ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(7): 23-29
www.allresearchjournal.com
Received: 15-05-2017
Accepted: 16-06-2017

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Effect of hip mobility exercises on pain and function in individuals with chronic neck pain-an experimental study

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Abstract
Background: Chronicity of neck pain may manifest itself in any part of the body. Relation between chronic neck pain and altered hip joint mobility has been proven in young adults but it has not been studied in the older age group. Pain and impaired Functional abilities are the predominant complaints in individuals with chronic neck pain. This necessitates treatment of the patient as a whole. The objective is to study the Effect of Hip mobility exercises on Pain in individuals with Chronic Neck Pain.
Methods: Forty-three subjects with chronic Neck pain were recruited based on the inclusion and exclusion criteria. Subjects were assessed for pain intensity using Numerical Pain Rating Scale, functional impairment using Copenhagen Neck Functional Disability Scale (CNFDS) and Functional Hip Mobility using Patrick's FABER test at Baseline and at the end of 3rd week. Intervention consisted of Hip mobility exercises along with Conventional neck pain exercises.
Results: Numerical Pain Rating Scale scores along with CNFDS scores improved ($p<0.0001$) with no significant change in Hip mobility scores. There was no association found between Age and Hip mobility measures.
Conclusion: The present study concluded that Hip mobility exercises given along with conventional neck exercises did not have an additional effect on pain intensity, functional impairment and hip mobility in individuals with chronic neck pain.

Keywords: Chronic Neck pain, Hip mobility, Pain, Functional Impairment

Introduction

Chronic neck pain is defined by the International Association for the Study of Pain as pain perceived anywhere in the posterior region of the cervical spine, from the superior nuchal line to the first thoracic spinous process [1, 2].

Chronic neck pain is an extremely common disease among the general population and professionals. Its incidence and prevalence has been found to be higher in females (15%) than in males (9%) [3]. The annual incidence of neck pain is estimated to be approximately 37.2% for the entire adult population (17-70 years) [4].

Several studies have described the higher rates of chronic neck pain in women [5] and also it has been found that women have a poorer outcome than men in the long run but few other studies have also proved that there is no gender difference in terms of prognosis and outcomes [6]. Middle and older age is a significant contributor to a poor prognosis for chronic neck pain than the younger age group [6].

The structures around the cervical spine have been implicated in the possible sources of neck pain. These include muscles, synovial joints, intervetebral discs along with cervical dura mater and the vertebral artery. Numerous studies have been conducted over the years to identify the probable causes of neck pain. Classic experiments involved the noxious stimulation of posterior midline structures with injections of hypertonic saline. These experiments concluded that the induced noxious stimulus did produce pain as well as referred pain. Conclusions from these studies were important as they highlighted the phenomenon of 'Convergence' in the cervical spine. Nociceptive afferents from the cervical spine converge with afferents from distal sites, on second order neurons in the spinal cord. Under these conditions, spinal pain can be perceived as also arising from distal sites [7].

The most painful pain generator will produce pain that is consistent with its referred pain pattern that will be the most severe symptom. If this muscle is treated, then the next most painful muscle will surface with its pain pattern. This will often create a shift from one area to another and often an adjacent area. Sometimes a certain muscle can improve or become aggravated spontaneously due to certain postures while sleeping or awake. This can cause pain to shift within a region, a phenomena that is commonly described by patients [8].

Clinical causes and diagnosis for chronic neck pain in middle aged and older adults include osteoarthritis, discogenic disorders, trauma, tumors, infection, myofascial pain syndrome, torticollis, and whiplash related disorders. While cervical disc herniation and spondylosis are most commonly linked to cervical radiculopathy and myelopathy, the bony and ligamentous tissues affected by these conditions are themselves pain generators and are capable of giving rise to some of the referred symptoms observed in patients with these disorders. As the clinical signs and symptoms vary to great extent with radiological findings, many of the individuals with chronic neck pain may be aptly diagnosed as having 'mechanical neck pain'. Although the cause of neck pain may be associated with degenerative processes or pathology identified during diagnostic imaging, the tissue that is causing a patient's neck pain is most often unknown. Thus, clinicians should assess for impaired function of muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain [7].

