Faculty of Medicine
University of Dhaka

"EFFICACY OF NEURAL TISSUE MOBILIZATION ALONG WITH CONVENTIONAL PHYSIOTHERAPY AND ONLY CONVENTIONAL PHYSIOTHERAPY IN PATIENTS WITH CHRONIC MECHANICAL RADIATING NECK PAIN OF DHAKA CITY IN BANGLADESH"

By

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Master of Science in Physiotherapy

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Department of Physiotherapy

Bangladesh Health Professions Institute (BHPI)

May 2016

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Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Physiotherapy

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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for acceptance of this thesis entitled, **"Efficacy of Neural Tissue Mobilization along with Conventional Physiotherapy and only Conventional Physiotherapy in Patients with Chronic Mechanical Radiating Neck Pain of Dhaka City in Bangladesh",** submitted by MD. IBRAHIM KHALIL, for the partial fulfillment of the requirements for the degree of Master of Science in Physiotherapy.

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Dedication to

I dedicated this work to

Almighty Allah who created me and the universe

My parents,

My respectful teachers,

My wife&

My sons

Who has shown unconditional love, help and support from beginning to end.

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Acknowledgement

At first I would like to thanks Almighty Allah for timely completion of my study. I am very much grateful to my family to give me mental and economical support and they always want to see me as a successful person in the world. I would like to express my highest gratitude to my honorable supervisor Nasirul Islam, Associate Professor and Principal (Acting), Bangladesh Health Professions Institute (BHPI) for his keen supervision and guidance without which could not able to complete this project.

I would also like to express my gratitude to my respected teacher Firoz Ahmed Mamin, Assistant Professor & coordinator, Department of Masters in Physiotherapy, for his encouraging behaves. S M Ferdous Alam, Assistant Professor, Department of Rehabilitation Science, for sharing his precious knowledge in class that helps me in various aspects of concerning this study.

I am thankful to all the staff of musculoskeletal unit of CRP, Savar for their kind support to collect information about this study specially Mohammad Anower Hossain, Associate Professor and Head of the Department, CRP and Md. Shahidul Islam, OPD In-charge, CRP, Movement Solution BD, Ghulshan 2, Dhaka, and Department of Physiotherapy, Prescription point, Ltd. Banani, Dhaka, for helping me to collect data.

I would like to thank all physiotherapists of CRP, Savar, Movement Solution and Prescription point who work in musculoskeletal unit and helped to provide intervention both control and experimental groups.

Especially, I would like to thank to my sons Rafsun Rahiq and Rushan Rowel for their inspiration and support not to disturbing me during my study.

I express my appreciation to my wife Ruba Aktar, she was always there cheering me up and stood by me through the best times and worst, for her endless support throughout the study, without which it would not be possible for me to complete this thesis.

I am thankful to my students who worked a lot in different stage of my study that made my work easy, relived from difficulties.

Also thanks to the staff of the Bangladesh Health Professions Institute (BHPI) Library for their friendly attitude to find out related books, Journal and access to internet specially HINARI.

I would like to give thanks to the participants of this study. Lastly thanks to all who always are my well-wisher and besides me as friend without any expectation.

LIST OF ABBREVIATIONS

NP	Neck Pain
CR	Cervical Radiculopathy
CNR	Cervical Nerve Root
SR	Spinal radiculopathy
PAG	Periaqueductal Grey
NGF	Nerve growth factor
GFAP	Glia FibrillaryAcidproteins
NM	Neural Mobilization
ULNTT	Upper limb Neural Tension Testing
ULTT	Upper Limb Tension Test
ONDI	Oswestry Neck Disability Index
NDIQ	Ncek Disability Index Questionnaire
CPR	Clinical Prediction Rule
BHPI	Bangladesh Health Professions Institute
BMI	Body mass Index
CRP	Centre for the Rehabilitation of the Paralyzed
RCT	Randomized Control Trail
SD	Standard Deviation
EBPT	Evidence-based physical therapy
BMRC	Bangladesh Medical Research Council
MT	Manual Therapy
PT	Physiotherapy
ROM	Range of Motion
SPSS	Statistical Packages for the Social Science
USA	United States of America
NPRS	Numeric Pain Rating Scale
WHO	World Health Organization
BMRC	Bangladesh Medical and Research Council.
CNS	Central Nervous System.

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ABSTRACT

Background: Neural tissue mobilization is one of the many methods of manual therapy of soft tissue conditions and more specifically, neural tissue and tissues surrounding the nervous system. Cervical radiculopathy is the result of cervical nerve root pathology that may lead to chronic pain, disability and reduce ROM.*Objective:* To determine the efficacy of neural tissue mobilization along with conventional physiotherapy and only conventional physiotherapy in improving pain, neck range of motion and neck disability index in patients with chronic mechanical radiating neck pain. *Methodology:* Experimental study was conducted with triple blinded. 32 participants were conveniently selected with history of radiating neck pain since 03 months and above. Subjects were distributed on the basis of odd and even number into two equal groups where odd number was in experimental group and even number was in control group with age group between 26-65 years. Initially, all the subjects were assessed for pain by NPRS, ROM by goniometer and Disability by Oswestry Neck Disability Index. Experimental group received nerve mobilization for radial, medial and ulnar along with conventional physiotherapy, while Control group received only conventional physiotherapy which include manual cervical traction, hot pack, IRR, retraction exercise and isometric strengthening exercises for cervical. Reassessment was done after six sessions of treatment program. *Analysis:* Significance test for difference of means were done using 'Wilcoxon signed-rank test' for between groups comparison and 'Mann-Whitney U test' for within groups comparison; t-test could not be applied as data violated the condition of normality. *Results:* About 59% participants were male and 41% participants were female. The study reveals that conventional physiotherapy group with a mean age was 44.63 ± 9.73 years and neural mobilization group with a mean agewas47.50 ±10.35. Subjects were evaluated before and after 06 sessions of treatment for pain, neck range of motion and neck disability index. After receiving six sessions of interventions data were analyzed

by ‘Wilcoxon signed-rank test’ for between group’s comparison and ‘Mann-Whitney U test’ for within group’s comparison for pain, ROM and disability. The outcome of the statistical test within group analysis showed statistically significant in maximum indicators ($p<0.05$) and between group analysis showed statistically significant of pain in case change of severity of neck pain ($p<0.05$) and change of neck pain during sitting position ($p<0.05$). Also there was improvement of pain in case of pain during lying, flexion, extension, side flexion to right, side flexion to left, rotation to right, rotation to left and travelling but not statistically significant. Between group analysis showed statistically significant improvement change in case of active ROM in rotation to right side of neck ($p<0.05$) and change in active ROM in rotation to left side of neck ($p<0.05$). Also there was improvement of range of motion in case of flexion, extension, rotation to right side and rotation to left side but it was not statistically significant improvement. Disability was improvement but it was not statistically significant improvement. *Conclusion and Recommendations:* This study showed a significant improvement in neck range of motion and decrease in neck disability index and pain within two therapeutic interventions that is conventional physiotherapy along with neural mobilization and only conventional physiotherapy. It can be concluded that both the intervention is effective therapeutic options in the treatment of cervical radiculopathy. However between group findings does not give a clear idea about which treatment approach is superior to another treatment approach. The results suggest that the addition of neural mobilization along with conventional physiotherapy yields no significant additional benefit to pain, ROM, or disability in patients with cervical radiculopathy, so simultaneously neural mobilization and conventional physiotherapy is not recommended.

Key words: Neural mobilization, conventional physiotherapy, Chronic Pain, ROM and Disability.

CHAPTER –I: INTRODUCTION

1.1 Background

Chronic mechanical radiating neck pain is worldwide health problem. Most often is the result of a compression or inflammatory pathology from a space occupying lesion such as disc herniation, spondylitic spur, or cervical osteophyte (Sambyal and Kumar, 2013; Ellenberg, et al., 1994).The average annual incidence rate of cervical radiculopathy is 85 per 100,000 for the population in its entirety, with an increased prevalence occurring in the fifth decade of life, 203 per 100,000 (priya Vishnu, 2015). The most frequently involved nerve roots are the cervical 6 (C6) and cervical 7 (C7) cervical roots which are typically caused by C5-C6 or C6-C7 disc herniation or spondylosis (Sambyal and Kumar, 2013; Milne, 1991; Radhakrishan, et al., 1994). It's estimated that 50% of the population experienced neck and upper extremity pain at some time in their lifetime (Sambyal and Kumar, 2013; Hult, 1954).

The position and arrangement of symptoms could be vary, depending on the nerve root level exaggerated and can include sensory and motor alterations if the dorsal and ventral nerve root is complicated. Although patients with radiating neck pain often seeking for medical assistance to reduce arm pain. Patients frequently present of pain, numbness, tingling, and weakness in the upper extremity, which often result in significant functional restrictions and incapacity. Physical therapy programs play a significant role in the treatment and improvement of symptoms in patients with cervical spine syndromes. Conservative treatment for radiating neck pain includes short-term use of a soft, cervical collar, traction, medications. Manipulation, physical therapy and steroid injections are also part of a conservative plan of management of physical therapy interventions; cervical traction has been considered as a therapy of

choice for patients with cervical radiculopathy. Neuromobilization is one of the many methods of manual therapy of soft tissue conditions, and more specifically, neural tissue and tissues surrounding the nervous system. Neuromobilization is a set of procedures considered to reestablish plasticity of the nervous system, defined as the ability of nerve-surrounding structures to shift in relation to other such structures. Moreover, it donates to reestablish the ability of neural tissue itself to mobilize, stretch and tension and stimulates the reconstruction of normal physiological function of nerve cells (Butler, 1991).

A multitude of physical therapy interventions has been projected to be effective in the management of cervical radiculopathy, including manual cervical traction, manipulation, therapeutic exercise, and modalities. But no study has directly compared the two different treatment procedures nor has seen the effect of nerve mobilization in comparison to conventional physiotherapy (Sambyal and Kumar, 2013).

The use of upper limb neural tension testing (ULNTT) and neural mobilization by physical and occupational therapists has become common in clinical practice. There is sufficient biomechanical evidence that the peripheral nerve under tension undergoes strain and glides within its interfacing tissue. Evidence supports that ULNTT causes strain within the peripheral nervous system however; it is also evident that ULNTT places strain on other multisegmental tissues. Clinical examination has scannedintrarater reliability and has begun to define the parameters of a positive test but there is lack of randomized controlled studies. There is limited evidence reporting favorable outcomes when using neural mobilization to treat specific patient populations and the appropriate parameters of dosage (i.e., duration, frequency, and amplitude) remain to be established. Clinical application of these techniques must be

applied in a practical mode that relies on repeated clinical reasoning(Walsh, 2005).The study objective was to investigate the efficacy of neural tissue mobilization along with conventional physiotherapy and only conventional physiotherapy in patient with cervical radiculopathy on improving neck pain, ROM, radicular symptoms and neck disability. It was hypothesized that neural tissue mobilization along with conventional physiotherapy and only conventional physiotherapy have a significant improvement on neck pain, ROM, radicular symptoms and neck disability in subjects with unilateral cervical radiculopathy.

1.2 Rationale

Mechanically radiating neck pain is one of the world wide health related complaints. Radiating neck pain is a common clinical finding classified as a syndrome of a nerve root and most often is the result of a compression or inflammatory pathology from a space occupying lesion such as disc herniation, spondylitic spur, or cervical osteophyte (Milne, 1991; Ellenberg, et al., 1994).

Neural mobilization techniques are movement based and attempt to take the nerve throughout the available range of motion, potentially affecting the nerve both mechanically and physiologically. Neural mobilization may improve the actual excursion or movement of the nerve, decreasing adhesions and reducing mechanosensitivity, thereby reducing the symptoms and allow the nerve to move freely. The technique may also improve intraneural blood flow; help to oxygenate the nerve (Cleland, et al., 2005).

The average annual incidence rate of cervical radiculopathy is 85 per 1000 for the population in its total, with an increased prevalence trendy in the fifth decade of life (203 per 1000). The most commonly involved nerve roots are the cervical 6 (C6) and cervical 7 (C7) cervical roots which are typically caused by C5-C6 or C6-C7 disc

herniation or spondylosis (Radhakrishan, et al., 1994). It's assessed that 50% of the population experienced neck and upper extremity pain at some time in their lifetime (Halt, 1954).

In our country, socio-economic conditions of many patients are not so favorable to take long time physiotherapy treatment. Therefore, patient's suffering is more throughout their life &patient satisfaction is not remaining same during the treatment regime. The study computed which treatment is more effective considering the others or relevant treatment and I hope the standardized treatment protocol will be established which will provide maximum benefit considering reducing time, consuming, suffering from pain & cost-effective, therefore the individual will be more productive and huge amount of currency will be saved.

The purpose of the study was to find out efficacy of neural tissue mobilization along with conventional physiotherapy and only conventional physiotherapy in patients with chronic mechanical radiating neck pain, which was essential to compare the efficacy of treatment approach for the best interest of the patients. In this study, conventional physiotherapy was more effective to reduce pain, increase range of motion and lessen disability. So conventional physiotherapy could be the best treatment option for those who are suffering by chronic mechanical radiating neck pain.

1.3 Statement of Hypothesis

1.3 a Alternate Hypothesis

There is difference in effectiveness of Neural Tissue Mobilization along with Conventional Physiotherapy and only Conventional Physiotherapy in Patients with Chronic Mechanical Radiating Neck Pain.

1.3 b. Null Hypothesis

There is no difference in effectiveness of Neural Tissue Mobilization along with Conventional Physiotherapy and only Conventional Physiotherapy in Patients with Chronic Mechanical Radiating Neck Pain.

1.4 Objectives of the Study

1.4. a. **General Objective**

To determine the efficacy of Neural Tissue Mobilization along with Conventional Physiotherapy and only Conventional Physiotherapy in Patients with Chronic Mechanical Radiating Neck Pain.

1.4. b. **Specific objectives**

1. To find out the socio-demographic factors of the participants;

2. To analyze the efficacy of conventional physiotherapy technique of the participants;

3. To measure the effectiveness of neural mobilization along with conventional physiotherapy in patients with chronic mechanical radiating neck pain;

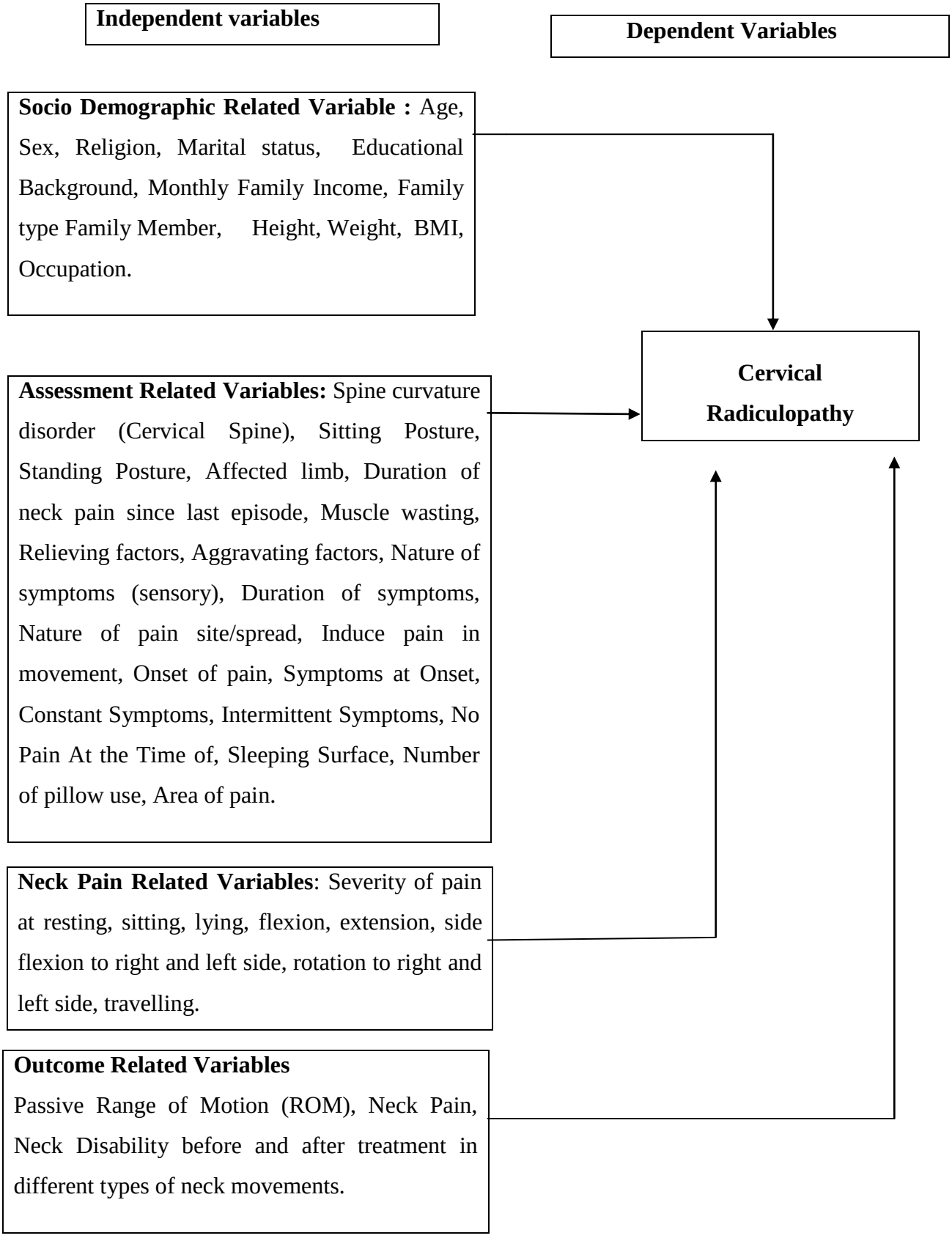
4. To evaluate effect of intervention in relation to pain (during resting, sitting, lying, flexion, extension, side flexion, rotation).

5. To examine the range of motion (ROM) in relation to pain (flexion, extension, side flexion, rotation);

6. To compute the functional outcome in relation to pain (by Oswestry Neck Disability Index (ONDI).

1.6 List of Variable /Conceptual Framework

Conceptual Framework



1.7 Operational definition

Chronic Neck pain

Pain must be continued more than 3 months. Chronic pain is any pain that lasts for more than three months. The pain can become progressively worse and reoccur intermittently, outlasting the usual healing process.

Mechanical pain

Mechanical pain is the general term that refers to any type of neck pain caused by placing abnormal stress and strain on muscles of the vertebral column. Typically, mechanical pain results from bad habits, such as poor posture, poorly-designed seating, and incorrect bending and lifting motions.

Radiating Pain

Pain must be radiated below shoulder. Radiating pain is a type of pain that radiates into the upper extremity directly along the course of a spinal nerve root. Radiating pain is caused by compression, inflammation and/or injury to a spinal nerve root arising from common conditions including herniated disc, foraminal stenosis and peridural fibrosis.

Neural Tension Test

It is a way for physiotherapist to determine the extent of nerve involvement whether pain is originating from the spine or the periphery.

Neural Tissue Mobilization

Neural Mobilization is a way of thinking about the body that uses the nervous system as a frame of reference. This is often helpful whenever one is experiencing tingling, numbness and other "nerve" sensations.

Neurodydamics

It is an innovative management tools involve conservative decompression of nerves, various neural mobilization techniques and patient education techniques.

Neural Mobilization Technique

This is utilizing to controlled neural tension maneuvers to mobilize the nerve up and down.

Conventional Physiotherapy

Physiotherapeutic interventions that are evidence based practiced (like mobilization, retraction, manual traction, IRR, stretching, strengthening exercise) by graduate physiotherapist.

Cervical radiculopathy

Cervical radiculopathy is the damage or disturbance of nerve function that results if one of the nerve roots near the cervical vertebrae is compressed. Damage to nerve roots in the cervical area can cause pain and the loss of sensation along the nerves.

Musculoskeletal Disorders

Musculoskeletal disorders include a group of conditions that involve the nerves, tendons, muscles and supporting structures such as intervertebral discs.

Poor posture

Poor posture is the posture that results from certain muscles tightening up or shortening while others lengthen and become weak which often occurs as a result of one's daily activities.

A clinical prediction rule

A clinical prediction rule (CPR) is a guideline in which the best combination of medical signs, symptoms, and other clinical findings in predicting the probability of a specific disease or outcome are determined.

Spinal stenosis

Spinal stenosis is a degenerative condition, which occurs due to narrowing of the spinal canal. The facet joint may also become enlarged**.** The narrowing or compression of the canal causes pressure on the nerve roots and spinal cord.

Thoracic outlet syndrome

Thoracic outlet syndrome is a group of disorders that occur when the blood vessels or nerves in the space between the collarbone and first rib (thoracic outlet) become compressed. This can cause pain in the shoulders and neck and numbness in fingers.

Axoplasmic transport

Axonal transport, is a cellular process responsible for movement of mitochondria, lipids, synaptic vesicles, proteins, and other cell parts (i.e. organelles) to and from a neuron'scell body, through the cytoplasm of its axon (the axoplasm).

Test re-tests reliability

Test re-tests reliability of accessor of questionnaire checked by principal author/researcher.

Graduate Physiotherapist

The physiotherapist who have completed five years duration (including internship) of BSc in Physiotherapy course of any recognized university.

Evidence-based physical therapy (EBPT)

Evidence-based physical therapy (EBPT) has been defined as "physiotherapy informed by relevant high quality clinical research"

Stinging

A kind of pain; something as sudden and painful as being stung; it just like a cutting pain.

Tingling

Tingling (paresthesia) is an unusual sensation most commonly felt in your hands, feet, arms and legs. Tingling is often associated with numbness, or a decrease in the ability to feel or sense pressure or texture. It is a burning sensation.

Numbness

Partial or total lack of sensation in a part of the body; a symptoms of nerve damage or dysfunction.

