EFFICACY OF SPINAL MANIPULATION ON POSTURAL INSTABILITY AND QUALITY OF LIFE IN PATIENTS WITH CHRONIC NON SPECIFIC LOW BACK PAIN

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DECLARATION

I,**KANCHAN KUMAR SARKER**, student of Ph.D. (Regular) under the Department of Physiotherapy of Lovely Professional University, Punjab, hereby declare that the thesis entitled **"Efficacy of spinal manipulation on postural instability and quality of life in patients with chronic non-specific low back pain"** has been prepared by me under the guidance of **Professor (Dr.) Umasankar Mohanty** , Department of Manual Therapy, Manual Therapy Foundation of India and **Professor (Dr.) Jasobanta Sethi**, Department of Physiotherapy, Amity University. No part of this thesis has formed the basis for the award of any degree or fellowship previously.

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ABSTRACT

Background: Chronic non-specific low back pain (CNSLBP) is one of the most common disorders, which signifies great trouble in modern civilization. It often results in abridged health-related quality of life (HRQOL) and significant medical expense. About 85% of the population will experience LBP at some point in their life. Numerous conventional treatments have been revealed to be useful in the treatment of CNSLBP, including different forms of exercises and spinal manipulation(SM). There is evidence that postural instability is found in patients with CNSLBP.

Aim: To determine the efficiency of spinal manipulation (high-velocity low amplitude thrust-HVLA-thrust) on postural instability and HRQOL, pain intensity and sensitivity in patients among CNSLBP.

Material and methods: This study used experimental design; single-blinded, parallel randomized a clinical trial which was performed on a sample size of 198 participants with CNSLBP (with the duration of pain for more than three months) recruited and conducted in August 2015 and completed in January 2018 from Outpatient Department, Dept. of Physiotherapy, Lovely Professional University, Jalandhar-Delhi G.T Road, Phagwara, Punjab, India and allocated to three groups of 66 each for the study. Study group-1 received supervised exercise therapy (SET); study group-2 received spinal manipulation (SM); study group-3, received core stability exercise (CSE) and all the three groups were provided with ergonomic advice. The outcome measures were postural instability (average centre of foot pressure) using Win-Track Platform, pain intensity using numeric pain rating scale (NPRS), pain sensitivity using digital algometer (pressure pain threshold) and HRQOL using EuroQoL questionnaire scores (EQ-5D-5L) at after 2 weeks of intervention and follow-up after 4 weeks. Two-way ANOVA with post-hoc Bonferroni multiple comparison tests was performed to determine outcomes of treatment and the changes in different groups across outcome measures at baseline, after two weeks of intervention and follow-up after four weeks respectively.

Result: Out of 198 patients, 87% were followed-up at 2 weeks after intervention and 83% after 4 weeks. The intra-group analysis revealed that study group-1 treatment protocol, showed no significant progress (ACOFP, η^2=.01, p>0.05; NPRS, η^2=.09, p>0.05; PPT, η^2=.06, p>0.05; HRQOL, η^2=.05, p>0.05); whereas study group-2 and 3 groups treatment protocols, showed significant improvement (p<0.05) but study group-2 (SM-HVLA thrust) was successful in significantly improving postural instability, HRQOL, pain intensity and sensitivity. Inter-group analysis, for all 3 intervention groups, outcomes improved after 2 weeks of treatment. The group received SM-HVLA thrust with ergonomic advice had a slightly better outcome than the SET and CSE at two weeks of intervention (inter-group difference in postural instability: η^2=.93, p=0.001); HRQOL: η^2=.94, p=0.001); PPT: η^2=.93, p=0.001; NPRS: η^2=.91, p=0.041) as well as after 4 weeks follow-up (inter-group difference: postural instability : η^2=.93, p=0.001; HRQOL: η^2=.94, p=0.003; PPT: η^2=.94, p=0.001; NPRS: η^2=.94, p=0.002).

Conclusion: For CNSLBP, spinal manipulation with ergonomic advice was more efficient and effective intervention than core stability exercise and supervised exercise therapy with ergonomic in relieving pain, improving postural instability and HRQOL in patients among CNSLBP. Hence spinal manipulation should be tried on patients with CNSLBP in comparison to other treatments like CSE and SET.

Keywords: Chronic non-specific low back pain, high-velocity low amplitude, spinal manipulation, core stability exercise, supervised exercise therapy

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LIST OF ABBREVIATIONS

CNSLBP	Chronic non-specific low back pain
LBP	Low back pain
ACOFP	Average center of foot pressure
PPT	Pressure pain threshold
NPRS	Numeric pain rating scale
CG	Control group
SG	Study group
SD	Standard deviation
M	Mean
EMG	Electromyography
SM	Spinal manipulation
HVLA	High-velocity low amplitude
Ant.	Anterior
Post.	Posterior
Rot.	Rotation
Lat.	Lateral
Rep.	Repetition
Wk	Week

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CHAPTER 1

INTRODUCTION

1.1 Background

Low back pain (LBP) is commonly explicated as pain, muscle tension or stiffness confined above the inferior gluteal folds and under the costal margin with or without leg pain (sciatica). LBP is predictably categorized as being “specific” or “non-specific.” Specific LBP makes mention of symptoms as an effect of a specific pathophysiologic mechanism, for example, infection, osteoporosis, fracture, hernia nucleus pulposus, inflammation, rheumatoid arthritis or a tumor. Approximately 11% of the patients might specific underlying conditions diagnosed (Ian D et al., 2018). Most of the patients (up to 89%) are categorized as having non-specific LBP, which is described as symptoms lack of clear specific reasons, i.e. starting of an LBP is unknown (Balague et al., 2012; Itz et al., 2013).

CNSLBP is generally categorized depending on the duration as acute (less than 6 wks), sub-acute (6 to 12 wks) and chronic (more than 12 wks) (Frymoyer JW, 1988). In preferred, the prediction is ideal and maximum patients among a period of non-specific LBP will get better in a few weeks. But, LBP along with patients of primary care is often a persistence difficulty among unpredictable symptoms. The maximum number of LBP patients may have skilled in an earlier period and acute aggravation of chronic low back pain is not unusual (Itz et al., 2013; Office of the Army Surgeon General (Washington et al., 2010).

Global surveys of low backache reported that one-month occurrence was 20-44% and point incidence was 16-32%. The anticipated intercontinental lifetime incidence of low backache fluctuate from 55% to 84% (Badley et al., 2010) and in India, surveys reported that the period of the one-month prevalence of LBP among women was 42% and men were 58% (Ahdhi et al., 2016). Researches in advanced countries have revealed that the low backache point occurrence was 12% in Sweden,14.7% in Denmark, 14.2% in the United Kingdom, 6.7% in North America, 35% in Belgium, and 28.6% in Canada.

Similarly, a number of researches in developing countries have discovered a much superior rate of 73.4% in Nigeria, 65% in China, and 55.2% in Thailand (Hoy et al., 2010). The occurrence of LBP in India is also alarming with nearly 60% of the people in India have suffered from LBP at some time during their lifespan (Koley et al., 2009) LBP also inhabits mobility, hamper among regular functioning and outcome in lifelong pain and permanent disability (Koley et al., 2010, Ramdas, 2018). In India, most of the low-income group people are connected in physically challenging jobs which might increase the danger of LBP and disability. LBP impacts man and woman in addition, with onset most usually among ages of 30 to 55 years (Sharma SC et al., 2003). LBP also affects HRQOL of not only the women themselves but their families as well (Nidhi et al., 2013.

Researcher included people of 12826, men and women aged between 18 to 60 years. Approximately half of the replying (48.3%, of whom 44.6% men and 53.5% women) said the low back pain inside the preceding 12 months. Higher than 41% of the replying proclaimed that the period lasted for greater than 3 months (8 %) or that the lower backache changed into constantly present (33%). CNSLBP was additional widespread along with a woman (21%) then man (19%) and enhanced among ages from 13% at 18 to 29 years of age to 26 % at the age between 48 to 60 years (Hoy et al., 2010).

In common, the termination from those incidence approximates were fairly comprehensible: CNSLBP was a universal disorder in developing countries and it was increased day by day in developing country like India. The approximate of prevalence could fluctuate due to variations of national, age or gender of the peoples and sampling technique utilized. Numerous epidemiological researches had been carried out comparing the association between danger issues and incidence of CNSLBP. Normally changeable related to CNSLBP was categorized as isolated, occupational and psychosocial reasons. Risk factors are reviewed in Table 1.

Table 1.1 Risk reasons for occurrence and chronicity

	Occurrence	Chronicity
Individual reasons (Leboeuf-Yde C et al., 1999; Leboeuf-Yde C et al.,1996; Hoogendoorn WE., 1999)	Age	Obesity
	Physical fitness	Level of lower education
	Strength of abdominal and back muscles	Higher levels of disability and pain
	Smoking	
Psychological reasons (Andersson GBJ., 1997; Hoogendoorn WE et al., 2000; Linton SJ, 2000)	Stress	Distress
	Anxiety	Depressive mood
	Mood/emotions	Somatization
	Cognitive functioning	
	Pain behavior	
Job-related reasons (Bongers PM et al., 1993, Linton SJ, 2001)	Manual material handing	Job dissatisfaction
	Bending and twisting	Unavailability of light duties on go back to workplace
	Whole-body vibration	Job obligation of lifting for three quarters of the day
	Job disappointment	
	Repetitive tasks	
	Work relations/social support control	

Numerous numbers of researchers had used an easy biomechanical version to suggest that stimulation of one or a number of peripheral nociceptors serves as the primary agent (or agents) for pain. A greater synchronous and complete view posits that the interaction among biologic, psychologic, and social elements engage in pain era and modulation (Seiler S et al., 2006). A multivariate view of the pain incident directly links one or several biomechanical or physiologic reasons to the sort of conditions of low back pain conditions. It was not coherent which came first-pain or alters in biomechanics and motor control of movement. It has been shown, such as, that precipitated pain can cause

motor control dysfunction just like clinically reported LBP (Keele KD, 1983). The evaluation, others have proven that deficits in motor control manage can lead to poor control of joint motion, repetitive microtrauma, and pain (Panjabi MM, 2003).

For many years, postural instability has served as a diagnostic criterion to identify lower back pain. One of the first studies in 1944 used functional radiographs to relate lower back pain to retrodisplacement of vertebrae throughout trunk flexion (Lawrence JS, 1969). The lack of a causal link among low back pain and postural instability are most likelihood due to (1) variability within the voluntary efforts of patients to provide spinal movement (in the incidence of pain), (2) the existence of pain and muscle spasm at some point of the radiographic examination, (3) deficiency of suitable controls matched for age and gender, and (4) the restricted truthfulness of Vivo approach to measuring movement. The instability-pain the hypothesis implies that a person with LBP has a biomechanical dysfunction in their lumbopelvic segment, which in some way hyperlinks to their pain symptoms (Klein GN et al., 2001).

Evidence recommended that psychosocial elements were essential inside the alteration from acute to chronic LBP of acute to chronic and disability (Linton SJ, 2000). A systematic overview of potential cohort review located that a few psychological factors (somatization, depressive mood, and distress) were related to multiplying threat of chronic low backache (Pincus T et al., 2002). Person and workplace of job factors, which includes job disappointment, level of low education, excessive stages of disability and pain, had additional been suggested to be related to the alteration to CNSLBP (Cats-Baril WL et al, 1991; Gatchel RJ et al, 1995).

Potential cohort research determined that intense leg ache, functional disability, obesity, low well-known health reputation, inaccessibility of light obligations on come again to the workplace and necessity of a job of exciting for $^{3}/_{4}$ of the day or greater have been connected among the alteration from acute to chronic of work-related LBP. Job disappointment or lowest place of work associations had been not related to chronic low backache (Fransen M et al, 2002). Any more potentials cohort research of 298 employees recognized analytical issues for going back to work of employees among 4–5 months

illness disappear because of low backache. Danger issues covered low stander health condition, lower job satisfaction, no longer being a worker, decrease age and better pain intensity. The writers accomplished that psychosocial factors of health and work in aggregate among financial elements have a notably better impact on going back to the workplace when evaluated to particularly extra physical factors of physical and disability necessities of the job (van der Giezen AM et al,. 2000).

Postural instability through itself isn't always painful and subjects among clear radiological signs and symptoms of instability might be absolutely innocent of the situation. Though, an unbalanced section created the spine additional risk to trauma; a forced and careless motion can be determined on the hyper-mobile section and convey dislocation of the posterior disc. Repetitive accidents might additionally be produced chronic pain of posterior structures which include zygapophyseal joints and ligaments. Shifting of a vertebra posterior or anterior can also slim the lateral recess to this kind of degree that the individual nerve roots turn out to be compressed. Postural instability isn't constantly a painful situation but might also predispose to minor lesions: recurrent discodural interactions and ligamentous sprain. White and Panjabi produced a checklist to record postural instability that included biomechanical considerations, neurologic damage or not and predicted spinal loading Table 2. Each item on the checklist associated with a point value and a total score of five or higher point out the presence of clinical postural instability (White AA et al,. 2000).

Table 1.2: Diagnostic checklists for Postural instability in the lumbar spine

Elements	Point value
Ant. elements damaged or incapable to task	2
Post. element damaged or incapable to task	2
Radiological criteria	4
Flex.-ext. radiographs	
Sagittal plane translation more than 5.5 mm or 15%	2
Sagittal plane rot. 15 degrees at L1-2, L2-3, and L3-4 20 degrees at L4-5 25 degrees at L5-S1	 2 2
Resting radiographs	
Sagittal plane displacement more than 5.5 mm or 15%	2
Relation sagittal plane annulations more than 22 degrees	2
Cauda equine injure	3
Risky loading predictable	1

A hyper-mobile section might additionally be predisposed to chronic disc dislocations main to persistent or chronic discodural connections. Pain arises not from the instability of the section itself however from the instability of a fragment of disc lying inside it. The standard data is generally chronic back pain, which starts both unexpectedly or steps by step relying on the stability of the reallocation fragment ('nuclear' or 'annular') (dural perception). There were stretches of a backache some instance 12 months and the various attacks, the affected person was matched and the back was no pain. But, the slightest unexpected motion or unexploited posture ends in a new discal shift ensuing in a changed discodural interplay and pain. It is apparent that during this situation management ought to no longer completely be addressed to the lessening of the dislocated fragment of the disc; however, that is also the management of the instability needs to be acknowledged (Kramer J, 1981).

Postural ligamentous pain appears, at the same time as ordinary ligaments were subjected to ordinary mechanical stresses (Ligamentous conception). This will rise up during the disorder level: a few losses of turgor in the disc and the decreasing in inter-vertebral joint space reason a few laxities of the stage and an increase of the neutral zone. The facet joints override with the higher articular approaches sliding downwards over the lower. The joints undertake the extension position and the posterior capsules turn out to be the excess stretch. As instability progressed, additional tension was required on the ligaments and the facet joint capsules, leading to additional postural ligamentous ache. The patient was mostly a young grownup, complaining of spread back pain, among bilateral radiation or no longer above the lower back and the sacroiliac joints. The pain normally initiated after maintaining a specific position for a long time and the intensity of the pain depended on the duration of the position. With the aid of contrast, there may be really no pain at some stage in activity or sports activities and all lumbar moves were unfastened (Dorwart RH et al., 1983).

On the maximum easy stage, instability was a lack of stability, a situation in which a small load motives an inordinately huge, probably catastrophic disarticulation (Pope MH and Panjabi M, 1985). This was additionally the outline specified by the American Academy of Orthopaedic Surgeons who states: 'Postural instability is an irregular response to implemented masses, characterized by using movement in movement sections beyond ordinary constraints (AAOS, 1985).

A biomechanical point of description of postural instability, the use of a 'neutral zone' thought has been recommended by Panjabi. The neutral zone idea was based on the commentary that the total range of movement of a spinal motion segment can consist of two zones: an elastic zone and a neutral zone (Panjabi MM, 1992). The neutral zone was the initial segment of the range of motion at some point which spinal movement was formed against minimum inner resistance. The elastic part of the range of movement (ROM) is the segment closer to the end ROM that is formed in opposition to great inner resistance.