There is evidence for disturbed oxidative metabolism and elevated levels of pain-generating substances in neck muscles, suggesting that impaired local muscle circulation or metabolism can be part of the pathophysiology. Neck pain is also associated with altered coordination of cervical muscles and impaired proprioception in the neck and shoulders. Evidence suggests that these phenomena are caused by the pain, but also that they can aggravate the condition [5].

Chronicity of neck pain may manifest itself in any part of the body in the form of compensatory changes in adjacent joint and soft tissue structures or as a part of continuum of the spinal structures. Kinematic chains in the body represent one form of interdependence of joints on each other. Janda has described the upper, lower and the layer syndrome which aptly describe the compensations occurring in the musculoskeletal system and their interdependence on one another. Crossed syndromes are imbalances of muscles in the shoulder and pelvic girdles.

Muscle imbalance occurs when the length or strength of agonist and antagonist muscles prevents normal function. Imbalance can be attributed to adaptations and dysfunctions over a prolonged period of time being functional or pathological. Functional muscle imbalances occur in response to adaptation for complex movement patterns, including imbalances in strength or flexibility of antagonistic muscle groups. When function is affected as a result of this imbalance, it is said to be pathological. Typically presents with pain and dysfunction, its cause may or may not be due to a traumatic event. It has a cyclical pattern of events wherein the muscle imbalance causes joint dysfunction and altered movement patterns which again cause pain further leading to muscle imbalance. The biomechanical cause of muscle imbalance is the presence of a constant stress that muscles experience due to prolonged postures and repetitive movements. Functionally this can be attributed to everyday activities of an individual that causes alteration in the level of participation of synergists and antagonists thereby affecting movement patterns [9].

The musculoskeletal system in the human body is a continuous chain of articular, muscular and fascial connections that are inter-linked. These linkages influence one another during muscular and articular dysfunctions associated with chronic pain. These can be seen as compensatory changes or patterns [9]. Recruitment patterns described by Janda suggest the compensatory nature of linked muscular and myofascial chains. These chains consist of anterior, posterior and lateral neuromuscular structures that appropriately link the upper body with the lower body particularly the upper and lower girdle muscles [9]. Hip mobility as such may be affected in individuals suffering from conditions associated with the upper trunk such as chronic upper back and neck pain. Many studies have assessed the sagittal alignment of the spine in individuals with chronic neck and shoulder pain. The results have shown an increased lumbar lordosis in such patients [10].

The major cause of chronic neck pain has been cited to be the cervical facet joints. Experimental studies have proved this through the use of controlled medial branch diagnostic blocks [11]. Therefore medical management is particularly aimed at controlling the source of pain. This is achieved by administration of opoids and steroids.

The Copenhagen Neck Functional Disability Scale (CNFDS) can be used to evaluate the disability experienced by patients with neck pain. The scores can be monitored over time to evaluate the disease course and response to any interventions [12]. Jordan A, Manniche C, Mosdal C and Hindsberger C have designed this questionnaire in 1998. It is partially derived from both the Neck Disability Index (NDI) and the Low Back Pain Rating Scale. The Copenhagen Neck Functional Disability Scale has been developed for those who have neck pain and disabilities due to the pain. The scale includes questions relating to headache, ability to sleep and to concentrate and activities of daily living. There are also questions of a psychosocial nature such as: social contact, emotional relationships and attitudes toward the future [13]. It was developed on people who had undergone neck surgery for cervical disc herniation, chronic neck pain and chronic mechanical neck pain. The CNFDS is a useful instrument for patients with neck complaints treated by physical therapy. The questionnaire is available for patients from 20 to 75 years. There are no ceiling or floor effects detected in the CNFDS. The total scoring is free of age and gender bias [13].

