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The effect of neural tissue mobilisation performed simultaneously with mechanical cervical traction on pain disability and functions of patients with chronic cervical radiculopathy

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ABSTRACT

Background and aim

Cervical radiculopathy is a disorder involving dysfunction of cervical nerve roots that commonly manifests as pain radiating from the neck into the distribution of the affected root. Mechanical traction expands the space between the vertebrae, increases the movement of the joints and stretches the muscle and ligaments around the vertebrae. Neural mobilisation is interventions aimed at affecting the neural structures or surrounding tissue (interface) directly or indirectly through manual techniques or exercises.The analgesic action of cervical traction and neural tissue mobilisations has been explored and recognized in many RCT studies and analyzed in systematic reviews, the effect of both modalities applied simultaneously has not been previously investigated. Therefore the need of this study is to present the effect of simultaneous application of cervical traction with neural mobilization on pain and disability in patient experiencing chronic cervical radiculopathy and observe any enhanced effect.

Methodology

An experimental study was carried out wherein 30 individuals selected by simple random sampling positive for signs and symptoms of chronic cervical radiculopathy of median nerve (Positive spurling's test/Distraction test and Upper limb tension test positive for median nerve or a combination of these).Experimental group was given mechanical traction and neural mobilisation simultaneously and control group separately. Both were given other conventional treatment. The interventions were for 6 consecutive days and Numerical Pain Rating Scale, Neck Disability Index and Patient Specific Functional Scale were taken pre and post intervention.

Result and conclusion

The study suggests that there is statistically significant difference for reduction in pain, neck disability and improvement in patient's functions in both groups pre and post treatment. It also suggests that there is statistical significant difference in improvement in neck disability and patient's functions in experimental group than the control group but equally effective in alleviation of pain.

Keywords: Mechanical traction, Cervical radiculopathy, Neural tissue mobilization, Pain, Neck disability, Patient functions.

INTRODUCTION

Cervical radiculopathy [1] is a disorder involving dysfunction of cervical nerve roots that commonly manifests as pain radiating from the neck into the distribution of the affected root. Chronic [2] cervical radiculopathy is symptoms of cervical radiculopathy lasting for greater than 6 weeks. Chronic radiculopathies materialize [3] from acute or sub acute radiculopathies that have failed to respond to treatment. The annual incidence [4] of cervical radiculopathy is reported to be 85 out of 100,000 in the population. Cervical radiculopathy is a pathological condition [5] of the cervical nerve root that may lead to chronic pain and disability. The common signs and symptoms of cervical radiculopathy include pain in the upper extremity, paresthesia or numbness, weakness or a combination of these. Patients may also have scapular pain [6, 7], neck pain [8] and headaches [9].Patients with both neck and upper extremity symptoms are reported to have greater functional limitation and disability than patients with neck pain alone [10].

The most common causes for cervical radiculopathy are cervical disc herniation [11] followed by cervical spondylosis [12, 13]. Few morphologoical changes occur in the cervical spine before the age of 20 years [3]. Beginning in the third decade of life, a progressive decline in the water content of the intervertebral disc occurs and continue with ageing [3]. In patients younger than 30 years, the water content of the intervertebral dics approaches 90% and it decreases to less than 70% by the eighth decade of life [3]. The nucleus pulposus becomes an indistinct fibrocartilage nous mass [14]. The basic structural unit of the nucleus pulposus is glycosaminoglycan protein, which has high molecular weight and overall negative charge, thus have a strong attraction for water molecules. With ageing these large sterically active glycosaminoglycans proteins gradually diminish in size and number [3]. As a result, the intervertebral disc's ability to retain water also diminishes [3]. These are age related changes in the chemical composition of the nucleus pulposus and annulus fibrosus cause the degenerated disc to become more compressible and less elastic [15]. Consequently the disc loses height and bulges dorsally into the spinal canal. As the vertebral bodies drift toward one another, the ligaventum flavum and facet joint capsule fold in dorsally causing a further decrease in the canal and foraminal dimensions [3]. This approximation of adjacent vertebral bodies leads to a reactive process that produces osteophytes around the disc margins and at uncovertebral and facet joints [3]. Compressive radiculopathy occurs as a result of mechanical distortion of the nerve root by either the hypertrophied facet joint or uncovertebral joints, disc protrusion, spondylotic spurring of the vertebral body, or a combination of these factors [3]. Pressure on the nerve root may lead to sensory deficits, motor weakness, radicular pain [3].