Postural instability is hence described as reducing in inside of the capacity of the spinal stabilization system to sustain the spinal neutral zone within the physiological limits with the intention to save neurological insufficiency, most important unbearable and/or deformity pain (Panjabi MM et al., 1994). The clinical definition of postural instability is: 'a situation wherein the clinical category of a patient among low back evils evolves, among the least irritation, from the mildly symptomatic to the excessive period (Kirkaldy-Willis WH and Farfan HF, 1982).

In the previous research stated that numerous interventions for CNSLBP have been attempted by means of various stages for achievement testing the clinician's knowledge of the most suitable technique of managing CNSCLBP. Interventions choice options contain strengthening, stretching, physical agents, traction, stabilization exercise, general exercise, aerobic exercise, manipulation therapy and various forms of mobilization. Several reviews had been done in current years to determine the effectiveness of this treatment (Delitto A, 2005). Numerous currently published RCTs fail to make out particular sub-populations among CNSLBP and this might cooperate the capacity of these research to discover effective interventions (Delitto A, 2005) In an effort to deal among the various ambiguities surrounding the assessment and intervention of CNSLBP, examiners have produced and examined scientific prediction policies to discover sub-groups of CNSLBP patients which can reply positively to particular treatments.

So far, numerous category systems and scientific prediction policies were developed among changeable stages of achievement. A scientific prediction regulation was developed and verified for verifying a sub-population that would react positively to a widespread SM (Flynn T et al., 2002; Childs JD et al., 2004). A first-round scientific prediction regulation for instability has additionally been advanced but has not yet been clarified prospectively (Hicks G et al., 2005). There may be a task for every treatment to play in almost all of the scientific causing systems and one intervention that might be carried out in each system and has been validated to be efficient among intervention is manipulation (Delitto A et al., 1995; DeRosa CP et al., 1992).

Biomechanics is the science worried about these forces and their effects when the system of interest is a biologic system (e.g., a human being, an animal, a plant) instead of an inanimate system (e.g., a bridge, a machine). Consequently, the mechanics of SM involved with internal and external forces produced all through treatments and the mechanical outcomes (i.e., movements) they produce (Adams and Wood, 1984). The external forces exerted by the physiotherapist on patients surely elicit measurable responses. These responses may be separated into mechanical, neuromuscular, and physiologic responses. In the following selected responses (Adams A and Wood J, 1984). First, the mechanical responses that consist of the movements of vertebral bodies as a role of the treatment forces and the responses associated with force transmission through internal systems which include the discs and spinal ligaments. Second, the neuromuscular reflex responses that accompany spinal manipulative management. Third, the physiologic responses that include the audible launch are covered. While discussing those diverse responses, it must be kept in thoughts that the beneficial effects of spinal manipulative treatments are probably associated among one or more (or possibly an intricate combination of several) of these responses (Triano JJ, 1992; Hessel BW, 1990).

It has been put forward that the thrust like forces fabricated at a few stages in excessive-speed, low-amplitude treatments obtain reflex responses which in twist can also influence spinal fitness in a diffusion of approaches: inhibition of reflex in spastic muscles, decreasing of pain and temporary activation of reflex in skeletal muscles of the back to name however among the possibilities (Raftis KL and Warfield CA, 1989; Zusman M, 1986).

In theory, the reflex responses (or inhibitions) can be obtained since a selection of receptors, as well as the diverse mechanoreceptors within spinal facet joints capsule, cutaneous receptors, proprioceptors and the nociceptors of skeletal muscles: Golgi tendon organs and the muscle spindles. This type of pathways and the spindle reflex pathway. Stretch of the muscles, and for this reason, the muscles spindle gives to increase to signals within the pathways of the afferent spindle. These indicators go into the spinal column via the dorsal roots. Inter-neuronal relations permit for transmission of those

alerts to different spinal levels and to the motor neurons, the pathway of efferent to the motor units of the skeletal muscles that generate reduction (Suter E et al., 1995).

In general, reflex pathways are excitatory or inhibitory for particular muscles; that is, they normally tend to lessen or discontinue muscular contraction and force creation, or they have a tendency to growth or provoke reduction and pressure creation, correspondingly. The reflex movement from a particular pathway may be excitatory or inhibitory for particular muscles, relying on the assignment. As Golgi tendon activity is inhibitory to the host muscle for isometric contractions; however shows to be excitatory for a confident stage of the step cycle in locomotion (Pearson KG, 1993).

Physiological effects produced during spinal manipulation which articular noise and audible release have usually accompanied manipulation treatments, and they have stimulated the creativeness of physiotherapy researchers for decades. Medical evidence shows that the audible release is associated with the cavitations of spinal facet joints; however, this affiliation could not be confirmed scientifically so far. Force and sound (or acceleration) measurements whilst distracting human metacarpophalangeal joints have supplied fantastic insight into the mechanics of joint cavitations (Sandoz R, 1969).

Stabilization of the lumbar spine was a complex issue. The study of neurophysiological biomechanical models when it relates to postural stability has developed as primary research awareness inside the persevering with seeks towards knowledge the factors that contribute and treatment of low backache. This research explores a hyperlink between back pain and lumbopelvic stabilization and considers the function of the muscular tissues worried with spinal stabilization. Via such attention, a number of the directions of CSE for the intervention of the CNSLBP patient are established (O'Sullivan PB et al., 1998).

Janda V *et al.,* 1978 determined a link between excessive neutral zone motion and pain, the impact of external fixation of the cervical segment changed into evaluated. This approach is used clinically to evaluate the effect of fixation at the possibly manage of spinal pain as a prognostic indicator for treatment by means of spinal fusion. Whilst the approach was carried to cadaveric cervical spine specimens, the movement parameter

that reduced the maximum was the neutral zone (71 %, compared to a 38% reduction in the total range of movement). This data of the sensitivity of an enhancement in the neutral zone relating to postural instability has caused to the latest definition of postural instability: A significant reduction in the stabilization system capability of the lumbar spine to sustain neutral zones of the intervertebral in the physiological limits which effects in pain and disability.

While the neutral zone conception was increased from learning passive (inert) structures, it was the involvement of contraction active muscles or muscles tone in connection to the neutral zone control that relation this idea to the real-life state of affairs. The ligaments and other passive (inert) structures might be only given maintain towards the range of end. Instability within this broader definition, which included 3 interconnected systems, might also, therefore, relate also to the insufficiency of the muscle system (Janda V, 1996).

Reduced muscle stiffness as a consequence of degenerative modifications, damage or fatigue additionally reason to postural instability. Moreover, damage to spinal structures might also result from inadequate muscle control to support stability at either or both levels of spinal postural control and or control at the inter-segmental level. On the other, the muscles system additionally has the capability to make amends for instability by way of reducing the lumbar spine stiffness and reducing the neutral zone size. This link between muscle role and spinal stiffness and the neutral zone gives the premise of the feasible conventional management, via core stability exercise, of postural instability (Gardner-Morse M et al., 1995).

1.2 Need of the study

CNSLBP is a common health problem in many developed and developing countries. Individuals affected by CNSLBP incident major physical, mental, social, and occupational distraction. It is not only one of the principal causes of pain but also an expensive burden on the healthcare budget as CNSLBP leads to frequent demand for medical services. In case of low back pain, epidemiological data give more information to assist in seeking and solving various problems related to low back pain. Furthermore, those records can prevent low back pain by avoiding or reducing danger factors for individuals. The incidence of LBP has been inspected in some systematic reviews. Global surveys of low backache described that one-month incidence was 18-41% and point incidence was 18-36%. The estimated universal lifetime occurrence of LBP varies from 50% to 84%. The occurrence of LBP in India is also alarming with nearly 60% of the people in India have suffered from LBP at some time during their lifespan.

The details of the clinical result for the management of CNSLBP have been unpredictable in this part. Scientific evidence may be difficult to determine as the majority researches compare an intervention among placebo instead of evaluating competing intervention strategies. However, a few treatments suggest being more efficacious than others, the execution of those treatments in physiotherapy clinics shows to be inconsistent or deficient. A part of the discrepancy in control and so guidelines of best practice might be attributable to a loss of consensus of causation and techniques of intervention in CNSLBP. Several interventions for CNSLBP had been challenged with varying stages of achievement, difficult the clinician to understand the most suitable approach to deal with CNSLBP (Delitto et al., 1995).

Most of the diagnosis of CNSLBP has established signs and symptoms of postural instability. An inclusive overview of the literature accepted that postural instability is differentiated through a lack of neuromuscular control system that reasons structural adjustments that arise within the muscle tissues liable for stabilization. So, the neuromuscular control system seems to be a large part liable for CNSLBP. So far, very few scientific experimental trials had been executed evaluating the effectiveness of SM on

postural instability and HRQOL in patients among CNSLBP. This will be the first study which measures postural instability with the help of Win track software in a Win track platform. EuroQoL questionnaire, which is used to check HRQOL of patients among LBP, is used in very few studies. It adds to the validity and reliability of the questionnaire. Thus, manipulation's effects on pain sensitivity, pain intensity, postural instability and HRQOL are to be analyzed with the present study.

1.3 Objectives of the study

General objective

The objective of this study was to determine the effectiveness of spinal manipulation on postural instability, HRQOL, pain intensity and pain sensitivity in patients among CNSLBP.

Specific objectives

1. To evaluate the effectiveness of spinal manipulation on postural instability and pain sensitivity patients among CNSLBP.
2. To evaluate the effectiveness of spinal manipulation on HRQOL and pain intensity patients among CNSLBP.

1.4 Hypothesis

- Alternative hypothesis: There will be a significant effect of spinal manipulation on postural instability, HRQOL, pain intensity and pain sensitivity among patients with CNSLBP.
- Null hypothesis: There will not be a significant effect of spinal manipulation on postural instability. HRQOL, pain intensity and pain sensitivity in patients among CNSLBP.

1.5 Significance of the study

In the previous studies, we have found that numerous interventions for CNSLBP have been attempted among various stages of achievement demanding the clinician's knowledge of the most suitable technique of management of CNSLBP. Intervention choices consist of stretching, traction, general exercises, stabilization exercises, and aerobic exercises, physical agents, strengthening, manipulation therapy and different forms of mobilization. Several reviews had been done in current years to determine the value of these treatments (Delitto, 2005). Numerous currently published RCTs fail to make out particular sub-populations among CNSLBP and this might cooperate the ability of these research to discover efficacious treatments (Delitto, 2005) In an attempt to deal among numerous doubts surrounding the assessment and the intervention of CNSLBP, scientists have created and examined scientifically prediction policies to discover sub-groups of CNSLBP patients that can reply positively to particular treatments.

A biomechanically greater correct description of postural instability, the use of a 'neutral zone' thought has been recommended by Panjabi. The neutral zone idea was based on the commentary that the total range of movement of a spinal motion segment can consist of two zones: an elastic zone and a neutral zone (Panjabi, 1992). The neutral zone was the initial segment of the range of motion at some point which spinal movement was formed against minimum inner resistance.

Postural instability was hence described as reducing in inside of the potential of the spinal stabilization system to sustain the spinal neutral zone within the physiological limits with the intention to save neurological insufficiency, most important unbearable and/or deformity pain (Panjabi et al., 1994). The clinical definition of postural instability is: 'a situation wherein the clinical categories of a patient among low back evils evolve, among the least irritation, from the mildly symptomatic to the excessive period (Kirkaldy-Willis WH and Farfan HF, 1982).

This study will provide a new intervention for the physiotherapy fraternity and patients in the efficiency of spinal manipulation in clinical practice with the patient's

community in the swift restoration of functional ability; reduce pain, improve postural instability and progress of HRQOL.

1.6 Operational definitions

1. Chronic non-specific low back pain (CNSLBP): CNSLBP is defined as pain, stiffness or muscle tension localized below the costal margin and above the inferior gluteal folds with or without leg pain (sciatica). CNSLBP is defined as an LBP not attributable to an identifiable, known specific pathology (infection, tumour, osteoporosis, and radicular syndrome, structural deformity, fracture, inflammatory disorder, or cauda equina syndrome (NIHCE, 2009).

2. **Spinal manipulation (SM):** Manipulation is described as a passive dynamic technique in which particularly directed manual forces are implemented to the vertebral and extra-vertebral articulations of the body, among the object of returning mobility to constrained place and improving a constrained joints range of movement (Gatterman MI, 1990). This is observed by using gapping or cavitations of the join that is the concept to contain gas separating from the fluid. Generally observed by an audible pop or click, manipulation has been proven to result in join movement contrasted to mobilization alone. This improvement of movement lasts for 20-30 minutes refractory phase throughout which further cavitations of the similar joint will not happen (Haldeman S et al., 2005).

3. **Numeric pain rating scale (NPRS):** The 11-point NPRS was used to detain the level of patient's pain. The scale is fixed on the left among the remark point "no pain" and on the right side with the remark point "worst imaginable pain" (Jensen MP et al., 1999).

4. **Postural instability:** is a state when one is unable to keep his/her body in a stable or balanced position. It is strongly connected with falls and is the best single predictor of the fall. Reactions in postural responses to the external perturbations are important for maintaining the equilibrium (Błaszczyk JW and Michalski AN, 2006).

CHAPTER-2

REVIEW OF LITERATURES

2.1 Anatomy

Boyling & Jully (1994) revealed that the human spine works as a multi-segmental, bendy rod forming the relevant axis of the neck and trunk. The lordotic curve of the lumbar spine is to permit decorating the rhythmic load-bearing capability of the spine with the aid of supplying damping function. The junctions between those curves are regions of maximum pressure detect and as a result frequent position of tissue injury following in dysfunction and nociception. The junction between L5 and S1 is a very common region of pain criticism. Theoretically, the intervertebral joints and the paired facet joints work to form the "motion phase'', in which these three joints act in the closed kinematic chain, the displacement of one joint involves a specific displacement of changed joints.

McGill &Norman (1987) determined the back spinal muscles were primarily the spinal extensors when acting bilaterally, but the lumbar longissimus and iliocostalis can also assist in lateral flexion when acting unilaterally. None of the muscles was primary contributors to the axial rotation, but activity in this movement may reflect their stabilizing counter to the flexion moment created by the oblique abdominals.

Bogduk (1997) determined that the trunk flexion, the multifidus, lumbar longissimus, iliocostalis control anterior translation, and anterior rotation. On come again to upright, muscle of multifidus provokes post. sagittal rot., supported by the lumbar erector spinae which also managed the sagittal translation posteriorly.

Bogduk *et al.,* (1992) revealed that the thoracic mechanism of the erector spinae which produce the majority of the torque to extend the thoracic cage on the pelvis. The multifidus contributes only 20% of the total extensor moment calculated at the level of L4 and L5 vertebral stage; the lumbar erector spinae contributes 30%, while the thoracic components of the erector spinae contribute 50%. Even though the multifidus was the major muscles at the lumbosacral junction, it was at a mechanical difficulty to create the thoracic cage extension on the pelvis.

Jorgensen *et al.*, (1993) found that all three of the lumbar muscles added to maintain and the control of the lumbar region orientation and sustain or stabilization of the lumbar region. The significance of their sustaining function might be revealed in the circulation of muscles fibres type. In contrast to most human muscles, which have a fairly even type I and type II fibre circulation, numerous autopsy reviews have explored that the lumbar multifidus, the thoracic and lumbar components of the erector spinae muscles have a high proportion of type I fibres. These para-vertebral muscles are also characterized by a large type I fibre cross-sectional part relation to other human extremity muscles and abdominal muscles (with the exception of the transverses abdominis).

Sirca & Kostevc (1985) found that a similar fraction of type I fibres in them multifidus and the lumbar longissimus. The presence of both a larger fraction of type I fibres and a larger type I fibre size evaluated to type II fast-twitch fibres supports the hypothesized tonic role of these muscles. The type I fibres proportion in the thoracic erector spinae muscles have been reported to be as high as 70%, while that in the lumbar erector spinae muscles varies in the range of 58-69%, When evaluating the multifidus composition among the muscles of lumbar erector spinae, an upper fraction of type I fibres, in the vicinity of 9-16% had been described in the muscle of the multifidus evaluated among the muscle of lumbar longissimus.

2.2 Historical aspects

Gower & Cram (1953) Back pain has plagued humans for many thousands of years. There is the explanation of lumbago and sciatica within the Bible and in the writings of Hippocrates. These terms had been acquainted with Shakespeare and perhaps to his public. In spite of the extensive records of awareness of this problem, a reasonable and scientific description of the source of LBP did now not appear until the 20th century.