Hip mobility is assessed by measuring the active and passive range of motion through a universal goniometer [14]. Functional hip mobility consisting of hip flexion, abduction and external rotation with knee flexion is required for Activities of Daily Living (ADL). It can be assessed by the Patrick's Flexion Abduction External Rotation (FABER) test developed by Michael L, Mark and Mathew. They have evaluated the test-retest reliability of assessing hip ROM through this test and have found good reliability and validity for assessing functional hip mobility in young healthy college students. It consists of measuring the distance from the tip of the patella to the couch of the limb placed in the FABER position [15].

A number of subjective and objective scales are used to assess pain intensity in individuals with chronic musculoskeletal pain such as the Visual Analogue scale (VAS), Numerical pain rating scale (NPRS), McGill pain questionnaire (MPQ) etc. The Numerical Pain rating scale has been found to have good reliability and validity to measure pain in chronic pain in a number of musculoskeletal conditions [16].

In the clinical practice guidelines for neck pain, the authors have observed that patients presenting with neck pain often present with impairments of muscle flexibility related to the lower cervical and upper thoracic spine, such as the anterior, medial, and posterior Scalenes, upper Trapezius, Levator Scapulae, Pectoralis minor, and Pectoralis major, that should be addressed with stretching exercises. Addressing specific impairments of muscle length for an individual patient may be a beneficial addition to a comprehensive treatment program [17].

The Hip joint is a major weight bearing joint connecting the lower limb to the axial skeleton via the lumbo-pelvic-hip complex. Any stresses or dysfunction in the lower limb may affect the trunk and conditions affecting the spine may lead to changes in the hip joint. The trunk is an integrated system connected to the appendicular skeleton. Dysfunction and derangement in one aspect of the spine or girdles may lead to changes in any other part of the trunk. This necessitates treatment of the patient as a whole. Relation between chronic neck pain and hip joint mobility has been proven in young adults but it has not been studied in the older age group where the prevalence of neck pain is high. A wide variety of treatment protocols and approaches have been evaluated for chronic neck pain but there is lack of literature on studies evaluating the effects of a distal approach for the same. There is dearth in evidence for the effects of using Janda's Approach of muscle crossed syndrome for treating chronic neck pain associated with altered hip mobility. Therefore this study aims to study the effects of Hip mobility exercises on Pain and Function in older individuals with chronic neck pain.

2. Methods

Study design and setting

Experimental study design. Study was conducted in Tertiary Care Hospital, Belgavi, Karnataka, India from March 2016 to February 2017.

Study Participants

Individuals diagnosed with Chronic Neck Pain were recruited if they met the following inclusion criteria: 1) Neck pain for more than 3 months. 2) Aged between 40-60 years. Participants were excluded on the following criteria: 1) Existing Hip/Knee pathology. 2) Cervical radiculopathy, Spondylolisthesis, Rheumatoid Arthritis of the cervical spine. 3) History of infections/trauma/tumor to the cervical spine. 4) Diagnosed cases of neuromuscular disorders. 5) Cervical spine fractures. 6) Head and Neck Surgeries. Ethical clearance was obtained from the Institutional Ethical Committee of KLE university's Institute of Physiotherapy for the conduct of the study. Individuals willing to participate in the study were screened for inclusion and exclusion criteria. Written informed consent was obtained from every participating subject. Demographic data was recorded of the participants along with Body Mass Index (BMI) and Duration of Neck pain.

Outcome measures

Patrick's FABER test

This test assesses the general and functional hip mobility for healthy individuals. It has a reliability of 0.9 and high validity to measure hip mobility [18]. The therapist first stabilized the Anterior Superior Iliac Spine (ASIS) of the contralateral side with one hand and used the other hand to place the leg into a figure if four position until the lateral malleolus rested just above the extended knee of the contralateral leg. The therapist the slowly lowered the test leg into abduction toward the examining table until a limit was encountered. The distance from the lateral edge of the patella to the table was measured [19]. The same was repeated on the other side and both were compared for asymmetry.

