

Butler's Neural Mobilization Versus Maitland's Spinal Mobilization Technique in C₅-C₈ Cervical Radiculopathy

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Original Research Article

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Article History

Received: 13.10.2018

Accepted: 25.10.2018

Published: 30.10.2018

DOI:

10.36348/sjmps.2018.v04i10.019



Abstract: The major objective of this study was to know about the efficacy of neural and spinal mobilization in patients with cervical radiculopathy and difference between the end results of both techniques. The sample population included participants with cervical radiculopathy, who followed inclusion and exclusion criteria. Simple Random sampling method was used for sample size of 30 participants. Sample design was Experimental Comparative study. This study used assessment forms, Consent forms, Examination couch, Goniometer, Visual Analogue Scale, Neck Disability Index Scale and Hot pack. Two groups were arranged including 15 participants each receiving Hot pack and Manual traction in common but Group A in addition received Butler's neural mobilization while Group B received Maitland's spinal mobilization. After the treatment participants were evaluated for their pain profile using VAS, their ROM using the universal Goniometer and neck disability using NDIS. Time Frame for this study and data collection was one year and the source of data was Liaquat National Hospital Physiotherapy Out Patients Department, Karachi, Pakistan. Ethical and human subject's issues were resolved by consent forms, signed by every single participant. The results indicated that both technique produced a hypoalgesic effect as revealed by improved NDIS and decreased VAS. Both the techniques when compared with each other with respect to post treatment NDIS, VAS and ROM, showed no significance difference (VAS P= 0.222, NDIS P= 0.324, Cervical Ranges > 0.05). The combination of all findings has supported the use of both techniques in C5-C8 cervical radiculopathy.

Keywords: Cervical, radiculopathy, cervical radiculopathy, Maitland mobilization, spinal mobilization, Butler neural mobilization, mobilization, neurodynamics.

INTRODUCTION

The famous quote of Pliny the Elder is "*Hope* is the pillar that holds up the world", similarly *Spine* is the pillar the holds up the whole human body, this study is showing with cervical spine. The word *radiculopathy* sounds like something radiating or running over the body but in reality radiculopathy denotes the condition due to compressed nerve which definitely gives signs of pain, tingling sensation and numbness over the nerve route pattern. Radiculopathy can occur anywhere in spine, but here this study is specifically concern with lower cervical radiculopathy, which includes nerve roots from C₅ through C₈. The sedentary life style, lack of exercise, poor postural control and age related problems can lead to cervical radiculopathy. The study conducted on Radiculopathy of cervical region in Rochester, Minnesota stated that cervical radiculopathy has an incidence rate of 83.2 per

100,000 [1]. Normally, the neck moves 600 times every hour whether we are awake or a sleep [2].

This study was tailored for the beneficial purpose of patients and manual therapist; it is an additional drop of water in the ocean of manual therapy because up till now very few studies have been conducted for comparing the efficacy of cervical spine Maitland's mobilization and Butler's neural mobilization in cervical radiculopathy. This study intends to do so, in order to alleviate the symptoms of the condition. It was an essential piece of work to do because it helped to know about the efficacy of neural and spinal mobilization in patients with cervical radiculopathy. It has also given the opportunity to know about difference between end results of both techniques.

In neck there are total seven cervical vertebrae that hold the skull and allow mobility to certain extent.

Cervical nerve roots come out from spine through spinal foramina of every cervical vertebrae from C₁ through C₇. Cervical nerve roots exit above the level of the corresponding pedicle. For example, C₅ nerve root comes out at the C₄-C₅ disc space; hence disc protrusion at the level of C₄-C₅ produces symptoms of C₅

radiculopathy. Cervical anatomy shows total seven vertebrae but features eight cervical nerves.

Cervical nerves provide sensation and motor control to shoulders, arms, hands and fingers. Pain in cervicobrachial area referred into upper extremity. The dermatome pattern of C₅-C₈ is shown in figure below:

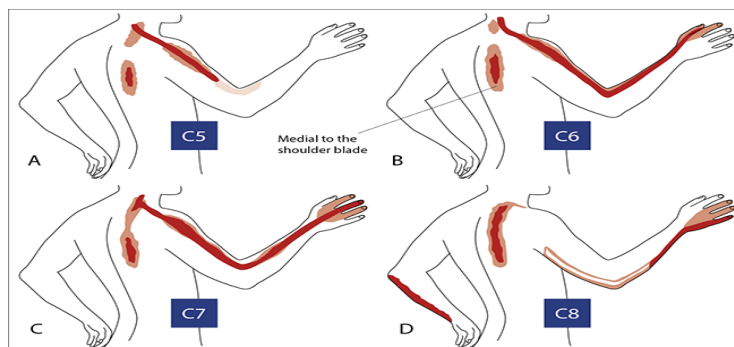


Fig-1.1: The dermatome pattern of C₅-C₈ [3]

The dermatome can be define as a route over skin supplied by an individual nerve and the Myotome can be define as collection of muscles supplied by an

individual spinal nerve. The myotome of cervical spine nerves from C₅-C₈ shown below:

Table-1.1: The myotome of cervical spine nerves from C₅-C₈ [4].

MYOTOMES OF CERVICAL SPINE NERVES C ₅ -C ₆		
Shoulder abduction/ lateral rotation		C ₅
Elbow flexion and/or wrist extension		C ₆
Elbow extension and/or wrist flexion		C ₇
Thumb extension and/or ulnar deviation		C ₈

The specialized role of cervical spine mobility is in gaze range as well, it directs gaze through a range of 180 degrees in the horizontal plane and a range of about 120 degrees in the vertical plane [5]. This functional capacity is unique for cervical as compare to the rest of spine, this is due to different shapes and size. The lower cervical joints allow a wide range of axial rotation, a movement that is restricted in the lumbar spine [5]. Short bifid spinous processes extend from C3 to C5. The spinous process of C7 is large and pointed, projecting prominently at the base of the neck so that C7 is called the vertebra prominens [5]. There are 14 facets (apophyseal) joints in cervical area.