The median nerve enters the arm from the axilla at the inferior margin of the teres major muscle. It passes vertically down the medial side of the arm in the anterior compartment and it radiated to the brachial artery throughout its course: In proximal regions, the medial nerve is immediately lateral to the brachial artery; in more distal regions, the medial crosses to the medial side of the brachial artery and lies anterior to the elbow joint. The median nerve has no major branches in the arm, but a branch to one of the muscles of the forearm, the pronator teres muscle, may originate from the nerve immediately proximal to the elbow joint (Darake, et al., 2005).

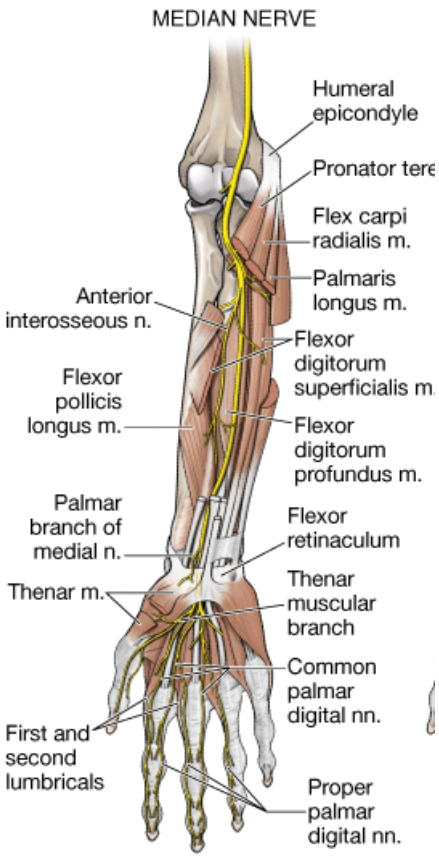


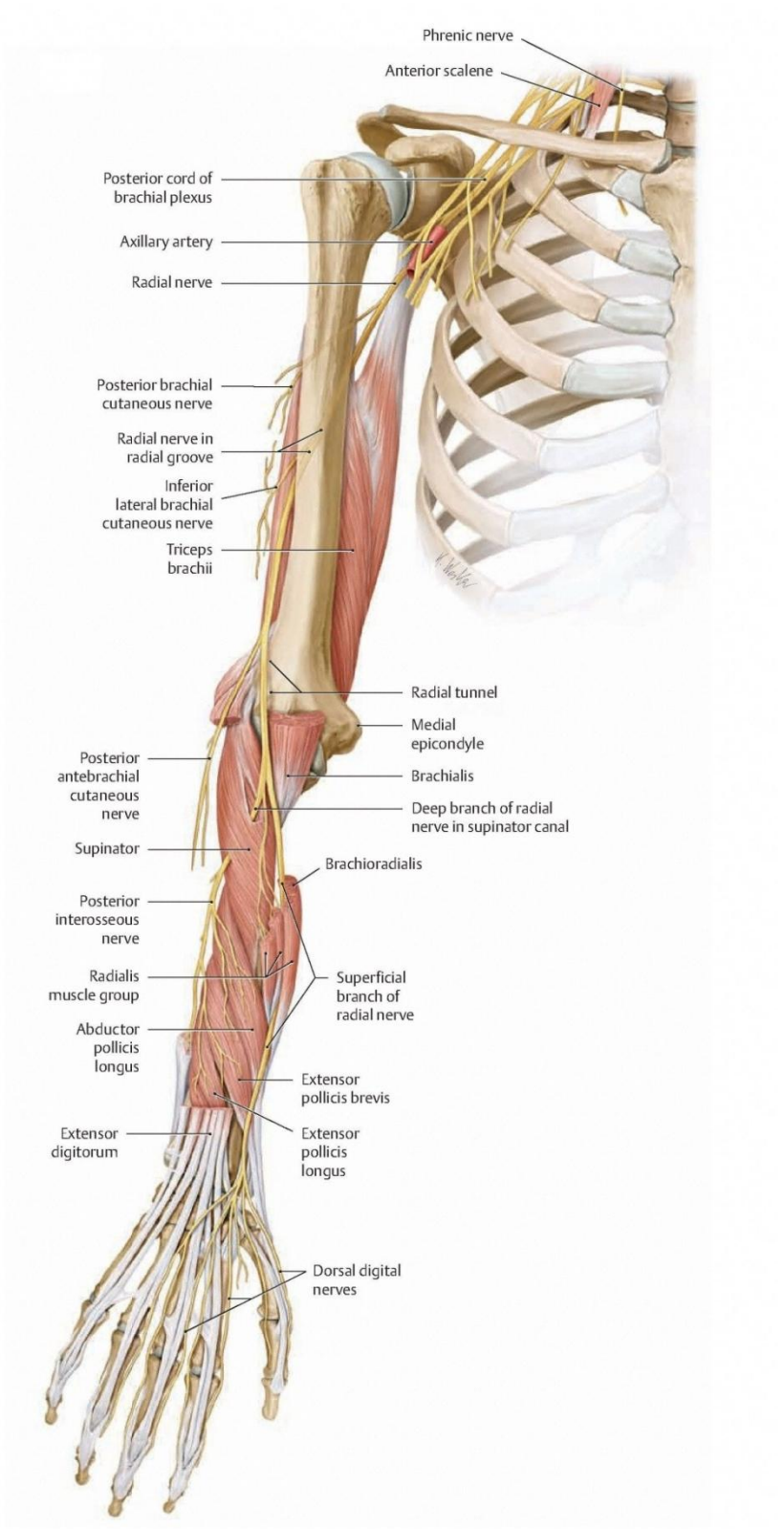
Figure: Median Nerve

The median nerve originates from the lateral and medial cords of the brachial plexus, and has contributions from ventral roots of C5-C7(lateral cord) and C8 &T1 (medial

cord).The median nerve is the only nerve that passes through the carpal tunnel. Carpal tunnel syndrome is the disability that results from the median nerve being pressed in the carpal tunnel (Wikipedia, 2016).

The radial nerve originates from the posterior cord of the brachial plexus and enters the arm by crossing the inferior margin of the teres major muscle. As it enters the arm, it lies posterior to the brachial artery. Accompanied by the profunda brachii artery, the redial nerve enters the posterior compartment of the arm by passing through the triangular interval. As the redial nerve passes diagonally, from medial to lateral, through the posterior compartment, it lies in the redial groove directly on bone. On the lateral side of the arm, it passes anteriorly through the lateral intermuscularseptum and enters the anterior compartment where it lies between the brachialis muscle and a muscle of the posterior compartment of forearm- the brachioradialis muscle, which attaches to the lateral supraepichondylar ridge of the humerus. The redial nerve enters the forearm anterior to the lateral epichondyle of the humerus, just deep to the brachioradialis muscle. In the arm, the radial nerve has muscular and cutaneous branches. Muscular branches include those to the triceps brachii, brachioradialis, and extensor carpi radialis longus muscles (Darake, et al., 2005).

In addition, the radial nerve contributes to the innervation of the lateral part of the brachialis muscle. One of the branches to the medial head of the triceps brachiimuscle arises before the radial nerve's entrance into the posterior compartment and passes vertically down the arm in association with the ulnar nerve. Cutaneous branches of the radial nerve that originate in the posterior compartment of the arm the inferior lateral cutaneous nerve of arm and the posterior cutaneous nerve of forearm, both of which penetrate through the lateral head of the triceps brachii muscle and overlying deep fascia to become subcutaneous (Darake, et al., 2005).



Course of the radial nerve after leaving the posterior cord of the brachial plexus
Right upper limb, anterior view with the forearm pronated.

Figure: Radial Nerve

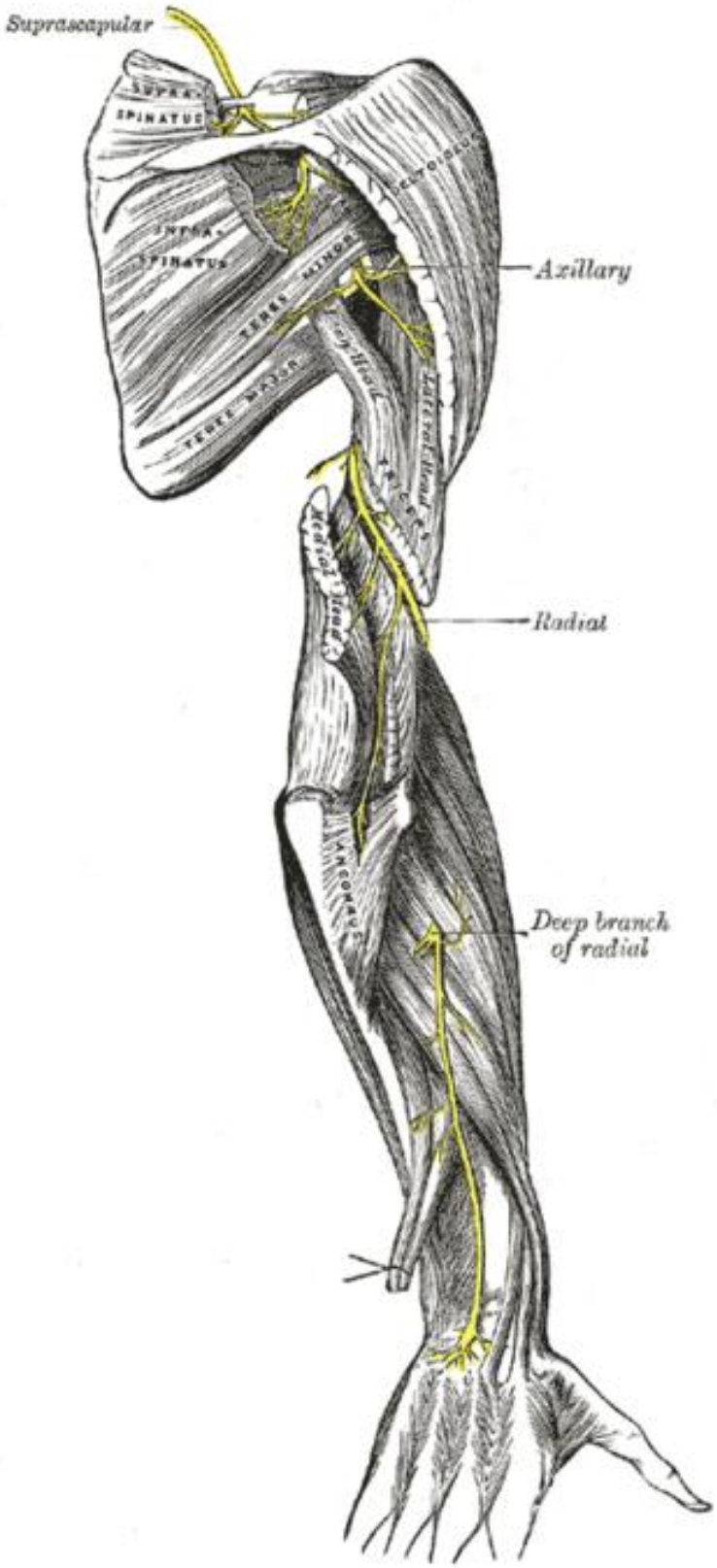


Figure: Radial Nerve

The ulnar nerve enters the arm with the median nerve and axillary artery. It passes through proximal regions medial to the axillary artery. In the middle of the arm, the ulnar nerve penetrates the medial intermuscular septum and enters the posterior compartment where it lies anterior to the medial head of the triceps brachii muscle. It passes and posterior to the medial epicondyle of the humerus and then into the anterior compartment of the forearm. The ulnar nerve has no majorbranches in the arm (Darake, et al., 2005).

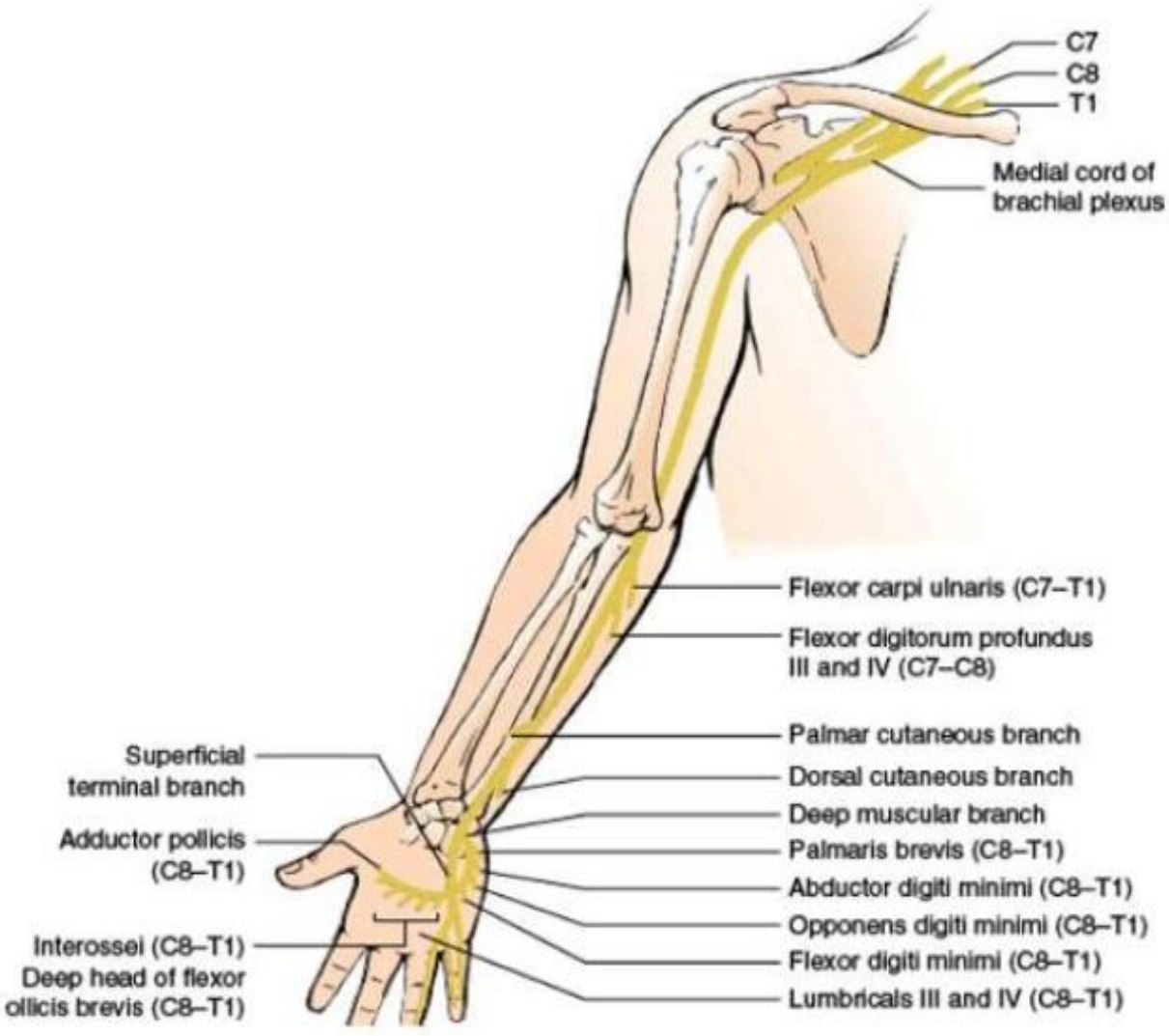


Figure: Ulnar nerve

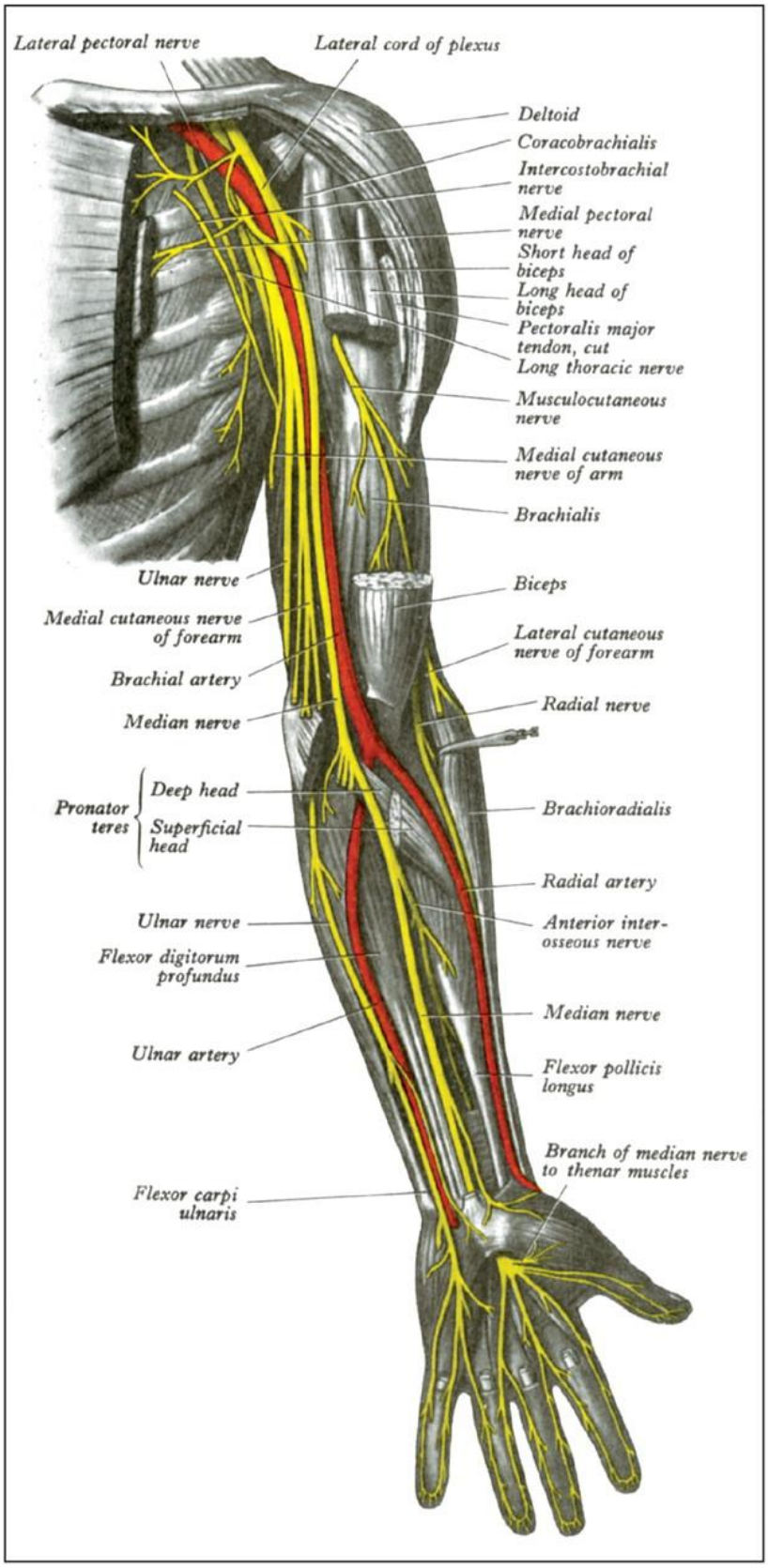


Figure. Common for all three nerves (Median, Radial & Ulnar)

This nerve is directly connected to the little finger, and the adjacent half of the ring finger, supplying the palmar side of these fingers, including both front and back of the tips, perhaps as far back as the fingernail beds *(*Hendrickson and Robert, 2016).

The ulnar nerve originates from the C8-T1 nerve roots (and occasionally carries C7fibres) which form part of the medial cord of the brachial plexus, and descends on the posteromedial aspect of the humerus (The Ulnar Nerve,2016).

Neck pain is the major worldwide health problem. When pain is neck and arm is called cervicobrachialgia. Life time prevelance of cervicobrachialgia is 71% (Shin, et al., 2006).Cervicobrachialgia causes huge financial and disabling impact on population (Shin, et al., 2006).In cervicobrachialgia the cervical canal may be narrowed by osteophytic lipping of the facet, by central disc herniations, by thickening of the ligamentum flavem (McRae, 2010).

Osteophytes arising from the anterior vertebral margins may sometimes, because of their size, give rise to dysphagia (Salt, et al., 2011). There was greater improvement in function and pain with manual therapy (manipulation/mobilization) directly on the cervical spine and indirectly on the shoulder and dorsal spine than without treatment (Oskouei, et al. 2014).

Neuromobilization maneuver has recently been used to treat nerve entrapment syndromes. It consists of a series of therapeutic active and passive movements aimed at restoring the normal mechanical properties of the nerve in common postures and during extremity movements. Neuromobilization maneuvers help to restore longitudinal motion of the affected nerve. Any pathology that reduces the nerve motion and normal strain may produce an abnormal tension in the corresponding nerve in common postures and during extremity movements (Martínez, 2012).As

nerve mobilization only improve the mobility of nerve within different interfaces (Oskouei, et al. 2014). If the compression is applied on these boundaries then it is relieved by neurodynamics. On the other hand cervical mobilization also decreases pressure on nerve roots. Individually these therapeutics techniques are effective for cervicobrachialgia but with certain limitations (Khan, et al., 2015). The results revealed significant pain reduction in the neck pain for the patients who received conventional physiotherapy. Over the investigation period, these patients showed a decreases in neck pain on the Numerical Pain Rating Scale which can be regarded as a clinically relevant change (Kovacs, et al., 2008).

Allison, et al., (2002) were conducted a study to compare articular with neurodynamic treatment; 30 patients with cervicobrachial pain was randomly assigned to one of three groups: neural treatment, articular treatment, and control group. Neural treatment involved mobilization techniques for neural and adjacent tissues, such as cervical lateral glide, shoulder girdle oscillation and muscle re-education. The articular treatment consisted of indirect approaches such as glenohumeral mobilization and thoracic mobilization. No treatment was performed in the third group. Pain was assessed at baseline and after four and eight weeks. The result showed significant pain reduction in both group. Furthermore the between group comparison revealed a significant difference after eight weeks with the patients in the neural treatment groups reporting lower pain on the VAS than those receiving the articular treatment.