Numerical Pain rating Scale

It is used to assess the pain score for chronic neck pain. Number from 1-10 are written at a regular interval on a 10 cms scale. Pain intensity can be graded based on the score obtained. It has a high reliability of 0.9 and a high validity for chronic pain as well as can be used in older individuals [16].

Copenhagen Neck Functional Disability Scale

It is a self administered questionnaire used to assess disability related to the neck. There are 15 items in this instrument, answered Yes, Occasionally or No. a total score is generated from differential numeric scores assigned to these categories. Questions 1-5 are "positive directed" (yes indicates good function) and questions 6-15 are "negative directed" (yes indicates poor function). It has a high reliability of 0.9 and a high validity as well [12].

Intervention

Individuals with chronic neck pain and associated altered hip mobility were subjected to the following intervention protocol. The exercises were administered by the therapist in the out-patient Department and then the subject was taught in doing the same exercises at home as a Home Program. Conventional neck exercises included Stretching of the Upper Trapezius and Pectoral Muscles Bilaterally, Chin tucks, Cervical Isometrics and Scapular Retraction Exercises. Hip mobility exercises were given in addition to Conventional neck exercises which included Stretching of the Iliopsoas, Hamstrings, Rectus Femoris and the Hip Adductor muscles [20]. (Additional File 1)

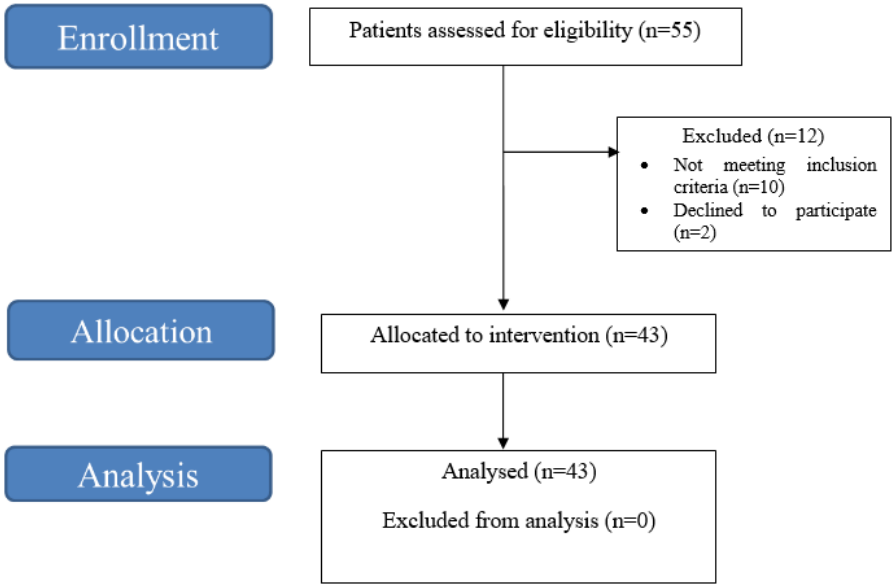

Fig 1: Flow Diagram of the Study

3. Results

Table 1: Baseline Data (n=43)

Sr.no	Variable	Mean ± SD
1.	Age(years)	48.09 ± 6.37
2.	Height(m)	1.56 ± 0.07
3.	Weight(Kgs)	62.84 ± 9.27
4.	BMI	25.98 ± 3.75
5.	Neck pain duration(years)	2.26 ± 1.77

There were a total 14 male participants and 29 female participants. Age of the participants in the study was between 40-60 years. Statistical analysis was done for Numerical Pain Rating Scale, Patrick's FABER test and Copenhagen Neck Functional Disability Scale using mean, Standard deviation and t-test.