Key (1838) said that research of the 19th and 20th centuries has yielded the accurate explanation of the anatomy and pathology of the highest of the possible resources of back pain, consisting of the intervertebral discs, the facet joints, the sacroiliac joints and the spinal ligaments.

LBP: An anatomical definition:

Len Kravitz & Ron Andrews found that the time era of an LBP referred to pain within the spinal lumbosacral region around the distance from the L5 vertebra to the S1 vertebra. That was the spinal area where formed the lordotic curve. The most commonplace of LBP was the fourth and fifth lumbar level.

2.3 Definition of low back pain

Gnegory *et al.*, (2005) defined that an LBP was the difference of the lumbopelvic complex from the normative anatomic and physiologic state. In a pathology-based totally methods to diagnose LBP, the affected person with LBP fall into heterogeneous as opposed to a homogeneous group. In addition, it has to be categorized into sub-groups that share, similar clinical characteristics like age, symptom period, distribution and so on.

Nordin *et al.*, (2006) defined that non-specific LBP was pain no longer credited to a recognisable pathology consisting of osteoporosis, Rheumatoid arthritis, fracture or infection.

Nachemson (2000) found that numerous observational studies on analysis and from RCT's on treatment efficiency that needs exist for the temporal definition of spinal pain problem. In accordance with the maximum critiques, we've agreed to the following definitions: Acute back pain: 0-3 week's period of pain or disability. Subacute: four-12 weeks duration of pain or disability. Chronic : >12 week's duration of pain or disability.

2.4 Pathology

Hanrahan *et al.*, (2005) revealed that complicated correlation exists among the lumbar spine paraspinal muscles and the mechanical systems concerned inside the motion of the spinal segments. The zygapophyseal joints of the lumbar spine had been cautioned to convey nociceptive output due to nearby anaesthesia controlling at the joint capsule has reduced the pain of the patient at some stage in motion. The annular fibres of the intervertebral discs have additionally been proven to be compactly innervated among

both nociceptors and mechanoreceptors which might be associated with the paraspinal musculature and the zygapophyseal joints. The annulus fibrosus stimulation on the lumbar spine consequences in contractions of the longissimus and multifidus muscles, while synchronized saline injection of the facet joint results in a decreasing in the reaction. These effects recommend a near courting the various nerve components of three systems.

Mechanical dysfunctions that effected in the tissue injuries and inflammation could enhance the sensitization of adjacent nerve fibres, most important to contraction of the adjacent muscles in reaction to neural stimulation. This postural sensitization was the idea to outcome in chronic spinal pain throughout enhance in muscle activity and once in a while muscle spasm. The similar mechanism of pain and spasm takes place among the spinal column the ligamentous systems with regards to related muscles.

Authors have proven that even though ligaments of the spine remain the primary restrictions adjacent to joint instability, the para-spinal muscles might be an important part in sustaining stability. Usually, the stimulation of nociceptors inside the supraspinous ligament has been proven to bring about the accelerated stage of multifarious muscle activation. As a result, numerous neural mechanisms materialized to manipulate paraspinal muscle activation, which might in flip bring about improved pain and exacerbation of signs. This muscle activation might also continue within the neural stimulation presence, even when the original damage has been cured.

2.5 Morbidity and mortality

McCulloch & Transfeldt (1997) reported that whilst no mortality is associated with lumbar spondylosis and sciatica, considerable morbidity is connected among chronic low back pain syndromes. A tremendous quantity of sufferers is not able to go back to their regular day by day exercises or feature in an effective work environment secondary to low back pain. There are sufferers, who after sure sports expand a dull, nagging back pain that slows them down. Marked modification of each leisure as well as work activities

becomes critical. Pain regularly isn't always sufficiently extreme to forestall affected the person from getting on with their day by day rounds, however it “insects” them.

de Jager & Ahern (2004) found that a latest World Health Organization record on the burden of musculoskeletal situations in 2002 stated that those had been the main reason for morbidity at some point of the world. at the same time as a good deal of this burden of the disorder is due to chronic arthropathies including rheumatoid arthritis and osteoarthritis, the most common troubles through a long way contain acute musculoskeletal pain within the back, neck and big joints.

2.6 Societal impact of CNSLBP

2.6.1 Epidemiology, incidence & prevalence

Ehrlich (2010) evaluated that the incidence and prevalence of low backache were more or less the same world extensive, anywhere epidemiological records had been gathered or approximates made but such pain ranks high (often first) as the cause of disability and lack of ability to workplace, as an interference with the exceptional quality of life, and as a purpose for medical session. Normally, but, the cause is obscure, and best in a minority of cases does a direct hyperlink to a few defined natural ailment exist.

(Hoy et al., 2010) the survey indicates that the lifetime incidence of LBP stages from 60%-90% with a 5% annual incidence. Of the affected population, but handiest 20% may be given a specific pathoanatomic analysis. No consensus exists among physicians, physical therapists or chiropractors concerning the maximum suitable treatment and management of this universal difficulty.

Damian Hoy *et al.*, (2010) found that 900 patients despatched to a lower back health facility servicing the west of Scotland become performed. In 97 percent of the patient, the presenting complaint becomes low back pain. It turned into discovered that during most cases in which a precise analysis is viable, the pain is attributed to disorders concerning the lumbar intervertebral discs and facet joints.

Hanrahan *et al.*, (2005) evaluated that every year 3-4% of the populace is disabled briefly and 1% of the running age population is disabled totally and permanently. In step

with a study achieved in the USA, the once a year fee of low back pain became estimated at 85 million dollars.

Pande (2004) achieved on the psychological trouble in Indian low backache patient determined a high incidence of tension and despair in Indian low back pain patients. Abnormal stage of tension and depression were observed in 71.7% and 64.8% respectively.

Laxmaiah Manchikanti *et al.,* (2014) revealed that a unique estimate is not possible, it's far achievable that the direct clinical and indirect costs of these situations are inside the variety of greater than $50 billion in keeping with annum, and could be as high as $100 billion at the extreme. of these costs, 75% or extra can be attributed to the 5% of those who emerge as disabled quickly or completely from back pain, a phenomenon that appears extra rooted in psychosocial as opposed to disorder determinants.

Volinn & Ernest (1997) determined that the literature on the epidemiology of a low backache is accumulating, however for the most part research are restrained to excessive-profits countries, which incorporate less than 15% of the area's population. Little is understood about the epidemiology of a low backache within the relaxation of the arena.

Croft *et al.,* (1997) revealed that in any one year 37% of adults experience as a minimum one day of low backache. A few 11% of adults in someone months experience restrict of work or other activities as the outcome of low backache. The course of LBP in a person's lifetime is regularly recurrent, intermittent, and episodic and for 6% of adults, it turns into a continually disabling condition.

Kopec *et al.,* (2004) evaluated that "On predictors of back pain in the fashionable population cohort" concluded that common health and psychological factors are vital predictors of back pain in both men and women. Different threat factors differ among sexes.

Cassidy *et al.,* (2005) in their look at "incidence and direction of low backache periods in preferred population" concluded that maximum new and recurrent low back pain episodes are moderately less than one-third of cases clear up yearly and more than 20% recur within 6 months. Low back pain episodes are extra recurrent in older adults.

2.6.2 Recurrence rates of NSCLBP

Macedo *et al.,* (2013) revealed that the prognosis of those with acute low backache was usually positive, with approximately 72% recovering by 1 year. For those who recover, recurrences within the next 1 year following the recovery are normal. It had been well established to facilitate CNSLBP was often recurrent and that 24% to 87% of those who recover from a period of low back pain will have a recurrence within 12 months.

2.6.3 Cost

Craig *et al.,* (2014) revealed that in the US alone, costs related to low back pain are determined between $20 and $120 billion annually and are rising.

Marjorie *et al.,* (2008) had been found that five million consultations among well-known practitioners and 1.7 million medical institutions of attending the outpatient department in Britain has been related to chronic low backache. This turn to 158 million misplace working days. It was determined that yearly cost to the National Health Service of £155.7million pays for physiotherapy treatment alone.

2.7 Problem of CNSLBP

2.7.1 Mechanisms of CNSLBP

Kenneth & Olson (2008) determined that the term "non-specific" approach that no specific structure has been recognized that causes pain. CNSLBP consists of not unusual diagnoses of lower back strain or lower back sprain, muscles spasm, myofascial syndrome, lumbago, mechanical low back pain. The following worldwide class of diseases diagnostic codes are counselled to satisfactory constitute CNSLBP, lumbago and sprains of the lumbo-sacral segment.

2.7.2 Risk factors and predictors of CNSLBP

Kopec & Burdorf (2004) executed to conclude different feature that can be analytical of low back pain. Most of those researches were the design of the cross-sectional with missing into enough statistical strength to establish a significant conclusion. In regards to

ages, ranges in the order of 40 to 60 appear to deserve the best prevalence fees however the link to incidence isn't as clean.

Miranda *et al.*, (2002) psychosocial factors consisting of despair, vanity, process pleasure and feelings of distress are more strongly associated. Research has also demonstrated that activity associated factors aside from psychosocial factors may be worried. The physical needs of the job have been additionally interpreters with high-quality unusual ratios for damage which includes: the peak of trunk velocity of the sagittal the plane, lower back moment, highest of lumbar shear forces, compression of the lumbar disc, and job associated twisting movements.

Celan & Turk (2005) Personal characteristics such as the cigarette which includes cigarette smoking, obesity, the strength of trunk and flexibility, familial history, exercise records and stylish physical health had all been associated. Factors related to frame build; dietary popularity and standard constitution can't reliably be expecting the incidence of back pain.

Waddell (1992) found that the same way pathoanatomical causation, one has to don't forget the interplay of danger features with anatomical causation. This method is characterised inside the bio-psychosocial approach of causation. This approach elucidates a segment of the changeability of CNSLBP totally on physiological/anatomical reasons and confirmed several types of research effects carried out on psychosocial reasons reported inside the literature.

2.8 Insufficiency with CNSLBP

2.8.1 Structural

Punjabi (1992) revealed that the osseoligamentous (passive subsystem) structure that makes contributions to static stabilization encompass the vertebrae, ligaments, joint capsule, intervertebral discs, and fascia. Structural elements of postural stabilization presented the maximum of management at or near the give up of range.

McGill (1997) accelerated the passive subsystem of structural role reduced the muscular necessity for postural stabilization may be revealed by means of using the flexion

relaxation incident which may be described because of the electromyogram quite that takes area within the spinal extensors whilst the trunk achieved closing range flex. This decreasing in electromyogram action has additionally been diagnosed at some point of lifting obligations from complete flexion.

Crisco *et al.,* (1992) determined that mechanical modelling has maintained the notion that about 90 Newton of pressure will purpose an unmaintained spinal column from crumble. This value can be decreased in situations where injuries to inert systems subsist. Example of inert system lacks may consist however weren't edged to disc herniation, spondylosis, spondylolisthesis, capsular injuries, degenerative disc disease, and ligamentous. Injure to inert structures elevated the neutral zone size that should be grown stable by way of using active systems. In spite of the passive structures aren't capable of tolerating masses drawing near efficient performance, their significance to dynamic postural stability was clear during the mechanoreceptors offering an afferent attempt to the sensorimotor system in an effort to be cited.

2.8.2 Muscular

Cholewicki *et al.,* (1997) revealed that muscular (active subsystem) of the second factor of postural stability surround to the spine which has the capacity of stabilization of the spine via the force of contractions. The total numbers of muscular importance have an effect on the total of stability at all sectional it overcomes and this courting had an outstanding connection. It needs to be cited that incredibly tiny quantities of motion will afford the spine with enough stabilization providing all factor is performing well. This total of motion, while stabilized to a most voluntary contraction, is about 1.7to 2% for common, resisted motions.

Bergmark (1989) revealed that the active (structural) subsystem had been subdivided into detaching parts, global and local muscle tissues. In his approach, global muscle tissues are mostly chargeable in support of keeping postural stability and are high transporters while the deeper muscles mass are more often than not responsible for retaining segmental stability all through all motion or static functional activities.

Nitz & Peck (1986) revealed that facilitated the local medial fibres' of rotators brevis and multifidus are wealthy in muscle spindles and feature nominal mechanical benefit for developing motion of the spine assisting the hypothesis to their number one movement is characteristic as proprioceptive activity transducers.

Richardson *et al.*, (2002) seen that belly muscle groups also are crucial in developing dynamic stability of posture. The transversus abdominis muscle affords stress during the thoracolumbar fascia due to its placing in the fascia on the lat. raphe that generates a compressive stabilization force via the complete lumbar segment. The transversus abdominis parallel fibres had been powerful and developing a closing pressure in the sacroiliac joint as discovered with the aid of Doppler examine measuring vibration afforded by means of a tuning fork; as a result, the muscle was able to rise stabilization and intra-abdominal pressure through the region of lumbopelvic.

2.8.2.1 Reducing of a cross-sectional region of select muscles

Parkkol *et al.*, (1993) & Hides, *et al.* (1996) analysed that CNSLBP, the multifidus muscles showed a minor cross-segment, and it may be an appearance that degeneration of muscle fibres of type II, structural alters fibres of type I, and multiplied intra-muscular fat. It had been referred to throughout analytical ultra-sonography and magnetic resonance imaging that the big defeat of multifidus crosses sectional region arise on a same region of the spine at or in 1 stage of the section incident pain.

Danneels *et al.*, (2001) determined that this takes place in patients with acute low backache, subacute and chronic low backache. It's been similarly reminded that multifidus recuperation did not arise unexpectedly in patients as their pain determines clearly. The quantity of decreasing within the cross-sectional region of multifidus was connected to signs and symptoms the period of symptoms and signs. The cross-sectional region in the same side of the psoas muscle was similarly decreased and this decreasing links clearly with the intensity of pain score. If patients with a backache teach multifidus properly, recuperation of move sectional region has occurred. Exclusive researches have

revealed that whilst strength and endurance enhance with education, cross-sectional region and muscles density did not.

2.8.2.2 Reduced erector spinae and multifidus strength

Kong *et al.,* (1996) determined that the histological modifications mentioned in the above segment, bring about a lack of endurance and strength. Muscular dysfunction shifted pressure switch beginning facet joints to ligaments and intervertebral disc in the posture of forwarding flexed similarly signifying interdependence of stabilizing subsystems.

Hicks *et al., (*2005) recommended that subject with the history of CNSLBP preserved to illustrate muscle composition and useful potential discrepancy in the 8^{th} decade connecting the stability of neural and/or muscular manage system modifications for chronic situations of dynamic stabilization.

2.8.2.3 Reduced endurance of quadratus lumborum and erector spinae

Mannion & Dolan (1994) Biering-Sorensen evolved test of an endurance and test of Biering-Sorensen where patients lied down the prone position on the couch among the upper part of the patient's body was placing off among eliminating of the inferior part of the body and the anterior superior iliac spine was banded on the desk for stability. The Biering Sorensen test assessed the erector spinae capability to keep a reduction of around 35% MVIC for time.

Biering-Sorensen (1984) used to identify sufferers with low back pain and can anticipate people probably to broaden LBP. Fatigability appreciably differed amongst a set of golfers among and without chronic LBP for average alters of the erector spinae through the Biering-Sorensen test and the distinction had a massive effect at the situation's capability to enlarge an MVIC within the quadriceps muscle tissues. These results connect a large segment of muscular impact away from deeper musculature; an idea transferred to as nearby interdependence.

2.8.3 Neuromuscular control

Silfies *et al.,* (2005) determined that the third problem was the neural control method accountable for synchronizing achievement of every muscle within the active subsystem. Spinal stiffness has defined stability of activity of all muscles and styles of specifics firing are implemented to afford this stiffness. There's proven that those firing styles were variable amongst patients, relying on the activity and the spinal loading, and might be displayed poor capability in CNSLBP. Neural management of the active subsystem might be revealed via feed forward and reflex method.

Barker *et al.,* (2004) revealed that postural instability may be defined because of the short-term lack of neuromuscular control all through any user activity. Research shreds of evidence that segmental specific lack of neuromuscular control can be observed within plenty of the latest studies on deeper muscles cross-sectional location and firing order of trunk muscle groups within healthful vs. CNSLBP. Those variations had been mentioned in patients among CNSLBP.

Wilke *et al.,* (1995) determined that recovery of the multifidus muscle seems critical considering the fact that it's very critical within the common functioning of the spine. It gives segmental stiffness so being high components of neuromuscular manage within the beneficial neutral region. Multifidus had been verified to liable for up to 2/3 of the stiffness of muscles adding to sectional stability of the L4-L5 section.