The superior facet joints directs upward, backward and medially while the inferior facet joint directs downward, forward and laterally [4]. The transverse and anteroposterior diameters of vertebral body increases from C₂-C₇. The width and height of superior zygapophyseal facets increases as well from C₃-C₇. Cervical spine can be divided into cervicocephalic or cervicocranial region from C₀-C₂ and cervicobrachial for lower cervical spine (C₃-C₇).

The atlanto-occipital joints exist between C₀-C₁ is the uppermost joint. The principal motion of these two joints is flexion-extension almost 15°-20° (nodding of head). Side flexion is 10°, rotation is negligible [4]. Atlanto-axial joints form between C₁-C₂ form the most mobile part of the spine. Flexion-extension upto 10° and side flexion almost 5°. Rotation, which is about 50° is the primary movement of these joints. The most part of flexion-extension occurs between C₅ and C₆; however, there is almost as much movement at C₄-C₅ and C₆-C₇. Because of this mobility, degeneration is more likely to occur at these levels. The resting position of cervical spine is in slight extension, while close packed position is full-extension. The capsular pattern of cervical spine is side flexion and rotation equally limited, extension. The normal cervical lordosis curvature is approximately 30°- 40°. The intervertebral disc make up approximately 25% of height of cervical spine. No disc present between C₀-C₁ or between C₁-C₂. The nucleus pulposus perform as a buffer to compression forces while annulus fibrosus resist tension within disc. The literature is limited and quite demanding [4].

Screen for cervical spine fracture. If there has been trauma

Although patients with cervical radiculopathy may have complaints of neck pain, the most frequent reason for seeking medical assistance is arm pain [6]. In this study the patients with Lthermitte sign are not included for further management while this sign is ususally positive in myelopathy. This is a test for spinal cord itself and a possible upper motor neuron leison [4]. It is a combination of Brudzinski test and the Straight Leg Raising test. Coughing and sneezing also produce sharp and electric shock like sensation which is provoke by lthermitte maneuver. Foraminal compression test or spurling's test is applied for provoking the symptoms in those patients who have history of cervical radiculopathy but no presenting complain of

radiculopathy. In this test patient actively side flex the head first to the unaffected side, followed by the affected side while the examiner presses straight down on the head carefully. Yoram Anekstein and colleagues in 2012 suggested that a maneuver including extension, lateral bending, and axial compression resulted in the highest VAS score (mean, 7) and was associated with the most distally elicited pain on average (mean, 2.5). The highest paresthesia levels were reported after applying extension, rotation, and axial compression (mean,1).These maneuvers, however, were the least tolerable, causing discontinuation of the examination on three occasions [7]. If the pain is felt in the opposite side to which the head is taken, it is called a Reverse Spurling's sign and this is an indicator of muscle spasm [4].

Table-1.3: Cervical Examination Red Flags [8]

Red Flags	Cervical Myelopathy	Neoplastic Conditions	Upper Cervical Ligamentous Instability	Vertebral Artery Insufficiency	Inflammatory or Systemic Disease
Signs & Symptoms	-Sensory disturbance of the hands -Hand intrinsic muscle wasting -Unsteady gait -Hoffman's reflex -Babinski -Clonus -Inverted supinator sign -Hyperreflexia -Bowel and bladder disturbances -Multisegmental weakness -Multisegmental sensory changes	-Age over 50 years -Previous history of cancer -Unexplained weight loss -Constant pain, not relieved with best rest -Night pain	-Occipital headache and numbness -Severe limitation during neck active range of motion (AROM) in all directions -Signs of cervical myelopathy -Post trauma -RA, Down Syndrome	-Drop attacks -Dizziness -Dysphasia -Dysarthria -Diplopia -Positive cranial nerve signs -Ataxia -Nausea	-Temperature >100 °F -Blood pressure > 160/95 mmHg -Resting pulse > 100 bpm -Resting respiration >25 bpm -Fatigue

Manual cervical distraction test is applied on patients with history and presenting complain of radiculopathy. Examiner place his one hand under patient's chin and other hand around occipital area, then slowly lifts the patient's head. The test is positive if pain decreased or relieved. If pain increased with this maneuver then patient is having muscle spasm, ligament sprain, starin, dural irritability or disc herniation.

Neck Disability Index scale has been used as an assessmnet tool which is a modification of the Oswestry Low Back Pain Index. This modification and amendment was conducted producing a 10-item scaled questionnaire entitled the Neck Disability Index (NDI).The NDI was reviewed in 2008 by the same author [9]. The NDI is the most widely used, translated and oldest questionnaire for neck pain. Vernon and

Mior in 1992 showed that the NDI achieved a high degree of reliability and internal consistency [10]. This scale is specifically designed for population with [9].

- Chronic neck pain
- musculoskeletal neck pain
- whiplash injuries and whiplash associated disorders
- cervical radiculopathy

Pool *et al.*, reported a prospective, single-cohort study to assess the minimally clinically important change (MCIC) on the NDI and the Numerical Rating Scale for neck pain patients. They summarized that the NDI is frequently used, has good validity and test-retest reliability [11]. In 2009, MacDermid *et al.*, systematically reviewed the measurement properties of the NDI. They concluded that the NDI has higher reliability, validity and responsiveness. The minimum detectable change

(MDC) is around 5/50 for uncomplicated neck pain and up to 10/50 for cervical radiculopathy. They observed cultural validation studies for multiple languages. They found inconsistency for the reported clinically important difference from 5/50 to 19/50. They stated that the NDI is related to physical and mental aspects of general health within reasonable limits [12]. NDIS

comprises of total 10 sections including pain intensity, personal care, lifting, reading, headache, concentration, work, driving, sleeping and recreational activities. Each section is having total 5 points with 6 questions, starting from zero to five. This scale is categories into two parts that is Raw score and Level of disability.