Table 2: Comparison of outcome measures at baseline and at the end of 3 weeks

Outcome measure	Variable	Mean ± SD	p-value
NPRS	Baseline	6.07 ± 2.34	0.00001*
	End of 3rd week	3.00 ± 1.95	
Patrick's FABER test	Baseline	R =11.57 ± 5.49; L = 10.65 ± 4.65	R = 0.2 ; L = 0.6
	End of 3rd week	R = 9.87 ± 5.37; L = 8.70 ± 4.24	
CNFDS	Baseline	13.49 ± 6.24	0.000003*
	End of 3rd week	7.66 ± 4.88	

*p< 0.05

On comparison of baseline and end of 3rd week NPRS scores, p-value of 0.00001 was obtained which was statistically highly significant. On comparison of baseline and end of 3rd week Patrick's FABER test scores, p-value of 0.2 and 0.6 were obtained for the right and left leg respectively which was statistically insignificant. On comparison of baseline and end of 3rd week CNFDS scores, p-value of 0.000003 was obtained which was statistically highly significant.

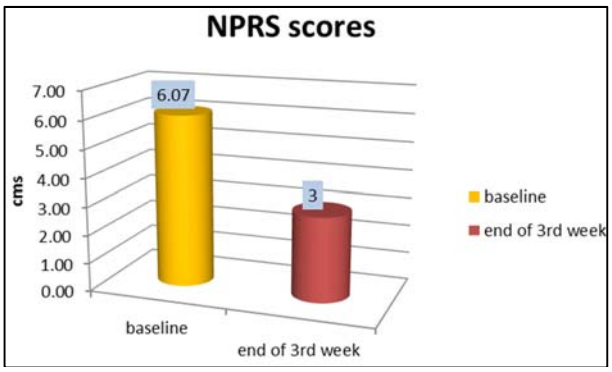

Fig 2: Comparison of NPRS scores

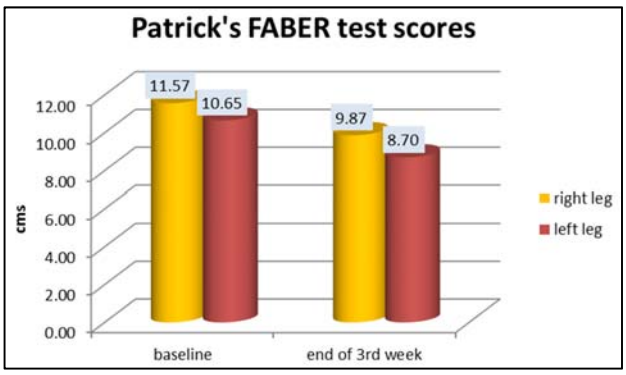

Fig 3: Comparison of Patrick's FABER test scores

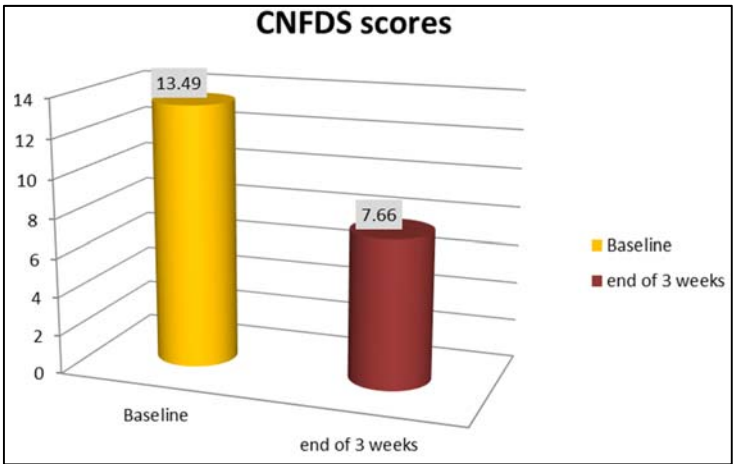

Fig 4: Comparison of CNFDS scores

Table 3: Association between Age and Hip mobility using Pearson's Correlation tests

Variable	t-value	p-value	Correlation coefficient
Age- right Hip mobility	0.7594	0.45	0.1177
Age- left Hip mobility	0.53784	0.59	0.083
Right-left hip mobility	6.3844	0.000001*	0.706

*p< 0.05

Correlation test between age and Hip mobility showed no significant correlation between the two variables.

