Introduction

Neck disorders remain a common problem in modern industrialized countries. Around two-thirds of population in the world is suffering from neck pain at some point in their lives[1].

Neck pain can be a disabling and recurrent disorder characterized by periods of remission and exacerbation[2]. It has been estimated that in any 6 months period 54% of adult will experience neck pain, with approximately 5% having substantial activity limitation due to their neck disorders[3].

Neck pain is generally said to be multifactor in origin. Includes work environment factors like repetitive work, exposure level, psychological factors like stress, high job demand & physical risk factors, poor postural mechanics during sitting & ADLs[1].

The cervical spine is a region of sophisticated motor functions. The cervical muscles serve the sensory system & support & orientate the head in space relative to the thorax[4].

There is an irrefutable evidence suggesting association between mechanical neck pain & dysfunction of muscle around cervical spine[5].

It has been suggested that prolonged postural malalignment may contribute to dysfunction[6]. Alteration in skeletal alignment during interaction with the environment may contribute to imbalances between muscular agonist, antagonists, facilitating abnormal musculoskeletal changes[7, 8]. These muscle imbalances may lead to chronic strain resulting in pain & dysfunction[8].

Evidence has shown that MNP dysfunctions could be due to imbalance of superficial and deep cervical muscles where there is heightened over activity of superficial neck muscles to compensate the weak or inhibited deep cervical muscles[9].

The compensatory heightened over activity of superficial cervical muscles during craniocervical flexion and upper limb movement will be sternocleidomastoid and anterior scalene[9, 10, 11]. Due to the imbalance of muscle activity there will also be change in physiological properties of muscle fibers.

Evidence with respect to changes in properties of muscle fibres in patients with MNP due to dysfunctions shows there is atrophic, pseudo hypertrophic, fatty replacement of cervical extensors muscle especially in sub occipital & deep cervical, superficial muscles such as semispinalis & capitus muscles. These pathophysiological changes create somatic dysfunction [12-14].

The term somatic dysfunction is defined as impaired or altered function of related components of the somatic (body frame work) system: skeletal, arthrodial, and myofasical structures, and related vascular, lymphatic and neural elements. Somatic dysfunction of the cervical region of the spine often results in increased muscle tension, sensitivity changes, asymmetry, and restriction of ROM[15].

There are various manual therapy techniques like stretching, myofascial release, manipulation, mobilization used for treating somatic dysfunction. Studies have shown that muscle energy technique an established osteopathic manipulative intervention is more effective in treating somatic dysfunctions of the spine. **Scott Dawkinset et al (1996)** did a study and shows that MET is more effective in reducing the symptoms of MNP in somatic dysfunction compared to other manual therapy technique[16].

MUSCLE ENERGY TECHNIQUE (MET) was originally devised and described by Fred Mitchell Snr in the 1940s and 1950s and the first technique manual was published in 1979[17]. It is a common conservative treatment for pathology around the spine & extremities. MET is considered a gentle manual therapy for restricted motion

of spine & extremities & is an active technique where the patient, not the clinician, controls the corrective force[18].

Basic isometric MET involves a muscle or a group of muscle being voluntarily contracted in a specific direction for a defined length of time (5-7 sec) involving sub maximal effort, with the contraction being matched by the therapist effort.

MET method are used to balance muscle tone, relieve asymmetrical forces acting on spinal & peripheral joints, encouraging restoration of normal joint motion & also used as a part of integrated sequences for trigger point deactivation. MET has shown to be effective in treating highly sensitive joints, where high velocity manipulation is contra indicated[19].

These above changes will be achieved in MET through two basic principles:

PostIsometric Relaxation:-Utilizes the contract relax technique with an added gentle stretch where in the muscle contraction activates GTO's which in turn inhibits target muscle[20].

Reciprocal Inhibition: The relaxation of the muscle is thought to occur due to a reciprocal inhibition reflex arc initiated by the contraction of agonistic muscles inducing a simultaneous inhibition of the antagonistic muscle providing a reflex relaxation of hypertonic muscle fibres[20].

Rationale and need for the study

Few studies have examined the effectiveness of MET. SCHENK R et al in 1997 showed the cervical ROM increased after 7 MET sessions, which consisted of four 5

second contraction over 4 week period, & lumber extension increased after 2 sessions per week for 4 weeks[21,22].

FREYER G, RUSZKOWSHI W et al in 2004 demonstrated that five second application of MET on atlanto-axial joints & thoracic spine showed improvement in ROM[23].

These above studies showed MET is effective in all dysfunction. However the treatment window and lasting effect of single MET is undefined.

NOELLE M. SELKOW et al conducted a pilot study on short term effect of MET on pain in individuals with non-specific Lumbopelvic pain. The study was a randomized controlled trial in which parameters like VAS indicating current pain & worst pain over past 24 hours only were measured. Results demonstrated that subjects receiving MET showed a decreased in VAS worst pain over the past 24 hrs, thereby suggesting that MET may be useful to decrease LPP over 24 hrs[18]. This study did not consider other parameters which is more important to be considered in any somatic dysfunction i.e. ROM and functional disability status.

Cervical region differs from lumbar region in various aspects. The cervical region bears less weight and is generally more mobile compared to lumbar region, the neutral zone of cervical region is larger compared to lumbar region, the whole cervical stability depends on deep cervical flexors and extensor muscle. The lumbar region has got major role in static and dynamic activities and is surrounded by larger group of muscle and depends on pelvic mobility. Since there is variation in functional aspect and stability wise between lumbar and cervical region, factor contributing and forming somatic dysfunction varies between lumbar and cervical region[24].

Considering the variation in functional and stability aspect of lumbopelvic region and cervical region and also considering the limitation of NOELLE M. SELKOW et al pilot study. The study is proposed to find out the SHORT TERM EFFECT OF MET ON INDIVIDUALS WITH MECHANICAL NECK PAIN DUE TO SOMATIC DYSFUNCTION.

Hypothesis

EXPERIMENTAL HYPOTHESIS

- One time application of MET is effective immediately in relieving symptoms i.e. pain, improve ROM and NDI in patients suffering from mechanical neck pain, and its effect will last for 24 to 48 hours.

NULL HYPOTHESIS

- One time application of MET is effective immediately in relieving symptoms i.e. pain, improve ROM and NDI in patients suffering from mechanical neck pain, and its effect will not last for 24 to 48 hours.

Objectives

- To evaluate short term effect of MET on ROM of cervical region, immediately, at 24 hours and 48 hours following one time intervention.
- To evaluate short term effect of MET on pain of cervical region, immediately, at 24 hours and 48 hours following one time intervention.
- To evaluate short term effect of MET on function disability of cervical region, immediately, at 24 hours and 48 hours following one time intervention.

Review of literature

NOELLE M. SELKOW et al (2009): conducted a pilot study on short term effect of MET on pain in individuals with non-specific lumbopelvic pain. The study was a randomized controlled trial in which 20 subjects with self reporting LPP assigned into 2 groups. Intervention group received MET on hamstrings & iliopsoas and control group received sham treatment. Results demonstrated that subjects receiving MET showed a decreased in VAS worst pain over the past 24 hrs[18].

DENISE K. BURNS et al (2006) conducted a study on gross ROM in the cervical spine to determine the efficacy of osteopathic MET in asymptomatic subjects. 32 subjects were assigned into 2 groups and Group A received osteopathic MET, Group B received sham manipulative treatment. Cervical AROM and PROM were measured before and immediately after treatment. Results showed increased ROM in Group A and slight decreased ROM in Group B[15].

GUPTA S et al (2008) have done a study to evaluate the efficacy of post isometric relaxation technique on 37 subjects diagnosed with non-specific neck pain. subjects were randomly allocated to 2 treatment groups. The experimental group received post isometric relaxation and the control group received isometric exercise for 3 weeks. VAS. ROM and NDI were recorded on 1st, 8th, 15th and 22nd day. Results show significant difference with experimental group showing greater improvement than the control group[25].

WOJTEK RUSZKOWSKI(2004) conducted a study on 52 asymptomatic subjects to investigate the effect of various duration of MET isometric contractions on active atlanto axial rotation ROM. Subjects were randomly allocated to either 5 or 20 sec isometric contraction MET group, or sham treatment control group. Active atlanto axial end range was measured pre and post intervention. Results revealed significant difference in the mean change between 5 sec MET group and the control group but not between the 20 sec MET group and control group[26].

SCHENK et al.(1994) examined the effects of MET on ROM for cervical flexion, extension, axial rotation and lateral flexion over a four-week period involving multiple MET sessions to correct participants' pre-determined cervical restrictions, and recorded post-test ROM at the completion of the treatment series. Cervical axial rotation was significantly increased following the treatment period, however, the cervical flexion, extension and lateral flexion treatments failed to reveal statistically significant increases in ROM. Mean ROM values post-treatment for these movements revealed an increase in ROM with a trend towards statistical significance for the treatment group compared with no change in the control group[21].

SCOTT DAWKINSET et al (1996) conducted a clinical trial comparing the effectiveness of Manipulation to MET in the treatment of chronic mechanical neck pain. Initially the manipulation group showed greater reduction in pain whereas the MET group showed a more gradual improvement over the three-week treatment period. However, at the end of treatment, a further three-week follow up period revealed no statistically significant difference between both groups. The

shortcomings of this study was that it was non parametric and the criteria for patient selection was poorly defined in terms of acute, sub-acute and chronic presentations. Hence the researcher suggested that further studies involving MET should incorporate a larger sample size and a placebo control[16].

BOODHOO et al (2002): Evaluated the efficacy of MET compared to detuned laser in the treatment of chronic mechanical neck pain. Sixty patients were recruited and if they met the inclusion criteria they were randomly allocated to either the MET or placebo group. Group A received MET together with detuned laser to the fixated levels. Group B received detuned laser only to the fixated levels. From the data, group A showed a statistically significant improvement in all ranges of cervical motion and pain intensity from visit one to six hence suggesting that MET is effective in treating chronic mechanical neck pain[27]

.

PATEL PUJA (2002): Had done a study on 40 female subjects between 20-25 years old with asymptomatic cervical spines who were randomly placed into 2 groups. Group 1 received neuromuscular technique on week one, followed by a 'rest' period on week two, followed by neuromuscular technique on week three. Group 2 received muscle energy technique on week one, followed by a 'rest' period on week two, followed by neuromuscular technique on week three. All treatments were a single application given to both scalene muscles (bilaterally) lasting 3 minutes. Before and after treatment, measurements were taken of the cervical spine ranges of motion, with the cervical range of motion goniometer T-test analysis demonstrated that both neuromuscular technique and muscle energy technique significantly increased

cervical range of motion in all planes of movement ($p<0.05$). A second t-test also showed that muscle energy technique increased range of motion in the cervical (in flexion, rotation and side bending) more effectively than neuromuscular technique[28].

MARIA LOUISA ELIZABETH ROODT (2009): Forty-five patients with chronic mechanical neck pain were assigned to three treatment groups. The three different treatment groups were: Spinal Manipulative Therapy (SMT), Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation (PNF). Each group received six treatments over a period of three weeks with a follow-up consultation. Range of motion, pain and disability measurements were taken at the first, third and sixth treatment and at the follow-up consultation. Results revealed that all three groups improved significantly between the first and the final consultation, for all measures[29].