Table-1.4: Source: Vernon, H. and Mior, S. The Neck Disability Index: A study of reliability and validity. Journal of Manipulative and Physiological Therapeutics, 1991, 14, 409-415 [13].

Raw score	Level of Disability
0-4	No disability
5-14	Mild disability
15-24	moderate disability
25-34	severe disability
35-50	completely disabled

How much irritating your pain is and how bad you feel about your pain today ?

This is the question usually asked by a physiotherapist and other health care professionals

while marking VAS. This scale scores from zero to ten and it depends on interpersonal, technical and communication skills of medical professional.

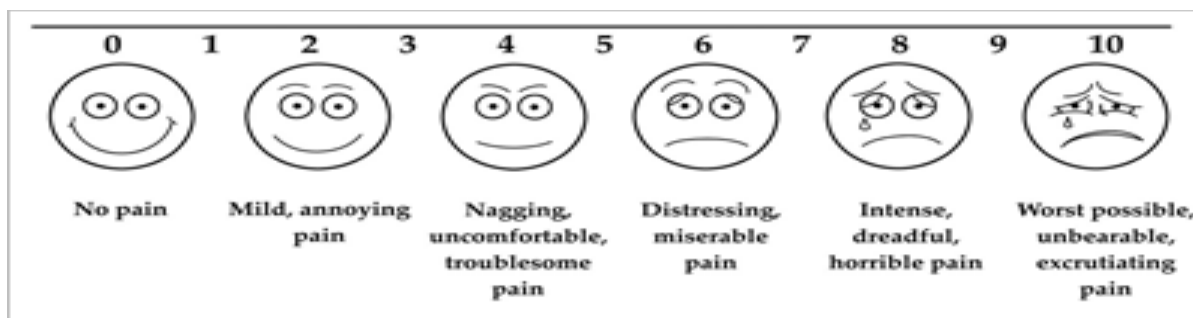


Fig-1.5: The Visual Analogue Scale [14]

In 2011, Gillian A. Hawker *et al.*, concluded that the reliability of VAS proof to be good, but its results are much higher reliable among literate than illiterate patients [15].

Thermoreceptors are special thermal-sensitive nerve endings, they are activated by changes in skin temperature. Receptors initiate nerve signals that block nociception within the spinal cord. Topical modalities

applied with physical support activate another type of specialized nerve endings called proprioceptors. Proprioceptors detect physical changes in tissue pressure and movement. Proprioceptor activity also resists the transmission of nociceptive signals to the brain. The activation of these receptors within the spinal cord reduces muscle tone, relaxes painful muscles, and enhances tissue blood flow [16].

Table-1.5: Showing pathophysiological effects of topical modalities [16]

Table 1.5 Pathophysiologic effects of topical modalities		
	COLD	HEAT
pain	decrease	decrease
spasm	decrease	decrease
metabolism	decrease	increase
inflammation	decrease	increase
edema	decrease	increase
extensibility	decrease	increase

Manual Therapy, as a name indicates “a healing with hands”. Any manual work always requires skill, power, knowledge and energy. In this study two

specific hands on techniques were used that is neurodynamics and mobilization.

Mobilization can improve joint-play by stimulating neurophysiological and mechanical effects. Neurophysiological effects takes place by stimulating mechanoreceptors that inhibit the transmission of nociceptive message at the level of spinal cord and brain stem. Mechanical effects occur by the movement of synovial fluid, which is the carrier for bringing nutrition to cartilage. Joint play help in maintaining nutrition exchange and thus prevent painful and degenerating effects of stasis when a joint is swollen or painful and cannot move through range of motion (ROM) [17].

Neurodynamics is an innovative treatment tool that involves conservative decompression of nerves, various neural mobilizing techniques and patient education techniques. It gives a fresh breeze of understanding and treatment strategies for common syndromes such as plantar fasciitis, tennis elbow, nerve root disorders, carpal tunnel syndromes and spinal pain. Butler in 1991 define neural mobilization technique as use multijointmovements to challenge and increase mechanosensitivity of the nervous system. It is a science of the relationships between mechanics and physiology of the nervous system. Different sliding maneuvers are used in this technique incorporated with the adjustment of cervical and shoulder for cervical radicular pain. The neurodynamic maneuvers can be done actively aswell as passively by the manual therapist. The active maneuvers are listed below [18]:

- Moses prayer : Shoulder depression & Scapular retraction.
- Push away : Median nerve, protraction.
- Cover ears : Ulnar nerve.
- Track baton : Radial nerve, shoulder depression, Internal Rotation.
- Throw behind : Musculocutaneousnerve, shoulder depression.

David Butler in 2005 stated that neurodynamic mobilization techniques can be effective in addressing musculoskeletal presentations of peripheral neuropathic pain. Liaqat Sammer and companions in 2014 suggested that the application of intermittent cervical traction along with neural mobilization is more effective than traction alone with exercises afterwards [19].

Micheal Shacklock *et al.*, [20], mobilization of the nervous system is an approach to physical treatment of pain. The method influences pain physiology via mechanical treatment of neural tissues and the non neural structures surrounding the nervous system. Elongation and changes in intraneural microcirculation, axonal transport and impulse traffic. Many events occur in body including tension; neural tension can better be explained by including mechanical and physiological mechanism. Neural tension test may be better described as Neurodynamic test [20].