Preuss & Fung (2005) found that atrophy and the presence of multifidus dysfunction were related to terrible consequences following lumbar disc surgical treatment. Purposeful restoration following surgery turned into connected with reduction of multifidus dysfunction. Postural stability is not always an innovative idea in assessment and therapy of CNSLBP. Preuss and Fung re-evaluated modern literature on the idea of spinal bulging beneath sub-maximal pressures and terminated that patients might additionally show positive features that affect them to this incident. Spinal bulging might be partial anatomical inconsistency or troubles with progressing of putting in via the centre nervous system however might also end outcome from untreated or insufficiently managed sectional injuries.

2.8.4 Proprioception

Riemann & Lephart (2002) revealed that proprioception is described while the concentration of the body function, orientation, motion and pressure sensation. Proprioception is defined the afferent enter into the inner stimulus from proprioceptive fibres inside the body screened and reacting of the outside surroundings answerable for the demanding situations to balance of the body. There may be plenty unpredictability as to what comprised the volume of proprioception within the body of human and for this reason of the survey, proprioception will be quit with the afferent enter being added to the centre nervous system through the precise neural paths. To develop ahead definition by Sherrington and above-said explanation of proprioception, it turns into vital of the outline of the motor reaction to the proprioceptive enter. Exclusive of the finest motor response, the afferent enter could be useless. The terms utilized to outline the efferent enter among the motor response is the sensorimotor system.

Lephart and Pincivero (1997) found that the sensory-motor system extensively developed the neural allegation of proprioception because they are currently connecting the unaware reception of neural enter via proprioception to somatosensory, vestibular enter and visible. This afferent put to cooperate and elucidated at the stage of the brain stem, cerebral cortex, cerebellum, basal ganglia and spinal cord stage. Subsequently, the complicated efferent reply should be completed via the fusimotor system.

Parkhurst & Burnett (1994) determined that the reason of the sensorimotor system was to permit the human body to combine records to modify the position of spine and improvement of neuromuscular reaction to the surroundings for secure, stability and suitable motion all through the function. The right combination of the neural enter was essential for synchronization of motion and place. Without proprioceptive control, suitable dynamic stabilization could no longer be sufficient.

Ghez (1991) described that proprioception is essential to set up a correct, efficient and synchronized reaction of the efferent system to the needs of surroundings. Every progressing centre collected proprioceptive in order and the information of methods in its own particular manner. At the stage of cortical, information of proprioceptive is utilized

to found posture alertness, the location of the body and motion sensors. On the stage of the spinal cord, proprioception is utilized to quality reflexive reply via the pathways of monosynaptic and polysynaptic. The reflexes are challenged to descending pathways of motor control.

Riemann *et al.,* (2002) described terminology significant to sensorimotor and proprioception. They wanted to be said that measurement of proprioception may be extremely hard, if no longer not possible to clinically carry out for the reason that proprioception is completely an afferent phenomenon going on each intentionally and unintentionally inside the body. Proprioception, is an important thing of the sensorimotor system, currents researcher of the perspective to circuitous determines it via several of sensorimotor pathways. At the same time whilst the variety and forms approach for measuring the sensorimotor system is large, this examines will be consciousness on the method that had been recognized earlier in the spine literature.

Grob *et al.,* (2002) at the same time as many researchers have targeted completely on any joint location experience or kinaesthesia as determines of proprioception, this has a look at tested four determines of proprioception (side force admiration and track of motion). It's been recommended that JPS and kinaesthesia were not fairly associated modalities recommending that a single check measure proprioception was missing. Loss of connection had been in addition tested through studies demonstrating that in acute knee ligament accidents, PS has become secured whilst kinesthesia turned into engaged and rehabilitation or surgery treatment might not the outcome to progress in each modality. They observed in the spine, ages associated adjustments can be marked depending on whether or now not JPS or kinaesthesia changed into testing.

Roberts *et al.,* (1995) determined that the afferent nerve endings liable for presenting proprioceptive enter were substantial at some stage of the body. Mechanoreceptors had been recognized in facet joints of lumbar, intervertebral discs, and connective tissues of other spines. The mechanoreceptors within the facet joints were not specifically thick by means of best 5 type 1, 6 types 2, and 1 type 3 receptor diagnosed within thirteen facet capsule. While there has been much less than one according to the joint capsule, it needs

to be cited that several, and not countable, free nerve endings have been located. They remain uncounted as they had been not defined as the kinds of summarized nerve endings liable for proprioception.

Grigg (1994) found that the implication from there the effort was that the receptors have a massive receptors subject which can show tremendous deficits with harm or likely that the free nerve ending (type four receptors), are not only mechanical in character cooperating an extra function but also nociceptive receptors in proprioception than formerly assumed.

Leinonem *et al.,* (2002) revealed that deficits have been mentioned in patients with a huge range of pathoanatomical diagnoses. A examine of 20 patients among CNSLBP from discodural as compared with 15 healthful control subjects that patients among CNSLBP occupied 2.5 times extra motion earlier than recognition (2.5^0 to 1^0) of reflexive kinesthesia in the rotation, in comparison with, manages, however, this shortage decreased to insignificant discrepancy three months of post-surgical intervention. Every different look at evaluated the passive rotational kinesthesia of 26 patients with postural instability and discovered to 76.9% of patients suggested motion inside the incorrect path and confined the motion to the incorrect place of the body.

Leinonen *et al.,* (2003) found that now not all diagnoses bring about joint repositioning deficits when you consider that no tremendous distinction turned into determined in joint relocate sense in 49 patients among mild ankylosing spondylitis and 49 controls among changes the position experience being assessed through an electromagnetic position tracking tool. A complies with-up recommended that the non-significant variation note in the earlier examine become retrained at the same time as the disease process stepped forward.

O'Sullivan (2003) observed in evaluation 15 patients signifying clinical segmental instability among gender and age liked controls and evaluated spinal relocation blunders among an electromagnetic monitoring machine and observed that the investigational group had an approximate 54.5% growth in relocation errors (1.7^0 to 1.1^0).

Allison and Fukushima (2003) studied 23 patients with utilized 6 experiments that kinesthesia and joints position sense plays a significant task in the management of normal motion of the spine and performed three ranges 20%, 50%, and 80% of the available range. It was concluded that trunk flexion relocation progresses as one movement additional into range.

Koumantakis *et al.,* (2002) determined the duration of low backache does no longer show to be an issue inside the proprioception test outcomes suggested. Shortages were referred to as subjects with CLBP, described as more than 12 months, or of 3 months to 12 months, and acute periods of LBP of less than 12 weeks [129].

Kaplan *et al.,* (1985) utilized a self-made tool to examine proprioception that changed into supported totally on a non-stop passive movement device to produce the motion within the spine. The decreased body turned into progressed whilst the upper part of the body remained constant to decrease the possibility of the upper trunk and vestibular centre's. It has to refer to this observe assessed a cohort of those who make quite a few exciting and wearing less than best situations which might additionally be impacted by the age factor due to the fact. That age factor and years of revel in at the job are linked also; but, this took a look at supports different literature that has confirmed age-associated variations.

Feipel *et al.,* (2003) assessed that no statistically substantial variations have been observed in relocation sense of 21 patients in group and age less than of the patients less than 40 years. On this research, relocation mistakes became examined by an instrumented spatial connection for 3 experiments which might not have enough energy to discover a significant exchange but the findings are consistent.

McNair and Heine (1999) revealed that the impact of outside stimuli on joint relocation sense inside the lumbar spine had verified outcomes reliable by those located in the different peripheral joint of the body. Research with 42 subjects, 21 with chronic low back pain and 21 controls, assessed spinal relocation inaccuracy by an electromagnetic monitoring approach pre and post the utility of the lumbar assist and again post sporting the maintain tilt for two hours. Each corporation the validated good sized decrease in

relocation mistakes post apply the brace however impact of the brace changed into decreased after two hours of utilizing to estimate preliminary circumstance.

Newcomer *et al.,* (2001) observed that special methodology in comparison by their past referenced take a look at in that four experiments of changing spinal angles had been utilized with a principle reference placing among every experiment. Combined outcomes were established while inspecting 40 healthy patients with the use of the design of Latin square crossover for evaluating spinal relocation, a Lumbar Movement Screen and 6 experiments at numerous angles of flexion. In this trial, while the healthful patients have been separated into excessive errors and low inaccuracy group, the high mistakes group skilled a major discount in total mistake while the low mistakes group remained unaffected. It's mile sensible to terminate that superior cutaneous enter added to proprioceptive remarks in patients at the same time as bearing brace and extended publicity reasons the system to deal with improved neural enter.

Brumagne *et al.,* (2000) evaluated the change of vibration on 44 patients, 23 patients of low back pain and 21 patients of controls. On this procedure, relocation sense was assessed before throughout and after vibration changed into carried out. Control subjects skilled expanded inaccuracy rate through vibration and decreased inaccuracy rate within the experiments post vibration while the low back pain group skilled progression of relocation sense at some stage in and after the application of vibration. The suggestion of these end, outcomes might also additionally aid the concept that inactive muscle spindles are superior to the more ordinary stage among vibration while in common; the vibration alters the spindle action creating them recognize bigger muscles extent causing them to undershoot the location goal.

Taimela *et al.,* (1999) found that proprioception had been reviewed pre and post-fatigue of the Erector Spinae muscle group. Total numbers of 106 patients, 56 in chronic low backache and 50 in controls groups, that tracking a fatiguing session of extensions of lower back among a sub-maximal pressure, kinesthesia of spine assessed with the aid of passive decrease body the rotation at 1o*second-1 was appreciably slower than before the fatigue procedure. Whilst tremendous modifications happened for both back pain

situations, the impact of fatigue changed into greater stated on patients with chronic low backache and interrelated with people with better self-statement pain intensity and frequency in addition with mentioned practical harm.

2.9 Treatment for CNSLBP

Van Tulder *et al.*, (2000) determined the most effective susceptible proof to help the usage of a common program application to raise action as management for CNSLBP. Numerous interventions for CNSLBP had been the effort by various levels of achievement, difficult the clinician's expertise of the majority suitable technique of dealing among chronic low back pain. Capability management options contain stretching, strengthening, traction, standard exercising, aerobic exercise, stabilization exercise, physical agents, numerous styles of mobilization with movement and manipulation. While analyzing the earlier cited to shortage related to acute, sub-acute and chronic low backache, it would seem that several types of exercise might be needed in almost every case; but, the effectiveness of the therapeutic exercises had unclear. The therapeutic exercises for low backache management had tested changeable consequences depending on the approach and also the type of exercising hired.

Frost H *et al.*, (1998) determined previously however extra support changed into suggested for the exercising being at least as useful as different kinds of conventional management for CNSLBP. This evaluation wasn't lacked their critics who think that a few types of research have validated outcome showing vast improvement of practical incapacity ratings as evaluated with controls. It's been proven that aerobic exercise presents several useful signs of progress for patients with chronic pain however on decrease mild pain.

Danneels L *et al.*, (2001) evaluated that strengthening of erector spinae application via lifts of the bilateral leg to parallel, more the threshold of a plinth displaying a link among persisted pain management and decreased disability with patients who sustained ordinary use of the exercises follow the achievement of the research. Researchers have verified that only stabilization does no longer outcome in major elevate in the cross-sectional

place of the para-vertebral muscles in normal or muscle of multifidus especially. If conflict education was introduced to the program of the stabilization both with/without a static five seconds hold at the end range, place of the cross-section was extensively multiplied in the paravertebral; but, multifidus simplest revealed a significant elevate when comprising to 5s static grip.

Verna JL *et al.,* (2002) utilized a changeable perspective chair of the roman tool by hyperextension of trunk exercises more then 8 weeks era to significantly elevate together endurance and strength of the trunk extensors. The development was too major at the four weeks midpoint assessment in addition.

Bang and Deyle (2000) revealed that the ambiguous consequences of therapeutic exercise intervention might additionally be implying an endured deficit that isn't being effectively addressed via exercise alone. Manual therapy enhances the outcome of exercising more than exercises alone in a trail of 52 patients imparting with sub-acromial impingement syndrome. Patients received manipulative therapy with exercising confirmed significantly higher results with the aid of decreasing of pain, strength gains of muscles and useful evaluation questionnaire. The authors advise that manipulation treatment decreases pain via afferent enter and thus allocated therapeutic exercise to be greater efficient re-establish motion by mechanical stretching of collagen.

Cordo *et al.,* (1996) taken into the consideration that manipulative therapy stimulates greater proprioception and advanced gamma bias via feed onward mechanisms permitting the exercises to stimulate the muscles below enhance better neuromuscular control system thus raising efficacy. Regarding as this data, it might be feasible to terminate that manipulative treatment may be utilized to develop neuromuscular control previous to the overall achievement of the therapeutic exercises inside the spine thus enhancing the efficacy of the exercising and decreasing the remaining shortage stated from preceding research.

Hicks GE *et al.,* (2005) achieved in current years to assess the effectiveness of those interventions. Several currently issued randomize control trails unsuccessful to become aware of unique sub peoples with low back pain and this will have co-operated the

capability of these studies to perceive efficient interventions. Reviewers have produced and tested scientific prediction policies to recognize subgroups of low back pain patients that could reply positively to particular interventions. So far, a number of categorization systems and scientific prediction policy had been evolved among various stages of achievement. A scientific prediction policy changed into progressed and validated for concluded a sub-population that might react positively to a common manipulation of sacroiliac. A beginning scientific prediction policy for instability has also been raised however had not yet been demonstrated eventually.

DeRosa and Porterfield (1992) revealed that no lengthy-time period, observe-up tests have no longer been accomplished on those medical prediction policies making it not possible to decide whether or not or no longer patients treated with utilizing them have alike reappearance quotes to formerly studied management. Classification systems had been utilized for forty years to help in categorizing sub-groups that could reply positively to precise interventions and those categorization systems have various stages of proof to sustain their utilize. There might be the rule for every treatment to play in almost each of the scientific analyzing systems cited and one treatment that may be realized inside all system and had been established to be efficient among management was spinal manipulation therapy.

2.10 Effect of spinal manipulation on CNSLBP

Whittingham and Nilsson (2001) determined that spinal manipulation gave a stronger spinal variety of movement greater than the direction of intervention. It had now not been surely illuminated through what mechanism alters in range of motion; it might be because of mechanical results or neurophysiological modifications allocating more motion via decreasing muscular guarding.

There were neighborhood neurophysiologic replies to spinal manipulation (SM) treatment. These neurophysiologic replies could be additionally beautified proprioceptive enter to the spine permitting the deeper muscle tissues to higher response to physical exercises which are considered to offer nearby postural stability. These neurophysiologic

replies may additionally provide to improve the muscle tissues' capability to determine postural stability and persistence. Afferents were discovered in different segments in the post. section of the trunk consisting of the stabilization ligaments of the inter-vertebral sections, zygapophyseal joints, intervertebral discs, the basic post-vertebral muscle groups, para-spinal muscles, and the thoracolumbar fascia.

Chiradejnant *et al.,* (2002) evaluated that tiny amounts of motion arise linking adjoining sections by spinal manipulation in every 3 planes and the amount of motion is comparative to the manipulation pressure, however, does not appear to be extremely sensitive to the course of pressure. The consequences were proven to be region to the section of intervention and adjoining sections, representing that it is not essential to be especially on the hypo-mobile phase to gain the most wanted outcome.

Wright (1995) speculated that spinal manipulation produces a stream of afferent enter to the centre nervous system reasoning stimulation of the dorsal periaqueductal gray (dPAG) effecting within through downward treatment of the pain stimulus on the sub-stantia gelantinosa surrounded by the 2nd laminar cover of the dorsal horn. The concept of gate manipulates had additionally been taken into consideration in explanation of pain reduction observable fact referred to spinal manipulation.

Teodorczyk-Injeyan *et al.,* (2006) found that the plethora helping the speculation to facilitate spinal manipulation decreases pain. The pain decreasing has been cited within the spine and the extremities. The mechanism of action had best been hypothesized ahead and spinal manipulation decreases inflammatory cytokines which evidence recommends.