Moreover, Allison et al., (2002) performed neurodynamic techniques in combination with articular mobilization techniques, for example the cervical lateral glide, which is thought to influence the neural as well as the articular tissues (Vicenzino, et al., 1999), within one group these techniques were explicitly separated in the present study. The

analgesic effect of cervical mobilization techniques is supported by the reinvestigations (Sterling, et al., 2001; Macaulay, et al., 2007; Schmid, et al., 2008; Schomacher, 2009). Schmid et al., (2008) and Bialskyet al (2009) suggested that supraspinal centers are likely to beimportant in pain modulation. In the patients who received cervical mobilization, the analgesic effects in the neck and arm improved functioning of the mechanical interfaces (Khan, et al., 2015).

Due to the mobilization, the facet joints are supposed to have a better opening and closing function, thereby reducing compression on neural tissues. This reduced compression might contribute to improve physiological and mechanical conditions in the neural tissues, leading to analgesic effects in the upper extremity **(**Shacklock, 2005).Regarding cervical range of motion, the patients in experimental group gradually improved more than the patients in control group (Shacklock, 2005).

Epidemiological data for CR has shown an annual incident of 0.1% in males and 0.06% in females (Radhakrishnan et al., 1994; Radhakrishnan et al., 1994; Cleland et al., 2005). The two most commonly affected levels are C7 (31%e81%), C6 (19%e25%) and C5 (2%e14%) among all CRs (Greathouse and Joshi, 2010). Common symptoms include weakness, numbness, paresthesia or a combination of all these symptoms (Young et al., 2009), which often cause disability and functional limitations (Cleland et al., 2005; Bogduk, 2009).

Pain, is typically generated when microvascular alterations as a result of compression lead to upregulation of inflammatory mediators (Kobayashi et al., 2004). There is evidence showing that, nerve injury is more pronounced when compression and chemical irritation present in combination than when each factor acts alone (Takahashi et al., 2003; Onda et al., 2005). Finally, as in any clinical pain state, insult to peripheral nerves will result in central sensitization with varying degree of severity

(Woolf, 2011). SR has a good prognosis and non-operative treatment is the appropriate initial approach (Kuijper et al., 2009; Stafford et al., 2007). Various interventions (manual therapy, traction, exercise and electrotherapy) have been proposed for cervical and lumbar radiculopathy and have been further scrutinized in systematic reviews (Clarke et al., 2010; Hahne et al., 2010; Boyles et al., 2011).

They involve a specific sequence of joint movements in which the therapist lengthens the nerve at one joint and simultaneously reduces its length at an adjacent joint in order to produce sliding movements of neural structures relative to adjacent tissues. These are known as sliders or gliding techniques (Shacklock, 2005; Butler, 2000). A slightly more aggressive maneuver is a tensioning technique which increases the distance between each end of the nerve tract in an oscillatory fashion (Shacklock, 2005; Butler, 2000). Assessment of nerve mobility in relation to joint range of movement has also been explored (Herrington, 2006), as well as the effectiveness of NM invarious types of peripheral neuropathies by means of improvement in pain (Tal Akabi and Rushton, 2000; Nagraleet al., 2012; Coppieters et al., 2003b) and motor nerve conduction velocity (Ha et al., 2012).McKeon and Yancosek (2008) conducted a systematic review to assess the effectiveness of NM techniques for the treatment of carpal tunnel syndrome. NM showed only apositive trend towards improvement. In another systematic review, (Ellis and Hing, 2008), the therapeutic efficacy of NM in various musculoskeletal disorders such as low back pain, carpal tunnel syndrome, cervicobrachialneurogenic pain and lateral epicondylalgia was examined. Ten RCTs were included and the majority of these showed significant benefit after the application of NM techniques. Nonetheless, the authors in both reviews concluded that evidence for the efficacy of NM must be considered as limited due to

methodological quality of the trials. They suggest that future studies should use more homogenous study designs, populations and pathologies (Efstathiou, et al., 2014).

In a prospected observational cohort study (Murphy et al., 2006), a multi-faceted treatment approach was applied in 27 patients with CR. Treatment was tailored to each patient and only those techniques that were deemed appropriate after thorough assessment were used on each patient. Modalities used in this study were cervical manipulation, over the door traction, end range loading maneuvers and NM directed to the affected nerve root. In the 3 months follow up, 25/27 patients reported clinically significant improvement in pain and disability. Despite the positive results, this study design does not allow any constructive conclusion on the effectiveness of NMs in isolation.

Ragonese (2009) carried out a randomized trial comparing manual therapy (cervical lateral glides, nerve glides, thoracic mobilizations) against therapeutic exercise (deep neck flexor, trapezius and serratus anterior strengthening) or a combination of both in 30 patients with CR. The group which received the combination of exercise and manual therapy demonstrated the greatest improvements in terms of pain and disability after 9 treatment sessions in 3 weeks. Although the researcher used a small sample size of patients with CR, results demonstrate an additive effect on pain when NMs complement therapeutic exercises.

A randomized controlled trial, conducted by Nee et al. (2012) used 60 patients with nerve related neck and arm pain who were randomized in two groups receiving either NMs (lateral glides, nerve glides) with manual therapy and education or advice to remain active alone. Patients in the experimental group showed immediate, clinically relevant benefits after only 4 treatment sessions without any adverse effects related to the application of NM. In another pilot study (Allison et al., 2002), the authors

randomly allocated 30 patients with cervico-brachial pain syndrome in three groups to receive either manual therapy with a focus on articular tissues of the shoulder and thoracic spine, NM techniques (lateral glides) or no treatment. Pain scores showed significantly lower values in the NM group compared to the other two groups.

Coppieters et al. (2003a) conducted a randomized clinical trial and divided 20 patients with peripheral neurogenic cervicobrachial pain in two groups to receive either NMs (lateral glides) or ultrasound. Inclusion criteria were based on certain clinical tests formulated by Elvey (1997) and included techniques of active and passive moment analysis, peripheral-nerve provocation tests and nerve palpation. Patients treated with NMs had significant changes for all outcome measures (ROM for elbow extension, symptom distribution, and pain intensity) immediately after the intervention compared to patients treated with ultrasound. Although there was no follow up in order to evaluate any sustained long term effects for NM, results indicate that NM has an immediate short term positive effect compared to ultrasound for patients with this type of neurogenic pain.

In one case study (Savva and Giakas, 2013), a slider NM technique was simultaneously applied on the median nerve with cervical traction, on a patient with CR. The patient reported improvement in all outcome measures including pain, and functional activities after 12 sessions spread over a period of one month. Collectively, current evidence for the efficacy of NM techniques for patients with CR seems to be limited as only 3 studies have explored these techniques in patients with CR (Murphy et al., 2006; Ragonese, 2009; Savva and Giakas, 2013) and 3 studies in patients with nerve related neck and arm pain (Nee et al., 2012; Allison et al 2002; Coppieters et al., 2003a).NM techniques used in these studies mainly include treatment protocols as described by Elvey (1986).

The location and pattern of symptoms in Cervical radiculopathy vary depending on nerve root level affected and primarily presents with sensory symptoms into the upper limb such as pain, numbness, tingling sensation; motor symptoms like muscle weakness; and reflex hypo activity which often result in significant functional limitations and disability (Tanaka, et al., 2000; Mark, 2006).

Neural tissue mobilization techniques (NMTs) theorize to examine the neural tension in nerves and mobilize the nerves that exhibit neural tension by passive or active movements by using Tensioning, Sliding and Single Joint Movement techniques and focused on restoring the ability of the nervous system to tolerate the normal compressive, friction, and tensile forces associated with daily and sport activities (Walsh, 2005; Nee & Butler 2006). With this method, tension was gently applied to the involved nerve root that caused mild pulling but no pain and a low-amplitude repetitive movement was introduced in the direction of perceived neural tension. NMTs are widely used to normalize the CNR's structure and function by reducing nerve adherence, facilitating nerve gliding and decreasing neural mechanosensitivity in patients with cervical radiculopathy (Nee& Butler 2006; Beneciuk, 2009; Carla, et al., 2010).

Mechanical cervical traction is technique used to decompress the nerve root by separating the cervical segments through long-axis traction. Many studies reveals that Intermittent Cervical Traction for Cervical Radiculopathy found to be effective in reduction of pain and disability (Cleland, et al., 2005; Joghataei , et al., 2004; Moeti & Marchetti, 2001).

Cervical traction and neural mobilization techniques (NMTs) have been advocated in the management of CR due to their immediate analgesic effect (Cleland, et al., 2005; Joghataei , et al., 2004; Moeti & Marchetti, 2001; Saunders, 2004; Takasaki, 2009;

Graham, et al., 2008; Ellis &Hing 2008; Sawa & Giakas, 2012).The analgesic effect of these two techniques has been explored and recognized in many RCT studies and in systematic reviews (Cleland, et al., 2005; Joghataei , et al., 2004; Moeti & Marchetti, 2001; Saunders, 2004; Takasaki, 2009; Graham, et al., 2008; Ellis &Hing 2008;).

In a case study, suggested with research question whether the simultaneous application of Cervical Traction and Neural Mobilization does have effect on improving neck pain, radicular symptoms and neck disability in subjects with unilateral cervical radiculopathy (Raval, et al., 2014).

Neural tissue mobilization techniques focus on restoring the ability of the nervous system to tolerate the normal compressive, friction, and tensile forces associated with daily and sport activities (Walsh, 2005; Nee & Butler 2006).The techniques used in this study were tensioning technique, Sliding technique and Single Joint Movement technique which are commonly used Neural Mobilization techniques (Coppieters & Butler, 2008; Shacklock, 1995; Wainner,et al., 2003;). Sliding techniques during traction allows large range neurally non-aggressive movements.

The clinical assumption is that these sliding techniques result in a larger longitudinal excursion of the nerve with a minimal increase in strain on impinged or tensed nerve. A gliding/ tensioning technique may reduce intraneural swelling and circulatory compromise via fluctuating effects on intraneural pressure. Dynamically altering intraneural pressure may result in a ‘pumping action’ or ‘milking effect’ with beneficial effects on nerve hydration as it facilitates evacuation of the intra neural oedema when correctly applied and hence brings about a reduction in symptoms (Dilley, et al., 2003; Szabo, et al., 1994; Dilley, et al., 2005).The effects of these techniques individually have been explored in many RCTs and systematic reviews. In

a single case study by Christos Savva et.al found that cervical traction combined with neural mobilization significantly shown effective in improving pain and disability in a patient with cervical radiculopathy (Sawa & Giakas, 2012).

Mechanical cervical traction have shown decrease in pain level and perceived disability in patients with cervical radiculopathy after 12 sessions of treatment. Mobilization Techniques that used to normalize the CNRs (cervical nerve root) structure and function via the possible reduction of nerve adherence, facilitation of nerve gliding and decreased neural mechanosensitivity (Carla, et al., 2010).

When the NPRS score and NDI means were compared at pre-intervention and 2nd week post intervention between the groups there was no statistically significant difference between the groups but 4th week post-intervention there was a statistically significant difference between the groups. Simultaneous application of Mechanical Cervical Traction along with Neural Mobilization subjects were -71.33% in NPRS and -59.71% in NDI and with greater percentage of reduction in radicular symptoms following 12 sessions of treatment during 4 weeks of duration. Therefore, based on findings it was found that the simultaneous application of mechanical cervical traction along with neural mobilization found to be more (Raval et al., 2014).

Cervical radiculopathy causes loss of sensation in different parts of the upper extremities, depending on where the damaged roots are located. Damage can occur as a result of pressure from material from a ruptured disc, degenerative changes in bones, arthritis or other injuries that put pressure on the nerve roots. The main symptom of cervical radiculopathy is pain that spreads into the arm, neck, chest, upper back and/or shoulders. A person with radiculopathy may experience muscle weakness and/or numbness or tingling in fingers or hands. Other symptoms may include lack of coordination; especially in the hands. Cervical radiculopathy occurs at

an annual incidence rate of 85 per 100,000 with much less frequency than radiculopathy of the lumbar spine with an increased prevalence in the fifth decade of life (203 per 100,000)(priya Vishnu, 2015).

The most commonly affected nerve roots are C7 (60%) and C6 (25%). A confirmed disc protrusion was responsible for cervical radiculopathy in 21.9% of patients, 68.4% were related to spondylosis, disc or both (Milne, 1991).

Different treatment methods or techniques are used for reducing the symptoms and improving mechanical status of the cervical spine. Cervical radiculopathy is one of the most common conditions for referral to a Physiotherapist. Physical therapy approach is a popular non-surgical approach which is relatively safe and possibly effective in the management of patient with neck pain. It includes active treatment such as range of motion exercises, proprioceptive exercises, strengthening and stretching exercises (Bland, 1994; Bland, et al., 1990; Milne, 1991; Rothman & Simone, 1975;Well, 2001; Kvarstrom, 1983; Bovim, 1994; Linton & Ryberg 2000; Nygren,et al., 2000; Cote, et al., 2004; Ellenberg, 1994; Radhakrishnan,et al., 1994; Varghen, 2000; Fast, et al., 1994; Kisner & Colby 2007; Calliet, 1992; Donald,et al., 2006)and passive treatment such as cervical traction (Bovim, 1994; Linton &Ryberg 2000), low level laser therapy, interferential therapy, cold therapy and manual therapy (Kvarstrom, 1983)approaches like mobilization/manipulation etc.

Heating modalities create local and reflex effects; the local response is an increase in tissue temperature and metabolic rate and the reflex effects includes regional and generalized responses. The regional responses include increase blood flow to the treated area and muscle relaxation. The clinical consequences from both extra neural and intraneural processes can be broadly considered as either pathophysiological (symptoms) or pathomechanical (loss of range of movement and elasticity)

Neural mobilization techniques are used by physical therapists in the treatment of patients with cervical Radiculopathy (Nygren,et al., 2000; Cote, et al., 2004; Ellenberg, 1994). Neural mobilization involves passive movement techniques where the neural structures and anatomic structures (mechanical interface) surrounding the affected neural tissue are gently mobilized with controlled movements. Treatment aims to decrease pain related to movement or bodily position and therefore restore normal movement, posture and hence function (priya Vishnu, 2015).

Neural mobilization techniques are movement based and attempt to take the nerve throughout the available range of motion, potentially affecting the nerve both mechanically and physiologically. Neural mobilization may improve the actual excursion or movement of the nerve, decreasing adhesions and reducing mechanosensitivity, thereby reducing the symptoms and allow the nerve to move freely. The technique may also improve intraneural blood flow; help to oxygenate the nerve (Cleland,et al., 2005)have done a study on effect of intermittent cervical traction, cervical lateral glide towards contralateral side in ULNT1 position, thoracic spine manipulation and strengthening exercises of deep neck flexors and scapulothoracic muscles in cervical radiculopathy.

The conventional physical therapy for treating cervical radiculopathy is moist heat therapy, intermittent cervical traction and isometric neck exercises. Moist heat is often used prior to other forms of treatment like muscle stretching, traction, joint mobilization or massage. Its therapeutic effects include reduction of muscle spasm, relaxation of the muscles, pain relief and sedation, facilitation of joint motion and preparation of tissues for rehabilitation. Moist heat pack conveys heat by conduction or convection. Superficial heat elevates the temperature of tissues and provides the greatest effect at 0.5 cm or less from the surface of the skin. By reducing the viscosity

of viscoelastic collagen, heat increases tissue extensibility and makes connective tissue less resistant to active or passive stretch/traction. However, there are no studies to explain the association between neural mobilization and improvement in the cervical range of motion (Priya, et al., 2015.

Cervical radiculopathy is a common disorder characterized by neck pain radiating to the arm and fingers corresponding to the dermatome involved(Kuijper, et al., 2009).It is a pathologic process which has been defined as pain in the distribution of specific cervical nerve root caused by nerve root compression (Joghataei, 2004).

In management of cervical radiculopathy many multimodal treatment approaches are beneficial which includes postural correction, stabilization exercises and neural mobilization neurodynamics, traction, neck strengthening, stretching, manipulation, modalities (Cleland, et al., 2005; Schenk, et al., 2008). For decades cervical traction has been applied widely for pain relief of neck muscles spasm or nerve root compression. Spinal elongation through an increase of intervertebral space and relaxation of spinal muscles is assumed to be the most important of the proposed mechanisms by which traction could be effective. Neural mobilization is emerging in the field of physiotherapy for radiculopathy. The rationale in treating patients with nervous system mobilization is an attempt to improve axonal transport and by this mechanism to improve nerve conduction (Shacklock, 1995).

The neural mobilization technique is used to regain the movement and elasticity of the nervous system, with the objective of improving neurodynamics and re-establishing axoplasmic flow, thus restoring nerve tissue homeostasis, which promotes the return to its normal functions (Elnaggar, et al., 2009. Strengthening mainly focusing the deep neck flexors and scapulathoracic muscles regardless of their strength levels are prescribed for cervical radiculopathy subjects (Cleland, et al., 2005; Costello, n.d).

The overall study proved that both cervical traction and neural mobilization is effective in improving range of motion and decreasing the disability level in cervical radiculopathy subjects (Chettri, et al., 2014).

It was found that the differences in mean for neck disability index and range of motion for both the groups were statistically significant ($P<0.05$) (Chettri, et al., 2014). Annova test for both the groups showed statistically significant results indicating decrease in disability level and improvement in range of motion in both the groups. Findings in this study are in accordance with other studies showing the effects of traction in cervical radiculopathy. The study(Chettri, et al., 2014) showed statistically significant results for traction in both outcome variables of neck disability index as well as of neck range of motion which is in correlation with study done by Joshua, et al., (2005)where traction has been shown to decrease pain and perceived disability in individuals with cervical radiculopathy(Chettri, et al., 2014).

Rhee et al (2007) explained the mechanism of traction in radiculopathy is due to relieve in symptoms by enlarging the neuroforaminal space which lead to increase neck range of motion and decrease in disability level. A study (Chettri, et al., 2014)correlates with study done by Peake, et al., (2005) in subjects with cervical radiculopathy treated with intermittent cervical traction which showed decrease in neck disability index. Traction was thought to mobilise the muscle and connective tissue, improve tissue–fluid exchange, and improve arterial, venous and lymphatic flow and psychological benefit to the patient.

Overall improvement in subject's range of motion and disability level with traction is explained in a study done by Elnaggar, et al., (2009) which showed decreased in neck and arm pain severity and improvement in neck mobility in patients with cervical

radiculopathy. Overall effect could be due to relief of muscle spasm and pain, decrease in electrical activity in the muscles producing relaxation, vertebral separation removing direct pressure from sensitized neural tissues and relieve the inflammatory reaction of nerve roots by improving the circulation to the tissues and reducing swelling of the tissues(Chettri, et al., 2014).

A study showed statistically significant results for neural mobilization in both outcome variables of neck disability index as well as of neck range of motion (Chettri, et al., 2014).

Richard, et al., (2008) did analysis of studies and concluded a positive benefit from using neural mobilization in the treatment of altered neurodynamics or neurodynamic dysfunction. Neural mobilisation restore the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces allowing reduced intrinsic pressures on the neural tissue promoting optimum physiologic function. There is facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity and improvement of axoplasmic flow which reduces disability level and improves range of motion (Chettri, et al., 2014).

Improvement in a study can be explained by study done by Langenhorst, (2009) to see the effect of neural mobilization where altered axoplasmic flow has been the underlying cause of symptoms in neck. Neural mobilization caused more improvement of symptoms which could be attributed to the fact that by neural mobilisation the internal faulty mechanical and physiological factors of the nerve were normalized. The above mentioned factors may be responsible for decreasing disability level and improving range of motion by neural mobilization technique in cervical radiculopathy subjects (Chettri, et al., 2014).

Identification of appropriate conservative management strategies appears to remain a clinical enigma (Joshua, et al., 2005). Therefore in this study the use of cervical traction as well as neural mobilization is proved to be beneficial for individuals with cervical radiculopathy (Chettri, et al., 2014).

When comparison was done between two intervention groups there was no statistically significant result. When analysis of disability level in neck was done between both the intervention groups, it was not statistically significant (P>0.05)(Chettri, et al., 2014).Comparison of neck range of motion between traction and neural mobilization groups was also not statistically significant (P>0.05)(Chettri, et al., 2014).

With an increasing sedentary population, especially with reliance on computer technology in the workplace, the prevalence rate of neck pain will continue to rise (Wainner & Gill, 2000).It might be unilateral or bilateral. Cervical radiculopathy constitutes 5 to 36% of all radiculopathies (Radhakrishnan, 1976).

Mulligan has described a mobilization technique, spinal mobilization with arm movement, for improvement in cervical lesion resulting in pain and other signs below elbow. There is lack of research evidence supporting its efficacy and are dominated by case report publication (Mulligan, 1999).

Neural mobilization is based on neurodynamics. Neurodynamics integrate biomechanical, physiological &morphological function of nervous system. The benefit of such technique includes facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increase inneurovascularity and axoplasmic flow (Butler, 1994).

The overall study proved that both Mulligan mobilization and neural mobilization is effective in improving pain and decreasing the disability level in cervical radiculopathy subjects. Vincenzino proposed that Mulligan techniques help in improving patient‟s symptoms by correcting minor positional fault and by neurophysiologic mechanism (Vincenzino, et al., 2007).

According to paungmali, et al., MWM produces a hypoalgesia and concurrent sympathoexcitation (Paungmali, et al., 2003). It has been previously proposed that the combination sympathoexcitation, non opioid hypoalgesia and improvement in motor function are indirect signs of possible involvement of endogenous pain inhibitory systems in manual therapy treatment effects (Vincenzino, et al., 2007).

Richard, et al., (2008) did analysis of studies and concluded a positive benefit from using neural mobilization in the treatment of altered neurodynamics. Neural mobilisation restore the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces allowing reduced intrinsic pressures on the neural tissue promoting optimum physiologic function. There is facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity and improvement of axoplasmic flow which reduces disability level and improves range of motion (Butler, 1989).

