)* Rhomboids muscles (6).

6-Mulligan SNAGs mobilization technique was applied at level C4/5 in form of SNAGs and was conducted as the following steps: participant in sitting supported while researcher behind applies antero-superior accessory glide through superior spinous process within involved spinal segment own thumb’s distal phalanx pad, where other fingers were placed lateral to neck prevent any substitutions, so spinous process moves upwards by researcher while asking participant to actively do ipsilateral side bending and rotation in continuous instructions,

till end-range physiological motion was sustained for seconds applied overpressure at range end to enhance effect then repeat three sets of 10 repetitions with holding for 10 seconds in each glide with 30 seconds interval between each repetition (7, 20)

3. Statistical analysis:

All data were collected and analyzed using SPSS version 17 as follows:
Descriptive statistics; mean and standard deviation for both (A& B groups) were reported.
Inferential statistics; comparing pre and post of each parameter within each group was done by Multiple Analysis of variance PPT, Root mean square for RMA, Median frequency for RMF and NDI. Comparing mean values of each parameter between groups before and after three months of treatment program was done by MANOVA. The probability was p > 0.05%.

Results:

1-General demographic features
The mean value of age / years in each group (study and control) were (24.25± 3.43, and 24.8± 3.94) respectively. Mean values of height of the participants in groups were 163.80 ± 5.53 and 163.50± 4.41 respectively. Mean values of weight in each group were 84.25± 7.89 and 87.50± 7.87 respectively. Mean values of BMI Kg/m² in each group were 26.83± 2.36, 27.21± 2.45 respectively, **table (1).**

Table (1): Mean values of demographic data and anthropometric measure of participants in each group.

Items	A group	B group	t-value	p-value
	Mean ± SD	Mean ± SD		
Age(years)	24.25 ± 3.43	24.8 ± 3.94	-0.54	0.59
Height (cm)	163.80 ± 5.53	163.50 ± 4.41	0.21	0.838
Weight (Kg)	84.25 ± 7.89	87.50 ± 7.87	1.83	0.083
BMI(Kg/m²)	26.83 ± 2.36	27.21 ± 2.45	0.17	0.833

SD: standard deviation, P > 0.05= non-significant.

Comparison of mean values revealed non-significant difference between groups regarding age, height, weight and BMI. The t-value for age was 0.31 at P 0. 756. t- value for height was 0.21 at P 0. 838. t- value for weight was 1.83 at P 0.08332, t-value for BMI was 0.17 at P 0.8332 **table (1).** Mean values of sex distribution in each group is showed in **table (2).**

Table (2): Mean values of sex distribution in each group

Sex Distribution	A group	B group	Chi squared value	p-value
	Mean ± SD	Mean ± SD		
Female	12 (60%)	11 (55%)	(χ^2 = 0.1)	0.74
Male	8 (40%)	9 (45%)		

P > 0.05 = non-significant.

II. Clinical features of the patients in both groups before and after treatment

2) Comparison of mean values of PPT in each group

Mean value of PPT in A group pre-treatment was 2.72 ± 0.64 and post treatment it improved (increased) significantly to 3.69± 0.65, percent of change was 35.66 and p-value was 0.001, **table (3).** In B group, mean value of PPT pre-treatment was 2.62± 0.59 and post-treatment. It improved (increased) significantly to 3.11± 0.61, percent of change was 18.70 and p-value was 0.001 **table (3).**

Table (3): Comparison of mean values of PPT in each group and between groups

Descriptive	Pressure pain threshold			
	A group		B group	
	Pre	Post	Pre	Post
Mean ± SD	2.72 ± 0.64	3.69 ± 0.65	2.62 ± 0.59	3.11 ± 0.61
MD	-0.97		-0.49	
% of change	35.66		18.70	
P-value	**p = 0.001**		**p = 0.001**	

SD: standard deviation. P < 0.05 = Significant.
MD: Mean difference.