Table-1.6: David S Butler, Mark A Jones. Textbook of ‘Mobilization of the nervous system’. Chp 8.1999:pp 147-160 [21]

Upper Limb Tension Tests Showing Order of Joint Positioning and Nerve Bias				
	ULTT1	ULTT2	ULTT3	ULTT4
Shoulder	Depression and abduction (110°)	Depression and abduction (10°)	Depression and abduction (10°)	Depression and abduction (10° to 90°), hand to ear
Elbow	Extension	Extension	Extension	Flexion
Forearm	Supination	Supination	Pronation	Supination
Wrist	Extension	Extension	Flexion and ulnar deviation	Extension and radial deviation
Fingers and thumb	Extension	Extension	Flexion	Extension
Shoulder	—	Lateral rotation	Medial rotation	Lateral rotation
Cervical spine	Contralateral side flexion	Contralateral side flexion	Contralateral side flexion	Contralateral side flexion
Nerve bias	Median nerve, anterior interosseous nerve, C5, C6, C7	Median nerve, musculocutaneous nerve, axillary nerve	Radial nerve	Ulnar nerve, C8 and T1 nerve roots

Miriam Marks *et al.*, cervical mobilization and neurodynamic techniques are very common in the treatment of patients with cervicobrachial pain. Experts recommend not treating affected neural tissues until the related mechanical interface influencing the neurodynamics is examined [22].

Manual therapy utilises passive joint movement techniques. The Graded Oscillation technique is represented by Maitland.

Dosages:

- Grade I : Small-amplitude rhythmic oscillations are performed at the start of range.
- Grade II : Large-amplitude rhythmic oscillations are performed within the range, not reaching the limit.
- Grade III : Large-amplitude rhythmic oscillations are performed upto the limit of available range and stressed into tissue resistance.
- Grade IV : Small-amplitude rhythmic oscillations are performed at limit of available range and stressed into tissue resistance.

- Grade V : small-amplitude, high velocity thrust.

In this study following Maitland mobilisation techniques are used :

- Postero-anterior central vertebral pressure (PACVP)
- Postero-anterior unilateral vertebral pressure (PAUVP)
- Transversal vertebral pressure (TVP)

In 2014, Reid SA and colleagues concluded in their research that Maitland mobilizations provide immediate decrease in intensity and frequency of chronic cervicogenic dizziness [23]. Another study conducted by Rafaela L Aquino *et al.*, asserted that Cervical joint mobilizations produce immediate pain reduction in patients who came with complain of chronic neck pain [24].

Cervical mobilization permits early treatment by gentle oscillatory movements which have the effects of decreasing muscle spasm and pain and thus gradually improving mobility [25]. There is an outstanding advantage of cervical mobilization over cervical manipulation, since there are risk of complications with cervical manipulation, whereas mobilization is safe as it does not past end range technique. Furthermore a lesser degree of skill is required for mobilization than manipulation [25]. Another technique introduced in this study is cervical manual traction. Study about Radiographic analysis of the cervical spine in healthy individuals while applying manual traction showed that an application of manual traction resulted in a statistically significant increase in the length the cervical spine in healthy individuals [26].

Suzanne J. Snodgrass *et al.*, [27] studied regarding cervical spine mobilization forces applied by experienced and new physiotherapists including students. They include 116 in practice physiotherapist and 120 physiotherapy students without clinical experience. These physiotherapists applied mobilization from grades I through IV posteroanterior mobilization to the pre-marked C2 and C7 spinous and articular processes. An instrumented table recorded applied forces, force amplitudes, and oscillation frequencies and a custom device measured subject's spinal stiffness. They concluded that students applied minimum forces than experienced therapists [27].

Michel W. Coppieters *et al.*, in their study regarding different nerve gliding exercises induce different magnitudes of median nerve longitudinal excursion [28]. By using dynamic ultrasound imaging they measured longitudinal excursion of the median nerve in the upper arm during 6 different nerve-gliding exercises. Nerve mobilization techniques that involved

the elbow and neck were evaluated in 15 asymptomatic volunteers. It showed that "sliding technique" was associated with the largest excursion; the amount of nerve movement associated with the "tensioning technique" was smaller than the nerve excursion induced with individual movements of the neck or elbow [28].

James R. Dunning *et al.*, studied the comparison of the short-term effects of upper cervical and upper thoracic high-velocity low-amplitude (HVLA) thrust manipulation to nonthrust mobilization in patients with cervical pain [29]. The combination of upper cervical and upper thoracic HVLA thrust manipulation is appreciably more effective in the short term than nonthrust mobilization in patients with mechanical neck pain [29].

Ian A. Young *et al.*, [30] examined the effects of manual therapy and exercise, with or without cervical traction, on pain, function, and disability in patients with cervical radiculopathy. They suggested that the addition of mechanical cervical traction yields no significant additional benefit to pain, function, or disability in patients with cervical radiculopathy [30].

Bronfort G *et al.*, [31] provided scientific proofs about the effectiveness of manual treatment for the management of different musculoskeletal and non-musculoskeletal conditions. They utilized the reviews that are accepted in US and UK. They concluded that spinal manipulation/mobilization is effective in adults for: acute, sub acute, and chronic low back pain; migraine and cervicogenic headache; cervicogenic dizziness; manipulation/mobilization is effective for several extremity joint conditions; and thoracic manipulation/mobilization is effective for acute/sub acute neck pain they also stated that spinal manipulation is not effective for asthma and dysmenorrhea when compared to sham manipulation, or for Stage 1 hypertension when added to an antihypertensive diet [31].

Deepti *et al.*, studied neural tissue mobilization [NTM] and cervical lateral glide [CLG] treatment protocols for cervico-brachial pain syndrome (CBPS). Results proved that both techniques are effective but the effectiveness of NTM is more than CLG [32].

Liaquat Sammer *et al.*, showed in their study that the prognosis is good among mostly patients after applying the cervical traction and mobilization in cervical radiculopathy patients. This study also concluded that application of intermittent cervical traction along with neural mobilization is more effective than traction alone with exercise afterwards [33].

METHODOLOGY

HYPOTHESIS

Null Hypothesis (H_0): There will be no significant difference produced between neural mobilization and cervical spine mobilization to decrease pain and improve ROM in patients with cervical radiculopathy.

Alternate Hypothesis (H_A): There will be significant difference produced between neural mobilization and cervical spine mobilization to decrease pain and improve ROM in patients with cervical radiculopathy.