EDWARD BROOKES (2010): Conducted an experimental study comparing functional technique with muscle energy technique for cervical range of motion. 60 asymptomatic students at the British School of Osteopathy were randomly allocated to an experimental (Functional technique or MET) or control group. FT was given for 1 min on the restricted joint and MET was given on the restricted side for 5 sec for two repetitions and the control group received no intervention. Results shows that FT fails to produce a significant increase in cervical rotation, however MET produces a significant increase compared to the control groups. Statistical analysis also revealed a significant increase in rotation between intervention and non-intervention sides[30].

F.GHIASI et al (2010): has done a study to compare the treatment effect of muscle energy technique and ultrasound therapy on myofascial trigger points in upper trapezius. 45 patients with trigger points in upper trapezius were randomly assigned to one of three groups: ultrasound group (N=15), muscle energy group (N=15) and control group (N=15). In ultrasound group, frequency of ultrasound 1 MHz, continuous mode, intensity 1.5W/cmand duration 4.5 min was selected. In muscle energy group, post-isometric relaxation with stretching was used, and control group did not receive any treatment. A 10 session treatment program which lasted 2 weeks was performed for interventional groups, and follow-up was done 3 months after treatment. . Outcome was based on neck disability index and shoulder pain and disability questionnaire, range of motion and muscles strength were measured immediately before, after and three months after intervention. Results shows effectiveness of ultrasound and muscle energy technique to reduce disability and pain in the short term in patients with myofascial trigger points and muscle energy therapy had more long benefit effect than ultrasound therapy[31].

VERNON H MIOR S **et al (1991):** Did a modification of the Oswestry Low Back Pain Index conducted producing a 10-item scaled questionnaire entitled the Neck Disability Index (NDI). Face validity was ensured through peer-review and patient feedback sessions. Test-retest reliability was conducted on an initial sample of 17 consecutive "whiplash"-injured patients in an outpatient clinic, resulting in good statistical significance (Pearson's r = 0.89, p less than or equal to .05). The alpha coefficients were calculated from a pool of questionnaires completed by 52 such

subjects resulting in a total index alpha of 0.80, with all items having individual alpha scores above 0.75. Concurrent validity was assessed in two ways. First, on a smaller subset of 10 patients who completed a course of conservative care, the percentage of change on NDI scores before and after treatment was compared to visual analogue scale scores of percent of perceived improvement in activity levels. These scores correlated at 0.60. Secondly, in a larger subset of 30 subjects, NDI scores were compared to scores on the McGill Pain Questionnaire, with similar moderately high correlations (0.69-0.70). While the sample size of some of the analyses is somewhat small, this study demonstrated that the NDI achieved a high degree of reliability and internal consistency[32].

ANNE M BOONSTRA, HENRICA R SCHIPHORS PREUPER et al (2008): Conducted a study to determine the reliability and concurrent validity of a visual analogue scale (VAS) for disability as a single-item instrument measuring disability in chronic pain patients was the objective of the study. For the reliability study a test-retest design and for the validity study a cross-sectional design was used. The study population consisted of patients over 18 years of age, suffering from chronic musculoskeletal pain; 52 patients in the reliability study, 344 patients in the validity study. Main outcome measures were as follows. Reliability study: Spearman's correlation coefficients (rho values) of the test and retest data of the VAS for disability; validity study: rho values of the VAS disability scores with the scores on four domains of the Short-Form Health Survey (SF-36) and VAS pain scores, and with Roland-Morris Disability Questionnaire scores in chronic low back pain patients. Results in the reliability study rho values varied from 0.60 to 0.77; and in the validity study rho values of VAS disability scores with SF-36 domain scores varied from 0.16

to 0.51, with Roland-Morris Disability Questionnaire scores from 0.38 to 0.43 and with VAS pain scores from 0.76 to 0.84.The result showed that study was that the reliability of the VAS for disability is moderate to good[33].

JAMES W YOUDA et al (1991): Conducted a study To determine reliabilities within and between persons measuring cervical active range of motion (AROM), three methods were examined: use of a cervical-range-of-motion (CROM) instrument, use of a universal goniometry (UG), and visual estimation (VE). Measurements were made on 60 patients with orthopedic disorders of the cervical spine who were divided into three groups of 20 subjects each. All subjects were tested in a standardized seated position using operationally defined goniometric placements and non goniometric estimation techniques. Cervical flexion and extension, lateral flexion, and rotation were measured. Intra class correlation coefficients (ICCs) were used to quantify within-tester and between-tester reliability and found that goniometric measurements of AROM of the cervical spine made by the same physical therapist had ICCs greater than .80 when made with the CROM device or the UG[34].

Methodology

Source of study: Department of physiotherapy, JSS Hospital, Mysore**.**

Population: Patients with mechanical neck pain due to somatic dysfunction.

Sample size: 30 subjects

Study design: Experimental study

Method of data collection: Personal structured interview

Duration of study : July 2011 to December 2011.

Inclusion Criteria

- Subjects diagnosed with mechanical neck pain due to somatic dysfunction based on the criteria proposed by **KENNETH K NELSON** et al. The physical diagnosis of somatic dysfunction is accomplished by palpation. Four diagnostic criteria of somatic dysfunction are as follows;
    - Tissue texture abnormality
    - Asymmetry of portion
    - Restriction of motion
    - Tenderness
- The presence of any one of these is justification for the diagnosis of somatic dysfunction[35].
- Both men and women of age group between 25-45 years.

Exclusion Criteria:

- H/O Fracture around cervical region

- Cervical Disc prolapse.
- Cervical Myelopathy with skeletal lesion
- Joint Hyper mobility /instability of cervical region.
- Tumour
- Infection in immediate underlying tissue.

Materials used:

- Goniometer
- Couch

Variables/ outcome measures:

- Visual Analogue Scale (VAS).
- Neck disability index (NDI): The NDI is a 10 item questionnaire that aims to measure the self perceived disabling effects of neck pain on daily life. NDI has high degree of reliability and internal consistency with high degree of correlation with McGill Pain Questionnaire(r=0.69-0.70)[32].
- Range of motion of cervical spine (CROM).

Procedure

An ethical clearance for the study was obtained from the ethical committee of JSS College of physiotherapy. Subjects who fulfilled KENNETH K NELSON criteria were included for the study and were given consent form prior to intervention. Detailed pre-test measurement on parameters of VAS, NDI and CERVICAL ROM was taken.

Cervical ROM was measured using goniometer. Several studies shown ICC interrater reliability of goniometer for measuring CROM(r=0.80)

<u>Procedure of measuring CROM using goniometer:</u>

Position: subject sitting, with the thoracic and lumbar spine well supported by the back of chair. The cervical spine was positioned in 0 degree of rotation and lateral flexion.

Flexion: Goniometer alignment:

- The fulcrum of the goniometer was centered over the external auditory meatus
- Proximal arm was aligned such that it is perpendicular to the ground.
- Distal arm was aligned with the base of the nares.

Extension: Goniometer alignment:

- The testing position and alignment were the same as for measuring cervical flexion.

Lateral flexion: Goniometer alignment:

- The fulcrum of the goniometer was centered over the spinous process of C7 vertebra.
- The proximal arm was aligned with the spinous process of the thoracic vertebra so that the arm is perpendicular to the ground.
- Distal arm with the dorsal midline of the head, using the occipital protuberance for reference.

Rotation: Goniometer alignment:

- The fulcrum of the goniometer was centered over the centre of the cranial aspect of head.
- Proximal arm was parallel to the imaginary line between the two acromion process.
- Distal arm with the tip of the nose.

Detailed evaluation on different muscular dysfunction around cervical spine on each subject was noted. Each subject underwent MET intervention on each dysfunction muscle on the basis on Ruddy's approach.

General steps taken to apply MET technique for each muscle is as follow:-

1. The therapist localizes the joint or body tissues into the position of initial range of motion resistance to a specific movement (i.e., flexion/ extension, side bending, and rotation).

2. The subject was instructed as to the amount (ounces to a few pounds) and duration (7 to 10 seconds) of contractile force to use when instructed to do so.

3. The subject was instructed to push his or her head and neck into the appropriate direction of movement.

4. An isometric counterforce was provided until an appropriate muscle contraction was perceived in the subject. This step generally required between 3 and 5 seconds,

5. The Subject was directed to gently cease contraction while the therapist simultaneously matched the decrease in the subject's force with an equivalent amount of isometric force.

6. The subject was allowed to relax for 3 to 5 seconds. At the same time, the therapist monitors the subject for tissue relaxation (i.e., decrease in muscle tonicity).

7. Then the joint is taken into a new barrier of motion in the subject, The reduction of tension in the subject's tight muscle allowed it to be lengthened passively.

8. Steps 1 through 7 was repeated **two to four times**, as part of the treatment process on shortened muscle[15].

Active cervical ROM, VAS and NDI was taken immediately following 4 times of MET intervention.

The main muscles found to be shortened around cervical region due to somatic dysfunction was trapezius, levator scapulae, scalene and sternocleidomastoid.

Procedure of Application of MET for trapezius muscle.

Patient position: Supine lying on the couch with the arm alongside the trunk, the head/neck side bends away from the treated side.

Therapist position: standing at the head of the couch.

Procedure: Shoulder stabilised with one hand and the mastoid area of the same side of the head cupped by the other hand, neck is fully side bent and fully rotated to the contra lateral side to stretch the posterior fibers of trapezius then neck is half rotated to stretch the middle fibers of trapezius and lastly neck is slightly rotated towards the treated side to stretch the anterior fibers of trapezius. Then the subject is instructed to lift the shoulder towards the ear (shrug movement) and bring the ear towards the shoulder and asked to maintain the contraction for 7 to 10 seconds and then relax for 3 to 5 seconds[37].

A) Posterior fibers

B) Middle fibers

C) Anterior fibers

Procedure of Application of MET for levator scapulae muscle

Patient position: supine lying with the arm of the side to be tested stretched out alongside of the trunk with the hand supinated.

Therapist position: Standing at the head of the couch.

Procedure: The contralateral arm is passed under the subject's neck to rest on the shoulder on the side to be treated, with the forearm supporting the neck and the other hand supporting and directing the head into subsequent movement. With the forearm, the neck is lifted into full flexion (aided by the other hand) and the head is turned fully into side flexion and rotation away from the treated side such that stretch is being placed on levators from both ends.Then the subject is instructed to take head back towards the couch and slightly to the side from which it was turned against the resistance given and and asked to maintain the contraction for 7 to 10 seconds and then relax for 3 to 5 seconds[37].

After applying MET on basis of Ruddy's approach for 4 times on each above mentioned dysfunction muscle, VAS, NDI and CROM were measured immediately. Same subjects were reevaluated again on parameters of VAS. NDI and CROM at 24hrs, 48hrs to know the long lasting effect. Subjects were instructed not to take any medications such as Anti-inflammatory and analgesic for 48 hours, patient were given counseling on ergonomic consideration while doing activities in office and home.

Results

DATA ANALYSIS

Statistical software: The Statistical software SPSS for windows (version 140) were used for the analysis of the data, Microsoft word and Excel have been used to generate graphs, tables etc.