Neural mobilization is said to affect the axoplasmic flow (Shacklock, 1995), movement of the nerve and its connective tissue (Coppieters, 2009) and the circulation of the nerve (Butler, 1991) by alteration of the pressure in the nervous system and dispersion of intraneuraloedema (Butler, 1991; Schmid, 2012).

Neural mobilization decreases the excitability of dorsal horn cells (Bialosky, et al., 2009).Neural mobilizations can be performed in various ways using passive

movement, manual mobilization of the nerve or interface, and exercise. The aim of neural mobilization is to restore the mechanical and neurophysiological function of the nerve (Shacklock, 1995).

CR is a pathological condition of the cervical nerve root (CNR) that may lead to chronic pain and disability (Rubinstein, et al., 2007; Kuijper,et al., 2009; Eubanks, 2010). The onset of this disorder is typically insidious and most commonly is caused by cervical disk derangement or other space occupying lesion, resulting in nerve root inflammation, compression or both (Greathouse and Joshi, 2010; Kim and Kim, 2010).

Several researchers have reported that the CR pain is probably caused by mechanical (compressive forces) and/or chemical (inflammation) stimuli found around the CNRs (Nee and Butler, 2006; Beneciuk et al., 2009; Carla, et al., 2010). The presence of these stimuli around the CNRs alters their normal structure and function leading to possible neural inflammation, edema, hypoxia, ischaemia, fibrosis, limited gliding movement and increased mechanosensitivity (Cleland, et al., 2005; Carla, et al., 2010. Cervical traction and neural mobilization techniques (NMTs) have been advocated in the management of CR due to their immediate analgesic effect (Maitland et al., 2005; Coppieters and Butler, 2008).

Cervical traction is applied to provide pain inhibition, through the widening of the cervical neural foramina and the reduction of the intradiscal pressure (Takasaki, et al., 2009). In addition, NMTs are widely used to normalize the CNR's structure and function via the possible reduction of nerve adherence, facilitation of nerve gliding and decreased neural mechanosensitivity (Butler, 2000; Coppieters and Butler, 2008). The analgesic effect of these two modalities has been explored and recognized in many RCT studies with these in turn being analyzed in systematic reviews (Ellis and

Hing, 2008; Boyles et al., 2011). However, the methodological quality of these studies has been questioned due to inappropriate use of outcome measures, lack of control group, homogeneous participants and short-term follow-ups (Joghataei et al., 2004; Beneciuk, et al., 2009; Young, et al., 2009).

Although the analgesic action of cervical traction and NMTs has been recognized in many studies, the effect of both modalities applied simultaneously has not been previously investigated (Savvaand Giakas, 2012).

The effect of cervical traction combined with neural mobilization in a patient experiencing CR and its findings have demonstrated significant improvements in terms of pain and disability (Savva and Giakas, 2012).Although the analgesic mechanism of cervical traction is still controversial (Constantoyannis, et al., 2002; Joghataei, et al., 2004),several imaging studies with the use of MRI and CT scans have revealed that cervical traction can increase the intervertebral space leading to neural foramen elongation and reduction of intradiscal pressure (Liu,, et al., 2008; Jellad, et al., 2009).

Czervionke, et al. (1988) also reported that the analgesic effect of cervical traction is a result of reduction in inflammation of the CNRs (Czervionke et al., 1988; Ma and Kim, 2010). Based on these findings, the study used cervical traction to elongate the cervical foramen at C4eC5 level and therefore to eliminate mechanical stimuli which were hypothesized to compress the C5 nerve root (Savva & Giakas, 2012).

Neural mobilization was performed to normalize the structure and function of the C5 nerve root through the possible facilitation of nerve gliding, reduction of intraneural swelling, pressure and inflammation, improvement of axoplasmic flow and decreased neural mechanosensitivity (Coppieters and Butler, 2008; Diniz, et al., 2010). In the

study, cervical traction and neural mobilization were applied simultaneously instead of separately for two reasons (Savva and Giakas, 2012).

To provide a more effective pain management in CR, Cervical traction and NMTs are used in relation to pathologies of the cervical nerve roots (CNRs) due to their analgesic action (Coppieters and Butler, 2008). The simultaneous use of these two modalities enhances the analgesic effect of manual therapy in the treatment of CR(Savva and Giakas, 2012).

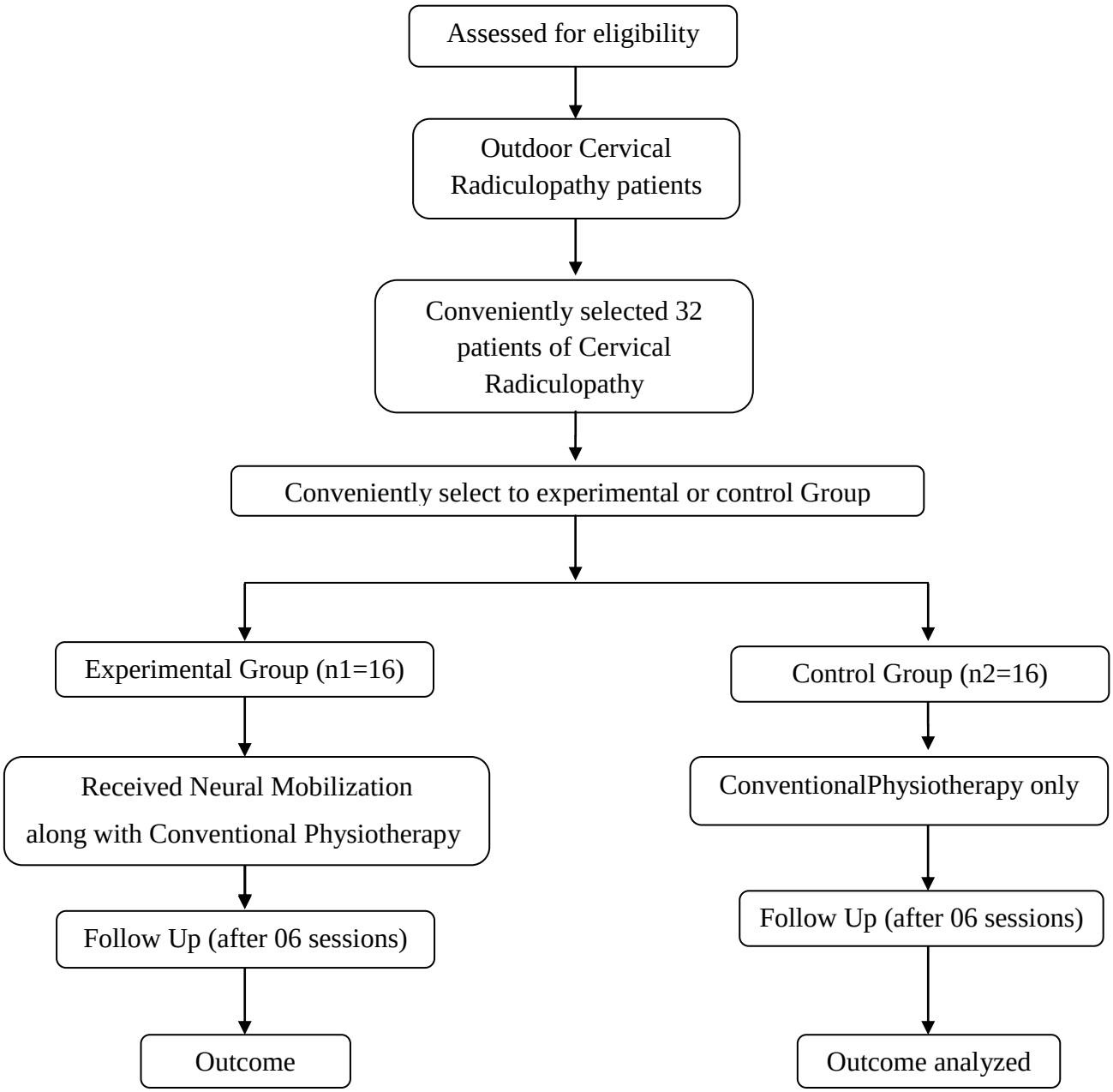
The rationale of using NMTs in CR is to mobilize the affected CNRs (Joghataei et, al., 2004; Coppieters, et al., 2009). However, in nerve root compression, the presence of mechanical stimuli around the CNRs may not allow their mobilization and this may increase CR pain. Thus, cervical traction was applied to elongate the cervical neural foramen at C4eC5 level and decompress the C5 nerve root. Maintaining the application of cervical traction for1 min, slider neural mobilizations were given in this period to mobilize and restore the normal structure and function of theC5 nerve root (Savva and Giakas, 2012).

CHAPTER – III: METHODOLOGY

3.1 Study Design

The study was experimental design conducted between June 2015 to May 2016. Measurement was obtained before starting the intervention and after the intervention period (6 sessions).

Flow chart of the phases of experimental study



A flowchart for an experimental trail of a treatment program including Neural Mobilization along with Conventional Physiotherapy and only conventional physiotherapy in patient with Cervical Radiculopathy

3.2 Study Site

Musculoskeletal unit of the Centre for the Rehabilitation of the Paralyzed (CRP), Savar, Movement Solution BD, Ghulshan 2, Dhaka, and Department of Physiotherapy, Prescription point, Ltd. Banani, Dhaka, were selected for the study site.

3.3 Study Area

The study was conducted at musculoskeletal unit.

3.4 Study Population

The study population consisted of both male and female who complain of neck pain.

3.5 Study Period

June 2015 to May 2016.

3.6 Sample Size

The researcher used convenient sampling procedure for this research. 32 participants were selected into two groups where16 participants were in control group and 16 participants were in trail group.

3.7 Inclusion Criteria

a. Patients having pain for more than 3 months

b. Patient with all age range

c. Both male and female will be included

d. The participants will be those individuals who continue physiotherapy treatment at least 12 sessions.

e. Unilateral upper-extremity pain, paresthesia, or numbness

f. 3 of 4 tests of clinical prediction rule positive (Ragonese, 2009):

- Spurling test

- Distraction test

- Upper Limb Tension Test 1-Median Nerve Bias

- Ipsilateral cervical rotation <60°

3.8 Exclusion Criteria

a. History of previous cervical or thoracic spine surgery

b. Bilateral upper-extremity symptoms

c. Signs or symptoms of upper motor neuron disease

d. Cervical spine injections (steroidal) in the past 2 weeks

e. Current use of steroidal medication prescribed for radiating symptoms

f. Traumatic injuries of upper limb and cervical spine

g. Circulatory disturbances of upper extremity

h. Known history of high level Spinal cord injury and malignancy

i. Patients with Vertebro basilar artery insufficiency

j. Hypermobility (Hypermobility describes joints that stretch further than normal)

k. Acute inflammation

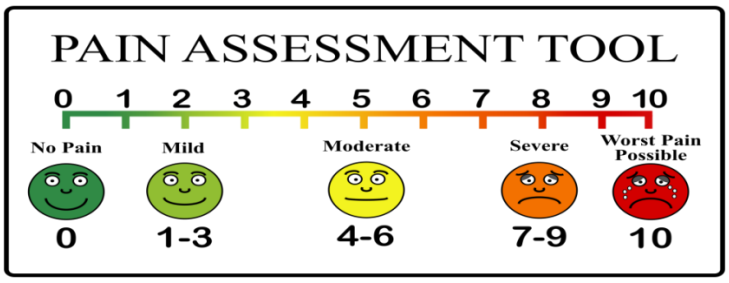
l. Congenital Spine curvature disorder

m. Thoracic outlet syndrome

3.9 Diagnostic Tools

For identifying CR includes the Spurling test, the distraction test, the Upper-Limb Tension Test (ULLT) (median nerve, radial nerve and ulnar nerve bias), and ipsilateral cervical rotation of less than 60 degrees.

Data Collection Instruments/Tools



A Pretested, modified, an interviewer administered, structured questionnaire were designed for information on related Cervical Radiculopathy associated with the use of instruments i.e. pen, pencil, papers, watch, goniometer, numerical pain rating scale, measurement tape & weight machine. The Questionnaire included items on socio-demographic variables, Disease related variables, Treatment related variables, Outcome related variables and severity of pain was measured by Numeric Pain assessment tools, where 0 = (0) No pain, 1 = (1-3) Mild pain, 2 = (4-6) Moderate pain, 3 = (7-9) Severe pain, 4 = (10) Worst pain and Neck Disability Index Questionnaire (Oswestry Neck Disability Index) were used.

3.10 Sampling Technique

Convenient sampling was applied considering the inclusion and exclusion criteria. Consecutive patients with reports of unilateral upper-extremity pain, paresthesia or numbness with or without neck pain were screened by a physical therapist for study eligibility.

3.11 Data Collection Procedure

Data collection procedure was conducted through assessing the patient, initial recording, treatment and final recording. After screening the patient at outdoor department, the patient assessed by qualified physiotherapist in emergency musculoskeletal department of CRP.Those patients who fulfilled all the inclusion and exclusion criteria; was chosen for the study.32subjects were chosen and allocated on the basis of odd and even number into two groups, where odd number was in experimental group and even number was in control group. One group received only conventional physiotherapy called control group and another group received neural mobilization along with conventional physiotherapy called trail group. Data was gathered through a pre-test, intervention and post-test and data was collected by using

a structured questionnaire. Pre-test was performed before beginning the treatment and functional outcomes were noted. The same procedure was performed to take post-test at the end of six (06) session of treatment. The accessor collected the data both in experimental and control group in front of the qualified physiotherapist in order to reduce the biasness.

All the subjects were informed in detail about the type and nature of the study. They were explained about safety and simplicity of procedure and information consent was obtained. The study protocol was duly approved from ethical committees of Bangladesh Health Professions Institute (BHPI). Data collection variables was structure Questionnaire, the Numerical Pain Rating Scale (NPRS), the Neck Disability Index (NDI) to assess neck pain complaints and universal Goniometer to measure Range of motion (ROM) and all the measurements were recorded in triple blinding fashion that is the participants, data collectors and researcher were blinded due to the nature of the interventions was used in this study. Treatment duration (approximate time) of neural tissue mobilization was done for 10 minutes including rest period as there was 1 minutes rest period after each technique. Thirty two patients who were willingly participated in this study were screened for inclusion and exclusion criteria. Sampling design was experimental study, sampling techniques was purposive technique with a sample size of N= 32patients with radiating neck pain, limited ROM of neck and pain persisting for more than 3 months, was included in the study. The study was conducted at the Centre for the Rehabilitation of the Paralyzed (CRP), Savar, from June 2015 to May 2016. Accessor collected data by following even and odd number in experimental and control group respectively. Collected subjects were assigned into two groups that are control and trail group respectively. The entire subjects were given intervention according to their groups. Participating therapists

undergo a 3-hour training session provided by one of the investigators. In control group there were given by following the Conventional Physiotherapy according to guidelines of CRP and Trail group were treated with standard protocol of neurodynamics (Elvey, 1986). In Neural mobilization, subject was positioned in supine position and remains relaxed with the feet uncrossed. The patient was slightly angled obliquely for easier access to the scapula. The therapist position was next to the plinth facing the direction of subject's face for ULTT-1 and ULTT-3 but for ULTT-2a and ULTT-2b, the therapist position was at head of the patient to the plinth facing the direction of subject's foot. The therapist depressed the scapula with concomitant upper extremity joint positioning as per nerve bias. The wrist was used as a tension factor and at the point where tension was felt by the therapist and which was perceived by the subjects.

The pain was recorded by 10 cm horizontal Numeric Pain Rating Scale (NPRS), the participant was asked to mark their intensity of pain on a 10 cm long scale, in the data collection sheet with 0 to 10 where 0 symbolized no pain and 10 was worst pain. Diagnosed Cervical Radiculopathy patients were the participants for the study. Accessor was trained by a qualified physiotherapist who has 12 years clinical experience and was a graduate physiotherapist from recognized University with at least completion of one year internship training. Neural Mobilization of Median nerve, Radial Nerve and Ulnar nerve were done. Both Tension and mobilization technique were used to elongate of nerve bed at on joint while reducing the length of the nerve bed at an adjacent joint by reducing intraneural swelling and circulating stasis by altering intraneural pressure where role of inflammatory products and limiting fibroblastic activity. Convenient sampling technique was used. Result was taken by graduate physiotherapists who have completed graduation from recognized

University. Treatment was done by graduate physiotherapists who has completed graduate from recognized University with at least completion of one year internship training with 02 years working experience as a clinical Physiotherapist. Assessment and treatment Photos and videos were taken during mobilization of Median, Radial &Ulnar nerve, conventional physiotherapy protocol of CRP, and the measurement of ROM by goniometer. Twice sitting per week, daily one session and total of 06 sessions of treatment were provided. Two (2) repetitions of each technique were done in per session for each nerve. Participants demographic, pain, Range of Motion (ROM) and disability related questionnaire were completed.

Neural Tissue mobilization (Elvey, 1986).

Name of the Nerve	**Components**	**Setting**	**Holding Time in Second at the final stretched position**
Median Nerve Bias (ULTT-1)	**Median Nerve:** Scapular depression, glenohumeral abduction, glenohumeral lateral rotation, wrist extension, finger extension, forearms supination, elbow extension, neck lateral bending to opposite side.	One session 2 repetitions/day	10
Median Nerve (ULTT-2a)	**Radial Nerve:** Scapular depression, shoulder external rotation, wrist extension, finger extension and elbows extension, glenohumeral abduction.	One session 2 repetitions/day	10
Radial Nerve Bias(ULTT-2b)	**Radial Nerve:** Scapular depression, whole arm internal rotation, wrist flexion, finger flexion, ulnar deviation, elbow extension, glenohumeral	One session 2 repetitions/day	10

	abduction.		
Ulnar Nerve Bias (ULTT-3)	**Ulnar Nerve:** Scapular depression, shoulder external rotation, wrist extension, finger extension, forearm pronation, elbow flexion, shoulder abduction.	One session 2 repetitions/day	10

Conventional Physiotherapy (Control group)

There are fifteen (16) subjects in control group. Total six (06) sessions they received only the conventional intervention, including isometric exercise, isotonic exercise, stretching exercise, myofacial release, manual mobilization, retraction exercise, manual traction, Infra Red Radiation (IRR), Postural correction, self-mobilization, therapeutic exercise (ROM, strengthening), manual therapy (muscle energy techniques, non-thrust mobilization, manipulation), massage therapy, and cervical collar (Robert, et al., 2011).

Isometric strengthening neck exercises with 25 repetitions in each direction with 7 seconds hold and one time in a day. An exercise program includes Cervical retraction, cervical extension, deep cervical flexors strengthening and scapular strengthening Exercises (Young,et, al.,2009).Strengthening exercise was done with hold for 10 sec and repeat for 10 times. Infra-Red Radiation (IRR) was given 15-20 minutes over the cervical region.

The total duration of the treatment program was six sessions' two sittings per week. The reassessment was done at 6 sessions and the parameters were assessed intensity of pain, functional disability and Range of Motion (ROM) using the Numeric Pain Rating Scale (NPRS), Neck Disability Index (NDI) and Goniometer. After 06 sessions of treatment, the outcomes were measured and analyzed with Statistical Package for Social Sciences (SPSS).

3.12 Data Management

Baseline variables included age, sex, occupation, height, weight and pain. Outcome measurements were taken at the baseline and after six (06) session of treatment in two groups. Measurements was made by NPRS (Numeric Pain Rating Scale), where (0-10) point, where 0 is no pain and 10 is the worst pain and by NDI (Neck Disability Index) scale has 50 scores, where Minimum score: 0 with a minimum disability of 0%, and Maximum score: 50 with maximal disability of 100%. After collecting data, all interviewed Questionnaire were checked for its completeness, correctness and internal consistency to exclude missing or inconsistent data and those was discard.

3.13 Outcome Measurement Tools

Primary and secondary outcome e.g. disability, and pain perception & ROM were assessed by using Neck Disability Index, Numeric Pain Rating Scale and Goniometer respectively.

3.14 Data Analysis

To find out the efficacy of neural mobilization for patient with mechanical radiating neck pain data collected. In this study there were two different group where one was control that received only conventional physiotherapy and another group was trail that received neural mobilization along with conventional physiotherapy. There were demographic data that obtained by the questioner and ratio data that scored for neural mobilizing test by NPRS (Numeric Pain Rating Scale), ROM by goniometer and NDI (Neck Disability Index) scale. The clinical outcome variables were analyzed by intention to treat. The results are expressed by means, and standard deviation (SD). Statistical analysis was performed using SPSS 20.0. Significance test for difference of means were done using 'Wilcoxon signed-rank test' for between groups comparison

and ‘Mann-Whitney U test’ for within groups comparison; t-test could not be applied as data violated the condition of normality.

Statistical test

For the significance of the study, a statistical test carried out, Statistical analysis refers to the well-defined organization and interpretation of the data by systematic and mathematical procures and rules (Deposy and Gittin, 1998). The U has done for the analysis of the neural mobilization after six (06) sessions treatment of both control and trail groups.

Mann-Whitney U test is a non-parametric test that is simply compares the result obtained from the each group to see if they differ significantly. This test can only be used with ordinal or interval/ratio data.