3) Comparison of mean values of NDI within each group

Mean value of NDI in A group pre-treatment was 36.85± 3.15 and post treatment it improved (decreased) significantly to 24.5± 2.92, percent of change was 35.51 and p-value was 0.001 **table (4).** In B group, mean value of NDI pre-treatment was 38.1± 3.38 and post treatment it improved (decreased) significantly to 27.1± 3.65, percent of change was 11 and p-value was 0.001, **table (4).**

Table (4): Comparison of mean values of NDI score within each group and between groups

Descriptive	NDI			
	A group		B group	
	Pre	Post	Pre	Post
Mean ± SD	36.85 ± 3.15	24.5 ± 2.92	38.1 ± 3.38	27.1 ± 3.65
MD	12.35		11	
% of change	33.51		28.87	
Statistical p-value	p = 0.001		p = 0.001	

NDI: Neck disability index, SD: standard deviation. P<0.05=Significant. MD: Mean difference.

4) Comparison of mean values of RMA within each group

Mean value of RMA in study B pretreatment was ١٨,١٩± 3.82 and post treatment it improved (decreased) significantly to 11.68± 3.04, percent of change was 33.79 and p-value was 0.001 **table (5).** In control A, mean value of RMA pretreatment was 18.43 ± 4.12 and post treatment it improved (decreased) significantly to 14.03± 3.58, percent of change was 23.87 and p-value was 0.001 **table (5).**

Table (5): Comparison of mean values of RMA within each group and between groups

Descriptive	RMA			
	A group		B group	
	Pre	Post	Pre	Post
Mean ± SD	18.19 ± 3.82	11.68 ± 3.04	18.43 ± 4.12	14.03 ± 3.58
MD	6.51		4.4	
% of change	33.79		23.87	
Statistical p-value	p = 0.001		p = 0.001	

RMA: Rhomboids muscle activities, SD: standard deviation. P < 0.05 = Significant. MD: Mean difference.

5) Comparison of mean values of RMF within each group

The mean value of RMF in A group pretreatment was 50.06± 5.16 and post treatment it improved (decreased) significantly to 39.52± 5.29, percent of change was 21.05 and p-value was 0.001 **table (6).** In B group, mean value of RMF pretreatment was 50.66± 4.96 and post treatment it improved (decreased) significantly to 43.67± 4.51, percent of change was 13.80 and p-value was 0.001 **table (6).**

Table (6): Comparison of mean value of RMF within each group and between groups

Descriptive	RMF			
	Study group		Control group	
	Pre	Post	Pre	Post
Mean ± SD	50.06 ± 5.16	39.52 ± 5.29	50.66 ± 4.96	43.67 ± 4.51
MD	10.54		6.99	
% of change	21.05		13.80	
Statistical p-value	p = 0.001		p = 0.001	

RMF: Rhomboids muscle fatigue, SD: standard deviation. P < 0.05 = Significant. MD: Mean difference.

6) Clinical features of patients in each group post treatment

The mean values for PPT in each group post treatment were 3.69± 0.65 and 3.11± 0.61 respectively, mean difference between each group post treatment was 0.58, P-value for PPT post treatment was P 0.006**.**

The mean values for NDI post treatment in each group were 24.5± 2.92 and 27.1± 3.65 respectively, mean difference between each group post treatment was -2.6, P- value for NDI.

Post treatment was P= 0.01. The mean values for RMA post treatment in each group were 11.68 ± 3.04 and 14.03 ± 3.58 respectively, mean difference between each group post treatment was -2.35, P-value for RMA post treatment was P= 0.03. The mean values for RMF that measured by RMA post treatment in each group were 39.52 ± 5.29 and 43.67 ± 4.51 respectively, mean difference between each group post treatment was -4.15, P- value for RMF post treatment was P= 0.01 **table (7).**

Table (7): Comparison of mean values of PPT, NDI score, RMA and RMF

Items	Post treatment			
	A group	B group	MD	p-value
	Mean ± SD	Mean ± SD		
PPT	3.69 ± 0.65	3.11 ± 0.61	0.58	0.006
NDI	24.5 ± 2.92	27.1 ± 3.65	-2.6	0.01
RMA	11.68 ± 3.04	14.03 ± 3.58	-2.35	0.03
RMF	39.52 ± 5.29	43.67 ± 4.51	-4.15	0.01

SD: standard deviation. P < 0.05 = Significant. MD: Mean difference.