Statistical Methods: Descriptive statistical analysis has been carried out in the present study. Results were analyzed repeatedly pre, immediate,24hrs and 48hrs following intervention using the repeated measure ANOVA test taking level of significance $p<0.05$

Study design: An experimental study was conducted to evaluate the short term effect of Muscle Energy Technique on individuals with mechanical neck pain due to somatic dysfunction.

Results: Result showed highly significant improvement in all the parameters within the subjects immediately, 24hrs, 48hrs following intervention (MET) with $p<0.000$. Result also showed significant improvement in all the parameters between the subjects immediately, 24hrs, 48hrs following intervention (MET) with $p<0.000$

.

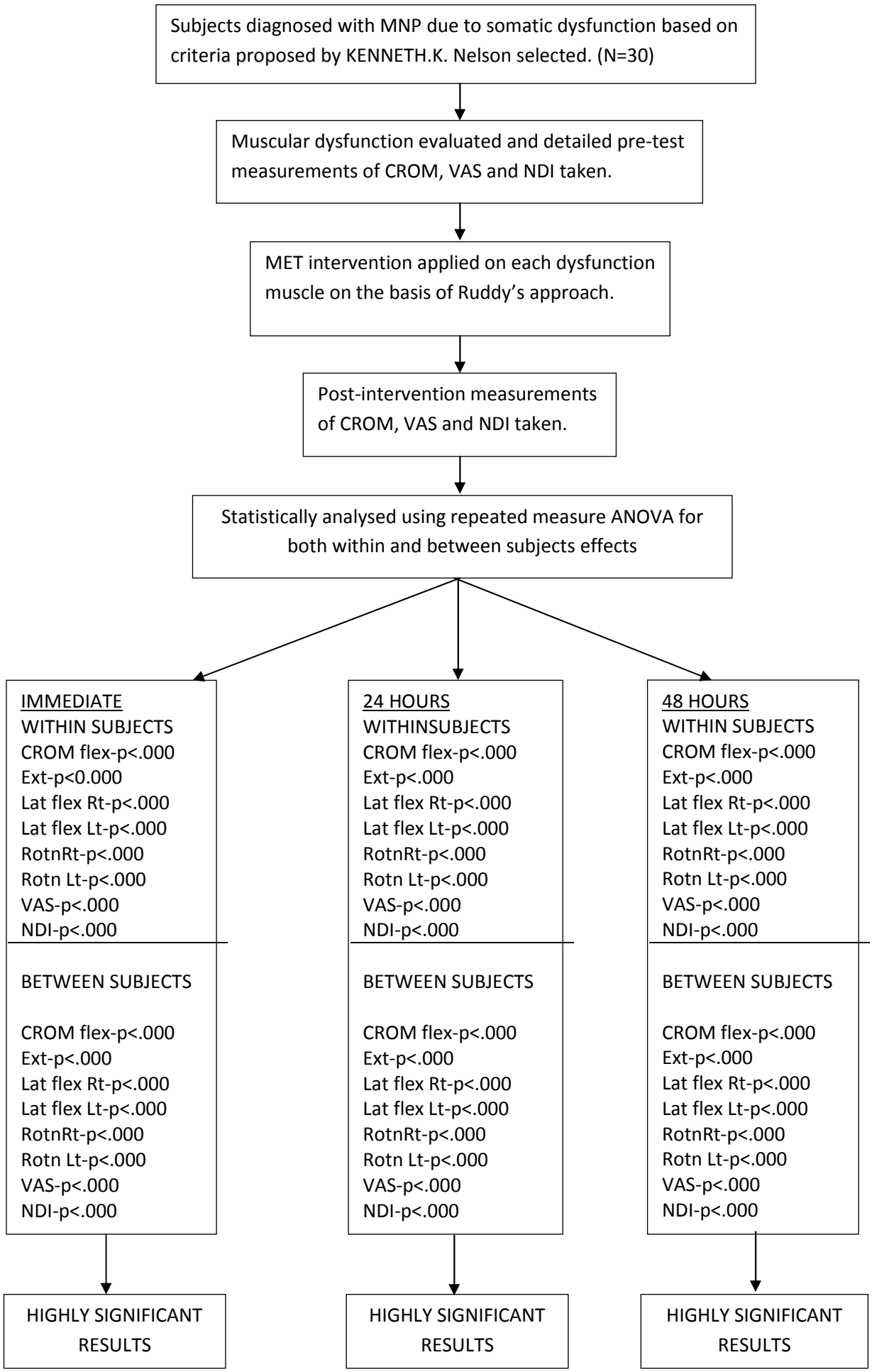

Subjects diagnosed with MNP due to somatic dysfunction based on criteria proposed by KENNETH.K. Nelson selected. (N=30)
Muscular dysfunction evaluated and detailed pre-test measurements of CROM, VAS and NDI taken.
MET intervention applied on each dysfunction muscle on the basis of Ruddy's approach.
Post-intervention measurements of CROM, VAS and NDI taken.
Statistically analysed using repeated measure ANOVA for both within and between subjects effects
IMMEDIATE
WITHIN SUBJECTS
CROM flex-p<.000
Ext-p<0.000
Lat flex Rt-p<.000
Lat flex Lt-p<.000
RotnRt-p<.000
Rotn Lt-p<.000
VAS-p<.000
NDI-p<.000
BETWEEN SUBJECTS
CROM flex-p<.000
Ext-p<.000
Lat flex Rt-p<.000
Lat flex Lt-p<.000
RotnRt-p<.000
Rotn Lt-p<.000
VAS-p<.000
NDI-p<.000
24 HOURS
WITHINSUBJECTS
CROM flex-p<.000
Ext-p<.000
Lat flex Rt-p<.000
Lat flex Lt-p<.000
RotnRt-p<.000
Rotn Lt-p<.000
VAS-p<.000
NDI-p<.000
BETWEEN SUBJECTS
CROM flex-p<.000
Ext-p<.000
Lat flex Rt-p<.000
Lat flex Lt-p<.000
RotnRt-p<.000
Rotn Lt-p<.000
VAS-p<.000
NDI-p<.000
48 HOURS
WITHIN SUBJECTS
CROM flex-p<.000
Ext-p<.000
Lat flex Rt-p<.000
Lat flex Lt-p<.000
RotnRt-p<.000
Rotn Lt-p<.000
VAS-p<.000
NDI-p<.000
BETWEEN SUBJECTS
CROM flex-p<.000
Ext-p<.000
Lat flex Rt-p<.000
Lat flex Lt-p<.000
RotnRt-p<.000
Rotn Lt-p<.000
VAS-p<.000
NDI-p<.000
HIGHLY SIGNIFICANT RESULTS
HIGHLY SIGNIFICANT RESULTS
HIGHLY SIGNIFICANT RESULTS

Table 1

% improvement of CROM immediate to 24hrs and 48 hrs

FLEXION	IMM TO 24 HRS	8.4%
	IMM TO 48 HRS	16.70%
EXTENSION	IMM TO 24 HRS	9.08%
	IMM TO 48 HRS	18.14%
LATERAL FLEXION(R)	IMM TO 24 HRS	9.69%
	IMM TO 48 HRS	19.12%
LATERAL FLEXION(L)	IMM TO 24 HRS	7.96%
	IMM TO 48 HRS	15.72%
ROTATION(R)	IMM TO 24 HRS	4.66%
	IMM TO 48 HRS	12.30%
ROTATION(L)	IMM TO 24 HRS	5.56%
	IMM TO 48 HRS	11.31%

The above table shows greater improvement of ROM of cervical flexion, extension, lateral flexion and rotation, 24 and 48 hrs following MET

Table 2

Inter and Intra subject analysis of Flexion CROM

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PREFLEX	34.33	4.866	30
IMMFLEX	38.90	4.693	30
HR24FLEX	42.17	4.488	30
HR48FLEX	45.40	4.446	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	2010.467	3	670.156	373.661	.000
Error(CHANGE)	156.033	87	1.793		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	193924.800	1	193924.800	2417.080	.000
Error	2326.700	29	80.231		

Results of the study shown significant improvement in FLEXION CROM, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

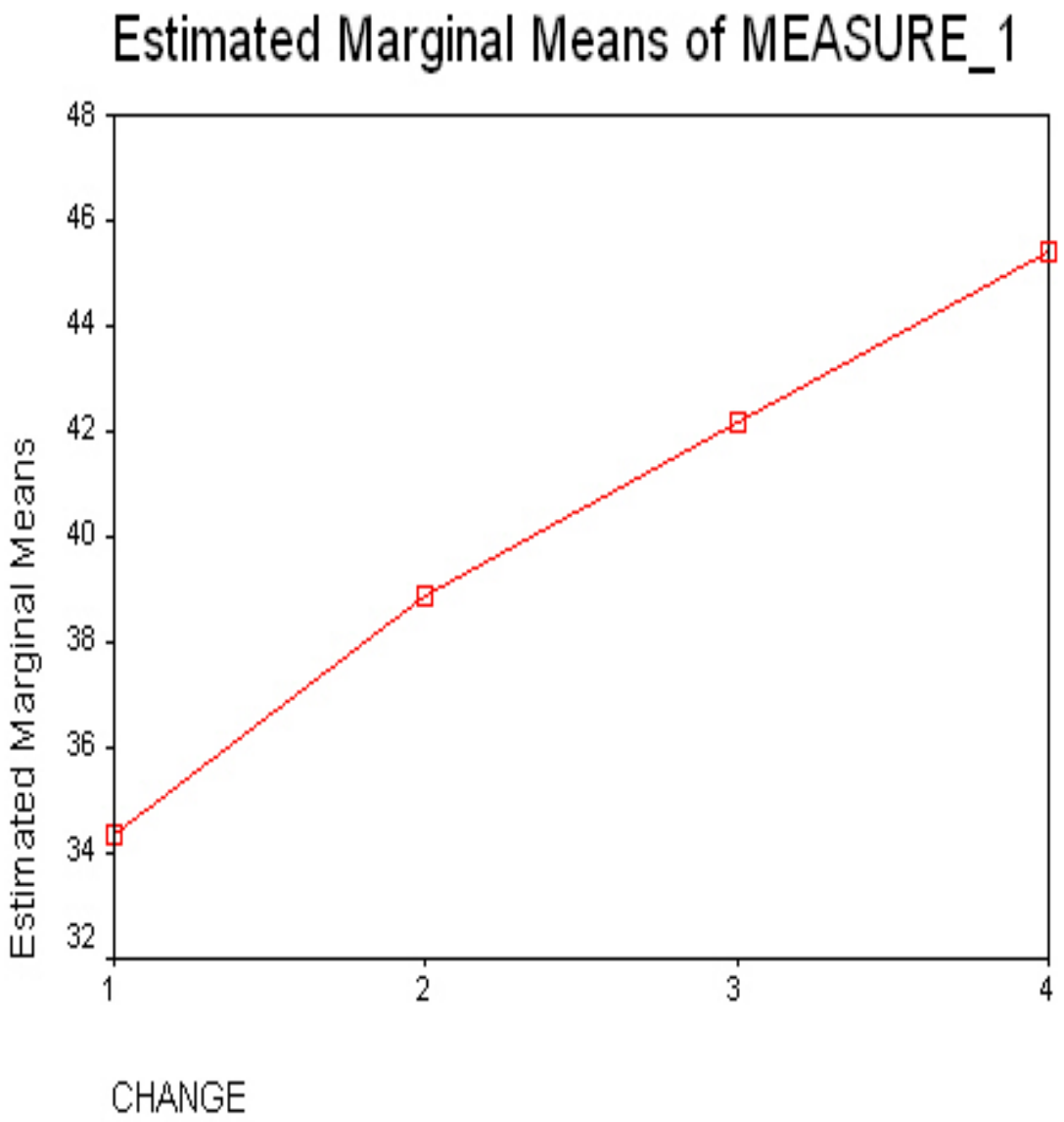

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
48
46
44
42
40
38
36
34
32
1
2
3
4
CHANGE