Indahl *et al.*, (1997) determined that the stimulation of complex action potentials had been validated in patients with lumbar radiculopathy. The researcher considered to reply to the end outcome of afferent fibers responding to the manipulation enter and that produced tiny however different vertebral movements. The put off among the stimulus and the reaction averaged 12miliseconds that's just like similar research on animal preparations. Another research repeated the electromyogram reaction to annulus stimulation after which injected with saline in the zygapophyseal joint and that outcome reduction of the electromyography reaction signifying a near neural correlation among

these systems of the lumbar spine signifying which the facet joint might also facilitate in control neuromuscular hobby within efficient spinal segments. Possibly capsule of the facet joint mechanical distention reproduces the mechanical outcome of manipulation reasoning reduction of spasm of the spinal sections decreasing pain and improving range of movements.

Colloca *et al.*, (2003) found that a reflexive reaction also cited in vivo as supported via electromyography reaction with spinal manipulation and CAP reaction with equal manipulation. The reaction, but might also have gentled by using the space the electromyography electrodes were gone from the section being manipulated. The electromyography length of reaction became constant among the previous conclusion from indahl. Spinal manipulation in every location of the spine outcome in an elevated electromyography effect between 50–200milisecond after the intervention that previous between 100–400ms in several muscle groups for the duration of the body recommending that there is a greater systemic electromyography reply to the intervention.

Indahl *et al.*, (1995) found that EMG activity expanded inside the multifidus muscles of the pathway of porcine specimen's stimulation of any annulus fibrosis or facet joints. Despite the fact that the styles of firing have been one of a kind for every section stimulated, the impact helps the speculation that the muscle of multifidus could also play a significant responsibility in the stabilization of the section.

Childs *et al.*, (2003) considered the results of LBP on the proportion of 66 patients among weight-bearing, where 35 in low back pain and 31 in healthful controls group to decide if LBP associated with the irregularity of weight-bearing. The pain was evaluated orally with the assist of 11 points numeric pain rating scale and weight-bearing proportionally changed into evaluated by 2 digital scales. The researchers established that patients with low back pain shown drastically additional irregularly weight-bearing character (p<0.01) through mean the discrepancy of 8.7% (6.1) of the body weight as evaluated to 4.5% (1.8) of bodyweight for control. Similarly, as pain scores accelerated, irregularly of weight-bearing extended among r=0.28 and p<0.05 however, the link was not important for the Oswestry Disability Index at r = 0.19 and p-value more than 0.05.

Childs *et al.,* (2004) revealed that a subsequent potential research which covered 30 subjects with either acute or chronic low backache obtaining spinal manipulative therapy discovered to them individual reviews of pain reduced (r=0.6, p=0.06), irregularity weight-bearing features, and the iliac crest irregularity notably superior (p=0.01) it had been assumed that the irregularity of the iliac crest peak and weight-bearing traits were the end outcome of deeper soft tissue irregularities of the deeper soft-tissue and that could need further researches to validate.

Knutson and Owens (2005) found that fatigued occurring on the same side of muscles got hypertonic resulting spasm which illustrates the iliac crest superiorly giving the illusion of pelvic obliquity pelvic illusion and reduced leg length. But the manipulation approach accurate for soft tissue defects, it is easy just to speculate forward the mechanism of action. Analyzing a section of the sensory-motor system via the proprioception might also, provide to clarify the potential mechanism for the effects of the SM in patients suffering among visible leg length discrepancies and irregular weight-bearing. This information provides the basis for this research effort to conclude if proprioceptive alters along with weight-bearing irregularity modifications in patients through chronic low backache.

Adams and Sim (1998) revealed that the optimistic effects of spinal manipulative therapy, individuals need to additionally possible hazards of imposing manipulative therapy. There is a scientific challenge concerning the ability dangerous effects of spinal manipulative therapy. The major apprehension is the distressing result of creating cauda equina syndrome with lumbar manipulation.

Shekelle *et al.,* (1992) found that systematic analysis of the literature determined eleventh cases about cauda equine in more than literature coverage of 76 years. These records had utilized to approximate that cauda equine occurred one in 100,000,000 manipulative therapy. Fewer severe side effects by spinal manipulative had been the statement and do occur among larger incidence.

Senstad *et al.,* (1997) defined as a temporary rise in the patient's symptoms. 62% of the cases, amplify in symptoms came about in four hours of management and 73% of cases revealed by one day of treatment.

2.11 Methodological consideration

The dependent variables mentioned in this research can be evaluated in several methods. There are potency and weakness correlated among every one of those methodologies. This phase of the section has been overviewed what was the significant literature statement on the complexities connected among the methodology and has been afforded the theoretical basis for the research approach decided on the following chapter.

2.11.1 Assessment of postural instability

The capacity to preserve balance in vertical standing posture was assessed by the Win-Track platform (Win-Track, Company-Medicapteurs, n^0-12k0022, Made in France), which assessed the postural instability (i.e., the motion of the average centre of foot pressure-ACOFP) in the side-to-side (Y) and anterior-posterior (X) instructions. The subjects stood gently on either the firm platform (i.e., directly on the Win-Track platform) for a duration of thirty seconds with uncovered feet. The primary thirty seconds of data have been evidenced at a sample charge of 1200 Hz by way of display information acquisition software (Win Track Software) (Win Track software, 2014; Wilder et al., 2011).

2.11.2 Assessment of HRQOL

Luo *et al.,* (2003) revealed that the validity and reliability of the EuroQoL questionnaire. To determine the validity of the EuroQoL-5D and interviewed 2 times within 2 weeks, 13 hypotheses relating the EuroQoL-5D self-classifier (5 Dimensions). Test-retest reliability has been evaluated by Cohen's Kappa. 48 patients were included in this study whereas 7 hypotheses out of 13 a priori hypotheses EuroQoL-5D dimensions to exterior variables were rewarded. Supporting the validity of the EuroQoL-5D and the study concluded

Singaporean Chinese EuroQoL-5D self-classified showed good reliability and validity of HRQOL.

Pinto *et al.* (2011) evaluated validation of the HRQOL scale, EuroQoL-5 Dimensions (EQ-5D), using on patients of stroke with sixty-seven participants and used the Pearson test for correlation of EQ-5D. A total of 31 participants were determined for EQ-5D evaluation and the result proved a good correlation of EQ-5D with NIHSS and mBI and concluded that EQ-5D was reproducible and applicable to the determination of HRQOL.

Hurst *et al.* (1997) determined that the EuroQoL questionnaire comprised a five-part questionnaire. The validity, reliability and responsiveness of EuroQoL-5D were assessed in 233participants with rheumatoid arthritis and it was correlation high with disability measure. The reliability of the EuroQoL-5D index is good or better than that of all other scales. They concluded that the EuroQoL questionnaire is simple to use, valid, responsive to alter and sufficiently reliable for groups comparisons in HRQOL scientific trials.

2.11.3 Assessment of pain sensitivity

Kinser *et al.*, [2009] had done the analysis to test the validity and reliability of digital pressure algometer. It utilized to recognize the pressure or force eliciting PPT. This review tested reliability and created the validity of the algometer (1000Hz) by utilizing manual pressure on a force plate (500Hz). The handheld of the algometer had a $1cm^2$ application surface round by the rubber and compared among maximum force scoring and highest force scoring by force platform using SEM and t-tests. Pearson used for connection between the highest force scoring of the algometer and the force platform exceptional in both trials to 80N (r=0.99) and incremental trials (r=0.988). In conclusion, it was the adjustment, practice and clinician might have higher reliability in the force application rate and might be considered valid.

2.11.4 Assessment of pain intensity

The numeric pain rating scale (NPRS) was a self-stated pain measurement a scale which needs the patients to verbally rate their pain on a zero-10 scale where “Zero being no pain and 10 being worst pain imaginable” (Katz J and Melzack R, 2009). This scale is the most commonly used scale in the medical profession (Jamison RN, 1996). The test-retest validity and reliability had been observed to be enough to utilize in participants among CNSLBP (Jensen et al., 1999). The NPRS score might be evaluated among the VAS and need to outcome in like scores because the VAS transformed from mm to cm. Adler and Ohnhaus observed while the NPRS and VAS were applied in tandem, the scores are probably arithmetically controlled and the numeric values compare fit for pain score *(r* =0.85, a *p*-value less than 0.01) and for pain release (*r*=0.83, a *p*-value less than 0.01) (Ohnhaus EE and Adler R., 1965).

2.12 Summary

Numerous deficits might be qualified to the neuro-muscular control lacking and the inter-relationship of those issues was the base of hypothetical of this research. Anyway, whether the insufficiency and injuries had arisen in the inert (passive), active, or neuromuscular control section, the outcomes were scientifically equal; challenging of the dynamic balance of the system through the function thus putting the system up for upcoming injuries throughout a vicious cycle of pain and pathoanatomical disorders. Several neurophysiologic results of SM had been shown inside the literature and their effect on spinal proprioception had not been inspected to conclude whether or not useful dynamic stabilization can be improved by SM. Examining proprioceptive alters by the manipulation might additional be improved the clinician’s understanding of the effect of the treatment might also have on different therapeutic modalities often applied for the treatment of CNSLBP.

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 Study design

The study used experimental design; a single-blinded, parallel randomized clinical trial which was used to determine the efficacy of SM on postural instability and HRQOL in patients among CNSLBP. This study was conducted from August 2015 to January 2018 at Out Patient Department (OPD), Department of Physiotherapy, Lovely Professional University, Phagwara, India. The study received ethical clearance from the Institutional Human Ethical Committee (ethical clearance number LPU/IEC/PTY/004) and the study procedure was registered among the clinical trials.gov registry (NCT03016676). Written informed consent was taken from all participants.

3.2 Population and sampling method

Total of 198 participants was selected from Out Patient Department (OPD), Department of Physiotherapy, Lovely Professional University campus, Phagwara, Punjab and allocated to three groups of 66 each for the study. Study group-1 received supervised exercise therapy, study group-2 received SM with ergonomic advice (EA) and study group-3 received core stability exercise with EA of CNSLBP. Method of sampling was systemic random sampling.

3.3 Selection criteria

3.3.1 Inclusion criteria

The following inclusion criteria were adhering in order to increase homogeneity in this study, and ensure that all participants accepted the study, suffered from CNSLBP. Participants had to be between the ages of 18 to 60 years (Bialosky et al., 2014 and Bronfort et al., 2011) and both male and female patients were included in the study. Patients had to have CNSLBP with duration more than 3 months and range of pain intensity ≥3 on 0 to 10 NPRS (zero= no pain at all to Ten = worst pain imaginable) were

included in this study(Craig et al., 2014 and Bialosky et al., 2014) and given written informed voluntary consent.

3.3.2 Exclusion criteria

Patients were screened for confirmation of severe lower back pathology and for contraindications to exercise therapy or spinal manipulation by a physiotherapist (Bergman et al., 1993). They were excluded previously to randomization if they had specific spinal pathology (e.g. vertebral basilar insufficiency, vertebral malignancy, infection, fracture), marked osteoporosis that was previously diagnosed, neurological signs, spinal fusion or spinal surgery and any congenital spinal deformity(scoliosis, ankylosing spina bifida, spondylitis) (Ferreira et al., 2007 and Bronfort et al., 2011).

3.4 Procedure

Interested participants were informed about the aims and process of the study. They signed the written consent, to be considered as study subjects. All patients fulfilled self-report and a physical examination. The following self-report questionnaires were fulfilled by patients at the baseline examination: demographic record (age, height, and weight), a numerical rating scale for pain intensity, Win Track platform (average center of foot pressure) for segmental instability, and EuroQol questionnaire (EuroQoL questionnaire-5D-5L has 5 dimensions and 5 levels) for HRQOL.

Intervention

The patients were assigned into three groups by systemic random sampling (allocation ratio was 1:1:1). All patients in the study received 2 weeks of treatment. The study group-1 was received supervised exercise therapy (SET) with ergonomic advice (EA) alone, 45 minutes per day for 2 weeks, study group-2 was received spinal manipulation (SM) with ergonomic advice (EA), 45 minutes per day for 2 weeks (wks), and the study group-3 was received core stability exercise (CSE) with ergonomic advice (EA), 45 minutes per day for 2 wks. Baseline reading of postural instability was

measured by Win Track Platform, pain intensity was evaluated by NPRS, HRQOL was evaluated by the EuroQoL questionnaire, and PPT was measured by digital algometer. The intervention was 2 wks then post-readings were recorded after 2 wks of intervention and after 4 wks of follow up.

Treatment protocol for study group-1

Supervised exercise therapy (SET) and ergonomic advice (EA): The protocol for study group-1 (SG-1) to instruct for supervised exercise therapy (SET) with ergonomic advice (EA) for self-care was provided by exercises therapists to instruct the participants with 45 minutes sessions. Individualized sessions consisted of advice and teach on self-care procedures, for example, utilize of heat and ice, EA for home and workplace, and showing off goods lifting methods. Strengthening exercises and easy stretching, as well as lumbar ext., abdominal crunches, and bridging were showed and practiced among patients' participation. Participants of this study were given a paper explaining these exercises and were encouraged to implement them every day (McKenzie, 1997). The participants were taking notes in patients two wks afterwards and then taught to persist among the exercises on their own for the remainder of the treatment phase. The program has to be of low dose due to the effortlessness of the exercises, time necessary to execute them (2 to 3 minutes per series), and the low number of contributor visits.

Treatment protocol for study group-2

Spinal manipulation(SM) with ergonomic advice: The protocol for study group-2 (SG-2) allocated to this group receive SM treatment in addition to the ergonomic advice (described above). SM was delivered by a therapist who coordinated a systematic physical examination that contained palpation of the lumbar and sacral regions manually to evaluate local gentleness places of the segmental dysfunction/hypo-mobility to be manipulated. Spinal manipulation treatment technique for CNSLBP is generally performed on patients in the position of a side-lying on a treatment couch with the affected side upward. The therapist stands at the ventral aspect of the patient than the therapist holds the upper spinous process of the affected segment with the pulp of the thumb and the index finger. The therapist holds the spinous process of the lower vertebra

of the affected segment with the pulp and index finger of the other hand. The therapist holds the arm of the patient and pulls it to create rotation and stops as soon as the movement is perceived at the affected facet joints than therapist apply SM (high-velocity low amplitude thrust) while applying the force to the upper vertebra towards the couch and the lower vertebra away from the couch (Randoll et al., 2017 and Mohanty, 2010). This thrust was often accompanied by a popping sound or an audible cracking which represents the creation and suspension of small gas bubbles within the joint cavity resulting from pressure alters as the articular surfaces shortly split in response to HVLA thrust (Miranda et al., 2002).

Figure 3.4.1: Participant receiving spinal thrust manipulation

Treatment protocol for study group-3

Core stability exercise (CSE) with ergonomic advice (EA): The protocol for study group-3 (SG-3) patient assigned to this group participates in a core stability exercise in addition to the ergonomic advice (described above). Two experienced physiotherapists (Experience was not less than 1 years) has delivered and the total duration of exercise 45 minutes and executed exercises highlighting a higher number of repetitions (reps.) (2 to 3 sets of 15 to 30 reps. for all exercise) and continuous enhancement in muscle load. The participants were instructed to execute reps. until they could no longer do so utilizing proper figure. For all exercise, the participants initiated at the stage of trouble that permitted them to complete the minimum number of 15 reps. then they improved to the next stage when they were capable to execute the maximum of 30 reps. (Moon et al., 2013). CSE had been a plank, oblique plank, and superman. A) The process of plank became i) presuppose a frontage maintain circumstance laying on patient's forearms with shoulders straight over patients elbows, ii) positioned directly patient's legs out in the back patients and lift up hips to form a dead-instantly line from shoulders to ankles. Patients would be adjusted on forearms and toes, with lower abdomen and back working to preserve the body instantly. Maintain for one minute and 15 to 30 repetitions. B) Oblique plank-i) on the side, balance at the right forearm among shoulder beyond the elbow, ii) among legs out directly to the left pelvis so that stability on forearm and feet. The body needs to seem a direct line and feel the oblique muscles down the side trunk operating to hold the position, iii) preserve for 1 minute then reflect on another side, 15 to 30 reps. C) superman-i) stability on the floor on hands and knees. The lower back would be flat and hips equal to the ground, ii) raised the right arm out in front of patients and raised left leg out after patients, preservation it directly, iii) kept for 1 minute and the reflection on the other side, 15 to 30 reps.