The formula of Mann-Whitney U test:

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n_2} R_i$$

Where:

U=Mann-Whitney U test

N_1 = sample size one

N2= Sample size two

R_i = Rank of the sample size

The *U* test is included in most modern statistical packages which do the calculations

In order to determine the efficacy of neural mobilization along with conventional physiotherapy technique and only conventional physiotherapy, the study followed the ‘difference-in-differences’ technique explained in the following table:

Initial and Terminal Value of Variables

Variables	**0**	**t**
Members of Experimental group	XP_0	XP_t
Members of Control group	XNP_0 ($\cong XP_0$)	XNP_t

The first column shows two variables. The second column refers to the situation during time '0' initial period (benchmark period). The third column depicts situation at the end of period 't' or impact survey period. In the second and third columns, the top two boxes refer to members of "programme" households and the lower two to members of "control" households. Now consider any variable X (say, severity of neck pain) on which the programme is likely to have an impact. Assuming that control households are chosen in such a way that all (or at least major) initial conditions are similar to the members of programme as well as control households, we have

$XP_0 \cong XNP_0$ ... ... (i)

On the programme households there are actually two types of influences on X, that of trend factor, symbolized by time t, and that due to the programme. On the control households, only the first type applies. The combined impact on the programme beneficiaries will, therefore, be

$(XP_t - XP_0)$ ... ... (ii)

and the change on control households will be

$(XNP_t - XNP_0)$ ... ... (iii)

Assuming that the programme households in the absence of the programme would be similar to the control households, the change due to programme can be symbolized as:

$(XP_t - XP_o) - (XNP_t - XNP0)$ ... ... (iv)

or (ii) – (iii)

The above equation clearly shows that to isolate the effect of 'time trend' on the programme household members, and to get the pure impact of the programme the so-called "difference-in- differences" methodology will have to be employed.

The difference between equation (ii) and (iii) will indicate the direction and magnitude of the impact of the programme, and the extent to which the goal of the programme has been achieved.

Statistical analysis was performed using SPSS 20.0. Significance test for difference of means were done using 'Wilcoxon signed-rank test' for between groups comparison and 'Mann-Whitney U test' for within groups comparison; t-test could not be applied as data violated the condition of normality.

3.15 Ethical Permission

The study protocol was duly approved from ethical committees of Bangladesh Health Professions Institute (BHPI).All the subjects were informed in detail about the type and nature of the study. They were explained about safety and simplicity of procedure and information consent was obtained. Again before beginning the data collection, researcher obtained the permission from concerned authorities ensuring the safety of the participants. In order to eliminate the ethical claims, the participants set free to receive treatment for other purposes as usual. Each participant informed about the study before beginning and given written consent. Before data collection, permission from the Ethical Committee of Bangladesh Health Professions Institute (BHPI) took and a requested letter hand overed to the appropriate authority of the study area for taking permission and seeking assistance for smooth access to data collection. All

ethical issues related to research involving human subjects addressed according to the guidelines of Bangladesh Medical Research Council (BMRC) and Ethical Review Committee of World Health Organization (WHO) prior to data collection.

3.16 Informed Consent

The researcher obtained consent to participate from every participant. A single informed consent form received from each participant. The participants informed that they have the right to meet with outdoor doctor if they think that the treatment is not enough to control the condition or if the condition become worsens. The participants also are informed that they were completely free to decline answering any question during the study and were free to withdraw their consent and terminate participation at any time. Withdrawal of participation from the study would not affect their treatment in the physiotherapy department and they would still get the same facilities.

CHAPTER IV: RESULTS

Thirty Two patients with chronic neck pain were enrolled in the study. Sixteen in the conventional physiotherapy group (control group) and sixteen in the neural mobilization along with conventional physiotherapy group (Trial group). This experimental study was conducted in Dhaka city in order to determine the efficacy of neural mobilization along with conventional physiotherapy technique and only conventional physiotherapy in patient with chronic radiating neck pain. A pre-tested modified interviewer administrated structured questionnaire was used to collect the information. A total of 32 patients were interviewed to collect the information. Section A contained socio-demographic related variables; section B contained disease related variables; section C contained neck pain related variables; section D contained active ROM related variables; and section E contained neck disability Index related variables. Subjects of both conventional and experimental group scored their pain on Numeric Pain Rating Scale (NPRS), Range of Motion (ROM) and disability on Oswestry Neck Pain Disability Index before and after completing treatment. The data were entered and analyzed by using SPSS (Statistical Package for Social Sciences) software version 20.Significance test for difference of means were done using 'Wilcoxon signed-rank test' for between groups comparison and 'Mann-Whitney U test' for within groups comparison; t-test could not be applied as data violated the condition of normality.

Socio-demographic characteristics of participants

Table 1: Distribution of respondents by age (n= 32)

Age in years	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
26-35	3	18.7	2	12.5
36-45	5	31.3	6	37.5
46-55	7	43.7	3	18.7
56 -65	1	6.3	5	31.3
Total	16	100.0	16	100.0
Mean± SD	**44.63 ± 9.73**		**47.50 ±10.35**	

The table revels that the mean age of the participants were 44.63± 9.73 years with a range from 26 to 60 years. It is found from table 2 that 43.7%, 31.3%, 18.7% and 6.3% of the participants belonged to age group 46-55 years, 36-45 years, 26-35 years,56-65 years respectively of conventional physiotherapy technique compare to neural mobilization technique mean age of the respondents were 47.50 ±10.35 years with a range of from 26 to 65 years. That 37.5%, 31.3%, 18.7%, 12.5% of the participants belonged to age group 36-45years, 56-65 years, 46-55 yearand 26-35 years respectively.

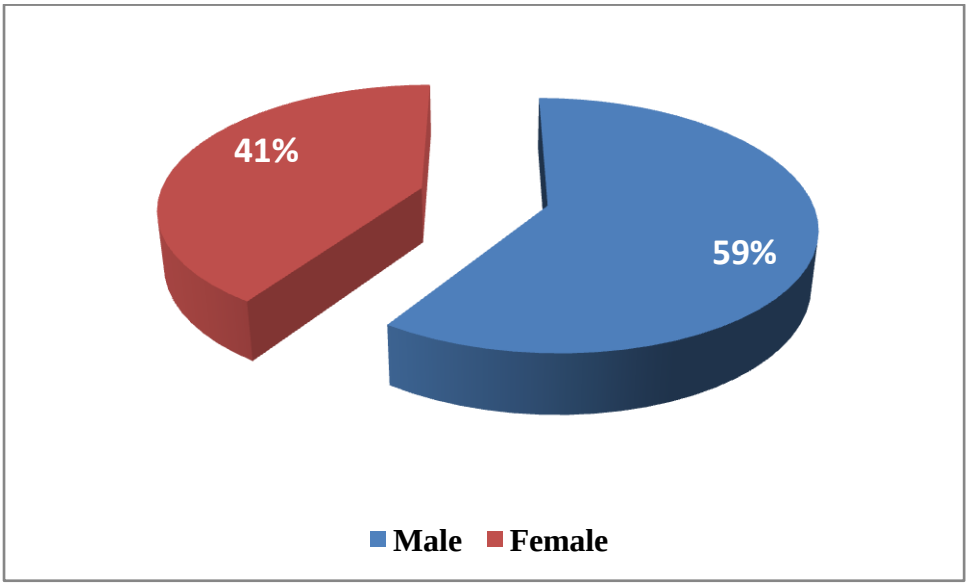


Figure 1: Distribution of participants by sex (n=32)
The figure 1 reveals that about 59% participants were male and 41% participants were female.

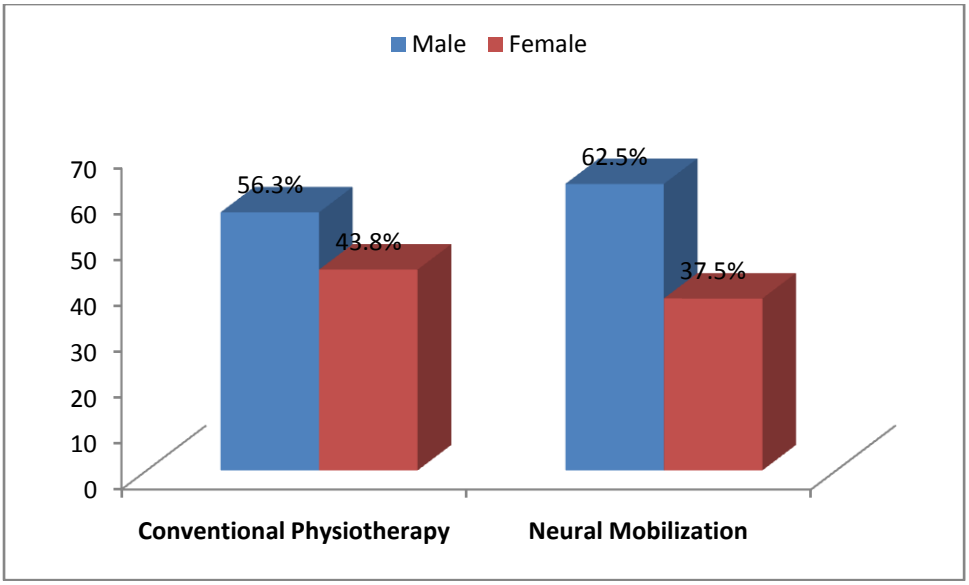


Figure 2: Distribution of participants by sex (n=32)

The figure 2 shows that among the participants of conventional physiotherapy, 56.3% were male and 43.8% were female. Other hands 62.5% were male and 37.5% were female in the participants of neural mobilization.

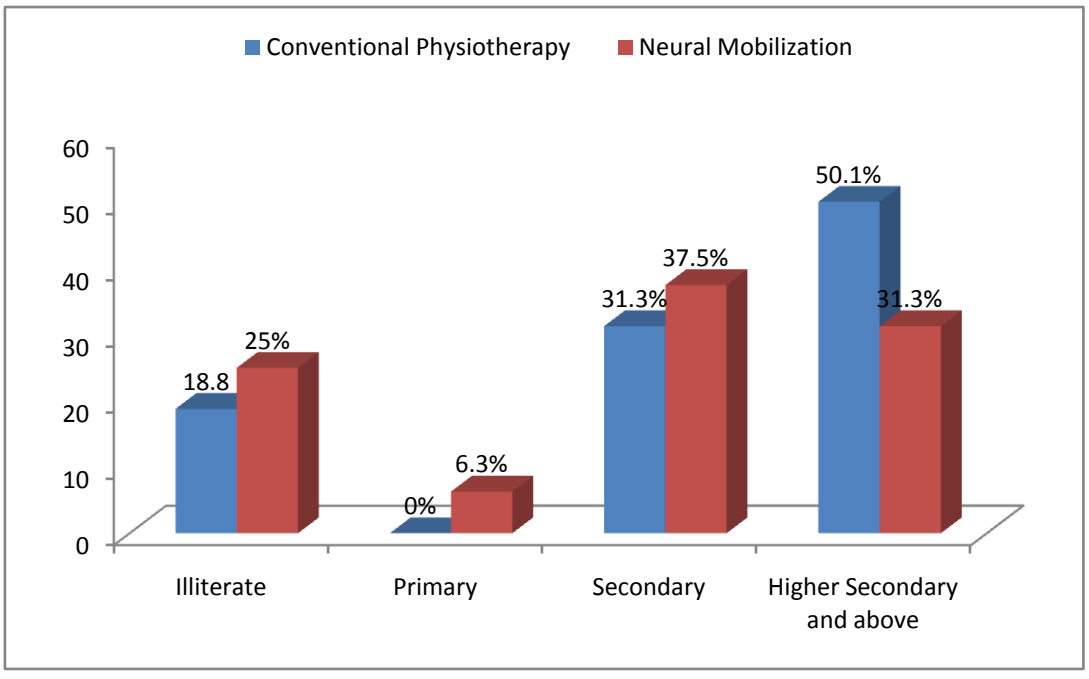


Figure 3: Distribution of participants by Educational Background (n=32)

Figure 3 found from the figure no. 3 that 50.1%, 31.3%, 18.8 and 0% of the respondents belonged to the level of education had Higher Secondary and above,

Secondary, Illiterate and Primary education respectively of conventional physiotherapy group compare to neural mobilization group, 37.5%, 31.3%, 25%and 6.3%had Secondary, Higher Secondary and above, Illiterate and Primary education respectively. The figure shown that Higher Secondary and above is the highest in conventional physiotherapy group (50.1%), moreover, the secondary (37.5%) is the highest in neural mobilization group.

In this study all participants were married and there were no any muscle wasting of the participants.

Table 2: Distribution of participants by BMI (n=32)

BMI	**Conventional Physiotherapy**		**Neural Mobilization & Conventional Physiotherapy**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Normal weight = 18.5–24.9	8	50	9	56.3
Overweight = 25–29.9	7	43.8	6	37.5
Obesity = BMI of 30 or greater	1	6.2	1	6.2
Total	**16**	**100**	**16**	**100**
Mean± SD	**25.38±2.86**		**25.3±2.64**	

The table 2 reveals that the mean BMI of the participants were 25.38 ± 2.86, with BMI range from 20.80 to 32.40. Table also reveals that, 50% of the participants were normal weight, 43.8% were overweight and 6.2% were obese persons respectively of conventional physiotherapy technique compare to neural mobilization technique, the mean BMI of the participants were 25.3 ± 2.64, with BMI range from 20 to 30. Among them 56.3% of the participants were normal weights, 37.5% were overweight and 6.2% were obese persons respectively.

Table 3: Distribution of respondents by Occupation (n=32)

Occupation	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	**Percentage**	**Frequency**	**Percentage**
House Wife	5	31.3	5	31.3
Worker	2	12.5	2	12.5
Service Holder	4	25.0	6	37.5
Business	4	25.0	1	6.3
Retired Person	1	6.3	2	12.5
Total	**16**	**100.0**	**16**	**100**

The table 3 found that 31.1 of the participants were house wife, 25% Service holder, 25% business, 12.5% worker and only 6.3% were retired persons respectively of conventional physiotherapy technique group compare to neural mobilization technique, 37.5% of the participants were service holder, 31.1% were house wife, 12.5% were worker, 12.5% were retired person and 6.3% were business man respectively.

Table 4: Distribution of participants by Sitting Posture (Before Treatment) (n=32)

Sitting Posture	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Good	10	62.50	3	18.8
Fair	6	37.50	12	75.0
Poor	0	0	1	6.3
Total	**16**	**100**	**16**	**100.0**

The table 4 reveals that the Sitting Posture among the participants of conventional physiotherapy, 62.50% was good and 37.50% were fair and 0% was poor. Other hands 75% were fair, 18.8% were good and 6.3% were poor in the participants of neural mobilization before treatment.

Table 5: Distribution of participants by Sitting Posture (After Treatment) (n=32)

Sitting Posture	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
Good	14	87.50	15	93.8
Fair	2	12.50	1	6.3
Poor	0	0	0	0
Total	**16**	**100**	**16**	**100**

The table 5 reveals that the Sitting Posture among the participants of conventional physiotherapy, 87.50% was good and12.50% were fair and 0% was poor. Other hands 93.8% were good, 6.3% were fair and 0% were poor in the participants of neural mobilization after treatment.

Table 6: Distribution of participants by Standing Posture (Before Treatment) (n=32)

Standing Posture	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
Good	10	62.5	3	18.8
Fair	6	37.5	12	75.0
Poor	0	0	1	6.3
Total	**16**	**100**	**16**	**100.0**

The table 6 reveals that the Standing Posture among the participants of conventional physiotherapy, 62.50% was good and 37.50% were fair and 0% was poor. Other hands 75% were fair, 18.8% were good and 6.3% were poor in the participants of neural mobilization before treatment.

Table 7: Distribution of participants by Standing Posture (After Treatment) (n=32)

Standing Posture	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
Good	14	87.5	15	93.8
Fair	2	12.5	1	6.3
Poor	0	0	0	0
Total	**16**	**100**	**16**	100.0

The table 7 reveals that the standing Posture among the participants of conventional physiotherapy, 87.50% was good and12.50% were fair and 0% was poor. Other hands 93.8% were good, 6.3% were fair and 0% were poor in the participants of neural mobilization before treatment.

Table 8: Distribution of respondents by duration of last episode of pain (n=32)

Last episode of pain in month	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
1-2	7	43.8	8	50.0
3-4	8	50.0	4	25.0
5-6	1	6.2	4	25.0
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**2.63±1.147**		**2.75 ± 1.983**	

The table 8 reveals that the mean last episode of pain in month of the participants was 2.63 ± 0.62, with last episode of pain in month range from 1 to 6. Table also reveals that, 50% of the participants were 3-4, 43.8% were 1-2 and 6.2% were 5-6 respectively of conventional physiotherapy technique compare to neural mobilization technique, the mean last episode of pain in month of the participants were 2.75 ± 0.86, with family member range from 1 to 6. Among them 50% of the participants were 1-2, 25% were 3-4 and 25% were 5-6 respectively.

Table 9: Distribution of participants by nature of symptoms during neurodynamic testing (sensory) (Before Treatment) (n=32)

Symptoms	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percent of Cases	Frequency	Percent of Cases
Stinging	2	12.5%	9	56.3%
Tingling	**6**	**37.5%**	**8**	**50.0%**
Tightness	4	25.0%	6	37.5%
Sharpness	4	25.0%	1	6.3%

*Multiple Responses

The table 9 reveals that the nature of symptoms among the participants of conventional physiotherapy, 37.5% of cases were in Tingling, 25% of cases were in Tightness, 25%of cases were in Sharpness and 12.5% of cases were in Stinging. Other hands 56.3% of cases were in Stinging,50% of cases were Tingling, , 37.5%of cases were in Tightness and 6.3%of cases were in Sharpness in the participants of neural mobilization before treatment.

Table: 10 Distribution of participants by nature of symptoms during neurodynamic testing (sensory) (After Treatment) (n=32)

Symptoms	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percent of Cases	Frequency	Percent of Cases
Stinging	4	26.7%	7	43.8%
Tingling	**4**	**26.7%**	**2**	**12.5%**
Tightness	1	6.7%	7	43.8%
Sharpness	5	33.3%	0	0
Numbness	3	20.0%	0	0

*Multiple Responses

The table 10 reveals that the nature of symptoms among the participants of conventional physiotherapy, 33.3% of cases were in Sharpness, 26.7% of cases were in Tingling, 26.7% of cases were Stinging, 20%of cases were in Numbness and 6.7%of cases were in Tightness. Other hands 43.8% of cases were in Stinging, 43.8%

of cases were in Tightness, 12.5% of cases were Tingling, 0%of cases wereinSharpnessand0%of cases were in Numbness in the participants of neural mobilization after treatment.

Table 11: Distribution of participants by nature of pain site/spread (Before Treatment) (n=32)

Nature of pain site/spread	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
Up to shoulder	1	6.3	4	25.0
Up to elbow	6	37.5	6	37.5
Up to wrist	2	12.5	1	6.3
Up to hand	1	6.3	1	6.3

The table 11 reveals that the by nature of pain site/spread among the participants of conventional physiotherapy, 37.5.5% were up to elbow, 37.5.5% were up to finger, 12.5.5% were up to wrist, 6.3% were up to shoulder and 6.3% were up to hand. Other hands 37.5.5% were up to elbow, 25.5% were up to shoulder, 25% were up to finger, 6.3% were up to wrist and 6.3% were up to hand in the participants of neural mobilization.

Table 12: Distribution of participants by nature of pain site/spread (After Treatment) (n=32)

Nature of pain site/spread	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
Up to shoulder	13	81.3	11	68.8
Up to elbow	3	18.8	5	31.3
Total	**16**	**100.0**	**16**	**100**

The table 12 reveals that the by nature of pain site/spread among the participants of conventional physiotherapy, 81.3% were up to shoulder, 18.8% were up to elbow. Other hands 68.8% were up to shoulder, 31.3% were up to elbow.

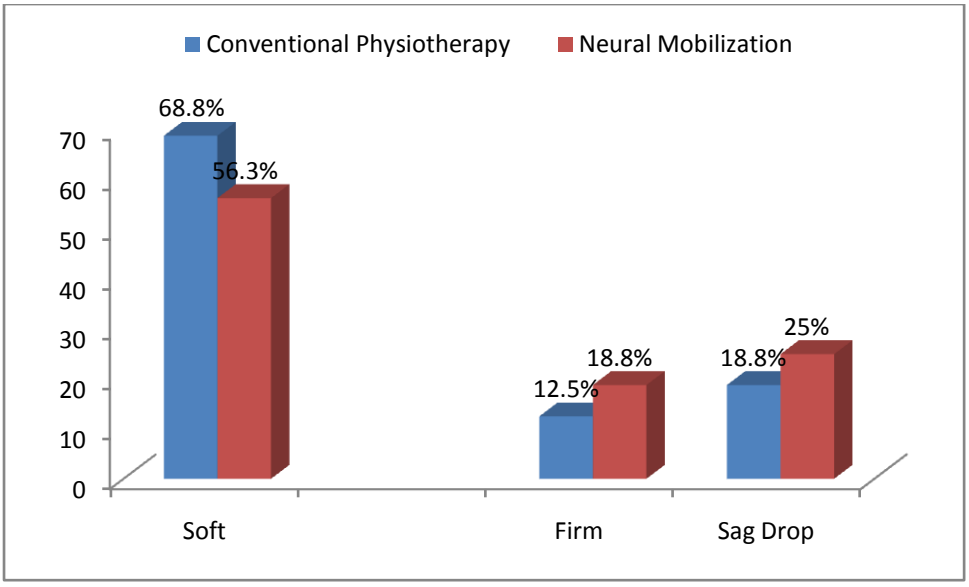


Figure 4: Distribution of participants by sleeping surface (n=32)

The figure 4 reveals that the sleeping surface among the participants of conventional physiotherapy, 68.8% were soft, 18.8% were sag drop and 12.5% were firm surface. Other hands 56.3%were soft and 25% were sag drop and 18.8% were firm in the participants of neural mobilization.

Table 13: Distribution of respondents by severity pain (before treatment) (n=32)

Severity pain	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
"4-6" (Moderate Pain)	4	25.0	6	37.5
"7-9" (Severe Pain)	12	75.0	10	62.5
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**3.75± 0.447**		**3.63 ± 0.50**	

The table 13 reveals that the mean severity pain of the participants was 3.75 ± 0.45, with range from 4 to 10 (0 to 10 Universal Pain Rating Scale). Among them 75% of the participants complains 7-9 grade pain, 25% complains 4-6 scales before treatment of conventional physiotherapy technique, compare to neural mobilization technique, the mean severity of pain 1.75 ± 0.86 with a range from 4 to 10 (0 to 10 Universal

Pain Rating Scale).Of them 62.5% of the participants complains 7-9 grade pain, 37.5% of the participants complains 4-6 scales before treatment.