4. Discussion

The purpose of this study was to investigate the effects of Hip mobility exercises on pain and functional impairment in individuals with Chronic Neck pain. The individuals were subjected to hip mobility exercises along with Conventional neck pain exercises.

An average neck pain duration of 2.26 years was observed which suggests the chronicity of the problem. Individuals in this age group are highly vulnerable to relapses of neck pain due to alterations in anatomical and biomechanical functions leading to a progressive disorder [6].

Anthropometric measurements taken in present study through height, weight and Body Mass Index (BMI) were 1.56 m, 62.84 Kgs and 25.98 respectively. 56% of the subjects were overweight, 5% class I obese and 7% class II obese. This suggests that increasing BMI of these individuals due to unhealthy lifestyle practices can further compromise on the body's ability to cope with musculoskeletal disorders and can be an important factor for prognosis for their chronic neck pain [21, 22].

Evaluation of mean pain scores revealed a 50% reduction at the end of 3rd week of intervention with a highly significant p-value of <0.000. Pain experienced in chronic neck disorders may be attributable to muscle imbalances owing to faulty postures, repetitive overuse of muscles, occupational disorders and compensatory biomechanical changes along with degenerative changes. Muscle imbalance causes an altered motor control and deficits in muscle strength and length lead to increased micro trauma within the soft tissues and ultimately cause more pain [23].

Therefore chronic neck pain can be managed to great extent by correction of local and global muscular imbalance. Many treatment protocols have been assessed for their efficacy in the management of chronic neck pain. Manual therapy consisting of cervical osteopathic mobilizations and traditional massage has been compared to passive stretching protocols in an experimental study done by Arja Häkkinen, Salo and Tarvainen *et al*., have assessed neck pain through a visual analogue scale and neck muscle strength along with cervical mobility. They found that both groups had improved in all outcome measures and proved that manual therapy as well as passive stretching protocols was effective in reducing chronic neck pain [23]. The results of this study are well comparable to the results of the present study that showed similar improvements in neck pain intensity measured through the numerical analogue scale. The present study included a combination of passive stretching as well as spinal as well as scapular stabilization exercises that effectively reduced the perceived level of neck pain of the participants to 50%.

A study done by Jari Ylinen stretching versus manual therapy for patients with chronic neck pain have also prove that both stretching and manual therapy are equally efficacious in managing neck pain in women. They have concluded that Low-cost stretching exercises can be recommended in the first instance as an appropriate therapy intervention to relieve pain, at least in the short-term [24].

Pain generated during movement is largely due to insufficient length of the muscles controlling the joints. Optimal length of the muscles causes an optimal muscle contraction and an efficient movement pattern that is then perceived by the brain as a pain free movement through the length-tension relationship [25]. Many of the muscles acting on the cervical spine are associated with the shoulder girdle and scapula through their insertions. Of particular significance are the upper fibers of the trapezius and the levator scapulae that act on the scapula to stabilize it during arm movements and on the cervical spine to cause neck movements. When scapular retractors and depressors are insufficient in strength to stabilize the scapula during the arm movements, their antagonists, the upper trapezius and levator scapulae compensate or even over act causing large stresses on their origins on the cervical vertebrae [9]. Exercises interventions in this study included scapular

retraction exercises thereby proving to be another reason for reducing pain in these subjects.