Pain is related to mechanical compression and to an inflammatory response [3]. To date, several researchers have reported that the cervical radiculopathy pain is probably caused by mechanical (compressive forces) and/or chemical (inflammation) stimuli found around the cervical nerve roots [16].The presence of these stimuli around the cervical nerve roots alters their normal structure and function leading to possible neural inflammation, oedema, hypoxia, ischaemia, fibrosis, limited gliding movement and increased mechanosensitivity [17].

Mechanical traction 'stretches' the neck [18]. With the patient lying on their back, a head halter is placed under the back of the head and possibly the jaw and attached to a machine [18]. The machine is set for a certain time period and specific weight for the pulling action to occur [18]. The traction can remain on steadily for the specified time (static) or intermittently (on/off)during the treatment session[18].Experts think the traction expands the space between the vertebrae, increases the movement of the joints and stretches the muscle and ligaments around the vertebrae [18]. The weight generally applied is 1/7 times the body weight.

Neural mobilisations is commonly used for upper quadrant pain like cervical radiculopathy [19]. Neural mobilisations are often used to affect the neural structures in conditions with signs of neural involvement or neural mechanosensitivity [20, 21]. Neural mobilisation is said to affect the axoplasmic flow [22], movement of the nerve and its connective tissue [23] and the circulation of the nerve by alteration of the pressure in the nervous system and dispersion of intraneural oedema [24]. Neural mobilisation can also decrease the excitability of dorsal horn cells [25]. Neural mobilisation is defined as interventions aimed at

affecting the neural structures or surrounding tissue (interface) directly or indirectly through manual techniques or exercises. The interface can be mobilised by mobilising the tissue surrounding the nerve, along the course of the nerve [26].

Hence it is required to be explored if there is any enhanced effect when traction and neural tissue mobilisation are applied simultaneously as it may achieve the benefit of faciliatation of nerve gliding which is movement of the neural tissue with respect to its surrounding tissue while the simultaneously applied mechanical traction will help increasing the intervertebral space and reduction of intradiscal pressure reducing the mechanical and chemical stimuli around the nerve and improving the function of the nerve in picture.

METHODOLOGY

Type of study: Experimental study
Type of sampling: Simple random sampling
Setting of study: Bhausaheb Sardesai Talegaon Rural Hospital (Physiotherapy O.P.D)
Sample size: 30 (experimental: 15 and control: 15)
Duration of study*:* 6 days (1 session per day: total 6 sessions*)*

Inclusion criteria

- Male and female patients in the age group 35 to 60 years with signs and symptoms of unilateral cervical radiculopathy for greater than 6 weeks.
- Patients with radiating upper limb pain consistent with cervical radiculopathy of median nerve (Positive spurling's test/Distraction test and Upper limb tension test positive for median nerve or a combination of these.)

Exclusion criteria

- Acute cervical radiculopathy(less than 6 weeks) and bilateral radiculopathies.
- Malignancies
- Active inflammation, infection, metabolic disorder of spine.
- Traumatic causes (sprain , strain , #s)
- Structural deformities and congenital causes.
- Other neurological disorders
- Cervical spine surgeries
- Cervical myelopathies
- Tumours and other space occupying lesions of spine
- Patients contraindicated to cervical traction and nerve mobilisation.
- Upper extremity nerve entrapment, primary shoulder disease, brachial plexus disorders and peripheral neuropathies.