5. Discussion:

Our study aim was to investigate C4/5 mulligan SNAGs effect on active trigger point of rhomboids musculatures in cervical radiculopathy. Forty subjects were allocated randomly into control and study groups.

Our findings showed improvements by the end of the study within control group came in line with Rhee and his colleagues, (21) conclusion regarding physical therapy graduated program might be beneficial in restoring flexibility and overall neck musculature conditioning. By initial pain onset along six weeks, gentle flexibility and stretching exercises plus massage, also various electrical modalities could be useful, however that has no proven long-term benefit. As reported pain improves, a gradual, isometric strengthening program might be initiated with progression to resistive training (22).

The PPT improvements in control group are thought to be due benefits of physical treatment, such as manual therapeutic interventions, strengthening training and intermittent traction. Although a cause-and-effect relationship cannot be inferred from a case series (4).

Due to some variation in the number of treatment sessions used in our study on the improvement of physical therapy intervention for cervical radiculopathy, including traction procedures, with number of sessions ranging from 7 to 15, the improvement of RMA for muscle activity in the control group observed in the study of (23) is due to the traction procedures. Each treatment session can last anywhere between 15 and 50 minutes. Higher session counts and longer traction periods are expected to produce greater effects for pain and disability, potentially indicating a dose-response relationship.

Also, RMF median frequency improvements were confirmed by Said and his colleagues, who applied gliding mobilization that occurs during Mulligan technique might lead to pain reduction, this reduction could be attributed to sympatho-excitatory effect. The activation of afferent nerve endings through manual contact influences the spinal cord neurons, inhibiting nociception and motor neuron pool, thus could explained marked reduction pain in a neutral position (24).

In addition, a similar study conducted by Cleland and his colleagues, who had conducted a case series on eleven patients with the objective to examine the outcomes of a subsequent series of patients coming to physical therapy with cervical radiculopathy and managed with the use of manual physical therapy techniques, cervical traction, and strengthening exercise programmes, is supported by the post-treatment results of the control group. At discharge and a 6-month follow-up visit, the outcomes as measured by NDI were impressive. Ten of the eleven patients (91%) showed improvement in pain and function (4).

When comparing between the pre and post treatment results of study group revealed an obvious improvement that supported by similar study done by Kotteeswaran et al, who stated revealed SNAGS combined with scapular strengthening exercises and interferential therapy, as opposed to resisted neck isometric exercises and interferential therapy alone, could improve pain management and disability management in the treatment of chronic cervical spine dysfunction. in a similar study has clinically reported remarkable neck pain modulation (25).

Results of the current study concluded that Mulligan SNAGs had more pronounced effect on pain reduction, this improvement gained by Mulligan SNAGs could be explained by the study conducted by (26) who considered that the predominant explanation provided for these effects is naturally mechanical and based on the bony positional faults and the ability of mobilization with movement to correct these positional faults.

Further explanations regarding Mulligan SNAGs recorded improvements were supported by Nagai et al. who explained that improvement from the near midrange to end range was enhanced by additional stimulation of cervical spine mechanoreceptors, which ultimately facilitates higher precision regarding position sense due to surrounding tissues stretch (27).

The improvement of neck functional abilities in our study could be supported by earlier study conducted by Jorritsma and his colleagues, who measured neck disability via NDI in112 patients with cervical radiculopathy and has revealed that the average NDI values was 21.5±7.4 points that came in line with our results (28).

Another conflicting opinion to our findings, Perez et al. had concluded nontherapeutic differs in gains of many therapeutic manual techniques including manipulation, SNAGs, also neural mobilization who suffered from chronic cervical disorder, not only immediately bur along their follow up period (29).

Finally, El-Sodany et al. did not report any extra functional gains due to additional mobilization using SNAGs in patients with cervical radiculopathy, where their functional capabilities assessed via NDI (19).

Conclusion:

Mulligan SNAGs technique of C4/5 combined with traditional physical protocol showed extra improvement excess traditional physical protocol in increasing pain threshold, muscle activities and functional abilities levels in patients with cervical radiculopathy with active trigger point in rhomboids muscles.

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