MATERIAL & METHOD

All the participants with cervical radiculopathy that report to clinic. After finding their suitability as per the inclusion and exclusion criteria, they were requested to participate in the study. Consent had been taken from them. Their demographic data, pain intensity was assessed with Visual Analogue Scale (VAS), range of motion was assessed with Universal Goniometer and neck disability was assessed with Neck disability index scale, were noted in assessment forms.

Then, participants were randomly divided into two groups' i.e.

- I. Group A
- II. Group B

In Group A:

15 Patients were treated with Hot Pack for 15 minutes then intermittent manual cervical traction applied for 5 minutes.

Following this the subjects were treated with neural mobilization for cervical radiculopathy. For this, participants had been given a comfortable supine lying position. ULTT methods were implemented to the ipsilateral upper limb.

After the treatment participants were evaluated for their pain profile using VAS, their ROM using the universal Goniometer and neck disability using NDIS.

In Group B:

15 Patients were treated with Hot Pack for 15 minutes then intermittent manual cervical traction applied for 5 minutes.

Following this, subjects were treated with cervical spine mobilization for 10 days using Grades I, II, III and IV with the following lower cervical methods of mobilization.

Anterior directed central gliding

- Patient position: prone lying

- Method: with the therapist's thumb, along the longitudinal axis, pressure is transmitted in a direct postero-anterior direction on the spinous process

Anterior directed unilateral gliding

- Patient position: prone lying
- Method: with the therapist's thumb, 2-3 cms from the midline, pressure is transmitted to the vertebrae over the spinous process mobilizing the successive joint.

Rotation

- Patient position: supine lying with head rotated from the painful side
- Method: the patients head is cradled into the therapist's hand, fingers supporting the chin.
- Rotation of the head and thus the cervical spine is achieved by even and rhythmic movements of both the hand in unison to produce a smooth oscillatory movement around a constant axis.

Lateral Flexion

- Patient position: supine lying
- Method: the therapist's hand cradles the occiput of the patient with the thumb anteriorly and fingers posteriorly. The patients head is then laterally flexed away from the painful side.

Longitudinal distraction gliding

- Patient position: supine lying
- Method: the therapist's hand cradle the head and applies traction by using body weight.

Duration for all methods: 3 sets of 30 sec.

After the treatment participants were evaluated for their pain profile using VAS, their ROM using the universal Goniometer and neck disability using NDIS.

Inclusion Criteria

- Age: 30 -50 years
- Gender : both genders
- Symptoms positive for C5-C8 cervical radiculopathy.
- Patients positive for provocative tests: Spurling's test, Manual Cervical distraction test, Lhermitte sign should be negative.

Exclusion Criteria

- Infection –Tuberculosis.
- Inflammation around the cervical spine.
- Tumors around the neck.
- Vertebrobasilar artery insufficiency
- Cervicogenic headache
- Cervical instability/ subluxation /fracture /spondylolisthesis.
- Osteoporosis.
- Joint hypermobility.

- Inability to comply with the study protocol due to cognitive impairment.

Outcome Measures

- Pain using VAS.
- ROM using Universal Goniometer.
- Neck Disability Index Scale NDIS.
- Assessment Form.

Statistical Analysis

Statistical analysis performed by using SPSS software version 21. Independent Sample T-test has been applied for the comparison of mean differences between pre and post treatment which was done through Maitland's mobilization technique and Butler's neural mobilization technique in C₅-C₈ cervical radiculopathy. The level of significance in calculations was set at the 5% confidence level.

RESULTS

Total 30 patients were evaluated 15 in each treatment group to determine the pre and post treatment score for Maitland's and Butler's techniques. SPSS version 21 was used and Independent sample t-test was used for the comparison of mean differences between pre and post treatment which was done through Maitland's mobilization technique and Butler's neural mobilization technique in C₅-C₈ cervical radiculopathy. P-value ≤ 0.05 was considered as significant while P-value > 0.05 considered as Non-significant.

The overall mean age of study subjects was 42.2 years, with minimum 30 years and maximum 50 years. The detailed descriptive statistics are presented in Table-1.

The Post treatment Visual Analogue Scale was evaluated by Independent Sample T-Test showed that mean of Butler's technique is 2.53 and Maitland's technique is 2.00 with significance level of 0.222, which showed the non-significance results. Consider Table- 2 and Graph-1.

The mean value of post treatment NDIS in Maitland technique through Independent Sample T-test was 1.73 while Butler's technique post treatment NDIS was 1.47. The P-value showed no significance result with P-value > 0.05 . The results are presented in Table-3 and graphical presentation of Mean values showed in Graph-2.

Table-4 presented the calculated values of Mean, Std. Deviation and P-value in relation to Post treatment cervical flexion. Mean value in Maitland technique was 45 while in case of Butler its calculated value was 42. P-value > 0.05 considered Non-significant. Graph-3 represented Mean value between Maitland and Butler's technique.

Independent Sample T-Test of Post Treatment Cervical Extension in Butler's & Maitland's Techniques showed mean values and Std. deviation with P-value non-significant results > 0.05 . Consider Table-5 for descriptive statistics and Graph-4 for graphical representation.

Table-6 represented detailed statistical analysis of post treatment cervical left lateral flexion with evaluated P-value > 0.05 . Consider graphical analysis in Graph-5.

Table-7 showed detailed statistical results of post treatment cervical right lateral flexion with evaluated P-value > 0.05 . Consider graphical analysis in Graph-6.

Stratification was done for Post treatment cervical left rotation, detailed analysis showed in Table-8. Considered P-value > 0.05 thus results are non-significant with graphical representation in Graph-7.

Among 30 patients with cervical radiculopathy having restricted cervical right rotation received Maitland's and Butler's technique with 15 patients in each group. The post treatment detailed stratum showed in Table-9 while the further graphical analysis observed in Graph-8.