MATERIALS

1. Mechanical traction machine with bed and head halter (Source: OPD)
2. Numerical Pain Rating Scale.
3. Neck Disability Index [42].
4. Patient Specific Functional Scale [43].
5. Pen.
6. Hot pack(Source: OPD)
7. Large wall mirror(Source: OPD)

PROCEDURE

An experimental study was done in subjects of Pune with history of chronic unilateral cervical radiculopathy of median nerve showing symptoms (neck pain, radiating pain in upper limb, paraesthesias in the upper limb) and signs (sensory loss and/or muscle weakness and /or diminished reflexes, Positive spurling's test/Distraction test and Upper limb tension test positive for median nerve or a combination of these) or a combination of these. They were selected on the basis of the above mentioned criteria. An informed consent was then taken from the subjects. The participants were then divided into two groups by simple random sampling:

PROCEDURE FOR EXPERIMENTAL GROUP

Procedure

Patient is asked to lie down in supine position and head halter is put to the patient keeping the patient's neck rested in neutral position (i.e. 0 degrees of flexion, lateral flexion and rotation).Then intermittent mechanical cervical traction and slider neural mobilization are given simultaneously in a slow and oscillatory manner. Six sets of these are given per session.

Six sets of intermittent mechanical cervical traction performed simultaneously with neural mobilisation are applied per session.

- Mechanical cervical traction machine settings:

- Traction Weight:1/7th of patient's body weight
- Hold time:60 seconds
- Rest time:40 seconds

In each set,1/7th of body weight of mechanical cervical traction is applied and maintained during which slider neural mobilization are given. The intermittent mechanical cervical traction and slider neural mobilization are given at the same time which are followed by rest period of 40 seconds. In the starting position, sitting on the affected side of the patient; the ipsilateral shoulder of the patient is depressed with one hand while the other hand is used to place the patient's wrist and fingers in neutral position(i.e. Fingers pointing straight to the ceiling) with shoulder in 90 degrees abduction and elbow in 90 degrees of flexion. When intermittent mechanical cervical traction is applied(i.e engaged);maintaining the shoulder depression, the patient's wrist and fingers are put into complete extension and simultaneously the patient's elbow is moved into complete flexion. Subsequently; maintaining the shoulder depression, the patient's wrist and fingers are put into complete flexion and simultaneously the patient's elbow is moved into complete extension from complete flexion. These combination of movements are performed in slow and oscillatrory fashion for one minute maintaining the shoulder depressed and 90 degrees abducted. Following 1 minute; when intermittent cervical traction is released, the shoulder depression is released and patient's wrist and fingers are placed in neutral position (i.e pointing towards ceiling) with elbow in 90 degrees of flexion. Six such sets are performed i.e. 1 minute of cervical traction and neural mobilization followed by rest period of 40 seconds.

These are given at the same time and followed by rest period of 40 sec.

Total treatment time for each session of mechanical traction with neural tissue mobilisation: 10 min. The numbers of sets and rest period remain stable throughout the physiotherapy sessions. In addition to these, following are given to the patient.

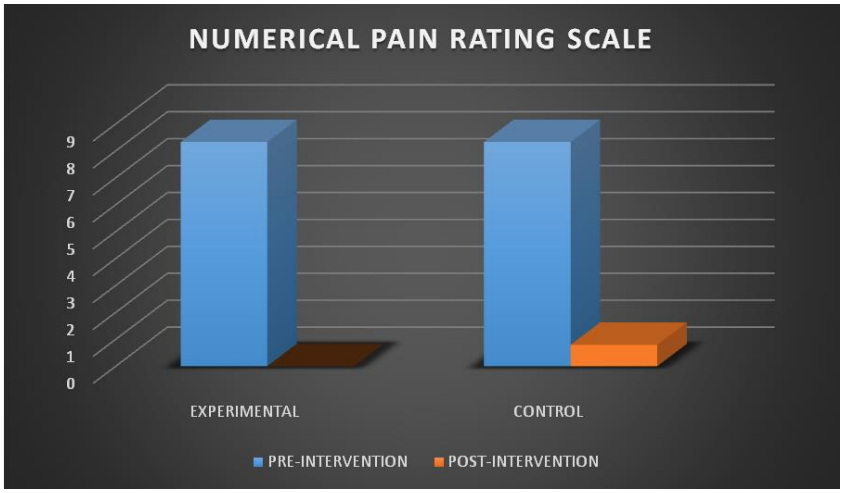
- Hot pack to upper trapezius (10 minutes): It can be given in prone lying or sitting on a chair with head supported over a couch or other comfortable position for the patient.
- Isometric exercises (cervical flexors, extensors, side flexors) 10 repetitions each with 10 seconds hold. Isometric exercises are given in supine lying position on a firm couch and therapist stands on the head end of the patient.
- For cervical flexors: Therapist places his palm over patient's forehead and asks the patient to push the palm.
- For cervical extensors: Therapist asks the patient to push his head on the couch.
- For cervical side flexors: Therapist places his ipsilateral hand on lateral aspect of the patient's head and asks the patient to push against the hand.
- Dynamic exercises:(upper, middle and lower trapezius and rhomboids)
- Upper trapezius: Patient in high sitting position is asked to perform shoulder shrugs.
- Middle trapezius and rhomboids: Patient is asked to lie in prone position with both arms abducted to 90 degrees and then asked to lift both arms off the bed such that scapulae move towards each other).
- Lower trapezius: In prone lying position patient is asked to place both arm overhead in direction of corners of the couch and raise both arms off the couch.
- Postural correction exercises: Patient is made to stand in front of the mirror and perform chin tucks and shoulder retraction 10 times each.