Table 3

Inter and Intra subject analysis of Extension CROM

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PREEXT	32.43	6.191	30
IMMEXT	37.10	6.076	30
HR24EXT	40.47	5.847	30
HR48EXT	43.83	5.831	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	2132.092	3	710.697	316.823	.000
Error(CHANGE)	195.158	87	2.243		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	177485.208	1	177485.208	1298.276	.000
Error	3964.542	29	136.708		

Results of the study shown highly significant improvement in EXTENSION CROM, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

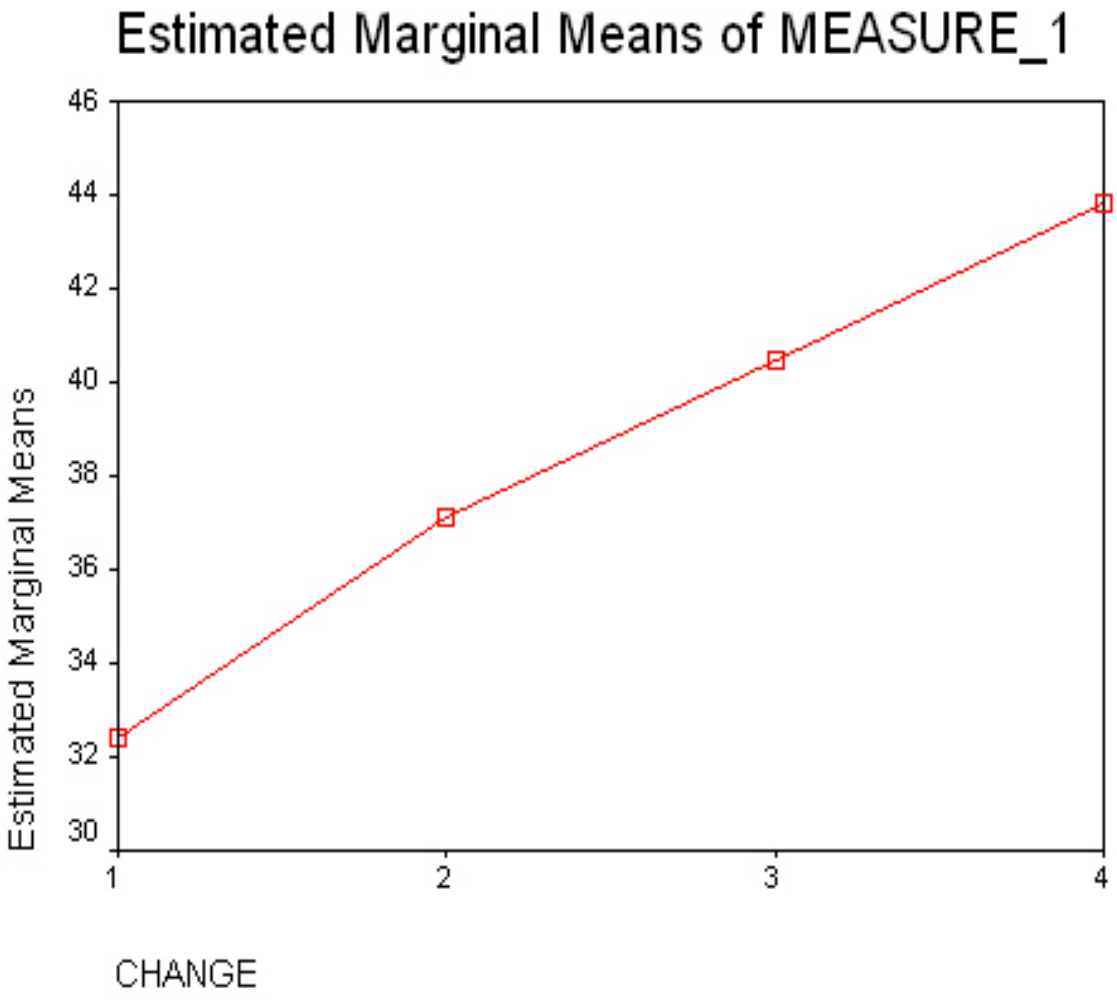

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
46
44
42
40
38
36
34
32
30
1
2
3
4
CHANGE

Table 4

Inter and Intra subject analysis of Lateral flextion(Rt) CROM

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PRELFL(R)	36.33	5.403	30
IMMLFL(R)	40.63	5.726	30
HR24LFL(R)	44.57	5.905	30
HR48LF(R)	48.40	6.055	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	2417.767	3	805.922	364.740	.000
Error(CHANGE)	192.233	87	2.210		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	216580.033	1	216580.033	1706.760	.000
Error	3679.967	29	126.895		

Results of the study shown significant improvement in LATERAL FLEXION(RT) CROM, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

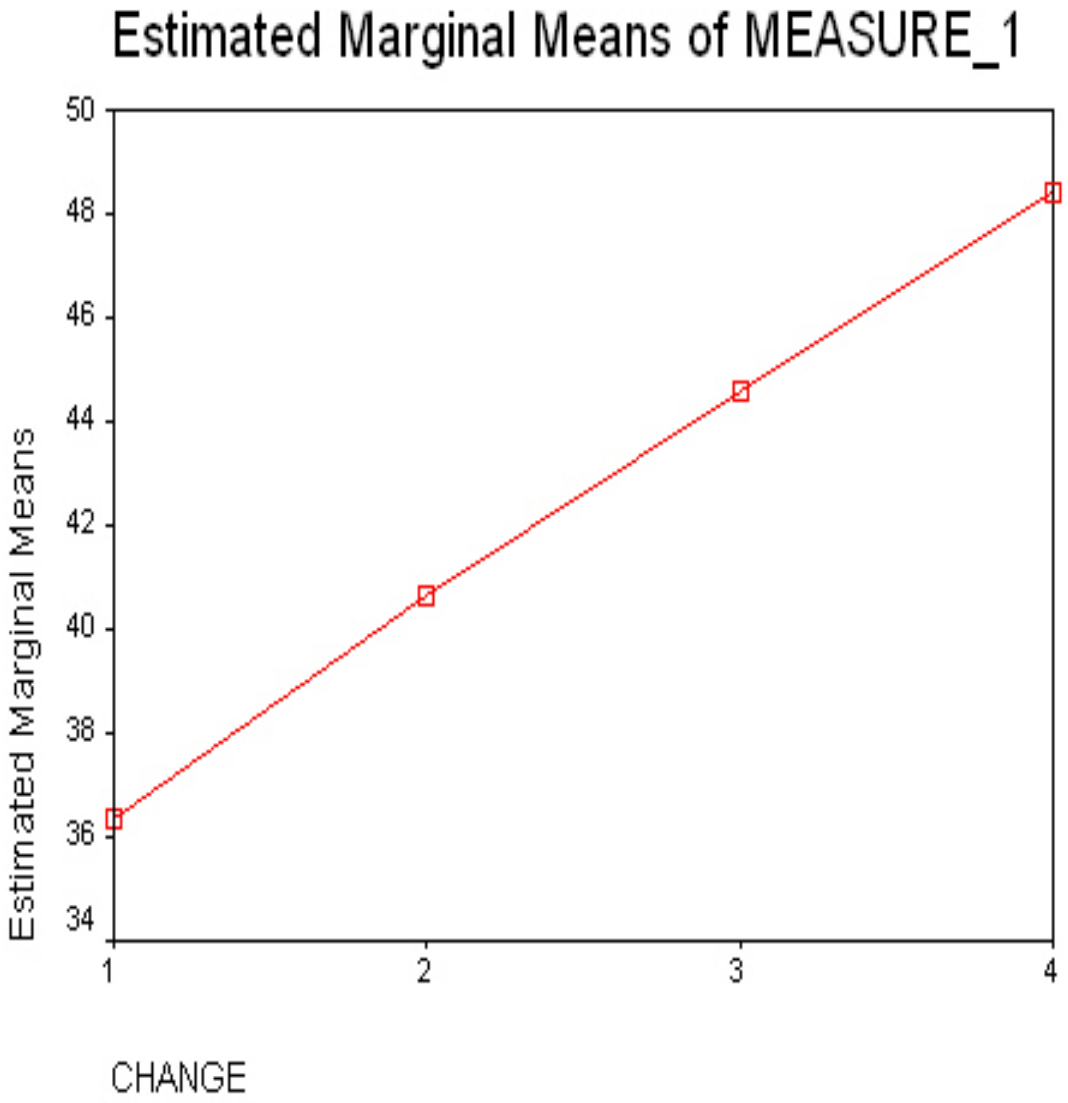

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
50
48
46
44
42
40
38
36
34
1
2
3
4
CHANGE

Table 5

Inter and Intra subject analysis of Lateral flextion(Lt)CROM

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PRELFL(L)	37.67	6.789	30
IMMLFL(L)	42.17	6.767	30
HR24LFL(L)	45.53	6.937	30
HR48LFL(L)	48.80	7.411	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	2040.692	3	680.231	369.741	.000
Error(CHANGE)	160.058	87	1.840		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	227505.208	1	227505.208	1201.092	.000
Error	5493.042	29	189.415		

Results of the study shown significant improvement in LATERAL FLEXION(LT) CROM, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