Table 14: Distribution of respondents by severity pain (after treatment) (n=32)

Severity pain	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
"0" (No Pain)	6	37.5	2	12.5
"1-3" (Mild Pain)	9	56.3	13	81.3
"4-6" (Moderate Pain)	1	6.3	1	6.3
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**1.69± 0.60**		**1.94 ± 0.44**	

Table 14 found that the mean severity pain of the participants was 1.69± 0.60, with range from 0 to 10 (0 to 10 Universal Pain Rating Scale). Among them 56.3% of the participants complained 1-3 grade pain,37.5% were0 grade of pain and 6.3% were 4-6 scales after treatment of conventional physiotherapy technique, compare to neural mobilization technique, the mean severity of pain 1.94 ± 0.443 with a range from 0 to 10 (0 to 10 Universal Pain Rating Scale).Of them 81.3% of the participant's complained1-3 grade pain, 12.5% of the participants were0scales and 6.3% complained 4-6 grades after treatment.

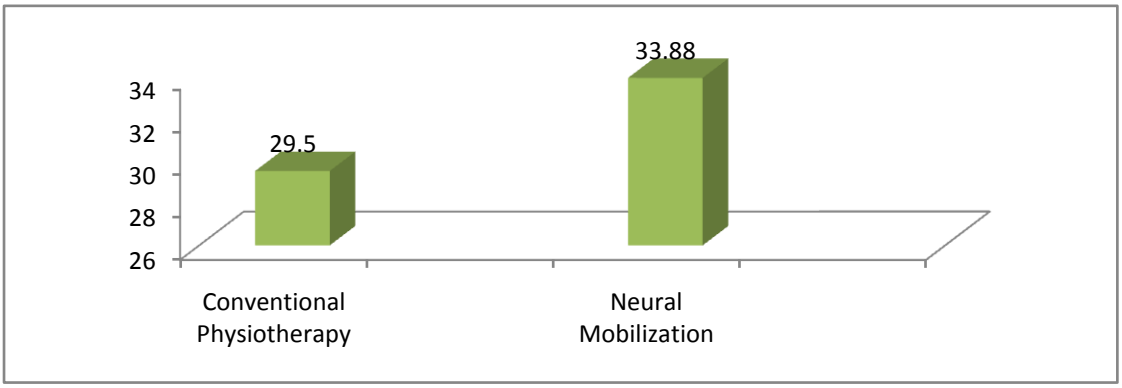


Figure 5: Mean distribution of participants by Oswestry Neck Pain Disability Index (before treatment) (n=32)

Table 15: Distribution of participants by Oswestry Neck Pain Disability Index (before treatment) (n=32)

Disability Index	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
10-20 **Index**	4	25.0	3	18.8
21-30 **Index**	5	31.3	4	25.0
31-40 **Index**	4	25.0	5	31.3
41-50 **Index**	2	12.5	2	12.5
51-60 **Index**	1	6.3	1	6.3
>61 **Index**	0	0	1	6.3
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**29.25± 12.369**		**33.88 ± 15.958**	

Table 15 found that Oswestry Neck Pain Disability Index 0-50. Among them 31.3% of the participants were informed 21-30, 25% were 10-20, 25% were 31-40, 12.5% were 41-50 and 6.3% were >61scale before treatment. The mean Oswestry Neck Pain Disability Index were 29.25± 12.369 with a range from 12 to 54 of conventional physiotherapy technique compare to neural mobilization technique, 31.3% the participants were informed 31-40, 25% were 21-30, 18.8% were 10-20, 12.5% were 41-50 and 6.3% were 51-60 and 6.3% were>61 scale before treatment. The mean Oswestry Neck Pain Disability Index was 33.88 ± 15.958 with a range from10 to 68.

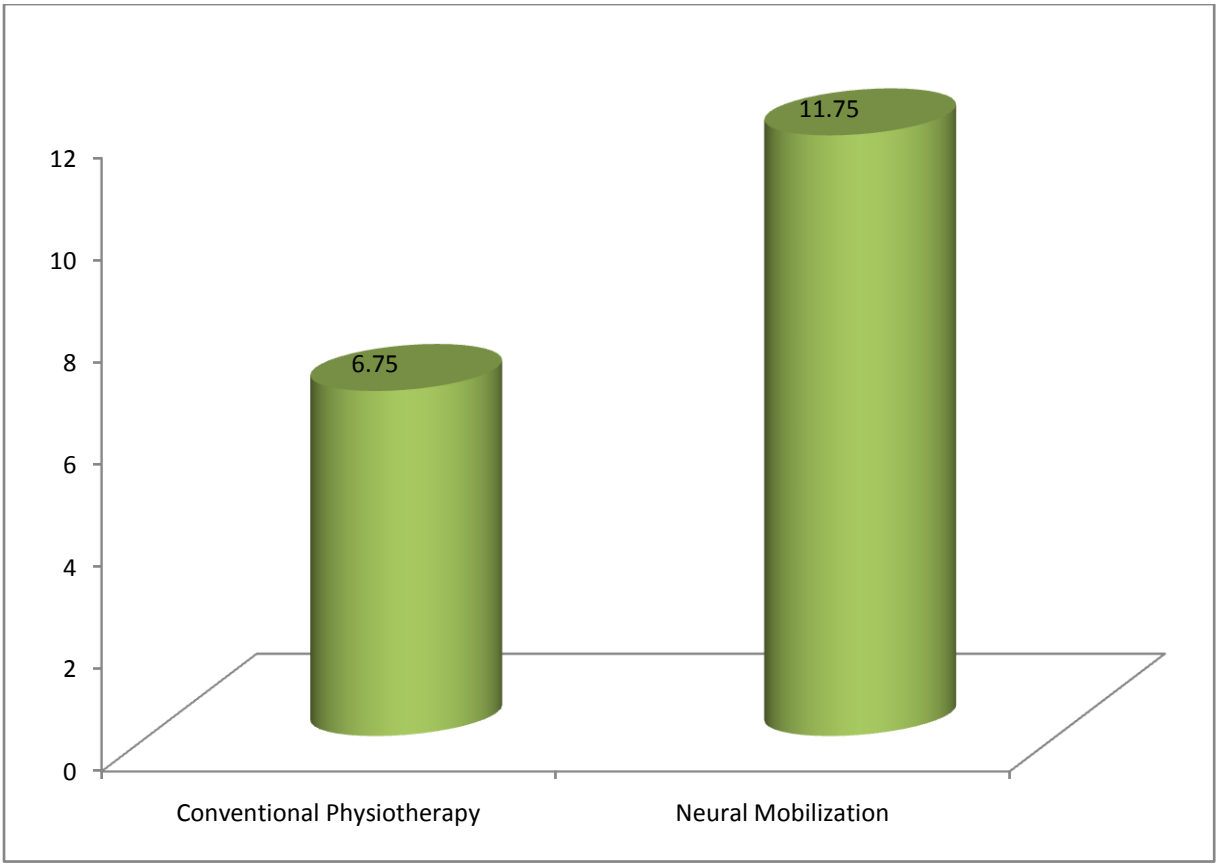


Figure6: Mean distribution of participants by Oswestry Neck Pain Disability Index (after treatment) (n=32)

Table 16: Distribution of participants by Oswestry Neck Pain Disability Index (after treatment)(n=32)

Disability Index	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	Percentage	Frequency	Percentage
Less than 10 Index	14	87.5	9	56.3
10-20 Index	2	12.5	5	31.3
21 and above Index	0	0	2	12.5
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**6.75± 3.42**		**11.75 ± 7.04**	

Table 16 found that Oswestry Neck Pain Disability Index 0-50. Among them 87.5% of the participants were informed less than 10, 12.5% were 10-20, scale after treatment. The mean Oswestry Neck Pain Disability Index were 6.75 ± 3.42 with a

range from 0 to 12 of conventional physiotherapy technique compare to neural mobilization technique, 56.3% the participants were informed less than 10, 31.3% were 10-20, 12.5% were 21 and above scale after treatment. The mean Oswestry Neck Pain Disability Index was 11.75 ± 7.04 with a range from 6-26.

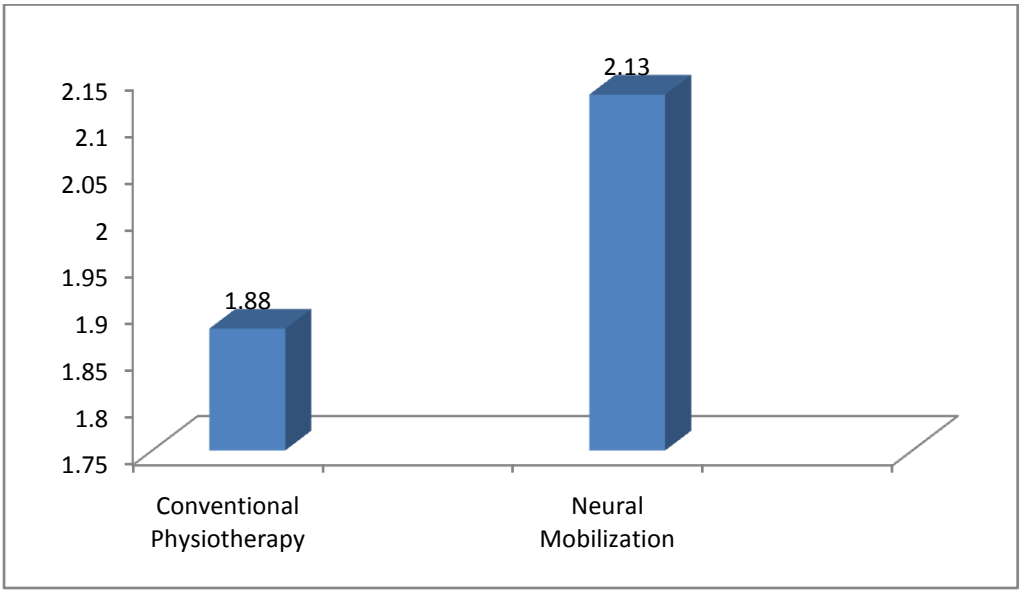


Figure 7: Mean distribution of participants by Oswestry Neck Pain Disability (before treatment) (n=32)

Table 17: Distribution of participants by Oswestry Neck Pain Disability (before treatment) (n=32)

Disability	**Conventional Physiotherapy**		**Neural Mobilization & Conventional Physiotherapy**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
(0-20%) Minimal Disability	5	31.3	3	18.8
(21-40%) Moderate Disability	8	50.0	9	56.3
(41-60%) Severe Disability	3	18.8	3	18.8
(61-80%) Crippled Disability	0	0	1	6.3
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**1.88± 0.72**		**2.13 ± 0.806**	

Table17 found that Oswestry Neck Pain Disability 0-100%. Among them 50% of the participants were informed Moderate Disability, 31.3% were minimal disability and

18.8% were severe disability scale before treatment. The mean Oswestry Neck Pain Disability were 1.88 ± 0.72with a range from 0 to 100% of conventional physiotherapy technique compare to neural mobilization technique, 56.3% the participants were informed moderate disability, 18.8% were minimal disability, 18.8% were severe disabilityand6.3% were crippled disability scale before treatment. The mean Oswestry Neck Pain Disability was 2.13 ± 0.806with a range from 0 to 100%.

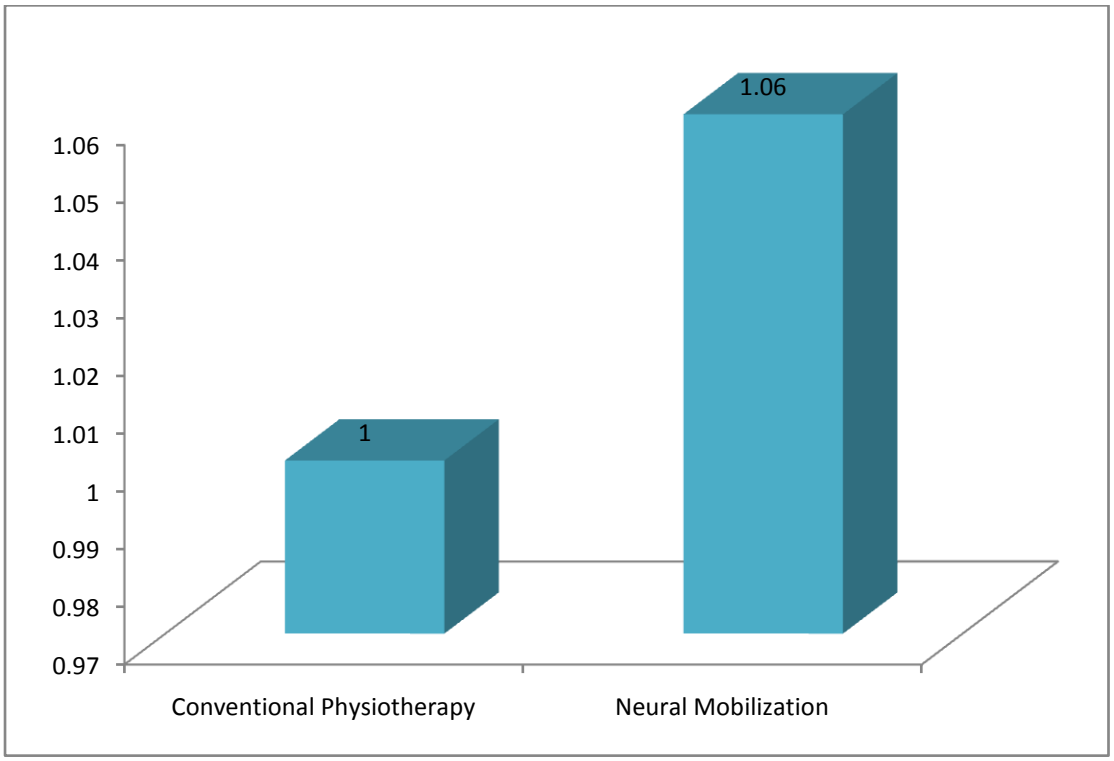


Figure 8: Mean distribution of participants by Oswestry Neck Pain Disability (after treatment) (n=32)

Table 18: Distribution of participants by Oswestry Neck Pain Disability (after treatment) (n=32)

Disability	Conventional Physiotherapy		Neural Mobilization & Conventional Physiotherapy	
	Frequency	**Percentage**	**Frequency**	**Percentage**
(0-20%) Minimal Disability	16	100.0	15	93.8
(21-40%) Moderate Disability	0	0	1	6.3
Total	**16**	**100.0**	**16**	**100.0**
Mean± SD	**1± 0.0**		**1.06 ± 0.25**	

Table 18 found that Oswestry Neck Pain Disability 0-100%. Among them 100% of the participants were informed minimal disability, scale after treatment. The mean Oswestry Neck Pain Disability were 1 ± 0.0 with a range from 0 to 100% of conventional physiotherapy technique compare to neural mobilization technique, 93.8% the participants were informed minimal disability and6.3% were moderate disability scale after treatment. The mean Oswestry Neck Pain Disability was 1.06 ± 0.25 with a range from 0 to 100%.

Table19: Baseline characteristic of patients

Criteria	**Conventional Physiotherapy group**	**Neural Mobilization & Conventional Physiotherapy group**
Age (year)- Mean± SD	44.63± 9.73	47.50± 10.34
Gender (%)		
Male	56.3	62.5
Female	43.8	37.5
Occupation (%)		
House wife	31.3	31.3
Worker	12.5	12.5
Service Holder	25.0	37.5
Business	25.0	6.3
Retired Person	6.3	12.5
Last episode of pain in month (%)		
1-2 Month	43.8	50.0
3-4 Month	50.0	25.0
5-6 Month	6.2	25.0
Pain at neck during resting position (Mean± SD)	7.31± 1.14	7±1.366
Pain at neck during sitting position (Mean± SD)	5.75± 1.125	4.938±1.806
Pain at neck during lying position (Mean± SD)	4.38 2.78	4.56±1.459
Pain at neck during flexion of neck (Mean± SD)	5.44± 2.25	5.25±2.324
Pain at neck during extension of neck (Mean± SD)	4.94± 1.95	4.25±2.176
Pain at neck during right side flexion (Mean± SD)	5.06± 2.235	4.75±2.324
Pain at neck during left side flexion (Mean± SD)	5.19± 2.401	4.31±1.662
Pain at neck during rotation to right side (Mean± SD)	5.19± 1.974	4.75±2.408
Pain at neck during rotation to left side (Mean± SD)	5.19± 2.401	4.19±1.682
Pain at neck during travelling (Mean± SD)	5.44± 1.931	5.94±1.124
Active ROM in flexion (Mean± SD)	43.75±8.062	47.19±10.483
Active ROM in extension (Mean± SD)	37.50±13.039	43.44±7.685
Active ROM of right side flexion of neck (Mean± SD)	38.44±8.509	37.81±7.296
Active ROM in left side flexion of neck (Mean± SD)	33.75±11.328	37.50±9.661
Active ROM in rotation to right side of neck (Mean± SD)	41.88±11.236	51.56±7.465
Active ROM in rotation to left side of neck (Mean± SD)	39.69±11.757	50.94±5.543
Oswestry Neck pain disability index (Mean± SD)	29.50±12.253	33.88±15.958
Disability (Mean± SD)	1.88±0.719	2.13±0.806

Table: 20: Means± SD measured by Numeric Pain Rating Scale after six sessions of intervention in both control and trail groups are shown (post-test)

Variables	Mean ± SD in control group	Mean ± SD in trial group
Neck Pain during resting position (Mean± SD)	0.88±0.957	2.19±1.109
Neck Pain during sitting position (Mean± SD)	0.93±0.961	1.81±0.911
Neck Pain during lying position (Mean± SD)	0.88±1.147	1.31±0.946
Neck Pain during flexion of neck (Mean± SD)	1.19±1.109	2.13±1.025
Neck Pain during extension of neck (Mean± SD)	0.94±1.181	1.19±1.223
Neck Pain during right side flexion (Mean± SD)	0.81±0.981	1.50±1.211
Neck Pain during left side flexion (Mean± SD)	1.19±1.047	1.50±1.033
Neck Pain during rotation to right side (Mean± SD)	1.19±0.981	1.25±1.238
Neck Pain during rotation to left side (Mean± SD)	1.06±1.124	1.38±1.50
Neck Pain during travelling (Mean± SD)	0.69±0.946	1.88±1.455
Active ROM in flexion (Mean± SD)	53±7.512	52.19±7.064
Active ROM in extension (Mean± SD)	46.67±6.455	46.56±5.692
Active ROM of right side flexion of neck (Mean± SD)	47.81±4.460	46.88±4.031
Active ROM in left side flexion of neck (Mean± SD)	46.56±5.977	46.25±2.887
Active ROM in rotation to right side of neck (Mean± SD)	55.63±5.123	57.19±2.562
Active ROM in rotation to left side of neck (Mean± SD)	55±4.082	55.94±2.016
Oswestry Neck pain disability index (Mean± SD)	6.75±3.416	11.75±7.038
Disability (Mean± SD)	1±0.00	1.06±0.250

Table: 21 Change in severity of neck pains

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
7.31	0.88	-6.43***	7.00	2.19	-4.81***	1.62*

Note: *** Significant at 0.001 level, * Significant at 0.05 level

Table: 21 reveals thatin the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 7.00 during pre test while it was found to be 2.19 at post test. The difference between these two averages, -4.81, is the improvement/decrease in average

severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 7.31 and 0.88, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -6.43 which is statistically significant at 0.001 level. The difference between these two changes, 1.62, is due to Neural Tissue Mobilization and is statistically significant at 0.05 level.

Table:22 Change in severity of neck pain in sitting position

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.75	0.88	-4.87***	5.00	1.81	-3.19***	1.68*

Note: *** Significant at 0.001 level, * Significant at 0.05 level

Table: 22 shows that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 5.00 during pre test while it was found to be 1.81 at post test. The difference between these two averages, -3.19, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 5.75 and 0.88, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.87 which is statistically significant at 0.001 level. The

difference between these two changes, 1.68, is due to Neural Tissue Mobilization and is statistically significant at 0.05 level.

Table:23 Change in severity of neck pain in lying position

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
4.38	0.88	-3.50***	4.56	1.31	-3.25***	0.25

Note: *** Significant at 0.001 level

Table: 23 reveals that in the neural mobilization group average score of severity of neck pain in the lying position was 4.56 during pre test while it was found to be 1.31 at post test. The difference between these two averages, -3.25, is the improvement/decrease in average severity of neck pain score in the lying position due to Mobilization plus Conventional Physiotherapy. The improvement is statistically significant at .001 level. On the other hand in the Control group, average of pre test and post test scores of severity of neck pain in the lying position were 4.38 and 0.88, the improvement/decrease in average severity of pain score being -3.50 which is statistically significant at .001 level. The difference between these two changes, 0.25, is due to Neural Tissue Mobilization and is not statistically significant.

Table: 24 Change in severity of neck pain during flexion of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.44	1.19	-4.25***	5.25	2.13	-3.12***	1.13

Note: *** Significant at 0.001 level

Table: 24 shows that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 5.25 during pre test while it was found to be 2.13 at post test. The difference between these two averages, -3.12, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 5.44 and 1.19, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.25 which is statistically significant at 0.001 level. The difference between these two changes, 1.13, is due to Neural Tissue Mobilization and is not statistically significant.

Table:25 Change in severity of neck pain during extension of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
4.94	0.94	-4.00***	4.25	1.19	-3.06***	0.94

Note: *** Significant at 0.001 level

Table: 25 shows that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 4.25 during pre test while it was found to be 1.19 at post test. The difference between these two averages, -3.06, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy,

average of pre test and post test scores of severity of neck pain were 4.94 and 0.94, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.00 which is statistically significant at 0.001 level. The difference between these two changes, 0.94, is due to Neural Tissue Mobilization and is not statistically significant.