PROCEDURE FOR CONTROL GROUP

The procedure for controls is same in all The procedure for controls is same in all manner except that neural tissue mobilisation of median nerve and cervical traction are given separately, one followed by another.

Six sets of intermittent mechanical cervical traction (1/7th body weight) are given (60sec.hold and 40 sec.rest) followed by six sets of slider neural tissue mobilisation (60 sec.hold and 40sec.rest).The remaining protocol is same for both groups.

RESULTS

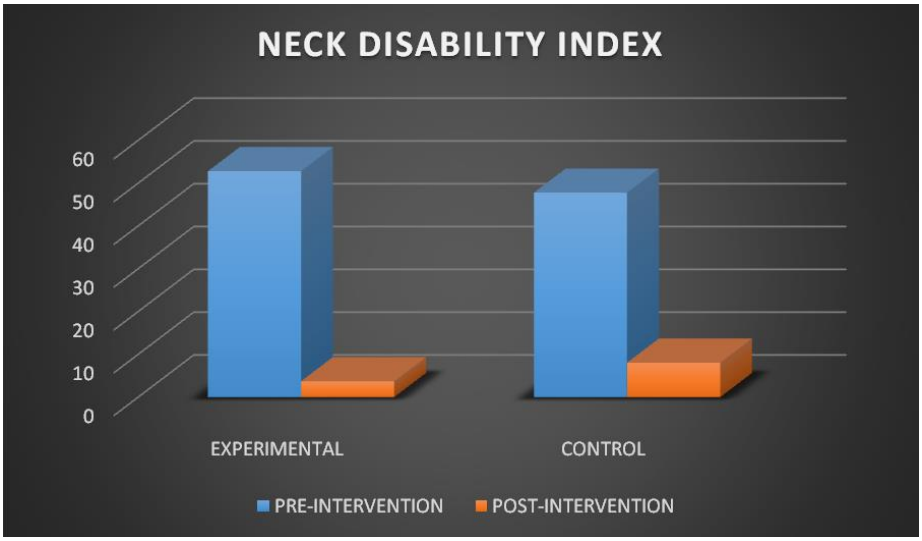


NPRS EXPERIMENTAL GROUP(PAIRED t TEST)	PRE INTERVENTION	POST INTERVENTION
MEAN	8.33	0.00
STANDARD DEVIATION	1.68	0.00
STANDARD ERROR OF MEAN	0.43	0.00
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001 to be extremely statistically significant.
By conventional criteria, this difference is considered

NPRS CONTROL GROUP(PAIRED t TEST)	PRE INTERVENTION	POST INTERVENTION
MEAN	8.33	0.80
STANDARD DEVIATION	1.05	0.68
STANDARD ERROR OF MEAN	0.27	0.17
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001 to be extremely statistically significant.
By conventional criteria, this difference is considered