Prone Plank

Superman Exercise

Oblique Plank

Figure 3.4.2 Core stability exercise

3.5 Outcome measures

3.5.1 Postural instability

Win Track platform has proven to be valid and has high inter-examiner reliability, r=0.95 (95% CI 0.82-0.96); the capability to preserve stability in an upright standing posture was measured by the Win Track platform (Win-Track, Medicapteurs, n^0-12k0022, Made in France), which measured the postural instability (i.e., the motion of ACOFP) in the side to side (Y) and anterior-posterior (X) directions. The participant stood gently on a firm platform (directly on Win track platform) for the time of 30 seconds while blindfolded and carrying socks without shoes. The first thirty seconds of the data were recorded at a sample rate of 1200 Hz utilizing monitor for the data acquisition software (Win Track software, 2014; Wilder DG et al., 2011). A large red dot placed at eye level about 4 meters in front of the force platform and asked the patients to fix their vision on a red dot. All stance positions were assessed among patients in bare feet with an average center of foot pressure in gram/cm^2. Postural instability (average center of foot pressure, g/cm^2) was assessed among participants with feet at equal distance from the midline of the platform.

Figure 3.5.1 Postural assessment by Win-track Platform

3.5.2 EuroQoL questionnaire

HRQOL assessed by the EuroQoL questionnaire, and has proven too valid and has high inter-examiner reliability (*r*=0.88) and it is a well-known questionnaire for HRQOL. EuroQoL questionnaire-5D-5L has 5 dimensions and 5 levels. The EQ-5D-5L evocative system contained the subsequent five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has 5 levels: no problems-1, slight problems-2, moderate problems-3, severe problems-4, and extreme problems-5. These facts might be applied as a quantitative evaluation of health as judged by the individual respondents (EQ-5D-%L User Guide, 2013). The instructions of the EQ-5D-5L task altered and made things easier. The EuroQoL group had received feedback over 15 days that respondents occasionally determined it complicated to draw a line from the box to the scale. The EQ-5D-5L now asked respondents to simply 'mark an X on the scale to point out how your health is TODAY' and then to 'write the number you marked on the scale in that box has been determined to be high (ICC=0.96; 95% confidence interval (CI: 0.91-0.96) (The EuroQol Group., 1990; Elen B et al., 2011).

3.5.3 Pressure pain threshold

A digital algometer was used to find out and confined tenderness by measurement of PPT of all patients. It was described as the amount of pressure parallel when the sensation of pressure alters to a perception of pain; a digital algometer (DA-112, Jagson scientific Industries, 6, M.C. Market, Ambala, India) was used. The physiotherapist were instructed the participants to lie down prone position on the table. This device consists of a round probe (1 cm^2) vertically to the patient's skin and the pressure was applied at a rate of 5 N/s. when the sensation of the algometer pressure or discomfort feeling of pain that time the participants have instructed to say "stop". The mean of three trials (intra-examiner reliability) was recorded and utilized for the core analysis. A 30-second resting phase was permitted between each trial (Dorron et al., 2016; Meeus et al., 2010 and O'Neill et al., 2011). The reliability of digital algometer has been determined to be high, *r*=0.89 (ICC=0.94; 95% confidence interval (CI: 0.90 to 0.96). Pressure pain threshold

has been assessed by digital algometer between lumbar vertebra1 to 5 bilaterally of the lumbar region.

Figure 3.5.3 Digital algometer

3.5.4 Numeric Pain rating scale

The reliability of the numerical pain rating scale has been determined to be high, *r*=0.93. The NPRS is a line marked among the numbers 0 to 10 at equal intervals where zero is ‘no pain’ and 10 is ‘worst pain imaginable.’ Participants marked the circle of that number and that represented their present pain intensity. There was proof to support the reliability and validity of the NPRS in younger and older patients (Jensen et al., 1999 and Gagliese., 2001). It had standard validity, convergent, low error rates, higher face, conflicting than the other scales. Most significantly, properties were not age-related. Pain intensity was measured baseline, after two wks of intervention and follow up after four wks.

3.6 Statistical tools

The sample size was considered by using equation no. 1 given below by preceding studies assessing exercise and SM. It is expected that to detect at least a medium effect size difference in pain between groups in both the short and long-term (Bronfort et al., 2008). With a three groups design, a power of 0.80, and an alpha level of 0.05, 66 individual were needed in each group (Cohen, 1988). To allow for a drop-out rate of 15%, we recruited a total of 198 participants (66 per group).

The data were entered in Microsoft Excel and then exported to SPSS version 19, where it used to analyze the data obtained from Win Track Platform, euroQoL questionnaire, digital algometer and NPR scale. Data analysis was measured after collecting the data for four outcome measures of the subjects in all the three groups consisting of ACOFP, EuroQoL questionnaire, NPRS, and PPT. SG-1 intervention consisted of supervised exercise therapy and ergonomic advice, in SG-2, received spinal manipulation (HVLA thrust) with ergonomic advice and SG-3 core stability exercises with ergonomic advice was given. Since the sample size was large (n=66 in SG-1, n=66 in SG-2, n=66 SG-3) changes in scores for all outcome measures were calculated using end intervention (2 wks) and baseline values. These were when analyzed for group's difference through two-way analysis of variance.

By evaluating the experimental value of F-test with the equivalent table value it was inferred whether the difference between the variances of samples could have arisen because of sampling for degrees of freedom, then it is regarded as significant. If F-ratio is not the significant null hypothesis is accepted. Similarly, two-way ANOVA, one considers the difference among numerous sample means as significant or a matter of sampling fluctuations. A statistical significance (p<0.05-time group interaction effect indicated a significant intervention effect. For this purpose, the table values are looked in for degrees of freedom at various levels of impact (Kothari 2007).

Sample size equation

The sample size was calculated using equation no. 1

$$n = \frac{\frac{Z^2 \times P(1-P)}{e^2}}{1 + (\frac{Z^2 \times P(1-P)}{e^2\ N})} \quad ---------- (\text{Eq. no. } 1)$$

$$n = \frac{\frac{1.96^2 \times .5(1-.5)}{.05^2}}{1 + (\frac{1.96^2 \times .5(1-.5)}{.05^2\ \times 406})} = \frac{\frac{.9604}{.0025}}{1 + (\frac{.9604}{1.015})} = \frac{384.16}{.9462} = 197.46 = 198$$

Where n= sample size

Z= is the critical value of the normal distribution of α/2 (e.g. 95% Confidence level, α is .05 and critical value is 1.96)

P= Expected proportion in population-based on previous studies or pilot studies (if not sure, leave this as 50%)

e= Margin of error (confidence interval) of ± 5%.

N=Population size (406)

Arithmetic means: it gives the common value of the total range of the data given. The value is received by including together all the items and through dividing this total by the number of items. Using statically equation for the mean of different groups and variables were calculated by:

$$X=\frac{\sum \mathcal{X}}{n} ---------- (\text{Eq. no. } 2)$$

Where=Arithmetic mean

∑=sum of the variables

N=the total number of variables

Standard deviation: it is described as the positive square root of the arithmetic mean. It is used generally in research studies and is considered to be the best measure of the depression of a series.

$$\mathcal{S} = \sqrt{\frac{\sum(x-x)^2}{n-1}} ---------- (\text{Eq. no. } 3)$$

Where S=the standard deviation

X=each value in the sample

$\overline{X}$= the mean of the values

$$F\ value = \frac{variance\ 1}{variance\ 2} = \frac{\sigma_1^2}{\sigma_2^2} ---------- (Eq. no. 4)$$

Variance is given by the following equation,

$$\sigma^2 = \frac{\sum(x-x)^2}{n-1} - - - - - - - - - (\text{Eq. no. } 5)$$

Where,

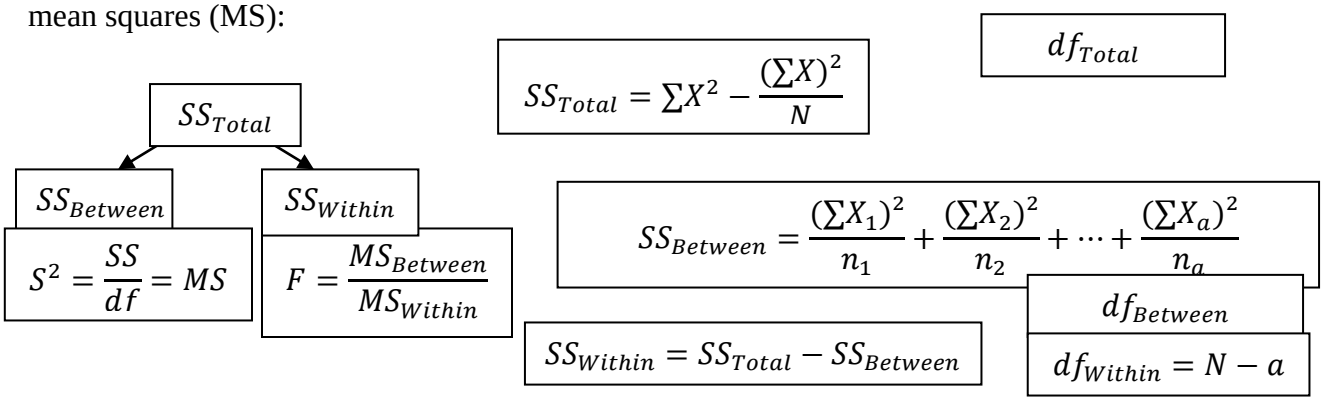
σ^2= Variance

x= Values given in a set of data

$\bar{x}$=Mean of the data

n=Total number of values.

Two-way ANOVA: ANOVA analyzed sample variances to draw inferences about population means, sample variances can always be calculated as SS/df and these sample variances are called mean squares (MS):



---------- (Eq. no. 6)

Where,

SSwithin = sum of squares within the groups

SSbetween=sum of squares between the groups

df=degrees of freedom

MS=mean of squares

N=number of values

Steps for post hoc

1. Calculate an ANOVA (e.g., Two-way between-subjects analysis of variance)
2. Choose two means and note the appropriate variables (Means, Mean Square within, and number per condition/group).
3. Calculate the Bonferroni test for each mean comparison.

4. Make sure to see if Bonferroni score is statistically considerable with Bonferroni possibility/critical value table taking into account proper df_{with} and number of interventions.

$$\frac{M_1 - M_2}{\sqrt{MS_W}(\frac{1}{n})}$$

M= Treatment group mean.

N=Number per treatment/group. ---------- (Eq. no.7)

CHAPTER-5

DISCUSSION

In the present randomized clinical trial was carried out to determine the efficiency of spinal manipulation, core stability exercises and supervised exercise therapy with common ergonomic advice on postural instability and HRQOL in patients among CNSLBP. A combination of an average center of foot pressure (postural instability) measurement by Win-Track Platform; HRQOL evaluated by using euroQoL questionnaire; pain sensitivity (PPT) assessment by using digital algometer and NPRS for pain intensity was used to evaluate the efficiency of SM-HVLA thrust techniques in patients among CNSLBP.

The purpose of this study was to determine the efficiency of SM-HVLA thrust technique on postural instability and HRQOL in patients among CNSLBP. The first specific objective was to evaluate the efficiency of SM on postural instability and pain sensitivity patients among CNSLBP which compared with supervised exercise therapy and core stability exercise. The 2nd specific objective was to evaluate the efficiency of SM on pain intensity and HRQOL among patients among CNSLBP which compared among a core stability exercise and home exercise program in patients among CNSLBP.

5.1 Demographic data

The demographic data of the study of gender exposed near about 2:3 ratio all groups of male and females individually, with males, were 44% and females 56% of the total intake which supported (Koes et al., 2010) review that the lifetime prevalence was illustrated to be more significant in females (56.4%) as resisted to for men (48.4%); this was supported by the findings in the present study. The allocation within the sample of 198 participants (Table 4.1) revealed that most of the patients fell into the 24 to 26 years age group (GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. 2017). Cassidy et al. reported the frequency of CNSLBP aged between 18-65 years which supported the present research. The current study age distribution and anthropometric

variables (height, weight) showed no statistical difference in the groups which represents the homogeneity of participants.

For postural instability (average center of foot pressure), these data did not support the null hypothesis as after 2 wks of intervention and after four wks of follow-up for SG-1, SG-2, and SG-3 achieved significance among p=0.001 and p=0.001 individually. For HRQOL (EuroQoL questionnaire to discover, the null hypothesis was rejected for all three groups after 2 wks of intervention and after four wks of follow-up and demonstrated p=0.001 and 0.003 respectively. For pain sensitivity (PPT), these data supported the hypothesis as three groups reading after 2 wks of intervention and after four wks of follow-up failed to get considerable among p-value=0.001 and p=0.001. For pain intensity (NPRS) to discover, the null hypothesis was rejected for all three groups post-test reading after 2 wks of intervention and after four wks of follow-up and achieved significant among p=0.041 and p=0.002 individually.

Reviewing the outcomes outlined above, it can be recommended that each group of spinal manipulation responded to all the parameters of this study. Results of this review were focused on the improvement of postural instability, pain relief, and improvement of HRQOL based on the EuroQoL questionnaire scores. It was observed that there was progress in all the above parameters in three groups.

5.2 Intra-group comparison (SG-1, SG-2 and SG-3)

Postural instability

The statistical data for the centre of foot pressure was located in Table 4.2 comparisons within supervised exercise therapy with ergonomic advice (SG-1) group at the baseline, post-reading after 2 weeks and follow-up after four weeks showed that there was no statistically significance improvement of postural instability after 2 weeks of treatment and effect size was very small (η^2=0.01, p=0.99). However multiple comparisons (Table4.6) between after two weeks of intervention and follow-up after four weeks of the outcome within supervised exercise therapy group (SG-1) was no significant improvement of postural instability (p=1.00). (Ferreira et al, 2007; Wilder et al., 2011)

recommend that CNSLBP was usually treated among exercise or SM. The European Guideline for treatment of CNSLBP revealed SET as first-line management.

Similarly, spinal manipulation with ergonomic advice group (SG-2) Table 4.2 comparisons within-group SG-2 for the average centre of foot pressure at baseline, post-reading after 2 wks and after four weeks of follow-up produced that there was a significant mean difference after 2 wks and four weeks of follow-up but long-term improvement after 4 weeks and the effect size was very large (η^2=0.90, p=0.01), whilst multiple comparisons (Table4.10) between after two weeks intervention and follow-up after four weeks of the outcome within the spinal manipulation group (SG-2) was a significant improvement of postural instability (p=0.001). However, there was an enhancing the body of evidence recommending that spinal manipulation presented a major an advantage to patient among CNSLBP and also changed the biomechanical and neural of the spine. Panjabi recommended a theory that linkage injury in the disc and ligaments of the lumbar spine to muscles control instability observed in CNSLBP. Incorrect feedback from proprioceptors in muscles, ligaments, and joints might be avoiding the proper beginning of protective muscle responses.

Core stability with ergonomic advice group (SG-3) Table 4.2 comparisons within-group SG-3 for the average centre of foot pressure at baseline, post-reading after 2 weeks and follow-up after four weeks produced that there was the significant mean difference after 2 weeks and follow-up four weeks but long-term improvement after 4 weeks and the effect size was less than SG-2 (η^2=0.51, p=0.01), whilst multiple comparisons (Table4.14) within-group baseline & after 2 weeks intervention was marked difference and statistical significant (p=0.001) whilst after two weeks intervention & follow-up after four weeks of the outcome within core stability exercise group (SG-3) was no significant long term effect of postural instability (p=0.18).

There were significant works demonstrating that the proprioceptors in muscles and joints might be stimulated by the forces of the magnitude of spinal manipulation loads and improved postural instability (Wilder et al., 2011)). The neurophysiological evidence supported that spinal manipulation potentially long-term influence on the

nervous system can be regarded, changes in spinal biomechanics and improved the postural instability caused by spinal manipulation (Pickar and Bolton 2012).

It has been assumed that thrust like forces formed through high-velocity, low-amplitude treatments obtain reflex reactions, which in turn might manipulate spinal health in different of methods: reflex inhibition of spastic muscles, reducing pain, and short-term reflex activation of skeletal muscles of the back and upper and lower limbs. Theoretically, the reflex responses (or inhibitions) may be obtained from a diversity of receptors, including the diverse mechanoreceptors in spinal facet joints capsule, nociceptors, cutaneous receptors, and the proprioceptors of skeletal muscle groups: Golgi tendon organs and the muscle spindles (Gillette, 1987).