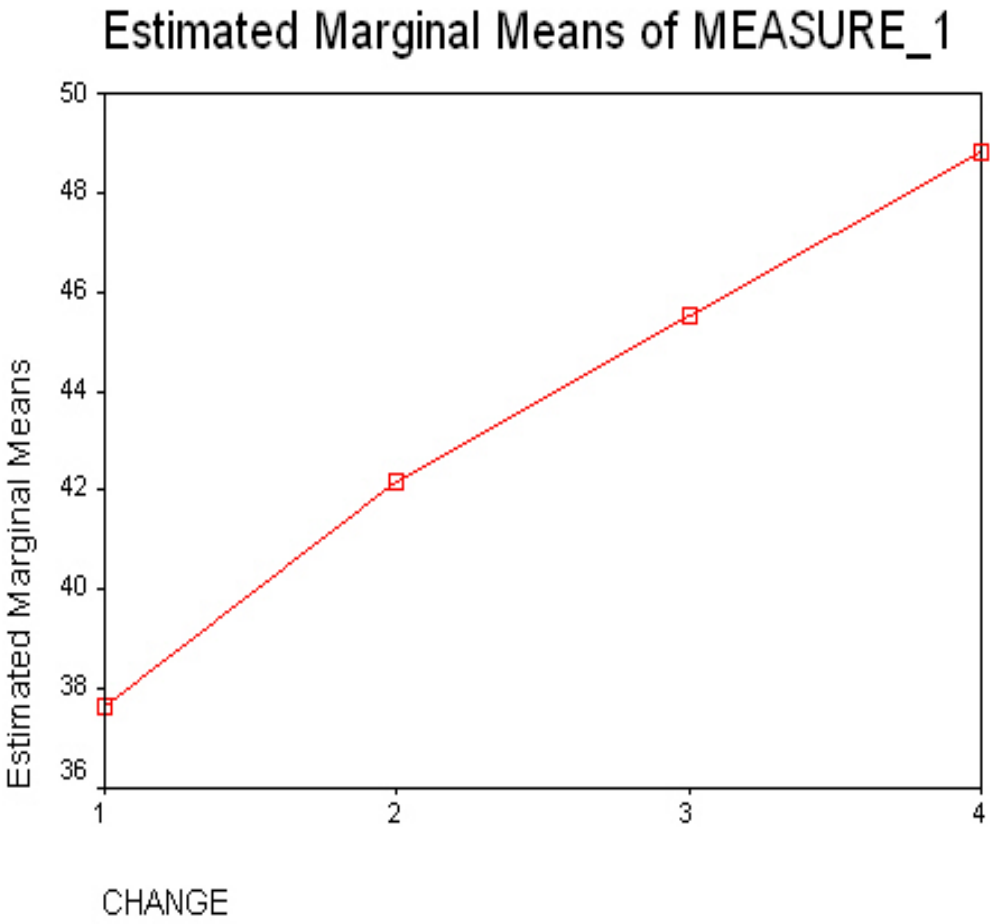

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
50
48
46
44
42
40
38
36
1
2
3
4
CHANGE

Table 6

Inter and Intra subject analysis of Rotation(Rt) CROM

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PRERT(R)	45.67	6.661	30
IMMRT(R)	50.13	5.888	30
HR24RT(R)	52.47	6.857	30
HR48RT(R)	56.30	6.513	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	1780.692	3	593.564	99.488	.000
Error(CHANGE)	519.058	87	5.966		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	313856.408	1	313856.408	2084.306	.000
Error	4366.842	29	150.581		

Results of the study shown significant improvement in ROTATION(RT) CROM, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

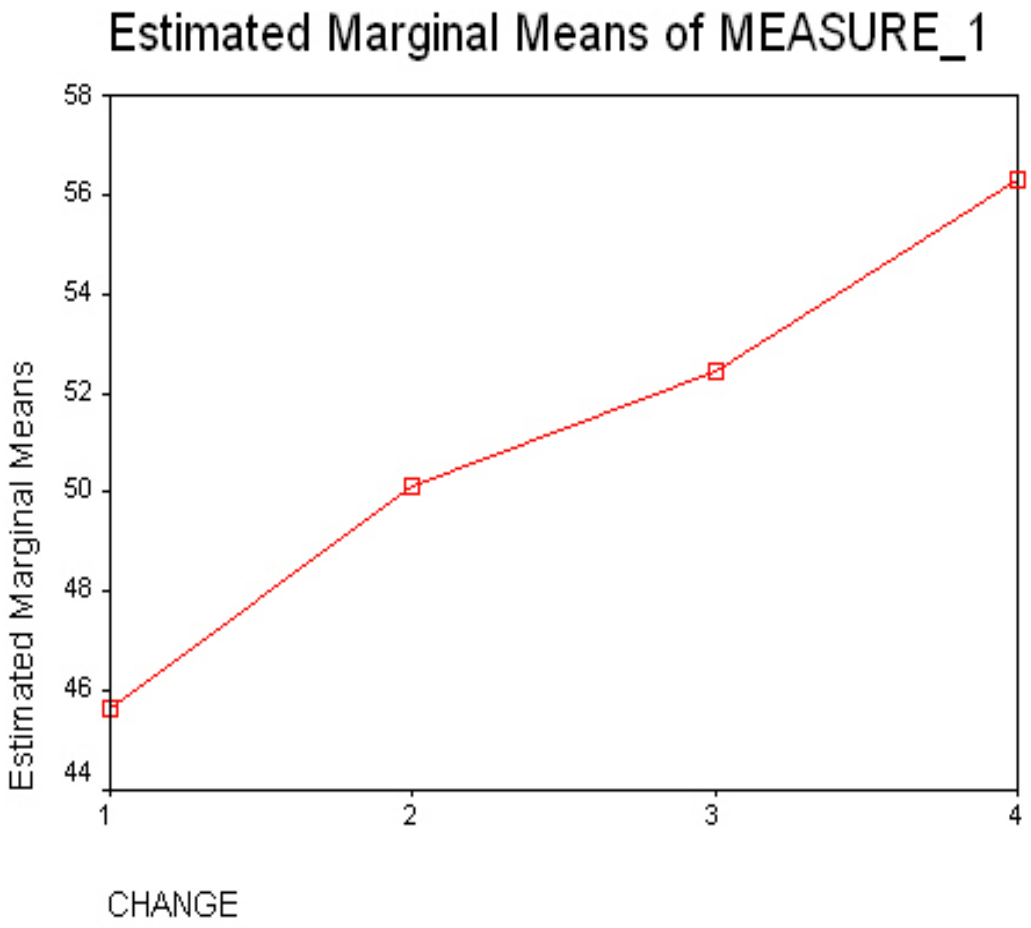

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
58
56
54
52
50
48
46
44
1
2
3
4
CHANGE

Table 7

Inter and Intra subject analysis of Rotation(Lt) CROM

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PRERT(L)	48.83	5.032	30
IMMRT(L)	52.67	5.222	30
HR24RT(L)	55.60	5.593	30
HR48RT(L)	58.63	4.860	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	1574.467	3	524.822	356.622	.000
Error(CHANGE)	128.033	87	1.472		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	349056.533	1	349056.533	3386.669	.000
Error	2988.967	29	103.068		

Results of the study shown significant improvement in ROTATION(LT) CROM, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

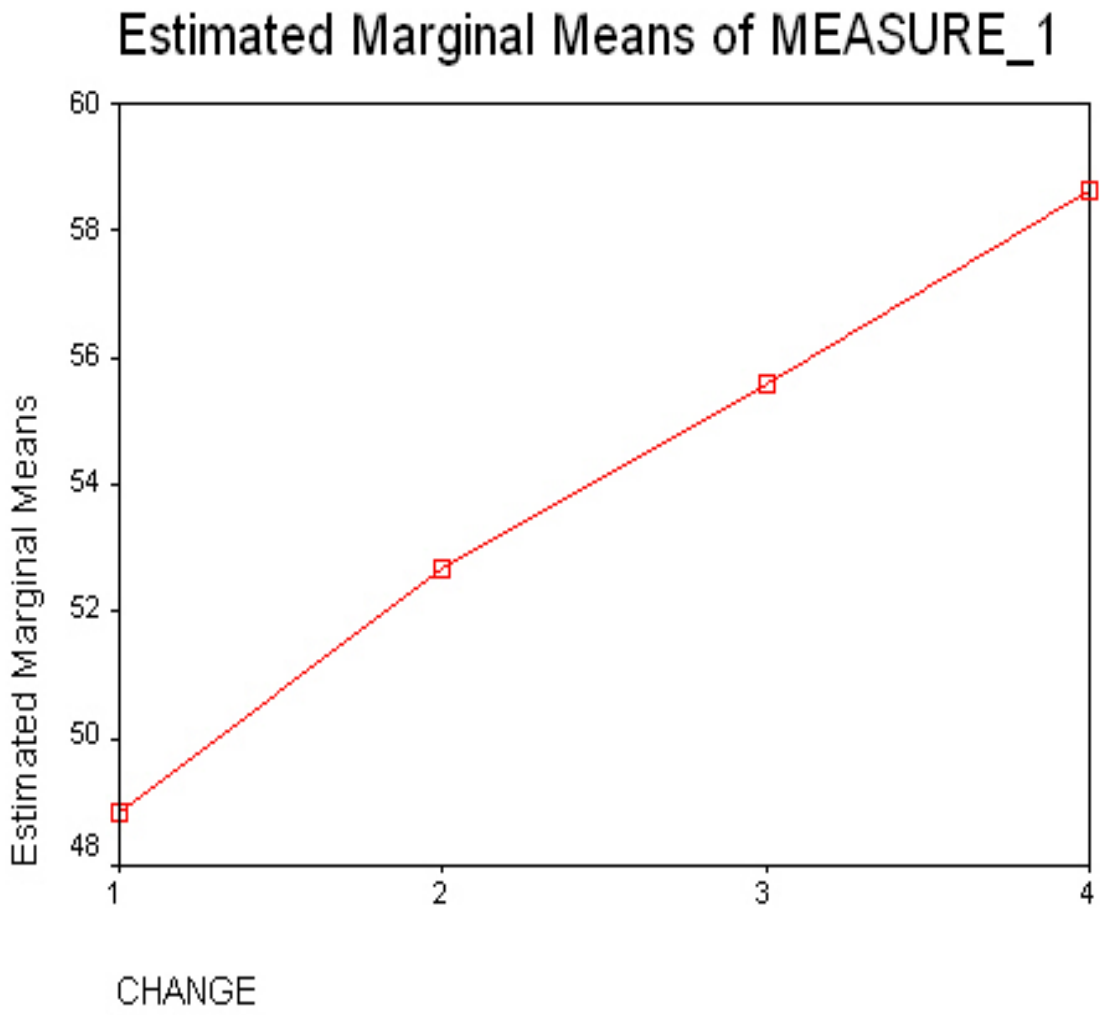

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
60
58
56
54
52
50
48
1
2
3
4
CHANGE

Table 8

Inter and Intra subject analysis of VAS

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PREVAS	7.13	.776	30
IMMVAS	5.33	.844	30
HR24VAS	3.63	1.033	30
HR48VAS	2.03	.964	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	433.800	3	144.600	480.160	.000
Error(CHANGE)	26.200	87	.301		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	2466.133	1	2466.133	1023.634	.000
Error	69.867	29	2.409		

Results of the study shown significant improvement in VAS, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).