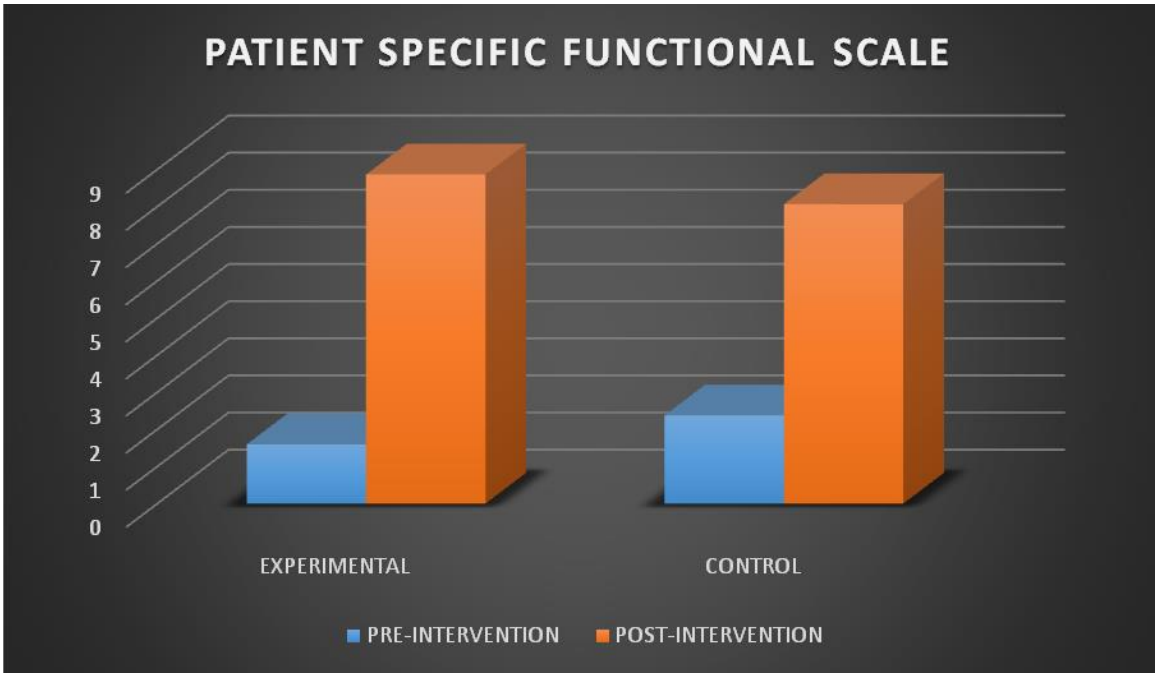


NDI EXPERIMENTAL GROUP(PAIRED t TEST)	PRE INTERVENTION	POST INTERVENTION
MEAN	52.8140	3.7333
STANDARD DEVIATION	2.8978	3.9905
STANDARD ERROR OF MEAN	0.7482	1.0303
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001 to be extremely statistically significant.
By conventional criteria, this difference is considered

NDI CONTROL GROUP (PAIRED t TEST)	PRE INTERVENTION	POST INTERVENTION
MEAN	47.7920	8.0587
STANDARD DEVIATION	5.3461	3.1250
STANDARD ERROR OF MEAN	1.3803	0.8069
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001 to be extremely statistically significant.
By conventional criteria, this difference is considered