Table-1: Descriptive Statistics of Age (years)

Age (years)				
N	Mean	Std.Dev	Minimum	Maximum
30	42.2	7.559	30	50

Table-2: Independent Sample T-TEST for Post Treatment VAS in Maitland & Butler Technique

Post Treatment VAS	N	Mean	P-value
Maitland	15	2	0.222*
Butler	15	2.53	

Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.

Table-3: Independent Sample T-Test between Pre & Post Treatment NDIS in Maitland versus Butler's Technique

Post Treatment NDIS	N	Mean	P-value
Maitland	15	1.73	0.324*

Butler	15	1.47	
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Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.

Table-4: Independent Sample T-Test of Post Treatment Cervical Flexion in Maitland versus Butler's Techniques

Post Treatment Cervical Flexion	N	Mean	Std.Deviation	P-value
Maitland	15	45	6.547	0.245*
Butler	15	42	7.27	

Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.

Table-5: Independent Sample T-Test of Post Treatment Cervical Extension in Butler's & Maitland's Techniques

Post Treatment Cervical Flexion	N	Mean	Std.Deviation	P-value
Maitland	15	49.33	11.159	0.822*
Butler	15	50.33	12.882	

Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result

Table-6: Independent Sample T-Test of Post Treatment Cervical Left Lateral Flexion in Maitland's & Butler's Technique

Post Treatment Cervical Left Lateral Flexion	N	Mean	Std.Deviation	P-value
Maitland	15	35.33	3.994	1.00*
Butler	15	35.33	2.289	

Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.

Table 7: Independent Sample T-Test of Post Treatment Cervical Right Lateral Flexion in Maitland's & Butler's Technique

Post Treatment Cervical Right Lateral Flexion	N	Mean	Std.Deviation	P-value
Maitland	15	34.67	5.164	1.000*
Butler	15	34.67	2.968	

Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.

Table-8: Independent Sample T-Test of Post Treatment Cervical Left Rotation in Maitland's & Butler's Technique

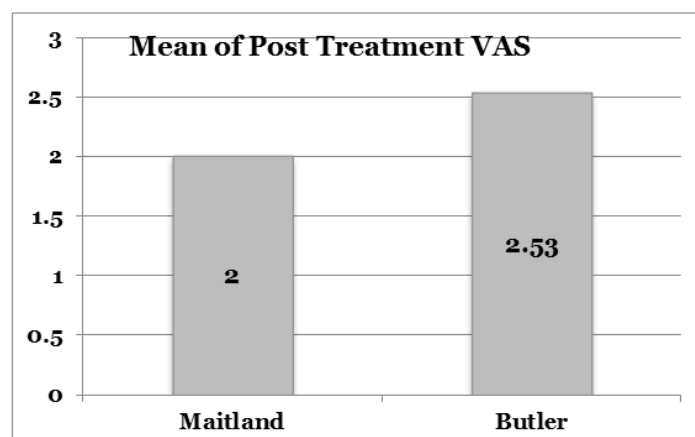
Post Treatment Cervical Left Rotation	N	Mean	Std.Deviation	P-value
Maitland	15	74.67	10.933	0.89*
Butler	15	74	15.024	

Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.

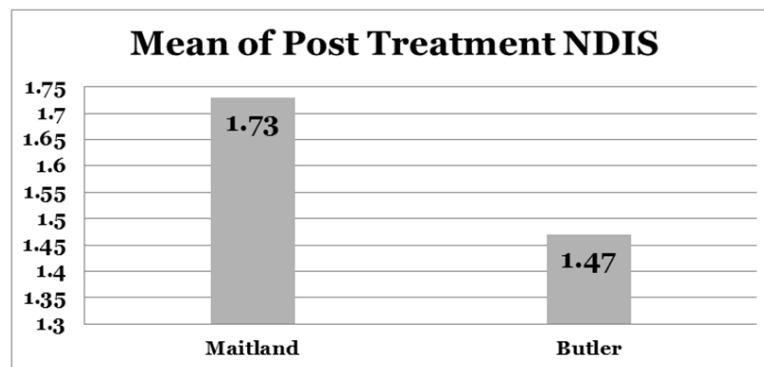
Table-9: Independent Sample T-Test of Post Treatment Cervical Right Rotation in Maitland's & Butler's Technique

Post Treatment Cervical Right Rotation	N	Mean	Std.Deviation	P-value
Maitland	15	35.33	3.994	0.817*
Butler	15	35.33	2.289	

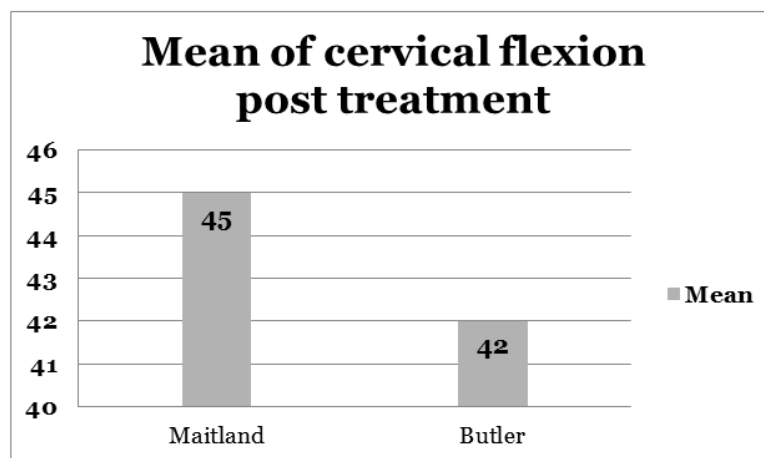
Independent samples T-test was applied, P-value ≤ 0.05 considered as significant, *Non-significant result.