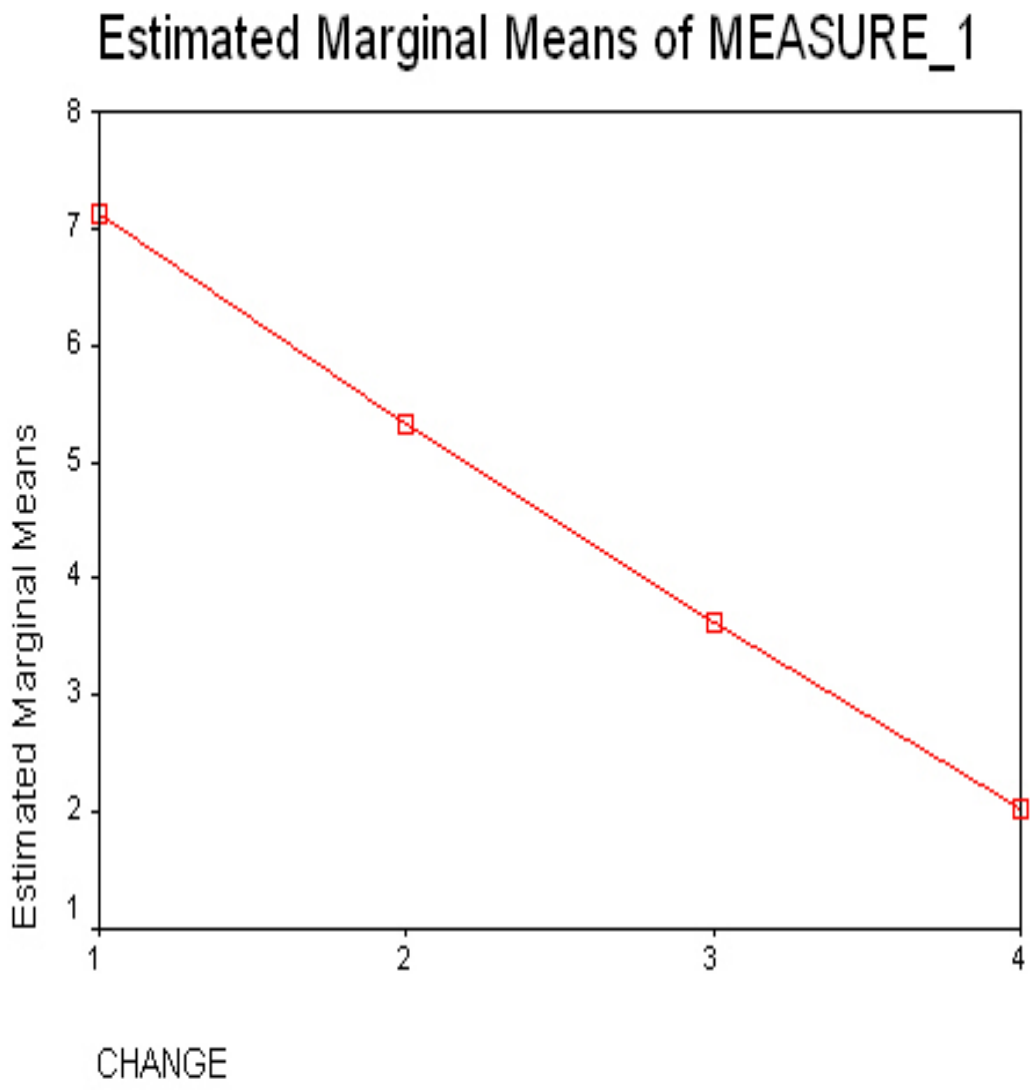

Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
8
7
6
5
4
3
2
1
1
2
3
4
CHANGE

Table 9

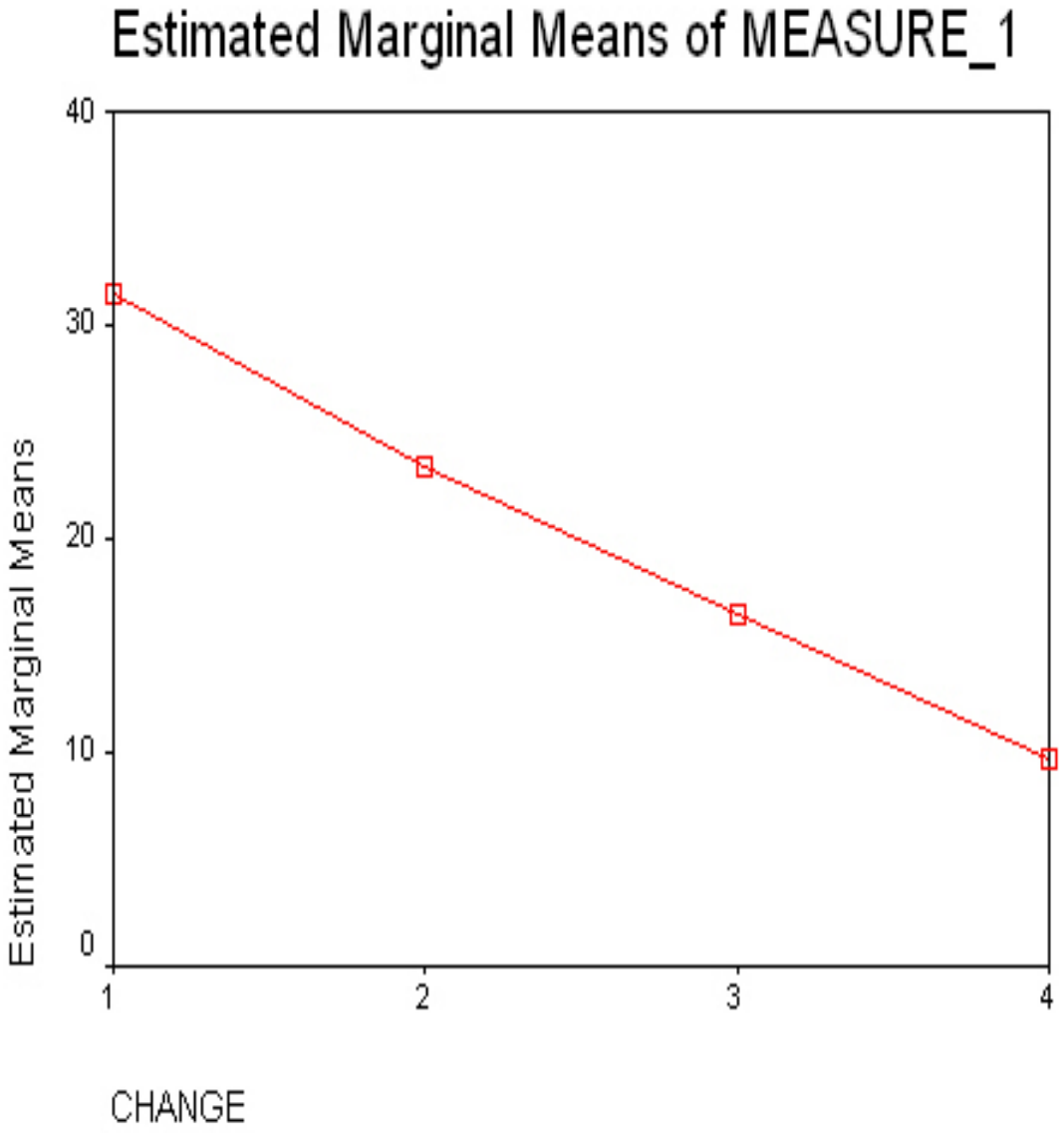
Inter and Intra subject analysis of NDI

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
PRENDI	31.47	7.114	30
IMMNDI	23.40	6.366	30
HR24NDI	16.53	4.703	30
HR48NDI	9.77	3.319	30

Tests of Within-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
CHANGE	7783.292	3	2594.431	313.077	.000
Error(CHANGE)	720.958	87	8.287		

Tests of Between-Subjects Effects					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	49410.208	1	49410.208	497.095	.000
Error	2882.542	29	99.398		

Results of the study shown significant improvement in NDI, with significant difference within the subject ($p<.000$) and also between the subjects effects ($p<.000$).


Estimated Marginal Means of MEASURE_1
Estimated Marginal Means
40
30
20
10
0
1
2
3
4
CHANGE

Discussion

The results of this study showed highly significant improvement in reducing the pain ($p<0.000$), improving range of motion of cervical spine with ($p<0.000$) and neck disability with ($p<0.000$) immediately, after MET application as well as 24 hours and 48 hours in subjects with MNP due to somatic dysfunction.

The term somatic dysfunction is defined as impaired or altered function of related components of the somatic system (body frame work): skeletal, arthrodial and myofacial structures, and related vascular, lymphatic and neural elements. Because of somatic dysfunction there will be enhanced imbalance of muscle occurs[15]. According to Smith et al (2009) in MNP due to somatic dysfunction there will be heightened activation of superficial muscle such as sternocleidomastoid, anterior scalene, upper trapezius, levator scapulae and pectoralis major and there will be inhibition of deep flexors of cervical and retractors of scapula leading to a syndrome called UPPER CROSS SYNDROME due to which there will be decrease in ROM of cervical spine[38].

According to Wang et al (2003) patients with with mechanical neck pain due to somatic dysfuntion present with bad posture resulting from shortening and increased activation of suboccipital, sternocleidomastoid, upper trapezius, pectoralis, and rotator cuff muscles[39]

In the present study on the basis on standardised criteria by Kenneth K Nelson we selected subjects with MNP due to somatic dysfunction and attempted to apply MET on the hyperactivating muscle.

Most of the shortened muscle included in study found higher activation of levator scapule and upper trapezius muscles, which correlate with Smith and Wang et al

study. Hence we applied MET on the hyperactivated muscle which showed significant improvement in ROM, decrease in pain and disability.

According to LEON CHAITOW MET is effective in reducing the symptoms and improving range on the basis of two mechanisms.

1. **Reflex muscle relaxation**- Here the muscle will be relaxed due to higher activation of golgi tendon organ and their inhibitory influence on motor neuron and also due to reciprocal inhibition produced by contraction of antagonist muscle due to post isometric contraction and relaxation mechanism applied in MET[40].

2. **Viscoelastic changes and stretched tolerance**- Visco-elasticity refers to the response of a connective tissue to load, a property of elastic and viscous components. The elastic component is the ability of the tissue to return to its previous form after deformation. The viscous component relates to the fluid part of the muscle, which deviates in response to mechanical forces.

According to Mc Hugh MP, Magnusson et al in MNP due to somatic dysfunction there will be pathophysiological changes in the viscoelastic properties of connective tissue where the viscous property increases and elastic property decreases due to prolonged shortening of the muscle. Passive static stretch is the generalized technique utilized in increasing the length of muscle[41].

According to Taylor et al passive stretching of shortened muscle stretches only the connective tissue elements arranged parallelly muscle fibres whereas by applying MET when stretched muscle is isometrically contracted, the contracting filament

places tension and stretches a series of connective tissue elements also creating more creep and plastic changes in connective tissue compared to passive stretch.

According to Magnusson SP et al and Halbertsma et al maximum creep and plastic changes in connective tissue happens due to its capability of greater stretch tolerance[42-45].

These above physiological effect of MET on the basis of reflex muscle relaxation and viscoelastic changes assisted in reducing muscle tension and helped in increasing ROM, the same effect even lasted upto 24 to 48 hrs.

According to Freyer G et al MET produces hypoalgesic effect, the mechanism by which MET produces hypoalgesic effect is by stimulating muscle and joint mechanoreceptors therby assisting the activation of peri aqueductal grey matter which help in descending modulation of pain[47].

In MET due to post isometric contraction and relaxation fluid flow movement occurs which in turn increases the drainage of fluid from interstitial spaces thereby assisting in reducing the concentration of Pro-inflammatory cytokines that helps in reducing the sensitization of peripheral nociceptors there by reducing pain[47].

These above mechanism correlate with the result of the present study where pain was decreased significantly ($p<0.0000$) and effect was maintained even at 24 and 48 hours.

Since there was Improvement in CROM and VAS due to the physiological effect of MET, the NDI also improved significantly ($p<0.0000$) and effect was maintained even at 24 and 48 hours.

Conclusion

The study concludes one time application of Muscle Energy Technique (Ruddy's approach) is efficient in alleviating symptoms of pain, increased ROM, and reduced disability of cervical spine and the effect was maintained and lasted for 24 to 48 hrs.