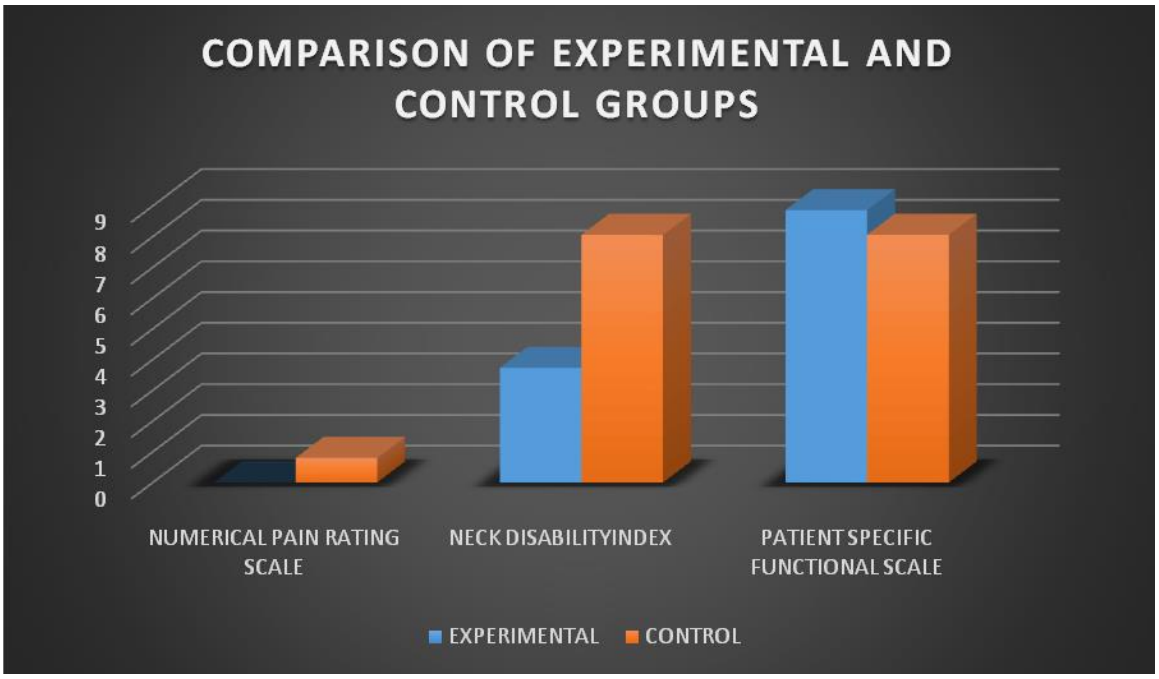


PSFS EXPERIMENTAL GROUP(PAIRED t TEST)	PRE INTERVENTION	POST INTERVENTION
MEAN	1.5980	8.8660
STANDARD DEVIATION	0.5661	0.8626
STANDARD ERROR OF MEAN	0.1461	0.2227
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001 to be extremely statistically significant.
By conventional criteria, this difference is considered

PSFS CONTROL GROUP (PAIRED t TEST)	PRE INTERVENTION	POST INTERVENTION
MEAN	2.3773	8.0660
STANDARD DEVIATION	0.9993	0.6698
STANDARD ERROR OF MEAN	0.2580	0.1729
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001
By conventional criteria, this difference is considered to be extremely statistically significant.



NPRS COMPARISON (UNPAIRED t TEST)	EXPERIMENTAL GROUP	CONTROL GROUP
MEAN	8.33	7.67
STANDARD DEVIATION	1.68	0.82
STANDARD ERROR OF MEAN	0.43	0.21
NUMBER OF VALUES	15	15

The two tailed P value equals 0.1770
By conventional criteria, this difference is considered to be not statistically significant.
The mean of experimental group minus control group equals: 0.67
95% confidence interval of this difference: from -0.32 to 1.65

NDI COMPARISON(UNPAIRED t TEST)	EXPERIMENTAL GROUP	CONTROL GROUP
MEAN	49.0807	39.73333
STANDARD DEVIATION	4.6573	5.2579
STANDARD ERROR OF MEAN	1.2025	1.3576
NUMBER OF VALUES	15	15

The two tailed P value is less than 0.0001
By conventional criteria, this difference is considered to be extremely statistically significant.
The mean of experimental group minus control group equals: 9.3473
95% confidence interval of this difference: from 5.6324 to 13.0623

PSFS COMPARISON(UNPAIRED t TEST)	EXPERIMENTAL GROUP	CONTROL GROUP
MEAN	7.2680	5.6887
STANDARD DEVIATION	1.0919	0.6841
STANDARD ERROR OF MEAN	0.2819	0.1766
NUMBER OF VALUES	15	15

- The two tailed P value is less than 0.0001
- By conventional criteria, this difference is considered to be extremely statistically significant.
- The mean of experimental group minus control group equals: 1.5793
- 95% confidence interval of this difference: from 0.8978 TO 2.2608

Paired t test was done to compare the pre and post results of Numerical Pain Rating Scale (NPRS), Neck Disability Index (NDI) and Patient Specific Functional Scale (PSFS)-(intragroup analysis).There was statistical significant difference in pre and post treatment in NPRS, NDI and PSFS in both experimental and control group.