The muscle stretching, and then the muscles spindle gives upward to indicators in the afferent spindle pathways (Ia). These signals enter the spinal column via the dorsal roots. Interneuron connections permit for the transmission of these signals to other spinal levels and to the motor neurons, the efferent pathway to the motor units of skeletal muscles that generate reduction. In general, reflex pathways are excitatory or inhibitory for a particular muscle; that is, they tend to lessen or stop muscular contraction and force production, or they tend to increase or instigate contraction and force production, respectively. The reflex action from a particular pathway may be inhibitory or excitatory for a particular muscle, depending on the task. Such as, Golgi tendon activity is inhibitory to the host muscles for isometric contractions but shows to be excitatory at some confident stages in positive tiers of the step cycle in locomotion (Suter et al., 1994).

Physiological effects produced during spinal manipulation articular noise and audible release, and they have stimulated the imagination of manipulation researchers for decades (e.g., Sandoz). Scientific evidence suggests that the audible release is associated with the cavitations of spinal facet joints6; however, this association could not be proven scientifically to date. Force and sound (or acceleration) measurements while distracting human metacarpophalangeal joints have provided tremendous insight into the mechanics of joint cavitation. When the tensile force applied along with the longitudinal axis of a

finger, the corresponding facet joint space increases. The amount of joint distraction for a given increase in force is initially small; that is, the joint is relative stiff (Pearson, 1993). Overall statistical data was noted that significantly improved postural instability within groups at after pre-test to after 2 weeks and follow-up after 4 weeks. Inpatient with CNSLBP, the normal amounts of these motions enhanced in the engaged sections because of the instability of movement controlling factors. Local muscles played an important role in maintaining postural stability and controlling intervertebral movement [Kong et al., 2009; Lederman, 2010; Areeudomwong et al., 2012).

A number of researchers informed that injury in local muscles function might alter the extent of segmental vertebral movement. Thus, Training of local muscle by particular exercises (stabilization exercises) was anticipated to progress intervertebral movement and result in good postural instability (Panjabi, 2003; Hicks et al., 2005). Exercises of core stability of lumbar region were meant at improvement of neuromuscular control, and the endurance of the trunk muscle was required for preserving postural stability (McGill, 2007; Moon et al., 2013; Franca et al., 2012). The evidence supported that the management of postural instability was supported on motor control re-training and re-education programs involving postural control re-training, segmental stabilization exercises utilizing multifidus and transverse abdominis co-activation (Kumar, 2011; Javadian et al., 2012). Another study concluded that CSE was more efficient in the improvement of postural instability in patients among CNSLBP (Javadian et al., 2015).

Numerous electromyography types of research has been reported alters in spinal muscles enrollment patterns after short and long-term specific core stability treatment inpatient among CNSLBP. It had been reported that temporally later in the preprogrammed feed-forward correction the amplitude of activation, firing patterns and reorganization of the trunk muscles illustration at the motor cortex got after specific stabilization exercises focused on multifidus and transversus abdominis co-contraction (Henry and Hodges, 2008; O'Sullivan et al., 1998; Tsao and Hodges, 2007). On other hands not emphasizing the local core muscle activation throughout exercises established

among no alters in relative electromyography amplitudes of local muscles after twelve weeks of complicated stabilization exercise training CNSLBP (Arokoski et al., 2004). An additional study accomplished that comparison of CSE and conservative physiotherapy on postural control impairment in patients among CNSLBP. CSE the group revealed significant progress after treatment in postural stability control (Muthukrishnan et al., 2010).

EuroQoL questionnaire

In this study, the statistical data for the euroQoL questionnaire readings are located in Table 4.3 revealed comparisons within supervised exercise therapy with ergonomic advice group (SG-1) at baseline, post-reading after two weeks and follow-up after four weeks. Analysis of the outcomes was no statistically significant progress of HRQOL after two weeks of intervention and after four weeks of follow-up and effect size was small (η^2=0.02, p=0.94), home exercise program. Evidence suggested that regarding home exercise program on NPRS and progressing HRQOL (Koes and Van Tulder, 200506). whilst multiple comparisons (Table4.7) between baseline & after 2 weeks of intervention was markedly difference and statistical significant (p=0.001) whilst comparison after two weeks of intervention & after four weeks of follow-up of the outcome within core stability exercise group (SG-1) there was no significance long term effect of HRQOL (p=0.13)

Spinal manipulation with ergonomic advice group (SG-2) Table 4.3 comparisons within-group SG-2 for euroQoL questionnaire reading at baseline, post-reading after 2 weeks and follow-up after four weeks produced that there was a significant mean difference after 2 weeks and follow-up four weeks but long-term improvement after 4 weeks and the effect size was very large (η^2=0.95, p=0.01), whilst multiple comparisons (Table4.11) between baseline & after 2 weeks of intervention and after two weeks of intervention & follow-up after four weeks of the outcome within spinal manipulation group (SG-2) was a significant improvement of HRQOL (p=0.001). Regarding spinal manipulation, Marjorie Chown et al conducted that patients treated with exercise therapy, physiotherapy or manipulation therapy and a randomized clinical trial with 239

participants among CNSLBP. The outcome was a significant progress of HRQOL at manipulation group which supported our study (Marjorie et al., 2008; Brian et al., 2017).

Core stability exercise with ergonomic advice group (SG-3) Table 4.3 comparisons within-group SG-3 for the euroQoL questionnaire reading at baseline, post-reading after 2 wks and follow-up after four wks produced that there was a significant mean difference after 2 wks of intervention and after four wks of follow-up but long-term improvement after 4 weeks of follow-up and the effect size was less than SG-3 (η^2=0.89, *p*=0.02), whilst multiple comparisons (Table4.15) between baseline & after 2 wks of intervention and after two wks of intervention & after four wks of follow-up of the outcome within core stability exercise group (SG-3) was a significant long term effect of HRQOL (*p*=0.001). Brain J et al. (2017) conducted a systemic review in 5 studies including 414 participants with general exercise therapy group versus core stability group whereas outcome was a significant improvement in the group received core stability (mean difference was -7.14, 95% CI= -11.64, -2.65; P= 0.002) which support this review. According to the outcome of this study, there was a significant progress in HRQOL. This progress might be as an outcome of the pain decreasing ability by the core stability exercises following appropriate adherence to the core stabilization exercises procedure for 4 wks and the general relaxation results that observed exercises.

The overall finding for the EuroQoL questionnaire on within-group comparison at after 2 wks of intervention and after four wks of follow-up disclosed a statistically significant improvement whereas spinal manipulation with ergonomic advice group (SG-2) was found the more significant mean difference of HRQOL. CNSLBP was usually managed with exercise or spinal manipulation. The European Guidelines for treatment of CNSBLP suggested core stability or SET as a first-line treatment. The same guidelines suggested that a short session of SM should be considered while the best intervention preference (Moussouli et al., 2014).

According to the outcome of the study, there was significant progress of HRQOL. This progress might be as an outcome of the pain-reducing the ability of the core stability exercises following appropriate adherence to the core stabilization exercises

protocols for 2 wks of intervention and the general relaxation effect that observed exercises. This study has also provided that psychological factor and functional status seem to decide HRQOL in CNSLBP patients (Moussouli et al., 2014; Horng et al., 2005; Schiphorst et al., 2008) .

Pressure pain threshold (pain sensitivity)

The statistical data for the pressure pain threshold is placed in table 4.4 within home exercises program and ergonomic advice group (SG-1) at baseline, post-reading after 2 weeks and follow-up after four weeks which statistical analysis revealed that there were no significant mean changes and the effect size was small (η^2=0.06, p=0.07) and did not improve the pain sensitivity by supervised exercise therapy with ergonomic advice. However, multiple comparison Table 4.8 within supervised exercise therapy with ergonomic advice group (SG-1) at baseline & post-reading after 2 weeks of intervention and post-reading after 2 wks of intervention & after four weeks of follow-up exposed that there were no significant changes in pain sensitivity of SET with EA group (SG-1).

Similarly, The statistical data for the pressure pain threshold placed in Table 4.4 within the SM with EA group (SG-2) at baseline, post-reading after 2 weeks and follow-up after four weeks which statistical analysis revealed that there was the significant improvement of pain sensitivity and the effect size was large (η^2=0.93, p=0.04). Whilst multiple comparison Table 4.12 within spinal manipulation with ergonomic advice group (SG-2) at baseline & post-reading after 2 weeks of intervention and after 2 weeks of intervention (p=0.001) & follow-up after four weeks (p=0.001) exposed that there was a significant change of pain sensitivity by spinal manipulation with ergonomic advice group (SG-2).

The statistical data for the pressure pain threshold placed in Table 4.4 within core stability exercise and ergonomic advice group (SG-3) at baseline, post-reading after 2 weeks and follow-up after four weeks which statistical analysis revealed that there was a significant improvement of pain sensitivity and the effect size was large (η^2=0.81, p=0.01) but less than spinal manipulation group. Also, Analysis of data Table 4.16 multiple comparisons within the core stability exercises with ergonomic advice group

(SG-3) at baseline & after two wks of intervention and after two wks of intervention & after four weeks follow up determined that there was a significant improvement of pain sensitivity of core stability exercises with ergonomic advice group (SG-3)

The overall finding for pressure pain threshold within-group comparison at after 2 weeks of intervention and after four weeks follow-up revealed a significant improvement of pain sensitivity while spinal manipulation with ergonomic exercise group (SG-2) was found a significant mean difference of PPT in patients with CNSLBP. Spinal manipulation was associated with the difference in pain sensitivity, suggesting a mechanism correlated to decreasing of central sensitization (Schiphorst et al., 2008).

Spinal manipulation results in enhanced mechanical pain thresholds in individuals among neck pain and several studies have considered the instant effects of manipulative therapy interventions upon neurophysiological reply such as alters in pain sensitivity. A methodological weakness of these studies was the failure to the connection of the experimental findings to the clinical conclusion (Cook, 2011). The clinical findings of the current review allocated for interpretation of the clinical significance of spinal manipulation connected difference in pain sensitivity. Our findings also inspected alter in pain sensitivity following SM in patient among CNSLBP. (Coronado et al., 2012).

However, the only study that included assessment of pressure pain threshold in patients among CNSLBP did not show pressure pain threshold changes after SM (Cote, 1994). In outcome, the summary effect estimation revealed a small favourable, but no considerable, the efficacy of SM on enhancing pressure pain threshold in participants who were symptomatic. This study also concluded that the effect of SM on PPT was largest when assessed at an isolated anatomical area, which was not detected in our study. Our review might add significant information about the efficiency of SM on PPT in patients among CNSLBP, as more than half of the reviews included in the systemic review engaged only people who were healthy.

Numeric pain rating scale (pain intensity)

The statistical data for numeric pain rating scale placed in table 4.5 within supervised exercise therapy and ergonomic advice group (SG-1) at baseline, post-reading

after 2 weeks and follow-up after four weeks which statistical analysis revealed that there were no significant mean changes and the effect size was small (η^2=0.05, p=0.58) and did not improve the pain intensity by supervised exercise therapy with ergonomic advice. However, multiple comparison table 4.9 within SET with EA group (SG-1) at baseline & post-reading after 2 weeks of intervention and post-reading after 2 weeks of intervention & follow-up after four weeks exposed that there were no significant changes in pain intensity of SET with EA group (SG-1).

Similarly, The statistical data for numeric pain rating scale scores placed in Table 4.5 within the SM and EA group (SG-2) at baseline, post-reading after 2 weeks and follow-up after four weeks which statistical analysis revealed that there was a significant reducing of pain intensity and the effect size was large (η^2=0.97, p=0.01). Whilst multiple comparison Table 4.13 within spinal manipulation with ergonomic advice group (SG-2) at baseline & post-reading after 2 weeks of intervention and after 2 weeks of intervention (p=0.001) & follow-up after four weeks (p=0.001) revealed that there were a significant reduction of pain intensity by spinal manipulation with ergonomic advice group (SG-2). A recent study revealed that a mechanical force from SM began a cascade of neuro-physiological reaction from central and peripheral nervous systems that might clarify progress in scientific results such as pain intensity in CNSLBP (Arokoski et al., 2004). A latest systemic review investigating significant reduces in pain intensity (mean difference, -12.91; 95% CI, -0.58 to -0.82) following spinal manipulation in patients among CNSLBP (Bialosky et al., 2009).

The statistical data for numeric pain rating scale scores placed in Table 4.5 within core stability exercise and ergonomic advice group (SG-3) at baseline, post-reading after 2 wks and after four wks of follow-up which statistical analysis revealed that there was a significant improvement of pain intensity and the effect size was large (η^2=0.79, p=0.03) but less than spinal manipulation group. Also, Analysis of data Table 4.17 multiple comparisons within the core stability exercises with ergonomic advice group (SG-3) at baseline & after two wks of intervention and after two wks of intervention & after four weeks follow up determined that there was a significant improvement of pain sensitivity

of core stability exercises with ergonomic advice group (SG-3). In a meta-analysis, Hayden et al (2005) presented sustains for the use of exercises in adult patients among CNSLBP and found that exercises reduced pain and progress physical function by modest amounts whereas spinal manipulation with ergonomic advice group was a more significant difference in numeric pain rating scale scores. Numerous systematic studies into the management of CNSLBP had been published.

5.3 Inter-groups comparisons

Postural instability (ACOFP)

The statistical data for the average centre of foot pressure was situated in Table 4.18 and 4.19. Post hoc Bonferroni analysis at after 2 weeks of intervention results between groups SG-1, SG-2 and SG-3 revealed that there was a significant improvement of postural instability and reduced average centre of foot pressure whereas spinal manipulation with ergonomic advice the treatment group was more improvement compare to other two groups and decreased the mean values and large effect size was large ($F_{2, 195}$=9.40, p=0.01, partial η2=0.87). Similarly, data analysis at after 4 weeks of follow-up results between groups SG-1, SG-2, and SG-3 explored that there was a significant difference in postural instability in patients among CNSLBP but spinal manipulation with the ergonomic the group was more stable compared to supervised exercise therapy and core stability exercise groups and large effect size ($F_{2, 195}$=11.36, p=0.01, partial η2=0.93). This study found that the average centre of foot pressure in patients among non-specific LBP is altered and this study evaluated that postural instability was significantly improved by spinal manipulation with ergonomic advice which supported. We have also revealed that conducted randomized study with 105 patients' recruited and SM- HVLA loads to the lumbopelvic region which compared with sham treatment and concluded that significant improvement of postural sway. (Wilder et al., 2011)

EuroQoL questionnaire

The statistical data for the euroQoL questionnaire multiple comparisons between the groups were situated in Table 4.20 and 4.21. Statistical analysis discovered that there was a significant improvement of HRQOL between the groups supervised exercise therapy with ergonomic advice, spinal manipulation with ergonomic advice, and core stability exercises with ergonomic advice at after 2 weeks of intervention (p<0.05) but spinal manipulation with ergonomic advice mean difference was less compared to the other two groups and the effect size was large ($F_{2,\ 195}$=15.14, p=0.001, partial η2=0.87). After 4 weeks of follow up post-hoc Bonferroni statistical analysis between the groups found that there were significant changes between the groups (p<0.05) but SM with ergonomic advice group was a more significant difference of HRQOL in patients among CNSLBP and the effect size was large ($F_{2,195}$=5.97, p=0.003, partial η2=0.94). According to the outcome of this review, there was significant progress of HRQOL. This progress might be as an outcome of the pain-reducing ability of the core stability exercises following appropriate adherence to the core stabilization exercises procedures for 4 weeks and the general relaxation effect that observed exercises.

Pressure pain threshold (pain sensitivity)

In the current study, the statistical data analysis for the pressure pain threshold multiple comparisons between the groups are located in Table 4.22 and Table 4.23. Statistical post hoc Bonferroni analysis determined that there was a significant improvement of pain sensitivity between the groups home exercise program with ergonomic advice, SM and ergonomic advice, and core stability exercises and ergonomic advice at after 2 weeks of intervention (P<0.05) but SM with ergonomic advice group was more mean difference compared to the other two groups and the effect size was large ($F_{2,195}$=21.68, p=0.01, partial η2=0.93). Post Hoc Bonferroni statistical analysis between the groups at after four weeks of follow-up discovered that there was a significant improvement of pain sensitivity between the groups in patients with CNSLBP (p<0.05) but spinal manipulation with ergonomic advice group was the greatest mean values compare to others, two groups and improved the pain sensitivity in patients among

NSCLBP and effect size was large ($F_{2, 195}$=17.41, p=0.01, partial η2=0.94). Spinal manipulation was associated with the difference in pain sensitivity, suggesting a mechanism correlated to decreasing of central sensitization (Schiphorst et al., 2008).