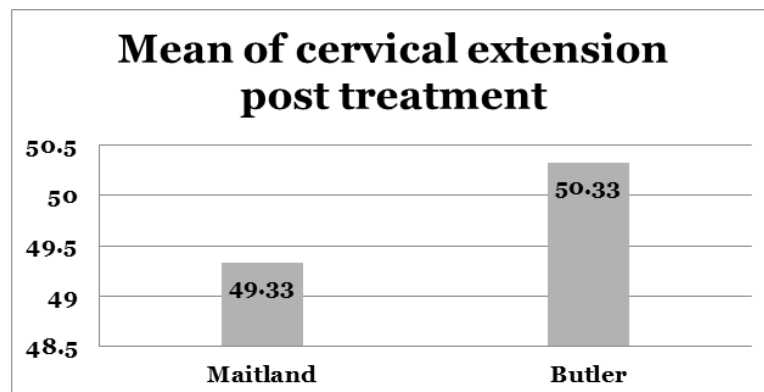
Graph-1: Distribution of Mean in Post Treatment VAS



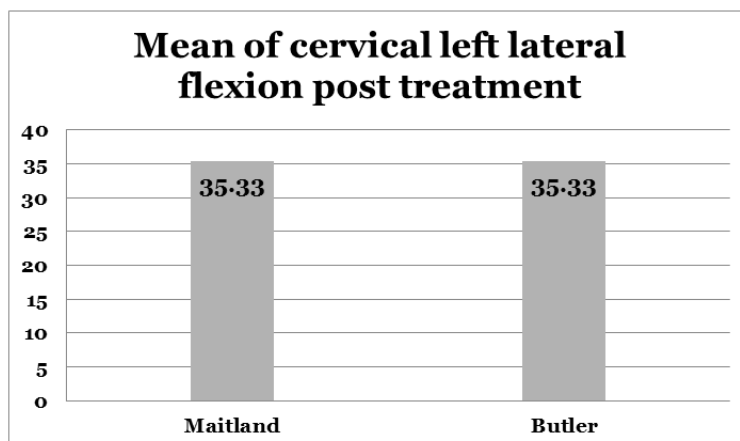
Graph-2: Mean of Post Treatment NDIS in Maitland versus Butler's Technique



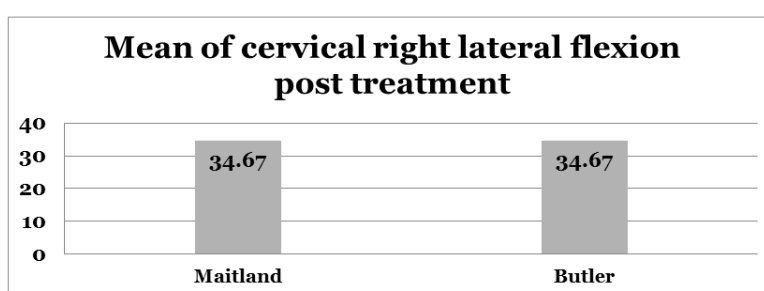
Graph-3: Mean of Cervical Flexion in Post Maitland & Butler's Technique



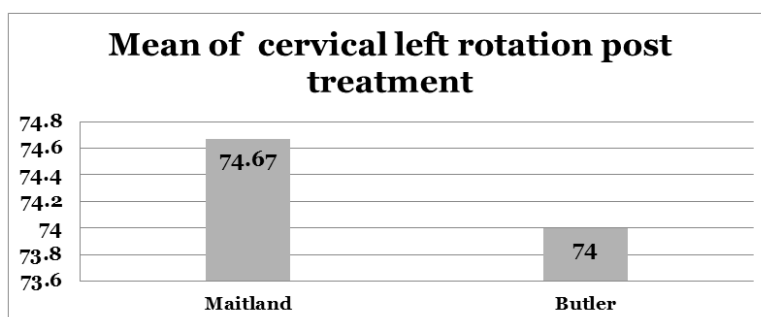
Graph-4: Distribution of Mean of Post Treatment Cervical Extension in Butler's & Maitland's Technique



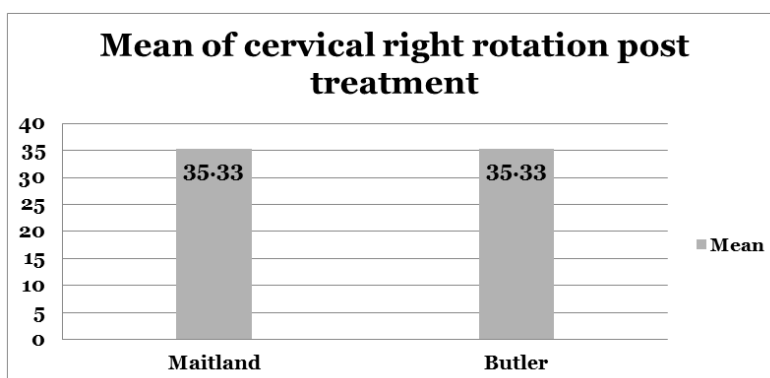
Graph-5: Distribution of Mean of Post Treatment Cervical Left Lateral Flexion in Butler's & Maitland's Technique



Graph-6: Distribution of Mean of Post Treatment Cervical Right Lateral Flexion in Butler's & Maitland's Technique



Graph-7: Distribution of Mean of Post Treatment Cervical Left Rotation in Butler's & Maitland's Technique



Graph-8: Distribution of Mean of Post Treatment Cervical Right Rotation in Butler's & Maitland's Technique

DISCUSSION

In past research has been conducted by reviewing different abstract of papers regarding neural mobilization which showed that there is the lack in quantity and quality of the available research [34]. While there are some studies available that has provided scientific proofs about the effectiveness of manual treatment for the management of different musculoskeletal and non-musculoskeletal conditions [31].

This thesis has provided a logical outcomes regarding butler's neural mobilization versus maitland's spinal mobilization technique in C₅-C₈ cervical radiculopathy with respect to pain and range of motion. It was an experimental comparative study; efficacy was measured using outcomes from Visual Analogue Scale (VAS), Neck Disability Index Scale (NDIS), Range of Motion (ROM) evaluated through goniometer. The null hypothesis for this thesis was that there would be no significant differences produced between neural mobilization and cervical spine mobilization to decrease pain and improve ROM in patients with cervical radiculopathy. Due to the lack of significant results in all measures between groups, the null hypothesis was accepted.