An unpaired t test was then done to compare between experimental and control group (Intergroup analysis). There was no statistical significant difference in NPRS but statistical significant difference in NDI and PSFS, the better being in experimental group.

Thus both are equally effective in alleviating pain but experimental protocol is better in improving the neck disability and patient functions compared to control protocol.

DISCUSSION

The findings of present study have demonstrated statistically significant improvements in terms of pain, disability and functions of the patients. We observe that there is statistically significant alleviation of pain in both experimental and control groups but in comparison more (i.e. completely alleviated) in experimental group.. There is greater improvement in pain in experimental group which shows complete alleviation of pain (mean value on NPRS being 0 post treatment for 6 sessions) whereas in control group mean value on NPRS is 0.8 post treatment for 6 sessions).The comparative difference in alleviation of pain in experimental and control groups is not statistically significant. We observe there is statistically significant improvement in disability in both experimental and control group but greater improvement in experimental group. The neck disability in experimental group improved greater; with mean disability being only 3.73% as compared to 8.05% in control group at the end of 6 treatment sessions. The comparative difference in improvement of neck disability is statistically significant, the patient specific functional scale (performance in 3 most important patient specific activities) in experimental group improved to a mean score of 8.86/10 compared to 8.06/10 in control group after 6 treatment sessions

both of which are statistically significant. There is statistical significant improvement in patient's functions in experimental group compared to control group. Thus the results are suggestive of greater improvement in pain ; neck disability and functions of patients in combined simultaneous application of mechanical traction with neural tissue mobilization compared to when both these are given separately. 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 [27]. The analgesic mechanism of cervical traction is a result of reduction in inflammation of the cervical nerve roots [28]. The study used mechanical cervical traction to elongate the cervical foramen at C5-C6 level to eliminate mechanical stimuli which are hypothesized to compress the C6 nerve root. Neural tissue mobilization is performed to normalize the structure and function of the C6 nerve root through the possible facilitation of nerve gliding, reduction of intraneural swelling, pressure and inflammation, improvement of axoplasmic flow and decreased neural mechanosensitivity [29]. Cervical traction and Neural tissue mobilisation are used in relation to pathologies of the Cervical nerve roots due to their analgesic action [30]. Therefore, it is hypothesized that the simultaneous use of these two modalities will further enhance the analgesic effect of manual therapy in the treatment of chronic Cervical radiculopathy .The presence of mechanical stimuli around the Cervical nerve roots while they are compressed may not allow their mobilization and this may increase Cervical radiculopathy pain. Thus, cervical traction is applied to elongate the cervical neural foramen at C5-C6 level and decompress the C6 nerve root. Mechanical cervical traction is maintained for 1 minute, slider neural mobilizations are given in this period to mobilize and restore the normal structure and function of the C6 nerve root. Irritation of the cervical nerve root leads to radiating pain in the course of the nerve. The pain may cause reflex inhibition of the movements of neck and upper limb. The pain is due to decreased space for the nerve in the intervertebral foramen which causes impingement to the nerve either due to the herniated disc or the surrounding osteophytes in cases of cervical spondylosis. Also the inflammation in the acute phase leads to intraneural oedema and formation of adhesions between the nerve roots and the surrounding tissues thus reducing the smooth and normal gliding movements of the nerve. Thus while performing the neck and shoulder movements there are traction and compressive forces acting on the nerve and thus pain is reproduced even after the inflammation subsides in the chronic phase. This pain causes reflex inhibition of normal physiological movements of neck and upperlimb, also the patients avoids these movements with the fear of pain being reproduced. This may cause limited use of the affected extremity and the muscles thus leading to disability and poor performance of the patient in his/her daily functions. Thus while applying mechanical cervical traction simultaneously with neural tissue mobilization, we achieve distraction of articular surfaces , unloading of spine by stretching muscles , ligaments , reducing adhesions within the dural sleeve , relieving tonic muscles contraction and improving vascular status within the epidural space and perineural structures[31-35], increase in the intervertebral foramen thus providing more space for the nerve and decreasing its irritation by herniated disc and/or osteophytes. Also neural tissue mobilization helps for restoring the normal physiological movements of the nerve with respect to the surrounding tissues as it affects the axoplasmic flow [22], movement of the nerve and its connective tissue [23] and the circulation of the nerve by alteration of the pressure in the nervous system and dispersion of intraneural oedema [24]. 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[36,37].Sliding techniques during traction allows large range neurally non-aggressive movements[38].The clinical assumption is that these sliding techniques result in larger longitudinal excursion of the nerve with a minimal increase in strain on impinged or tensed nerve[38].A gliding technique may reduce intraneural swelling and circulatory compromise via fluctuating effects on intraneural pressure. Nerve gliding is induced by elongation of the nerve bed which elongates the nerve, increses the nerve tension and intraneural pressure reducing the intraneural blood flow in the oedematous neuropathies [38]. Dynamically altering intraneural pressure may result in a 'pumping action' or 'milking effect' with beneficial