Summary

Neck disorders remain a common problem in modern industrialized countries. There is an irrefutable evidence suggesting association between mechanical neck pain & dysfunction of muscle around cervical spine. The term somatic dysfunction is defined as impaired or altered function of related components of the somatic system (body frame work): skeletal, arthrodial and myofacial structures, and related vascular, lymphatic and neural elements. Because of somatic dysfunction there will be enhanced imbalance of muscle, to overcome this muscle imbalance various physiotherapy technique are applied. Studies have shows that MET is more effective in neutralizing muscle imbalance compared to other techniques. But long lasting effect of one time MET intervention is not known. Hence the study was proposed to find out the SHORT TERM EFFECT OF MET ON INDIVIDUALS WITH MECHANICAL NECK PAIN DUE TO SOMATIC DYSFUNCTION.

In the present study on the basis on standardised criteria proposed by Kenneth K Nelson we selected 30 subjects with MNP due to somatic dysfunction. Musclular dysfunction around cervical spine was evaluated and detailed prettest measurments of CROM, VAS, and NDI was taken. MET intervention on the basis of Ruddy's approach was applied on the hyperactivated muscle (trapezius and levator scapulae) 4 time, with contraction maintained for 7 to 10 seconds and then relax for 3 to 5 seconds. Post intervention measurements were taken immediately, 24 hrs and 48 hrs. Results were statically analyzed using repeated measure ANOVA.

The results of this study showed highly significant improvement in reducing the pain ($p<0.000$), improving range of motion of cervical spine with ($p<0.000$) and neck disability with ($p<0.000$) at immediately, after MET application as well as 24 hours and 48 hours in subjects with MNP due to somatic dysfunction.

The study concludes one time application of Muscle Energy Technique (Ruddy's approach) is efficient in alleviating symptoms of pain, increased ROM, and reduced disability of cervical spine and the effect was maintained and lasted for 24 to 48 hrs.

LIMITATIONS

- Number of subjects taken in a study was low
- Quantification of the pressure applied by therapist on patient was not measured.
- Home exercise program was not advised.

RECOMMENDATIONS

- Further studies required to do the same on large number of subjects
- Further studies required to know short term effect of MET on dysfuntion around other joints.
- In the present study goniometer was used but it is less reliable compare to inclinometer, in future studies inclinometer can be used to check the ROM of cervical spine.
- The long term follow up can be performed which may lead to valuable results

Bibliography

1. Rekola K “Health services utilization for musculoskeletal disorders in Finnish primary health care”.1993, 259:53-59.
2. Cote P, Cassidy JD. The annual incidence and course of neck pain in the general population: a population-based cohort study. Pain 2004;112:267-273.
3. Cote P, Cassidy JD. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. Spine.1998:23:1689-1698.
4. Jull G, Sterling M, Falla D. Whiplash, Headache and Neck Pain: Research Based Direction for physical Therapies. Eidenburgh , UK: Elsevier; 2008.
5. Shaun O’Leary: “Muscle Dysfunction in Cervical spine pain: Implications for Assessment and Management”.2009 Volume 39:No.5, Journal of orthopaedic & sports Physical therapy.
6. Kendall FP, McCready EK, “Muscles: Testing and function, with posture and pain”, 2005.
7. Gurfinkel V, Cacciatore TW, “Postural muscle tones in the body axis of healthy humans” 2006:96:2678-2687.
8. Smith LK,Weiss El,,Lehmkuhi Ld,Brunnstorm’s clinical kinesiology,5th ed, Philadelphia:F.A.Davis 1996.
9. Falla DL, Jull GA, Hodges PW, Patients with neck pain demonstrate reduced electro myographic activity of deep cervical flexor muscles during performance of the craniocervical flexion test. Spine .2004;29:2108-2114.
10. Jull G, Amiri M, Bullock-Saxton J. Cervical musculoskeletal impairment in frequent intermittent headach. Part 1: Subjects with single headaches. Cephalagia. 2007;27:793-802.

11. Falla D, Bilenkij G, Jull G, patients with chronic neck pain demonstrate altered pattern of muscle activation during performance of a functional upper limb task. Spine.2004;29:1436-1440.
12. Andary MT, Hallgren RC, Greenman PE. Neurogenic atrophy of sub-occipital muscles after a cervical injury: a case study. Am J Phys Med Rehabil. 1998;77:545-549.
13. Elliott J, Jull G, Noteboom JT.fatty infiltration in cervical extensor muscles in persistant whiplash-associated disorders: a magnetic resonance imaging analysis. Spine. 2006;31:E847-855
14. KristjansonE. Reliability of ultrasonography for ervical multifidus muscle in assymptomatic and symptomatic subjects; Man Ther. 2004;9:83-88
15. Denis K Burns, Michael R. Wells "Gross ROM in cervical spine: The Effect of osteopathic MET in Asymptomatic subjects": JAOA, Vol.10, No.3, 2006:137-142.
16. Scott Dawkins, C.A. 1996. The Comparative Effectiveness of Adjustments versus Mobilization in Chronic Mechanical Neck pain. Master's Degree in Technology: Chiropractic, Durban Institute of Technology.
17. Mitchell FL Jr, Moran PS, Pruzzo NA. An evaluation and treatment manual of osteopathic muscle energy procedures. 1979, Institute for Continuing Education in Osteopathic Principles, Missouri.
18. Noelle M, Selkow: "Short term effect of muscle energy technique on pain in individuals with non-specific Lumbopelvic Pain:" *The journal of manual & manipulative Therapy 2009Volume.*
19. Grubb ER, Hagedorn EM, Inoue N. Muscle Energy. University of Kenucky, At 690, Spring 2010.

20. Berne, Robert M., Levy, Matthew N., Principles of Physiology, Second Edition, Mosby, 1996 Chaitow, Leon, Muscle Energy Techniques, Second Edition, Churchill Livingston, 2001.
21. Schnek R. The effects of muscle energy technique on cervical ROM. J Man Manip Ther 1994;2:149-155.
22. Schenk R. The effect of muscle energy technique on lumbar ROM. J Man Manip Ther 1997;5:179-183.
23. Freyer G, Ruszkowsi W. The influence of contraction duration in muscle energy Technique applied to atlanto – axial joint.J Osteopath Med. 2004;7:79-84.
24. CC Norkin, Pamela K. Levangie, "Joint Structure and function" 2nd edition.
25. Gupta S, Jaiswal, P.Chhabra, D. A comparative study between postisomertric relaxation and isometric exercises in non specific neck pain. Journal of exercise science and physiotherapy, Vol. 4 No. 2, 88-94, 2008.
26. Wojtek Ruszkowski, Gary A.Fryer B, Patrick Mc Laughlin. The effect of change to duration of isometric contraction in muscle energy technique to the upper cervical spine.
27. Boodhoo, V. 2002. The Efficacy of Muscle Energy Technique in the Treatment of 52 Chronic Mechanical Neck Pain. Master's Degree in Technology: Chiropractic, Durban Institute of Technology.
28. Patel Puja. 2003. Comparison of neuromuscular technique and a muscle energy technique on cervical range of motion. Undergraduate project, British College of Osteopathic Medicine
29. Maria Louisa Elizabeth Roodt 2009 .Comparative study of three different types of manual therapy techniques in the management of chronic mechanical

neck pain. Master's Degree in Technology: Chiropractic. Faculty of Health, Durban University of Technology.

30. Edward Brookes 2010. A randomized controlled experiment comparing functional technique with muscle energy technique.
31. F. Ghiasi, A. Akbari, M. Abed comparison of muscle energy techniques with ultrasound therapy in myofascial trigger point treatment in upper trapezius. Vol. 10, No. 5, 2008.
32. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther. 1991 Sep; 14(7):409-15.
33. Anne M Boonstra, Henrica R Schiphorst Preuper et al International Journal of Rehabilitation Research: June 2008 - Volume 31 - Issue 2 - pp 165-169 (2008)
34. James W Youdas, James R Carey and Tom R Garrett ,Reliability of Measurements of Cervical Spine Range of Motion—Comparison of Three Methods, Vol. 71, No. 2, February 1991, pp. 98-104
35. Somatic dysfunction in osteopathic family medicine, by KENNETH K NELSON American College of osteopathic family physician, (Page 12-14).
36. Measurement of joint motion. A guide to goniometry. Cynthia C. Norkin, D Joyce White. 2nd edition.
37. Leon Chaitow, Muscle energy techniques, second edition, advanced soft tissue techniques. Page 2-3 &122- 132.
38. Smith, M., Sparkes, V. (2009). Upper and lower trapezius muscle activity in subjects with subacromial impingement symptoms: Physical Therapy in Sport, 10 (2), 45-50.

39. Wang WTJ, Olson SL. Effectiveness of physical therapy for patients with neck pain: an individual approach using a clinical decision-making algorithm. Am J Phys Med Rehabil. 2003;82:203-18.

40. Kuchera WA, Kuchera ML 1992 Osteopatic Prinicipal in Practice.Missouri,Kirksville College of Osteopatic Medicine Press.

41. Mc Hugh MP, Magnusson SP.Viscoelastic stress relaxation in human skeletal muscle. Medicine and Science in sports and exercise.1992;24(12);1375-1382.

42. Magnusson SP, Aagaard P. A Biomechanical Evaluation of Cyclic and Static Stretch in Human Skeletal Muscle. International Journal of Sports Medicine 1998; 19: 310-316

43. Magnusson SP, Simonsen EB. A mechanism for altered flexibility in human skeletal muscle. Journal of Physiology. 1996; 497.1: 291-298

44. Halbertsma JP, Mulder I. Repeated Passive Stretching: Acute Effect on the Passive Muscle Moment and Extensibility of Short Hamstrings. Archives of Physical Medicine and Rehabilitation. 1999; April 80: 407-413

45. Halbertsma JP, Van Bolhuis AI. Sport Stretching: Effect on Passive Muscle Stiffness on Short Hamstrings. Archives of Physical Medicine and Rehabilitation. 1996; July 77: 688-692

46. Taylor DC, Brooks DE, Ryan JB 1997 Visco-elastic characteristics of muscle: passive stretching versus muscular contractions. Medicine & Science in Sports & Exercise,29(12):1619-1624!

47. Fryer G,Fossum C 2008. Therapeutic mechanism underlying muscle energy approaches. In physical therapy for tension type and cervicogenic headache: physical examination muscle and joint management.

Annexure

ANNEXURE I

CONSENT FORM

I.....hereby agree to provide my fullest consent and co-operation as a subject for the dissertation work of **MS. RASHMI.D** entitled **"SHORT TERM EFFECT OF MUSCLE ENERGY TECHNIQUE ON INDIVIDUALS WITH MECHANICAL NECK PAIN DUE TO SOMATIC DYSFUNCTION"** towards her post graduation in physiotherapy. The benefits and possible risks of the procedure and duration of the study have been explained to me. The questions and queries I have posed have been answered to my satisfaction and I am aware that I can discontinue the study at any time I wish to do so.