Table: 26 Change in severity of neck pain during flexion to right side

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.06	0.81	-4.25***	4.75	1.50	-3.25***	1.00

Note: *** Significant at 0.001 level

Table: 26 shows that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 4.75 during pre test while it was found to be 1.50 at post test. The difference between these two averages, -3.25, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 4.06 and 0.81, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.25 which is statistically significant at 0.001 level. The difference between these two changes, 1.00, is due to Neural Tissue Mobilization and is not statistically significant.

Table: 27 Change in severity of neck pain during flexion to left side

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.19	1.19	-4.00***	4.31	1.50	-2.81***	1.19

Note: *** Significant at 0.001 level

Table: 27 reveals that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 4.31 during pre test while it was found to be 1.50 at post test. The difference between these two averages, -2.81, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 5.19 and 1.19, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.00 which is statistically significant at 0.001 level. The difference between these two changes, 1.19, is due to Neural Tissue Mobilization and is not statistically significant.

Table: 28 Change in severity of neck pain during rotation to right side

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.19	1.19	-4.00***	4.75	1.31	-3.44***	0.56

Note: *** Significant at 0.001 level

Table: 28 shows that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 4.75 during pre test while it was found to be 1.31 at post test. The difference between these two averages, -3.44, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 5.19 and 1.19, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.00 which is statistically significant at 0.001 level. The difference between these two changes, 0.56, is due to Neural Tissue Mobilization and is not statistically significant.

Table:29 Change in severity of neck pain during rotation to left side

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.19	1.06	-4.13***	4.19	1.38	-2.81***	1.32

Note: *** Significant at 0.001 level

Table: 29 reveals that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 4.19 during pre test while it was found to be 1.38 at post test. The difference between these two averages, -2.81, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy,

average of pre test and post test scores of severity of neck pain were 5.19 and 1.06, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.13 which is statistically significant at 0.001 level. The difference between these two changes, 1.32, is due to Neural Tissue Mobilization and is not statistically significant.

Table: 30 Change in severity of neck pain during travelling

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
5.44	0.69	-4.75***	5.94	1.88	-4.06***	0.69

Note: *** Significant at 0.001 level

Table: 30 reveals that in the neural mobilization group, who were given both Conventional Physiotherapy and Neural mobilization, average score of severity of neck pain was 5.94 during pre test while it was found to be 1.88 at post test. The difference between these two averages, -4.06, is the improvement/decrease in average severity of neck pain score due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, who were given only Conventional Physiotherapy, average of pre test and post test scores of severity of neck pain were 5.44 and 0.69, the improvement/decrease in average severity of pain score due to Conventional Physiotherapy only being -4.75 which is statistically significant at 0.001 level. The difference between these two changes, 0.69, is due to Neural Tissue Mobilization and is not statistically significant.

Table: 31 Change in active ROM of neck in flexion

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
43.75	52.19	8.44**	47.19	52.19	5.00	-3.44

Note: ** Significant at 0.01 level,

Table: 31 reveals that in the neural mobilization group average active ROM of neck in flexion was 47.19 during pre test and 52.19 at post test. The difference between the post test and pre test averages, 5.00, is the improvement/increase in average active ROM of neck in flexion due to Neural mobilization plus Conventional Physiotherapy. The improvement is not statistically significant. On the other hand in the experimental group, average of pre test and post test active ROM of neck in flexion were 43.75 and 52.19, the improvement/increase in average active ROM of neck in flexion being 8.44 which is statistically significant at .001 level. The difference between post test and pre test changes is -3.44 and is due to Neural Tissue Mobilization. Although the impact is negative and is not statistically significant.

Table: 32 Change in active ROM in extension of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
37.50	46.25	8.75**	43.44	46.56	3.12*	5.63

Note: ** Significant at 0.01 level, * Significant at 0.05 level

Table: 32 reveals that in the neural mobilization group average active ROM of neck in extension was 43.44 during pre test and 46.56 at post test. The difference between the post test and pre test averages, 3.12, is the improvement/increase in average active

ROM of neck in flexion due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.05 level. On the other hand in the conventional group, average of pre test and post test active ROM of neck in extension were 37.50 and 46.25, the improvement/increase in average active ROM of neck in extension being 8.75 which is statistically significant at 0.01 level. The difference between post test and pre test changes is 5.63 and is due to Neural Tissue Mobilization. Although the impact is positive and is not statistically significant.

Table: 33 Change in active ROM of right side flexion of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
38.44	47.81	9.37**	37.81	46.88	9.07***	0.30

Note: *** Significant at 0.001 level, ** Significant at 0.01 level

Table: 33 shows that in the neural mobilization group average active ROM of neck in right side flexion was 37.81 during pre test and 46.88 at post test. The difference between the post test and pre test averages, 9.07, is the improvement/increase in average active ROM of neck in right side flexion due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the conventional group average of pre test and post test active ROM of neck in right side were 38.44 and 47.81, the improvement/increase in average active ROM of neck in right side flexion being 9.37 which is statistically significant at 0.01 level. The difference between post test and pre test changes is 0.30 and is due to Neural Tissue Mobilization. Although the impact is positive and is not statistically significant.

Table: 34 Change in active ROM of left side flexion of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
33.75	46.56	12.81***	37.50	46.25	8.75*	4.06

Note: *** Significant at 0.001 level, * Significant at 0.05 level

Table: 34 reveals that in the neural mobilization group average active ROM of neck in right side flexion was 37.50 during pre test and 46.25 at post test. The difference between the post test and pre test averages, 8.75, is the improvement/increase in average active ROM of neck in left side flexion due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.05 level. On the other hand in the conventional group, average of pre test and post test active ROM of neck in left side flexion were 33.75 and 46.56, the improvement/increase in average active ROM of neck in left side flexion being 12.81 which is statistically significant at 0.001 level. The difference between post test and pre test changes is 4.06 and is due to Neural Tissue Mobilization. Although the impact is positive and is not statistically significant.

Table: 35 Change in active ROM in rotation to right side of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
41.88	55.63	13.75***	51.56	57.19	5.63**	8.12*

Note: *** Significant at 0.001 level, ** Significant at 0.01 level, * Significant at 0.05 level

Table: 35 shows that in the neural mobilization group average active ROM of neck in in rotation to right was 51.56 during pre test and 57.56 at post test. The difference between the post test and pre test averages, 5.63, is the improvement/increase in average active ROM of neck in rotation to right due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.01 level. On the other hand in the conventional group, average of pre test and post test active ROM of neck in rotation to right were 51.56 and 57.19, the improvement/increase in average active ROM of neck in rotation to right being 13.75 which is statistically significant at 0.001 level. The difference between these two changes, 8.12, is due to Neural Tissue Mobilization and is statistically significant at 0.05 level.

Table: 36 Change in active ROM in rotation to left side of neck

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
39.69	55.00	15.31***	50.94	55.94	5.00**	10.31*

Note: *** Significant at 0.001 level , ** Significant at 0.01 level, * Significant at 0.05 level

Table:36 reveals that in the neural mobilization group average active ROM of neck in rotation to left was 50.94 during pre test and 55.94 at post test. The difference between the post test and pre test averages, 5.00, is the improvement/increase in average active ROM of neck in rotation to left due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.01 level. On the other hand in the conventional group average of pre test and post test active ROM of neck in rotation to left were 39.69 and 55.00, the improvement/increase in average active ROM of neck in rotation to left being 15.31 which is statistically

significant at 0.001 level. The difference between these two changes, 10.31, is due to Neural Tissue Mobilization and is statistically significant at 0.05 level.

Table: 37 Change in Oswestry neck pain disability

Conventional physiotherapy			Neural Mobilization & Conventional Physiotherapy			Diff. in Diff. (7=6-3)
Pre Test (1)	Post Test (2)	Change (3=2-1)	Pre Test (4)	Post Test (5)	Change (6=5-4)	
28.13	6.75	-21.38***	33.88	11.75	-22.13***	-0.75

Note: *** Significant at 0.001 level

Table: 37 reveals that in the neural mobilization group average score of Oswestry neck pain disability was 33.88 during pre test and 11.75 at post test. The difference between these two averages, -22.13, is the improvement/decrease in average score of Oswestry neck pain disability due to Neural mobilization plus Conventional Physiotherapy. The improvement is statistically significant at 0.001 level. On the other hand in the Control group, average of pre test and post test scores were 28.13 and 6.75 respectively, the improvement/decrease in average disability score being -21.38 which is statistically significant at 0.001 level. The difference between these two changes, -0.75, is due to Neural Tissue Mobilization. It is found that the impact/improvement of Neural Tissue Mobilization is less/negative and not statistically significant.

On the basis of all results, the alternative hypothesis was accepted and null hypothesis was rejected i.e. the neural mobilization has negative impact to use simultaneously with conventional physiotherapy.

CHAPTER V: DISCUSSION

In this chapter the results are discussed in relation to the aim and objectives of the study, as well as relevant literature. The primary aim of this study was to determine from a review of patients records, the treatment approaches used by physiotherapists, and the documented outcomes in the management of patients with NP at CRP, Savar, Dhaka.

The analysis of the study sample reveals that more males than females were treated during the study period. The average age of the sample was 46 years, indicates that most ofthe affected persons were of working age. The mean age of the participants of conventional physiotherapy technique group were less than neural mobilization technique group which could be an influencing factors for better improvement in conventional physiotherapy group in comparing to neural mobilization group. The mean monthly income in conventional physiotherapy group was higher than neural mobilization group, it could also be a confounding variable to influence for better improvement in conventional physiotherapy group.

Occupation is very important variable to be considered not only in research process, but also in daily practice as it can influence decision making in the management options. It is difficult to find reasons why more males than females attended for physiotherapy treatment although similar trends regarding gender, age and attendance for treatment were found in many studies: Chiu, Lau, Ho et al., (2006); Tseng et al., (2005) and Côté et al., (2003) to mention a few Service holder participants were more in neural mobilization group than conventional physiotherapy group, it would be a confounding factor for less effective of treatment for their job stress like computer work and other desk work in static posture. Neural Mobilization has great role for

improving posture correction. In this study also revealed that the before treatment there was 3 in number in good posture in both standing and sitting posture, moreover, after neural mobilization there were 15 in number in both standing and sitting posture which was significantly improved in terms of postural correction than conventional physiotherapy group. Duration of pain in last episode was more in neural mobilization group than conventional physiotherapy group, which might be a influencing factors for less effectiveness of neural mobilization technique compared conventional physiotherapy. The study revealed that the symptoms (Stinging, Tingling, Sharpness, and Numbness) were reduced more in neural mobilization group than conventional physiotherapy group. The study showed the radiation of pain was reduced in both group. The study also found that induced pain in movement was reduced more in neural mobilization group than conventional physiotherapy group. The study revealed that both constant and intermittent symptoms were reduced more in neural mobilization group than conventional physiotherapy group. Severity of pain was reduced in both groups where as moderate pain was reduced more in neural mobilization group than conventional physiotherapy group. Severity of disability was reduced in both group, and it also revealed that the neural mobilization is effective to minimize crippled disability.

Pain Related Variables

Disability was measured using the Oswestry Neck Pain Disability Questionnaire and pain intensity was measured using the Numerical Pain Rating Scale. The mean percentage of improvement in the Oswestry Neck Pain Disability Questionnaire score was 76% in conventional physiotherapy group and 65% in trail group. The mean percentage of improvement in the Numerical Pain Rating Scale score was 88% in conventional physiotherapy group and 69% in trail group this is supported by

Donald,et al., (2006),where disability was measured using the Bournemouth Disability Questionnaire and pain intensity was measured using the Numerical Pain Rating Scale. The mean percentage of improvement in the Bournemouth Disability Questionnaire score was 78%. The mean percentage of improvement in the Numerical Pain Rating Scale score was 72%.

The results revealed significant pain reduction in the neck pain for the patients who received conventional physiotherapy. These patients showed decreases in neck pain on the Neumeric Pain Rating Scale which can be regarded as a clinically relevant change (Khan, et al., 2015; Kovacs, et al., 2008; Vincenzino, et al., 2007).

In this study the authors concluded that the reduction of pain is more in conventional physiotherapy group than neural mobilization combined with conventional Physiotherapy group. These finding were similar to the study carried out by (Khan, et al., 2015).

In this study the result showed significant pain reduction in both group. These finding were similar to the study carried out by (Allison, et al., 2002).

Nonetheless, in this the author concluded that evidence for the efficacy of NM must be considered as limited due to methodological quality of the trials. They suggest that future studies should use more homogenous study designs, populations and pathologies. These finding were similar to the study carried out by (Efstathiou, et al., 2014).

In this study, the result revealed despite the positive results, this study design does not allow any constructive conclusion on the effectiveness of NMs in isolation. These finding were similar to the study carried out by Ragonese (2009). But a randomized controlled trial, conducted by Nee et al. (2012) used 60 patients with nerve related neck and arm pain who were randomized in two groups receiving either NMs (lateral

glides, nerve glides) with manual therapy and education or advice to remain active alone. Patients in the experimental group showed immediate, clinically relevant benefits after only 4 treatment sessions without any adverse effects related to the application of NM. In another pilot study (Allison et al., 2002) showed significantly lower in pain scores values in the NM group compared to the other two

In this study, according to patient perception it is revealed that NM has an immediate short term positive effect compared conventional physiotherapy. These finding were similar to the study carried out by Coppieters et al. (2003a) conducted a randomized clinical trial and divided 20 patients with peripheral neurogenic cervicobrachial pain and got the same result.

In this study, the result revealed NM technique is less effective than conventional physiotherapy; but in one case study (Savva and Giakas, 2013), a slider NM technique was simultaneously applied on the median nerve with cervical traction, on a patient with CR. The patient reported improvement in all outcome measures including pain, and functional activities after 12 sessions spread over a period of one month. Collectively, current evidence for the efficacy of NM techniques for patients with CR seems to be limited as only 3 studies have explored these techniques in patients with CR (Murphy et al., 2006; Ragonese, 2009; Savva and Giakas, 2013) and 3 studies in patients with nerve related neck and arm pain (Nee et al., 2012; Allison et al 2002; Coppieters, et al., 2003a).

In this study, the result revealed NM technique along with conventional physiotherapy has significant improving ROM and reducing pain and disability. In a case study, suggested with research question whether the simultaneous application of cervical traction and neural mobilization does have effect on improving neck pain, radicular symptoms and neck disability in subjects with unilateral cervical radiculopathy

(Raval, et al., 2014) and in a single case study by Christos Savva et.al found that cervical traction combined with neural mobilization significantly shown effective in improving pain and disability in a patient with cervical radiculopathy (Sawa & Giakas, 2012).

In this study, the result revealed NM technique along with conventional physiotherapy has positive effect on improving NPRS score and NDI when compared conventional physiotherapy. These finding were similar to the study carried out by (Carla, et al., 2010).

In this study the researcher found simultaneous application of Neural Mobilization along with conventional physiotherapy subjects were -76% improvement in conventional physiotherapy group and 63.5% improvement in neural mobilization group in NDI; Raval et al., 2014 found -71.33% in NPRS and -59.71% in NDI and with greater percentage of reduction in radicular symptoms following 12 sessions of treatment during 4 weeks of duration.

In this study, the study participants experienced muscle weakness and/or numbness or tingling in fingers or hands during neurodynamic test. These finding were similar to the study carried out by (priya Vishnu, 2015).

In this study the conventional physiotherapy group was treated with range of motion exercises, manual cervical traction, retraction exercise, mobilization/manipulation strengthening, stretching exercises and IRR. The similar study was done by Bland, 1994; Bland, et al., 1990; Milne, 1991; Rothman & Simone, 1975;Well, 2001; Kvarstrom, 1983; Bovim, 1994; Linton &Ryberg 2000; Nygren,et al., 2000; Cote, et al., 2004; Ellenberg, 1994; Radhakrishnan,et al., 1994; Varghen, 2000; Fast, et al., 1994; Kisner& Colby 2007; Calliet, 1992; Donald,et al., 2006, 1994; Linton &Ryberg 200,Kvarstrom, 1983.

In this study, the result revealed NM technique along with conventional physiotherapy and only conventional physiotherapy did not show statistically significant result on ROM. However, there are no studies to explain the association between neural mobilization and improvement in the cervical range of motion (Priya, et al., 2015. Present study showed significant improvement in disability and range of motion in both the intervention groups after six sessions of treatment; Chettri, et al., 2014; Richard, et al., 2008; Butler, 1989proved that both cervical traction and neural mobilization is effective in improving range of motion and decreasing the disability level in cervical radiculopathy subjects ($P<0.05$).

In this study showed no statistically significant results for neural mobilization in both outcome variables of neck disability index as well as of neck range of motion but Chettri, et al., 2014 showed statistically significant results for neural mobilization in both outcome variables of neck disability index as well as of neck range of motion ($P<0.05$).

In this study, when analysis of disability level in neck was done between both the intervention groups, it was not statistically significant ($P>0.05$). These finding were similar to the study carried out by Chettri, et al., 2014).

In this study, when analysis comparison of neck range of motion between conventional physiotherapy and neural mobilization groups was also not statistically significant ($P>0.05$). These finding were similar to the study carried out by Chettri, et al., 2014.

Severity of neck pain at rest of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization &conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is statistically significant at 0.05

level. The results revealed significant pain reduction in the neck pain for the patients who received conventional physiotherapy. These patients showed a decreases in neck pain on the Neumeric Pain Rating Scale which can be regarded as a clinically relevant change (Khan, et al., 2015; Kovacs, et al., 2008).These finding were similar to the study carried out by Cleland, et al., 2005; Pratik, et al., 2014; Richard, et al., (2008); Savva and Giakas, 2013.The results of the present study reported that the combination of nerve mobilization along with conventional physiotherapy and only conventional physiotherapy may be useful for patients with chronic mechanical radiating neck pain in ROM, NPRS and NDI. These results are in agreement with the work done by Donald, et al., (2006) in which he did a study on 31 patients with cervical radiculopathy who received a non surgical approach which included manipulation, mobilization and exercise therapy (Donald , et al.,2006) Disability was measured using the Bournemouth Disability Questionnaire and pain intensity was measured using the Numerical Pain Rating Scale. The mean percentage of improvement in the Bournemouth Disability Questionnaire score was 78%. The mean percentage of improvement in the Numerical Pain Rating Scale score was 72%.The significant improvement due to nerve mobilization can be due to following explanation. It is hypothesized that these therapeutic movements can have a positive impact on symptoms by improving intraneural circulation, axoplasmic flow, neural connective tissue viscoelasticity, and by reducing sensitivity of AIGS (Butler, 2000; Shacklock, M. (1995a).), but these biologically reasonable arguments have not been authenticated. These techniques may also be able to reduce unwanted fear of movement (Butler, 2000).

The application of neuromobilization in musculoskeletal conditions is effective provided that the patient is properly diagnosed and the pathology is functional.

Neuromobilization procedures should be performed in musculoskeletal system diseases on condition that the results of tension and mobility tests are positive (Sambyal & Kumar, 2013).

There was significant improvement in both the groups but more clinically meaningful changes were seen in the nerve mobilization group which is in accordance with the work done by Donald Murphy et al (2006)who did a study on lumbar spinal stenosis patients receiving neural mobilization and distraction manipulation (Donald , et al., 2006).

Severity of neck pain in sitting position of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is statistically significant at 0.05 level. These finding were similar to the study carried out by Cleland et al. 2005; Pratik et al 2014; Richard et al (2008).

Severity of neck pain in lying position *of* both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Severity of neck pain during flexion of neck of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Severity of neck pain during extension of neck of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Severity of neck pain during flexion to right side of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Severity of neck pain during flexion to left side of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Severity of neck pain during rotation to right side of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Severity of neck pain during travelling of both groups showed improvement, the improvement is statistically significant within group at 0.001 level in both neural mobilization & conventional physiotherapy group respectively. The difference between these two changes is due to Neural Tissue Mobilization and is not statistically significant.

Cervical ROM

Flexion increased in both groups immediately after six sessions of treatment and control group was statistically significant at 0.01 levels.

Extension, both groups showed improvement in extension, the improvement was statistically significant at 0.05 & 0.01levelsin neural mobilization & conventional physiotherapy group respectively.

Right side flexion (RSF), both groups showed improvement in right side flexion, the improvement is statistically significant at 0.01 & 0.001 levels in neural mobilization & conventional physiotherapy group respectively. These finding were similar to the study carried out by Cleland, et al. 2005; Richard et al., 2008; Pratik, et al., 2014.

Left side flexion (LSF), both groups showed improvement in left side flexion, the improvement is statistically significant at 0.05 & 0.001 level in neural mobilization &conventional physiotherapy group respectively.

Right rotation

Both groups showed improvement in right rotation, the improvement is statistically significant at 0.01& 0.001 level in neural mobilization & conventional physiotherapy group respectively. There was also statistically significant at 0.05 levels between groups. These finding were similar to the study carried out by Cleland, et al., 2005; Richard, et al., (2008); Pratik,et al., 2014.

Left rotation

Both groups showed improvement in right rotation, the improvement is statistically significant within at 0.01 & 0.001 level in neural mobilization & conventional physiotherapy group respectively. There was also statistically significant at 0.05 level between groups. These finding were similar to the study carried out by Cleland, et al., 2005; Pratik, et al., 2014; Richard, et al., (2008).

Oswestry neck pain disability

Both groups showed improvement in disability, the improvement is statistically significant at 0.001 level in neural mobilization & conventional physiotherapy group respectively. It is found that the improvement of Neural Tissue Mobilization is less and was not statistically significant. This finding was similar to the study carried out by Cleland, et al., 2005; Pratik, et al., 2014; Richard, et al., (2008); Murphy, et al., 2006; Ragonese, 2009; Savva and Giakas, 2013) Nee, et al., 2012; Allison, et al., 2002; Coppieters, et al., 2003a.