effects on nerve hydration as it faciliatates evacuation of the intraneural oedema when correctly applied and hence brings about a reduction in symptoms [39-41]. Thus when pain is relieved and nerve function is restored; patient slowly regains the normal physiological movements of neck and upperlimb and is able to perform his/her daily activities without pain thus improving the disability and performance of daily activities. We observe that there is no statistical significant difference on NPRS scale thus proving that there is near equal alleviation of pain when mechanical cervical traction is given with neural tissue mobilization either simultaneously or separately. But we observe that there is statistical significant improvement in neck disability and patient functions when cervical traction and neural tissue mobilization are given simultaneously. Thus we hypothesise that pain is not only the factor which has effect on neck disability and patient's functional performance but it is the nerve's function too that plays an important role in the neck disability and patient's functional performance and that nerve function is improving better when mechanical cervical traction and neural tissue mobilization are given simultaneously as compared to when given separately because there is statistical significant difference in improvement of neck disability and patient's functional performance in experimental group. This can be explained saying that when mechanical traction is applied the mechanical irritants on the nerve reduces. As mechanical traction decreases the intradiscal pressure [27], thus impingement of the herniated disc on the nerve root decreases. Also mechanical cervical traction causes elongation of neural foramen [27] thus providing more space for the nerve and reduces impingement from osteophytes, hypertrophied surrounding tissues, adhesions, herniated disc. Simultaneously dynamic pumping action of the nerve by gliding techniques reduces the intraneural odema, improves the circulation, break the surrounding adhesions hence reduces the mechanosensitivity and improves the health and functions of the nerve. These might not be achieved that effectively when mechanical cervical traction and neural tissue mobilization are given separately because the mechanical irritants may be present even not if in the same magnitude when neural tissue mobilization is given without mechanical cervical traction i.e not simultaneously. Thus the health and nerve function is not improved in the same amount and thus disability and patient's functions are improved better in experimental group compared to the control group. 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. Also in an experimental study by Kattela Suneel Kumar et al concluded that simultaneous application of mechanical cervical traction with neural tissue mobilization is more effective in improving pain , functional disability and severity of radicular symptoms than mechanical cervical traction and neural mobilsation alone Also in a experimental study conducted by Dheeraj Lamba et al provides evidence that neural mobilisation in combination with cervical traction is an effective treatment in decreasing pain in cervical radiculopathy patients. Another randomised clinical trial conducted by Pratik Chettri et al showed a relevant improvement in neck disability index when intermittent cervical traction and neural tissue mobilisation are given along with neck strengthening exercises. All these conclusions support the findings of the present study. Therefore the present study accepts the H1 hypothesis and rejects H2 and null hypothesis.

CONCLUSION

Thus we conclude that neural tissue mobilisation performed simultaneously with mechanical cervical traction has better effect on relieving pain and improving neck disability and patient's functions in chronic cervical radiculopathy.

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