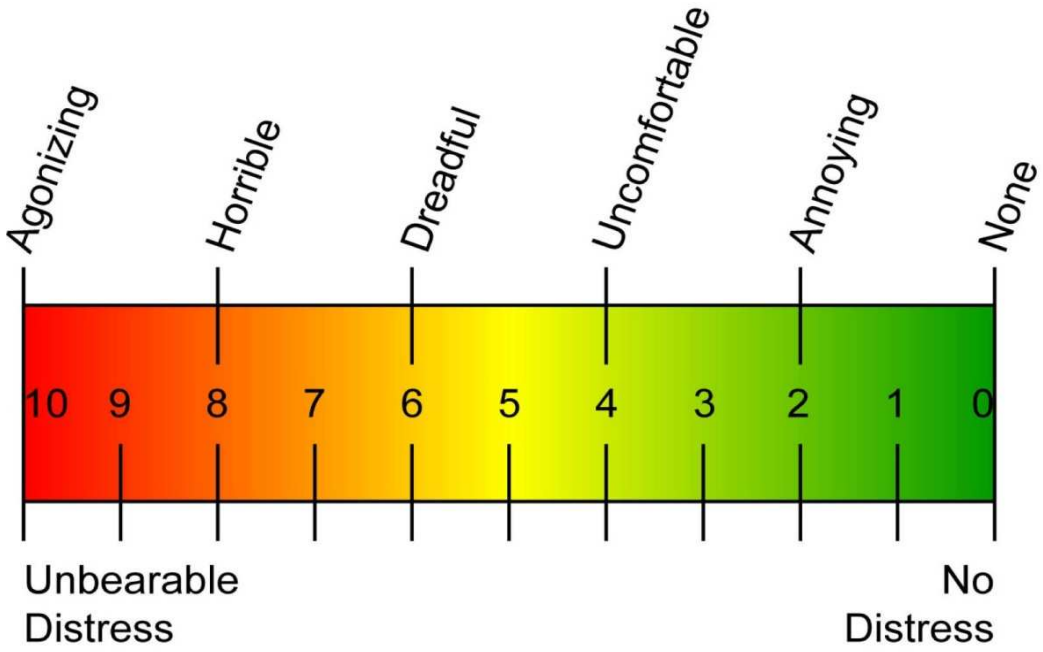
Place: **Signature of the participant**

Date:

ANNEXURE II

Visual Analogue Scale (VAS)

VAS attempts to represent measurement quantities/ intensity of pain in terms of a straight line that is believed to range across a continuum of values and cannot easily be directly measured. Operationally a VAS is usually a horizontal line, 100mm in length, anchored by word descriptors at each end.



ANNEXURE III

Neck Disability Index

This questionnaire has been designed to give us 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 that applies to you.** We realize you may consider that two or more statements in any one section relate to you, but please just mark the box that most closely describes your problem.

Section 1: Pain Intensity

£ I have no pain at the moment

£ The pain is very mild at the moment

£ The pain is moderate at the moment

£ The pain is fairly severe at the moment

£ The pain is very severe at the moment

£ The pain is the worst imaginable at the moment

Section 2: Personal Care (Washing, Dressing, etc.)

£ I can look after myself normally without causing extra pain

£ I can look after myself normally but it causes extra pain

£ It is painful to look after myself and I am slow and careful

£ I need some help but can manage most of my personal care

£ I need help every day in most aspects of self care

£ I do not get dressed, I wash with difficulty and stay in bed

Section 3: Lifting

£ I can lift heavy weights without extra pain

£ I can lift heavy weights but it gives extra pain

£ Pain prevents me lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table

£ Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned

£ I can only lift very light weights

£ I cannot lift or carry anything

Section 4: Reading

£ I can read as much as I want to with no pain in my neck

£ I can read as much as I want to with slight pain in my neck

£ I can read as much as I want with moderate pain in my neck

£ I can't read as much as I want because of moderate pain in my neck

£ I can hardly read at all because of severe pain in my neck

£ I cannot read at all

Section 5: Headaches

£ I have no headaches at all

£ I have slight headaches, which come infrequently

£ I have moderate headaches, which come infrequently

£ I have moderate headaches, which come frequently

£ I have severe headaches, which come frequently

£ I have headaches almost all the time

Section 6: Concentration

£ I can concentrate fully when I want to with no difficulty

£ I can concentrate fully when I want to with slight difficulty

£ I have a fair degree of difficulty in concentrating when I want to

£ I have a lot of difficulty in concentrating when I want to

£ I have a great deal of difficulty in concentrating when I want to

£ I cannot concentrate at all

Section 7: Work

£ I can do as much work as I want to

£ I can only do my usual work, but no more

£ I can do most of my usual work, but no more

£ I cannot do my usual work

£ I can hardly do any work at all

£ I can't do any work at all

Section 8: Driving

£ I can drive my car without any neck pain

£ I can drive my car as long as I want with slight pain in my neck

£ I can drive my car as long as I want with moderate pain in my neck

£ I can't drive my car as long as I want because of moderate pain in my neck

£ I can hardly drive at all because of severe pain in my neck

£ I can't drive my car at all

Section 9: Sleeping

£ I have no trouble sleeping

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

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

£ My sleep is moderately disturbed (2-3 hrs sleepless)

£ My sleep is greatly disturbed (3-5 hrs sleepless)

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

Section 10: Recreation

£ I am able to engage in all my recreation activities with no neck pain at all

£ I am able to engage in all my recreation activities, with some pain in my neck

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

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

£ I can hardly do any recreation activities because of pain in my neck

£ I can't do any recreation activities at all

Score: /50 Transform to percentage score x 100 = %points

Scoring: For each section the total possible score is 5: if the first statement is marked the section score = 0, if the last statement is marked it = 5. If all ten sections are completed the score is calculated as follows:

Example: 16 (total scored)

50 (total possible score) x 100 = 32%

If one section is missed or not applicable the score is calculated: 16 (total scored)

45 (total possible score) x 100 = 35.5%

Minimum Detectable Change (90% confidence): 5 points or 10 %points.

MASTER CHART

age	gender	preflex	immflex	hr24flex	hr48flex	preext	immext	hr24ext	hr48ext	preLF(R)	immLF(R)	hr24LF(R)	hr48LF(R)	preLF(L)	immLF(L)	hr24LF(L)	hr48LF(L)	preRT(R)	immRT(R	hr24RT(R	hr48RT(R)	preRT(L)	immRT(L)	hr24RT(L)	hr48RT(L)	preVAS	immVAS	hr24VAS	hr48VAS	preNDI	immNDI	hr24NDI	hr48NDI
29	M	35	40	42	44	40	45	42	44	35	40	44	45	35	40	44	45	40	44	45	45	50	55	58	60	8	6	4	3	30	18	14	8
35	M	30	33	35	35	30	35	38	40	25	28	30	35	25	30	33	35	25	38	45	45	45	48	50	55	7	6	5	4	25	21	15	6
30	F	40	45	48	50	30	33	35	38	30	34	35	40	35	38	40	44	40	45	48	50	45	48	52	55	7	6	5	3	28	21	14	9
26	M	35	38	42	44	30	35	38	40	35	40	45	50	35	40	44	45	40	42	44	45	40	44	45	50	8	6	4	2	38	25	16	10
25	M	40	44	48	50	35	40	42	45	30	34	40	45	25	30	38	40	45	50	55	60	50	55	58	60	7	6	4	3	30	25	20	16
33	F	30	35	38	45	30	35	40	44	35	40	48	54	35	40	44	50	45	50	55	60	45	50	55	60	8	7	5	3	40	35	28	15
34	M	35	40	44	45	30	35	38	40	30	35	38	40	30	33	35	40	45	50	54	60	40	44	45	50	8	6	4	2	45	38	22	11
35	F	40	44	45	50	35	38	40	44	35	38	40	45	35	38	40	45	55	58	60	65	50	54	55	60	7	5	3	3	23	18	11	6
30	F	40	44	45	50	35	40	44	45	40	45	48	50	40	45	48	50	50	54	55	55	50	52	55	55	6	5	4	2	25	21	16	8
26	M	35	40	44	45	40	44	45	50	40	40	45	50	45	48	50	50	45	48	50	55	40	44	48	50	7	5	3	1	23	19	12	10
38	F	30	35	40	45	30	35	40	45	35	38	40	45	35	40	42	45	50	54	55	60	55	58	60	60	8	7	6	4	46	35	22	14
30	F	25	30	32	35	20	25	30	35	30	33	38	40	30	35	38	40	40	44	45	50	50	52	55	60	7	5	3	2	37	28	19	12
25	M	35	38	40	45	20	25	30	35	30	35	40	45	35	40	42	45	45	50	35	60	55	60	64	65	6	5	3	2	31	24	18	10
26	F	30	35	40	45	30	35	40	45	35	40	45	50	45	48	50	55	50	55	58	60	55	53	60	60	6	5	4	2	36	32	27	14
40	F	40	42	45	50	35	38	40	45	35	38	40	43	35	38	40	45	55	57	60	65	50	55	58	60	6	4	2	1	18	15	12	9
45	F	25	30	35	40	25	30	33	35	35	40	45	50	35	40	45	50	35	38	40	45	40	42	45	50	8	6	6	4	44	33	24	18
40	F	30	35	38	40	25	30	35	40	30	35	40	45	30	35	38	40	45	48	50	55	45	48	50	55	8	6	4	2	28	16	14	10
35	F	35	40	42	44	30	35	38	40	40	44	45	50	40	44	45	50	45	50	52	55	45	50	52	55	7	5	3	1	30	21	18	6
33	F	30	35	40	45	25	30	32	35	35	38	45	45	30	35	38	40	40	44	45	50	45	48	50	55	7	4	3	2	32	22	15	8
26	F	40	44	45	50	38	40	44	45	40	45	48	50	40	45	48	50	50	52	55	60	55	58	60	65	6	4	3	1	30	22	15	9
38	M	35	40	44	45	35	40	44	45	40	45	48	50	45	48	50	55	45	50	54	55	50	55	58	60	8	6	3	1	35	22	12	6
25	M	40	45	50	50	30	35	40	45	45	50	54	60	45	50	55	60	50	55	58	60	55	60	62	65	7	5	4	2	28	21	15	10
37	M	35	40	45	50	35	40	45	50	45	50	55	60	45	50	55	60	50	55	58	60	50	55	58	60	6	4	2	1	25	15	10	5
26	F	40	45	48	50	35	40	44	50	40	44	50	55	45	50	55	60	50	55	60	65	55	60	62	65	7	5	3	2	37	24	19	11
28	F	35	40	42	45	35	40	42	45	45	50	55	60	45	50	55	60	55	60	64	65	55	60	65	65	8	6	4	2	40	33	21	14
25	M	25	30	35	40	30	35	40	45	30	35	40	45	40	45	50	55	40	45	50	50	50	55	60	65	7	5	4	2	28	21	16	8
40	M	35	40	45	50	45	50	56	60	45	50	52	55	55	60	63	65	50	55	58	60	50	54	58	60	7	5	3	1	28	20	12	7
27	F	40	45	48	50	45	50	53	55	40	45	48	50	40	45	49	50	55	58	60	64	55	58	60	64	8	6	3	1	33	21	14	6
29	M	30	35	38	40	30	35	38	40	40	45	48	50	35	40	44	45	40	45	48	50	45	50	52	55	6	4	2	1	21	15	10	7
29	F	35	40	42	45	40	45	48	50	40	45	48	50	40	45	48	50	50	55	58	60	50	55	58	60	8	5	3	1	30	21	15	10