The study conducted on Radiculopathy of cervical region in Rochester, Minnesota stated that cervical radiculopathy has an incidence rate of 83.2 per 100,000, Ages ranged from 13 to 91 years; the mean age +/- SD was 47.6 +/- 13.1 years for males and 48.2 +/- 13.8 years for females [35].

The cervical radiculopathy occur due to the pressure over nerve root thus spurling test further provoke the symptoms while manual cervical distraction test decreased the symptoms of pain and numbness. Other study stated that while applying spurling maneuver first do extension and lateral bending, followed by the addition of axial compression in cases with an inconclusive effect [36].

During the collection of data the common pain aggravating activity was neck bending either during book reading, poor posture while using computer or poor placement of pillow while sleeping. Study done by Sami S. Abdul wahab *et al.*, in 2000, showed that a reading posture exacerbated cervical and radicular pain and reduced H-reflex amplitude in the patient group [37].

Use of analgesics, rest and retraction of neck relief symptoms to some extent. Neck retraction, however, caused immediate reduction or relief of radicular pain and increased the H-reflex amplitude in the patient group. Neck flexion and forward head posture are postulated by McKenzie to cause movement of the nucleus pulposus to a more posterior position

[38]. The findings from this study showed that careful restriction of neck flexion in cervical radiculopathy patients can decrease the chance of further squashing or squeezing of nerve roots.

This comparative study showed that both techniques markedly decrease the pain symptom which was evaluated by visual analogue scale. Independent Sample T-Test showed that mean of Butler's technique was 2.53 and Maitland's technique was 2.00, the resulted P-value showed insignificant relation between both techniques.

While evaluating the significance level of post treatment Neck Disability Index Scale (NDIS) between two groups through independent sample T-test the results were insignificant but both techniques amazingly improved NDI scores. The NDIS was considered in this study because of high reliability and validity. Other research suggested that NDI achieved a high degree of reliability and internal consistency [17].

The use of hot pack and gentle manual traction helped in relaxing cervical muscles due to local warm up and decompression of nerve roots.

The Butler's mobilization of the nervous system influences pain physiology via mechanical treatment of neural tissues and the non-neural structures surrounding the nervous system while the Maitland's graded oscillations changes mechanical energy into heat energy within the restricted joints. During this study Maitland's Postero-anterior unilateral vertebral pressure (PAUVP) showed effectiveness in unilateral radiculopathy while central vertebral pressure technique showed marked results in bilateral radiculopathy.

The evaluation of Post treatment cervical ranges which included flexion, extension, left lateral flexion, right lateral flexion, left rotation and right rotation showed insignificant P-value results between both techniques. The calculated P-value for post treatment cervical flexion between both groups was 0.245 while for extension it was 0.822, which showed that the extension after treatment has more insignificant results as compare to flexion. Consider section of result for detailed statistical analysis of each range of motion after receiving specific technique.

This study also supported mobilization over manipulation because it's much safer and any of its grade don't allow to past end range while grade V is for manipulation technique. There is a chance of human error while applying pressure and force during manual therapy.

During treatment sessions with manual therapy and hot packs safety and precautions were given highest priority. Majority of patients were from middle age

group with co-morbid of hypertension (HTN) and diabetes mellitus (DM). Thus while applying hot pack in diabetic patients high safety measures were used because there is a decline in sensation and chances of burning are highest. Other studies also supported this view, while applying hot pack with 4 cm of towels were heating was very minimal to the deep tissue. In contrast if only a ½ cm of towels was used, heating was strong but there is always a chance of burning the skin, especially in subjects with diminished sensation. Diabetic subjects had been reported to have diminished sensation [39].

LIMITATIONS AND RECOMMENDATIONS

This study had some limitations. This study was primarily limited by its small sample size. The sample size could have been expended by including further greater range for age, this study have included age range between 30-50 years but while collecting data it has been observed that patients aged greater than 50 years also report to OPD with cervical radiculopathy issues. An earlier start in data collection would have increased the time needed to treat more patients which eventually can increase a sample size. Ideally, the number of participants would have been more evenly distributed across gender and occupation while in this study the number of female subjects was more than male. A larger sample with more diversity would have benefited results of this study.

The greater depth of information and focused results could have been obtained by conducting patients treatment only with either Butler's mobilization or spinal mobilization in each group and excluding the use of Hot pack and cervical manual traction because both Hot pack and manual traction have their own effects on cellular level as well as they both can alter pain intensity and range of motion. The study also confirms the feasibility of using the NDIS to evaluate patients with neck pain. So, for the focused results isolated manual technique has been recommended for future studies.

CONCLUSION

As sedentary life style and poor posture control is common which can lead to cervical radiculopathy, in this study many subjects with history of prolong book reading also reported cervical radiculopathy symptoms. This study investigated two forms of manual therapy interventions that are Maitland spinal mobilization and Butler's neurodynamics combined with hot pack and cervical manual traction technique. Both interventions demonstrated marked improvement in Pain intensity which was observed through decrease in VAS level, improved NDIS and cervical ROM. The effects of treatment in both the groups were maintained throughout the follow-up.

APPENDIX # 01

EXPERIMENTAL RESEARCH CONSENT FORM

I _____ permit _____ to obtain the experiment results of myself for research purpose. I agree that the result and information relating to the experiment may be published or used for purposes, which may include lectures and professional journals. However, I shall not be identified by name in any such publications or use. All the information and experiment results remain the property of research conductors.

I understand that my participation is completely voluntary, and that I am free to withdraw from the experiment at any time without penalty.

I understand that this experimental research is not expected to involve risks of harm. I also understand that all reasonable safeguards have been taken to avoid any potential risks.

Truthfully,

Signature:

Date:

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