It was hypothesized in the present study that hip mobility exercises in accordance with Janda's muscle crossed syndrome approach given along with conventional neck exercises would help in reducing pain in the subjects with chronic neck pain. As per the results, hip mobility scores did not differ significantly post intervention. Therefore it was proved that reduction of pain was independent of the addition of hip muscle stretching exercises. But there was a study conducted to compare the effects of global postural re-education exercises and passive static stretching exercises on pain, ROM and QoL in subjects with chronic neck pain. Results of the study suggested that distal muscle stretching was beneficial in improving the above mentioned outcome measures particularly pain scores [26].

Statistical analysis for comparing pre and post intervention values for hip mobility scores showed did not show any significant difference with lower percentage change measured over time variables. Pain scores in the subjects improved despite of no significant change in functional hip mobility suggesting that hip mobility issues may be present independent of chronic neck pain. Or a possible other theory that could explain this is that the right muscles were not targeted in the intervention protocol.

Global postural re-education is an emerging intervention for patients with chronic musculoskeletal conditions wherein local as well as global muscles are targeted. Anterior and posterior spinal muscles are stretched in certain positions for an approximate duration of 20 minutes. This approach has been studied and compared to other conventional treatment strategies and has been found to be effective in reducing pain and improving function in patients [26]. Stretching of distal muscles and improving muscle balance has been proved beneficial as already stated. But the results in the present study proved otherwise.

Hip mobility measured by using the Patrick's FABER test had shown a high correlation in healthy young adults [15] and it was proved that young adults with diagnosis of chronic neck pain had significantly reduced functional hip mobility using the same test [19]. The present study was done on middle and older adults wherein correlation test between their age and hip mobility through the FABER's test showed that age of the individuals did not correlate with their hip mobility. (Table 3)

Considering Janda's findings on muscle imbalance, improving muscle imbalance in patients with chronic neck pain, targeting the upper as well as the lower cross muscles may substantially improve pain and functional disability. Muscle imbalance can be managed effectively by targeting both the tight and the weak muscles through strengthening and stretching protocols.

Functional neck disability was assessed in our study using the Copenhagen Neck Functional Disability scale (CNFDS). The components of the scale included positive and negative questions about the functional activity level of individuals with chronic neck pain. Results proved that function in the study subjects improved significantly with a highly significant p-value (<0.000).

Literature on chronic musculoskeletal conditions has proved that reducing pain causes a substantial and satisfactory improvement in functional activities. Efficient and pain-free activities require that the joints work in a stress free environment. Pain causes restriction of joint movement leading to reduced activity level. Therefore as pain scores reduced in the present study, the Copenhagen scale scores also improved.

Karen J. Sherman, Cherkin and Hawkes *et al* conducted an RCT to evaluate whether therapeutic massage is more beneficial than a self-care book for patients with chronic neck pain. The Copenhagen neck functional disability scale was used as a secondary outcome measure following massage treatment. Their results showed a modest improvement in Copenhagen scale scores similar to present study results thereby showing its reliability and accuracy in measuring functional disability related to chronic neck pain [27].

Wang, Olson and Campbell *et al* have evaluated the Effectiveness of Physical Therapy for Patients with Neck Pain: An Individualized Approach Using a Clinical Decision-Making Algorithm. According to them an individualized treatment approach is statistically and clinically more effective in managing patients with chronic neck pain than a standardized treatment approach. The Copenhagen scale has components that guide the therapist towards specific impairments and difficulties faced by the patient. Targeting these impairments results in better patient satisfaction and compliance towards the treatment approach in the long term [28].

Limitations encountered in the study were as follows: Compliance towards performing the exercises at home could not be assessed and the Exercises were standardized and were not tailored to individual signs and symptoms.

The present study concluded that Hip mobility exercises given along with conventional neck exercises did not have an additional effect on pain intensity, functional impairment and hip mobility in individuals with chronic neck pain.

5. Acknowledgements

We would like to acknowledge all the study participants for their cooperation and time towards completion of the study. We would also like to appreciate KLE University's Institute of Physiotherapy and KLES Dr. Prabhakar Kore Hospital and Medical Research Center for providing the infrastructure for the conduct of the study.

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