5.1 Limitations

Matching did not do. There was an absence of randomization in sampling method. There was no follow up. The study was conducted with 32patients of neck pain with radiating, which was a very small number of samples in both groups and was not sufficient enough for the study to generalize the wider population of this condition. The mean age of the participants of conventional physiotherapy technique group were less than neural mobilization technique group which could be an influencing factors for better improvement in conventional physiotherapy group in comparing to neural mobilization group. It was limited by the fact daily activities of the subject were not monitored which could have influenced. Treatment sessions were not efficient to get the actual result. Subjects with wide range group between 26 to 65 years of age were considered for the study, thus results could not be generalized to individual age. Dosage of treatment parameters of the combined treatment techniques in the study was not standardized according to individual patients. Only efficacy of neural mobilization of radiating neck pain did not compute.

CHAPTER VI: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The result of this experimental study has identified the efficacy of neural tissue mobilization along with conventional physiotherapy and only conventional physiotherapy in patients with chronic mechanical radiating neck pain. Participants in the neural tissue mobilization along with conventional physiotherapy group showed negative impact compare to only conventional physiotherapy group but a small separate compares improvement than those in the only conventional physiotherapy group, which indicate that the multimodal conventional physiotherapy can be effective therapeutic approach for patient with chronic mechanical radiating neck pain. Moreover, simultaneously neural tissue mobilization along with conventional physiotherapy is not recommended treatment in patients with chronic mechanical radiating neck pain. Both Neural tissue mobilization along with conventional physiotherapy and only Conventional Physiotherapy are effective therapeutic approach for patient with chronic mechanical radiating neck pain. Within group analysis showed a relevant significant improvement in most indicators of neck pain, neck range of motion and decrease in neck disability level within two therapeutic interventions that was conventional physiotherapy combined with neural mobilization exercises and conventional physiotherapy only. But between group findings gave a clear idea that only Conventional Physiotherapy are effective therapeutic approach for patient with chronic mechanical radiating neck pain.

6.2 Recommendations

The aim of the study was to find out the efficacy of neural tissue mobilization among the patients with chronic mechanical radiating neck pain. However, the study had some limitations. Some steps were identified that might be taken for the better accomplishment for further study. The main recommendations would be as follow:

- Investigator use only 32 participants as the sample of this study, in future the sample size would be more
- Population can be taken gender specific in future study.
- A comparative study can be done between nerve mobilization and other single manual therapy technique.
- Further study can be done on effects on nerve mobilization in lower limb radiculopathy.
- In future treatment session would be increased for better improvement
- In future studies should use more homogenous study designs, populations and pathologies.
- Only efficacy of neural mobilization for radiating neck pain will be done in future.
- Further clinical researches are necessary to support and explain the relationship between neural mobilization and improvement in cervical range of motion in participants with cervical radiculopathy.
- High quality trials that will allow firmer conclusions on the effectiveness of these interventions
- In future research study, matching will be done to avoid cofounding variable.

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APPENDIX-I: INFORMED CONSENT FORM

PARTICIPANT ID

BANGLADESH HEALTH PROFESSIONS INSTITUTE
SAVAR, DHAKA

Assalamualykum/ Namaskar,

I am **Md. Ibrahim Khalil**, student of MSc in Physiotherapy at Bangladesh Health Professions Institute (BHPI), CRP. I shall have to conduct a research and it is a part of my academic activity. The participants are requested to participate in the study after reading the following.

My research title is **"Efficacy of Neural Tissue Mobilization along with Conventional Physiotherapy and only Conventional Physiotherapy in Patients with Chronic Mechanical Radiating Neck Pain" of Dhaka City in Bangladesh.**Through this experimental research, I will test the hypothesis on "Neural Tissue Mobilization along with Conventional Physiotherapy whether is more effective than conventional Physiotherapy for the treatment of Chronic Mechanical Radiating Neck Pain. The objective of my study is to identify the efficacy of Neural Tissue Mobilization to improve Chronic Mechanical Radiating Neck Pain.

To fulfill my research project, I need to collect data. Considering the area of my research, you would be an eligible participant of the study. Therefore I want to meet you a few couple of session, during your regular therapy. The exercises that will be given are pain free and safe for you.

I would like to inform you that are a purely academic study and obtained data will not be used for any other purpose. I assure that all data will be kept confidential. Your participation will be voluntary. You will have the right to withdraw consent and discontinue participation at any time of the experiment.

If you have any query please feel free to share the study with your participate. You will be treated with neural tissue mobilization along with existing treatment of Musculoskeletal Unit at CRP in patients with chronic mechanical radiating neck pain. Neural tissue mobilization is very safe noninvasive maneuver which will cause no any harm to you.

Signature of interviewer _____Date ...../...../.....

I ---------- have read and understood the contents of the form. I agree to participate in the research without any force.

Participant's Signature..... ..… Date...../...../.....

Signature of the witness ……Date...../...../.....

Supervisor Signature _____

ANNEXURE II: **QUESTIONNAIRE**

_____
PARTICIPNT ID

TITLE: "Efficacy of Neural Tissue Mobilization along with Conventional Physiotherapy and only Conventional Physiotherapy in Patients with Chronic Mechanical Radiating Neck Pain" of Dhaka City in Bangladesh

Name of interviewer.....

Date of interview ……./……. . ./…….. Time of interview……

Participant's Identification

Participant
ID/CODE.....

Address……

Contact No……...……

Section A: Socio-Demographic Characteristics Related Variables

Sl. No.	QUESTIONS	RESPONSES
01	Age	☐☐ Years
02	Sex	1 = Male 2 = Female
03	Religion	1 = Islam 2 = Hinduism 3 = Buddhism 4 = Christianity
Sl. No.	**QUESTIONS**	**RESPONSES**
04	Marital status	1 = Married 2 = Unmarried 3 = Divorced / Separate 4 = Widow 5 = Discard
05	Educational Background	1 = Illiterate 2 = Primary 3 = Below S.S.C 4 = S.S.C 5 = Higher Secondary 6 = Graduate

		7 = Post-Graduate 8 = Technical degree 9 = Other _____ (Specify)
06	Monthly family income (Tk.)	☐☐☐☐☐☐☐☐ Taka
07	Family type	1 = Nuclear family 2 = Extended family
08	How many family members you have?	☐☐ Number
09	Height	☐☐☐ Cm
10	Body weight	☐☐☐ Kg
11	BMI	☐☐☐ BMI

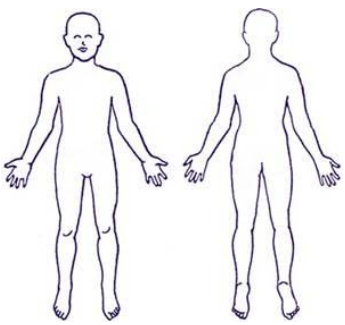
Sl. No.	QUESTIONS	RESPONSES
12	Occupation	1 = Student 2 = Housewife 3 = Worker 4 = Service Holder 5 = Buisness 6 = Retaired Person

Section B: Assessment Related Variables

Sl. No.	QUESTIONS	RESPONSES
13	Spine curvature disorder (Cervical Spine)	1 = No 2 = Kyposis 3 = Scoliosis 4 = Lordosis
14	Sitting Posture	1 = Good 2 = Fair 3 = Poor
15	Standing Posture	1 = Good 2 = Fair 3 = Poor
16	Affected limb	1 = Right upper limb 2 = Left upper limb
17	Duration of pain since last episode	☐ Month/Year

18	Muscle wasting	1 = No muscle wasting 2 = Trapezius muscle 3 = Rhomboids muscle 4 = Biceps Brachii muscle 5 = Deltoid muscle
19	Relieving factors	1 = Rest in sitting 2 = Rest in lying 3 = Activity modification 4 = Positioning
20	Aggravating factors	1 = Activities with movement 2 = Loading activities
21	Nature of symptoms during Neurodynamic Testing (Sensory)	1 = Stinging 2 = Tingling 3 = Tightness 4 = Sharpness 5 = Numbness
22	Duration of symptoms	1 = Intermittent 2 = Constant
23	Nature of pain site/spread	1 = Up to shoulder 2 = Up to elbow 3 = Up to wrist 4 = Up to hand

		5 = Up to finger
24	Induce pain in movement	1= Flexion 2 = Extension 3 = Side flexion 4= Side rotation 5 = Retraction movement
25	Onset of pain	1 = Sudden 2 = Gradual
26	Symptoms at Onset	1 = Head 2 = Neck 3 = Scapula zone 4 = Arm 5 = Forearm
27	Constant Symptoms	1 = Neck 2 = Arm 3 = Forearm 4 = Head 5 = Scapula zone

Sl. No.	QUESTIONS	RESPONSES
28	Intermittent Symptoms	1 = Neck 2 = Arm 3 = Forearm 4 = Headache 5 = Total upper extremity
29	No Pain At the Time of	1 = A.M 2 = As the Day Progress 3 =P.M 4 = When Still 5 = On the Move
30	Sleeping Surface	1 = Firm 2 = Soft 3 = Sag drop
31	Number of pillow use	☐ Number
32	Area of pain  Body Chart	1 = Below shoulder 2 = Below elbow 3 = Below Wrist 4 = Hand 5 = Finger 6 = Scapula zone

		7 = Total upper extremity
33	Severity of Pain in Numerical Pain Rating Scale (NPRS)	1 = 0 (No Pain) 2 = 1-3 (Mild Pain) 3 = 4-6 (Moderate Pain) 4 = 7-9 (Severe Pain) 5 = 10 (Worst Pain)

Section C: Neck Pain Related Variables

0–10 Numeric Pain Rating Scale (NPRS) where "0" means no pain and "10" means worst pain

34. How severe is your neck pain present?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. 6.6: Zero (0) means no pain and Ten (10) means extreme pain

35. How severe your pain in sitting position of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means extreme pain

36. How severe your pain in lying position of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means extreme pain

37. How severe your pain is during flexion of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means worst pain

38. How severe your pain is during extension of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means worst pain

39. How severe your pain is during side flexion to right side of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means worst pain

40. How severe your pain is during side flexion to left side of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means worst pain

41. How severe your pain is during rotation to right side of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means worst pain

42. How severe your pain is during rotation to left side of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Fig. Zero (0) means no pain and Ten (10) means worst pain

43. How severe is your neck pain during travelling of neck?

Pre Test **0-------1--2--3------4--5--6------7--8--9------10**

Post Test **0-------1--2--3------4--5--6------7--8--9------10**

Zero (0) means no pain and Ten (10) means worst pain

Section - D: Active ROM (Range of Motion) related variables

44. Active ROM of in Flexion of neck

Pre- treatment ... ... Degrees

Post- treatment ... ... Degrees

45. Active of ROM in Extension of neck

Pre- treatment ... ... Degrees

Post- treatment ... ... Degrees

46. Active ROM of right side flexion of neck

Pre- treatment ... ... Degrees

Post- treatment ... ... Degrees

47. Active ROM of left side flexion of neck

Pre- treatment ... ... Degrees

Post- treatment ... ... Degrees

48. Active ROM in rotation to right side of neck

Pre- treatment ... ... Degrees

Post- treatment ... ... Degrees

49. Active ROM of rotation to left side of neck

Pre- treatment ... ... Degrees

Post- treatment ... ... Degrees

Section E: Neck Disability Index (NDI) Related Variables

Sl. No.	**QUESTIONS**	**RESPONSES**
50	Oswestry Neck Pain Disability Index (Before treatment)	☐ Score
51	Oswestry Neck Pain Disability Index (After treatment)	☐ Score

52	Disability	1 = (0 – 20%) Minimal Disability 2 = (21 – 40%) Moderate Disability 3 = (41 – 60%) Severe Disability 4 = (61 – 80%) Crippled Disability 5 = (81 – 100%) Bed Bound Disability in percent = (total score) / 50 * 100

The Neck Disability Index

Overview

The Neck Disability Index is an instrument to assess neck pain complaints. It was developed from the Oswestry index for back pain and the Pain Disability Index. The authors are from the Canadian Memorial Chiropractic College in Toronto Canada.

Patient Instructions

This questionnaire has been designed to give the doctor information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only the ONE box which applies to you. We realize you may consider that two of the statements in any one section relate to you but please just mark the box which most closely describes your problem.

NECK DISABILITY INDEX QUESTIONNAIRE (Oswestry Neck Disability Index)

Patient Name _____ Date _____

Score SECTION 1 – Pain Intensity

0 = I have no pain at the moment.

1= The pain is very mild at the moment.

2 = The pain is moderate at the moment.

3 = The pain is fairly severe at the moment.

4 = The pain is very severe at the moment.

5 = The pain is the worst imaginable at the moment.

Score SECTION 2 – Personal Care (washing, dressing, etc.)

0 = I can look after myself without causing extra pain.

1 = I can look after myself normally but it causes extra pain.

2 = It is painful to look after myself and I am slow and careful.

3 = I need some help but manage most of my personal care.

4 = I need help every day in most aspects of self-care.

5 = I do not get dressed, wash with difficulty and stay in bed.

Score SECTION 3 – Lifting

0 = I can lift heavy weights without extra pain.

1 = I can lift heavy weights but it gives extra pain.

2 = Pain prevents me from lifting heavy objects off the floor, but.

I can manage if they are conveniently positioned, e.g. on a table.

3 = Pain prevents me from lifting heavy weights but I can manage

light to medium weights if they are conveniently positioned.

4 = I can lift very light weights.

5 = I cannot lift or carry anything at all.

Score SECTION 4 – Reading

0 = I can read as much as I want with no pain in my neck.

1 = I can read as much as I want with slight pain in my neck.

2 = I can read as much as I want with moderate pain in my neck.

3 = I cannot read as much as I want because of moderate pain in my neck.

4 = I can hardly read at all because of severe pain in my neck.

5 = I cannot read at all.

Score SECTION 5 Headaches

0 = I have no headaches at all.

1 = I have slight headaches which come infrequently.

2 = I have moderate headaches which come infrequently.

3 = I have moderate headaches which come frequently.

4 = I have severe headaches which come frequently.

5 = I have headaches almost all the time.

Score SECTION 6 – Concentration

0 = I can concentrate fully when I want to with no difficulty.

1 = I can concentrate fully when I want to with slight difficulty.

2 = I have a fair degree of difficulty in concentrating when I want to.

3 = I have a lot of difficulty in concentrating when I want to.

4 = I have a great deal of difficulty in concentrating when I want to.

5 = I cannot concentrate at all.

Score SETION 7 – Work

0 = I can do as much work as I want to.

1 = I can only do my usual work, but no more.

2 = I can do most of my usual work, but no more.

3 = I cannot do my usual work.

4 = I can hardly do any work at all.

5 = I cannot do any work at all.

Score SECTION 8 – Driving

0 = I can drive without any neck pain.

1 = I can drive as long as I want with slight pain in my neck.

2 = I can drive as long as I want with moderate pain in my neck.

3 = I cannot drive as long as I want because of moderate pain in my neck.

4 = I can hardly drive at all because of severe pain in my neck.

5 =I cannot drive my car at all.

Score SECTION 9 – Sleeping

0 = I have no trouble sleeping.

1= My sleep is slightly disturbed (less than 1 hr. sleepless).

2 = My sleep is mildly disturbed (1-2 hrs. sleepless).

3 = My sleep is moderately disturbed (2-5 hrs. sleepless).

4 = My sleep is greatly disturbed (3-5hrs. sleepless).

5 = My sleep is completely disturbed (5-7 hrs. sleepless).

Score **SECTION 10 – Recreation**

0 = I am able to engage in all my recreation activities with no neck pain at all.

1 = I am able to engage in all my recreation activities with some pain in my neck.

2 = I am able to engage in most, but not all of my usual recreation activities because of pain in my neck.

3 = I am able to engage in a few of my usual recreation activities because of pain in my neck.

4 = I can hardly do any recreation activities because of pain in my neck.

5 = I cannot do any recreation activities at all.

Total score = SUM (points for all 10 findings)

Disability in percent = (total score) / 50 * 100

Interpretation:

• Minimum score: 0 with a minimum disability of 0%

• Maximum score: 50 with maximal disability of 100%

Disability	**Disability**	**Comment**
0 – 20%	minimal	The patient can cope with most living activities. Usually no treatment is indicated apart from advice on lifting sitting and exercise.
21 – 40%	moderate	The patient experiences more pain and difficulty with sitting lifting and standing. Travel and social life are more difficult and they may be disabled from work. The patient can usually be managed by conservative means.
41 – 60%	severe	Pain remains the main problem in this group but activities of daily living are affected. These patients require a detailed investigation.

61 – 80%	crippled	Pain impinges on all aspects of the patient's life. Positive intervention is required.
81 – 100%	bed bound	Need to exclude exaggeration or malingering.

Thank you for answering these questions.

Signature of the interviewer

APPENDIX-III

Action Plan

Activities	Months											
	June 2015	July 2015	Augt. 2015	Sept. 2015	Oct. 2015	Nov. 2015	Dec. 2015	Jan. 2016	Feb. 2016	Mar. 2016	April 2016	May 2016
Thesis proposal submission and approval												
Literature review												
Questionnaire design and pre-test												
Protocol training sessions & data collection												
Data entry and management												
Data analysis												
Report writing												
Final thesis building, submission and Printing												

APPENDIX IV:	Testing ROM

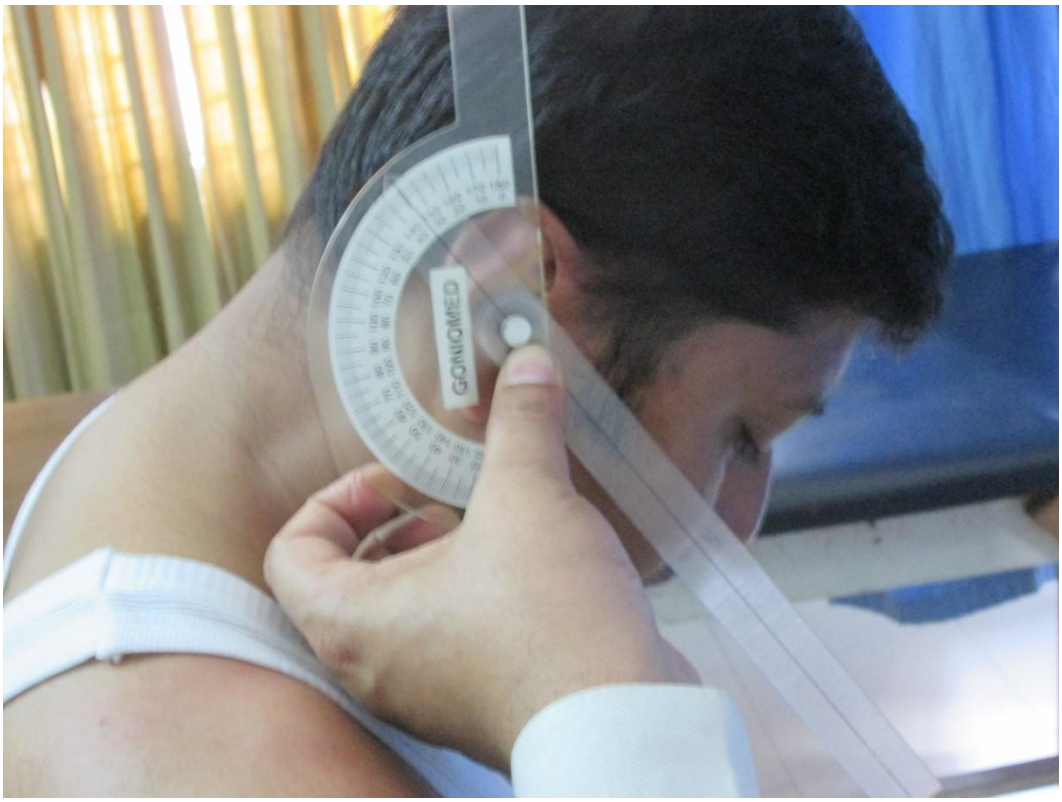


Figure: Measurement of Flexion ROM by Goniometer

Figure: Measurement of Extension ROM by Goniometer

APPENDIX IV:	TestingROM (Contd.)

Figure: Measurement of Right Side Flexion ROM by Goniometer

Figure: Measurement of Left Side Flexion ROM by Goniometer

Figure: Measurement of Right Side Rotation ROM by Goniometer

Figure: Measurement of Left Side Rotation ROM by Goniometer

APPENDIX V: Neural Tissue Mobilization

Neurodynamics (Median Nerve (ULTT1) Testing and Mobilizing Procedure)

Figure: ULTT1 (1ST Stage)

Figure: ULTT1 (2nd Stage)

Figure: ULTT1 (3rd Stage)

Figure: ULTT1 (4th Stage)

Figure1: ULTT1 for Median Nerve

APPENDIX V: Neural Tissue Mobilization (Contd.)

Neurodynamics (Median Nerve (ULTT-2a) Testing and Mobilizing Procedure)

Figure: 1st- Stage-ULTT-2a (Median Nerve)

Figure: 2ndStage-ULTT-2a (Median Nerve)

Figure: 3rd- Stage-ULTT-2a (Median Nerve)

Figure: 4thStage-ULTT-2a (Median Nerve)

Figure 2: ULTT-2a (Median Nerve)

APPENDIX V:	Neural Tissue Mobilization (Contd.)

NeurodynamicsULTT-2b (Radial Nerve bias) Testing and Mobilizing Procedure

Fig: 1st Stage-ULTT-2b (Radial Nerve)

Fig: 2nd Stage-ULTT-2b (Radial Nerve)

Fig: 3rd Stage-ULTT-2b (Radial Nerve)

Fig: 4th Stage-ULTT-2b (Radial Nerve)

Figure 3: ULTT-2b (Radial Nerve bias)

APPENDIX V:	Neural Tissue Mobilization (Contd.)

NeurodynamicsULTT3- Ulnar Nerve Testing and Mobilizing Procedure

Fig: 1stStage-ULTT3 (Ulnar Nerve)

Fig: 2ndStage-ULTT3 (Ulnar Nerve)

Fig: 3rd Stage-ULTT3 (Ulnar Nerve)

Fig: 4thStage-ULTT3 (Ulnar Nerve)

Figure 4: ULTT3- Ulnar Nerve