Numeric pain rating scale (pain intensity)

The statistical data analysis for the numeric pain rating scale multiple comparisons between the groups were located in Table 4.14. Statistical Post Hoc Bonferroni analysis revealed that there were significant mean changes of pain intensity between the groups home exercise program, with ergonomic advice, spinal manipulation with ergonomic advice, and core stability exercises with ergonomic advice at after 2 weeks of intervention (p<0.05) but spinal manipulation with ergonomic advice group was relief of pain intensity in patients among CNSLBP.

Post-hoc Bonferroni statistical analysis between the groups at after four weeks of follow up discovered that there was a significant improvement of pain intensity between the groups supervised exercise therapy with ergonomic advice, spinal manipulation with ergonomic advice, and CSE with EA in patients among CNSLBP (p<.05) but spinal manipulation with ergonomic advice group was more significant difference pain intensity evaluated to the other two groups. Anderson et al. executed the effect size pooling for 23 low back pain trials, 5 of which were non-randomized, and resulted that spinal manipulation was constantly more efficient than a number of comparison treatments. A sensitivity analysis including only the reviews among comparatively high-quality scores yielded a little lower pooled the approximation of effect size (Anderson et al., 1992). In the same way, Di Fabio revealed that the published clinical trials have given evidence of the effects of SM for management of CNSLBP and significant improvement of pain intensity (Di Fabio, 1992).

CHAPTER-6

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSIONS

For CNSLBP, SM with ergonomic advice was more efficient and effective intervention than core stability exercise and supervised exercise therapy with ergonomic in relieving pain, improving postural instability and HRQOL in patients among CNSLBP. Hence spinal manipulation should be tried on patients with CNSLBP in comparison to other treatments like core stability exercise and home exercise program.

Between-groups comparison revealed that there was a statistically significant improvement of postural instability and HRQOL after 2 wks of intervention and 4 weeks of follow-up whilst within-group comparison spinal manipulation with ergonomic advice group showed better efficacy in improving postural instability and HRQoL than core stability exercise and supervised exercise therapy groups. Between-group comparison determined that there was a statistically significant reduction of pain intensity and sensitivity after 2 wks of intervention and 4 wks of follow-up whilst within-group analysis, spinal manipulation with ergonomic advice group showed better efficiency in the reduction of pain intensity and sensitivity than core stability exercise and supervised exercise therapy with ergonomic advice groups after 2 wks of intervention and follow-up after 4 weeks.

In conclusion, the present randomized clinical trial provided evidence to support the using of spinal manipulation with ergonomic advice, core stability exercise and supervised exercise therapy with ergonomic advice in reducing pain, getting better postural instability and HRQOL in patients among CNSLBP. As well as, an outcome of this study supported that spinal manipulation was more efficient than CSE and SET in relieving pain intensity and improving pain sensitivity, postural instability and HRQOL in patients among CNSLBP. Awareness of this therapeutic needs time to become popular among clinicians as well as clients.

6.2 LIMITATIONS AND RECOMMENDATION

1. This was a heterogeneous group among both male and female population, further research could be done taking on a homogenous sample among either male or female patients individually which would thus allocate for greater precision and reliability of the outcome.
2. Researches among longer duration are recommended and longer follow-up period to evaluate long-term advantages of each treatment protocol.
3. Static posture measurements were taken using the latest Win Track Platform with eye-opening; in future research could be done taking static and dynamic posture measurements with eyes opening and closing procedure which would thus allocate for greater precision and reliability of outcomes.
4. The demographic outcome from Table 4.1 showed that three groups to be very similar in terms of age and gender distribution but the particular occupation was not considered. The discrepancies in the study population with regard to occupation distribution could be probably influence the interpretation of the outcome.
5. In an attempt to deal among numerous ambiguities surrounding the assessment and the intervention of CNSLBP, researchers have produced and examined scientifically prediction policies to discover sub-groups of CNSLBP patients that can reply positively to particular treatments.

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PUBLICANTION

Publications with full details

1. Kanchan Kumar Sarker, Jasobanta Sethi and Umasankar Mohanty. Effect of spinal manipulation on pain sensitivity, postural sway, and health-related quality of life among patients with non-specific chronic low back pain: A randomized control trial. Journal of clinical and diagnostic research. 2019; 13(2):YC01-YC05.
2. Kanchan Kumar Sarker, Jasobanta Sethi, and Umasankar Mohanty. Effect of spinal manipulation on specific changes in segmental instability, pain sensitivity and health-related quality of life among patients with chronic low back pain-A randomized clinical trial. ARRB. 2017; 18(2): pp 1-10.
3. Kanchan K, Umasankar M, and Jasobanta S. Effect of spinal manipulation on postural instability in patients with non-specific low back pain. Int J Pharm Bio Sci. 2016; 7(3): (B), pp 992-999.
4. Kanchan Kumar Sarker, Umasankar Mohanty, and Jasobanta Sethi. Effects of spinal manipulative therapy on postural stability and quality of life among patients with non-specific low back pain-a randomized clinical trial. J Phys Ther. 2015; 12: pp 11-22.
5. Manuscript has been accepted for publication in "Journal of Natural Science, Biology and Medicine". Title was "Comparative clinical effects of spinal manipulation, core stability exercise on pain intensity, segmental instability and health-related quality of life among patients with chronic non-specific low back pain: A randomized control trial".(Accepted 6th September 2019).
6. Manuscript has been accepted for publication as a book chapter in the following book: Current Trends in Medicine and Medical Research Vol. 5. Title was "Spinal Manipulation on Segmental Instability, Pain Sensitivity and Health- Related Quality of Life in Chronic Non-specific Low Back Pain". (Accepted 3rd August 2019).

Conferences Attended:

1. Paper presented in the 54th annual conference of Indian Association of Physiotherapist (IAP) held at Sai Palki Nivara, Shirdi from 19th to 21st February, 2016.
2. Paper presented in the 6th international Conference of Physical Therapy-AIIMS-2017, held at Neuro-Physiotherapy Unit, Neurology Department, AIIMS, New Delhi from 9th to 10th December 2017.
3. Paper presented in the 1st international conference on Orthopaedic Manual Therapy Conference (1st OMPTCON 2018) held on 11th march 2018 in Centre for Physiotherapy and Rehabilitation Sciences, Jamia Millia Islamia, Great Noida and organizing by Academy of Orthopaedic Manual Physical Therapists.
4. Paper presented in the 1st international conference on expanding domains of physiotherapy held from 12th to 13th April 2019, organized by school of physiotherapy and paramedical sciences, Lovely Professional University, Punjab.
5. Paper presented in 2nd international conference of Pharmacy (ICP-2019) held on 13-14th September 2019 organized by School of Pharmaceutical Science, Lovely Professional University, Punjab, India.

APPENDICES

APPENDIX-1

(INFORMED CONSENT-ENGLISH)

Sir/Madam,

You are invited participate in the study titled "Efficacy of spinal manipulation on postural instability and quality of life in patients with chronic non specific low back pain."

Basis of subject selection

The reason you are invited to participate in this study is because you are between 18to 60 years of age and you are having non-specific chronic back pain at least 12weeks.

Purpose of this study

To analyze efficacy of spinal manipulation on postural instability and quality of life in patients with non specific chronic low back pain.

Description of study

After assessing the pain sensitivity by algometer, pain intensity by numeric pain rating scale, postural instability by Win-track gait analyzer and quality of life analyzed by Euro Qol questionnaire, you will be assigned in control group, study group-1, and study group-2 for 2 weeks with treatment protocol then the variables mentioned above will be assessed again.

Benefits of the study

Benefits of the study lies in its application of physiotherapy among patients with non specific chronic low back pain.

Side effects

Whole research procedure is not having any side effects.

Confidentially

All the information will be kept strictly confidential, limits to supervisor Prof. (Dr.) Umasankar Mohanty and co-supervisor Prof. (Dr.) Jasobanta Sethi and will not be shared with other person.

Refusal or withdrawal

You may refuse to participate in this study and if you do consent to participate then you will be free to withdraw from the study at any time without consequence, fear or prejudice. In the event of withdrawal, all data pertaining to you will be destroyed.

Voluntary participation

I understand that participation in this study is voluntary. I may withdraw from this study at any time and for any reason without penalty .The name, address and telephone no. of the person to contact (if required) in reference to this study is given.

This study has been explained to me, I have read the consent form and I agree to participate. I have a copy of this signed consent form.

Signature of participant

Date…….

Kanchan Kumar Sarker

PhD scholar

INFORMED CONSENT-PUNJABI

ਸੂਚਿਤ ਸਹਿਮਤੀ

ਸਰ / ਮੈਡਮ,

ਤੁਹਾਨੂੰ "ਪੁਰਾਣੀ ਗੈਰ ਖਾਸ ਘੱਟ ਪਿੱਠ ਦਰਦ ਵਾਲੇ ਮਰੀਜ਼ਾਂ ਵਿਚ ਮੁਢਲੇ ਅਸਥਿਰਤਾ ਅਤੇ ਜੀਵਨ ਦੀ ਗੁਣਵੱਤਾ ਤੇ ਮੇਰਿਆ ਦਾ ਹੇਰਾਫੇਰੀ ਦੇ ਪ੍ਰਭਾਵ ਵਾਲੇ ਸਿਰਲੇਖ ਵਿੱਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਸੱਦਾ ਦਿੱਤਾ ਜਾਂਦਾ ਹੈ."

ਵਿਸ਼ਾ ਚੋਣ ਦੇ ਆਧਾਰ

ਇਸ ਅਧਿਐਨ ਵਿਚ ਭਾਗ ਲੈਣ ਲਈ ਤੁਹਾਨੂੰ ਸੱਦਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਇਸ ਲਈ ਕਿਉਂਕਿ ਤੁਸੀਂ 18 ਤੋਂ 60 ਸਾਲ ਦੀ ਉਮਰ ਦੇ ਹੋ ਅਤੇ ਤੁਹਾਡੇ ਕੋਲ ਗੈਰ-ਵਿਸ਼ੇਸ਼ ਗੰਭੀਰ ਪਿੱਠ ਦਰਦ ਘੱਟ ਤੋਂ ਘੱਟ 12 ਵੇਚ ਹੈ.

ਇਸ ਅਧਿਐਨ ਦਾ ਉਦੇਸ਼

ਬੇਰੋਕ ਦਰਜੇ ਦੇ ਘੱਟ ਪੀੜ ਦੇ ਦਰਦ ਵਾਲੇ ਮਰੀਜ਼ਾਂ ਵਿਚ ਪੋਸਟਰੀਅਲ ਅਸਥਿਰਤਾ ਅਤੇ ਜੀਵਨ ਦੀ ਸਿਹਤ ਨਾਲ ਸੰਬੰਧਿਤ ਗੁਣਵੱਤਾ 'ਤੇ ਸਪਾਈਨਲ ਹੇਰਾਫੇਰੀ ਦੀ ਕਾਰਗੁਜ਼ਾਰੀ ਦਾ ਵਿਸ਼ਲੇਸ਼ਣ ਕਰਨਾ.

ਅਧਿਐਨ ਦਾ ਵਰਣਨ

ਅਲਕੋਮੀਟਰ ਦੁਆਰਾ ਦਰਦ ਸੰਵੇਦਨਸ਼ੀਲਤਾ ਦਾ ਅੰਦਾਜ਼ਾ ਲਗਾਉਣ ਤੋਂ ਬਾਅਦ, ਯੂਰੋ ਕੁੋਲ ਪ੍ਰਸ਼ਨਾਵਲੀ ਦੁਆਰਾ ਵਿਸ਼ਲੇਸ਼ਣ ਕੀਤੇ ਗਏ ਅੰਕਾਂ ਵਾਲੇ ਦਰਦ ਦੇ ਰੇਟਿੰਗ ਸਕੇਲ, ਵਿੰਨ-ਟਰੈਕ ਗੇਟ ਵਿਸ਼ਲੇਸ਼ਕ ਅਤੇ ਜੀਵਨ ਦੀ ਗੁਣਵੱਤਾ ਦੁਆਰਾ ਪੋਸਟਰੈਸਲ ਅਸਥਿਰਤਾ, ਦਰਦ ਦੀ ਤੀਬਰਤਾ, ਤੁਹਾਨੂੰ ਨਿਯੰਤਰਣ ਸਮੂਹ, ਸਟੱਡੀ ਗਰੁੱਪ -1 ਅਤੇ ਸਟੱਡੀ ਗਰੁੱਪ- ਇਲਾਜ ਪ੍ਰੋਟੋਕੋਲ ਦੇ ਨਾਲ 2 ਹਫਤਿਆਂ ਲਈ 2, ਫਿਰ ਉਪਰ ਦੱਸੇ ਗਏ ਵੇਰੀਏਬਲਾਂ ਦਾ ਦੁਬਾਰਾ ਮੁਲਾਂਕਣ ਕੀਤਾ ਜਾਵੇਗਾ.

ਅਧਿਐਨ ਦੇ ਲਾਭ

ਅਿਧਐਨ ਦੇਲਾਭ ਗ਼ੈਰ-ਖ਼ਾਸ ਿਚਰਕਾਲੀਨ ਘੱਟ ਪੀੜ ੀ ਦਰਦ ਦੇਮਰੀਜ਼ਾਂਿਵੱਚ ਫਿਜ਼ਿਓਥੈਰੇਪੀ ਕਰਨ ਦੀ ਆਪਣੀ ਅਰਜ਼ੀ ਿਵੱਚ ਮੌਜੂਦ ਹਨ.

ਬੁਰੇ ਪ੍ਰਭਾਵ

ਪੂਰੀ ਖੋਜ ਪ੍ਰਕਿਰਿਆ ਦਾ ਕੋਈ ਮੰਦੇ ਅਸਰ ਨਹੀਂ ਹੁੰਦਾ.

ਗੁਪਤ ਰੂਪ ਵਿੱਚ

ਸਾਰੀ ਜਾਣਕਾਰੀ ਨੂੰ ਸਖ਼ਤੀ ਨਾਲ ਗੁਪਤ ਰੱਖਿਆ ਜਾਵੇਗਾ, ਸੁਪਰਵਾਈਜ਼ਰ ਪ੍ਰੋ. (ਡਾ.) ਊਮਾਸਨਕਰ ਮੋਹੰਤੀ ਅਤੇ ਸਹਿ-ਨਿਗਰਾਨ ਪ੍ਰੋਫੈਸਰ (ਡਾ.) ਜਸਬੋਂਟਾ ਸੇਠੀ ਨੂੰ ਸੀਮਾ ਅਤੇ ਹੋਰ ਵਿਅਕਤੀ ਨਾਲ ਸਾਂਝਾ ਨਹੀਂ ਕੀਤਾ ਜਾਵੇਗਾ.

ਨਾਮਨਜ਼ੂਰ ਜਾਂ ਕਢਵਾਉਣਾ

ਤੁਸੀਂ ਇਸ ਅਧਿਐਨ ਵਿੱਚ ਹਿੱਸਾ ਲੈਣ ਤੋਂ ਇਨਕਾਰ ਕਰ ਸਕਦੇ ਹੋ ਅਤੇ ਜੇ ਤੁਸੀਂ ਹਿੱਸਾ ਲੈਣ ਦੀ ਸਹਿਮਤੀ ਦਿੰਦੇ ਹੋ ਤਾਂ ਤੁਸੀਂ ਕਿਸੇ ਵੀ ਸਮੇਂ ਨਤੀਜਿਆਂ, ਡਰ ਜਾਂ ਪੱਖਪਾਤ ਦੇ ਬਿਨਾਂ ਕਿਸੇ ਵੀ ਸਮੇਂ ਅਧਿਐਨ ਨੂੰ ਛੱਡਣ ਲਈ ਆਜ਼ਾਦ ਹੋਵੋਗੇ. ਕਢਵਾਉਣ ਦੀ ਸੂਰਤ ਵਿੱਚ, ਤੁਹਾਡੇ ਨਾਲ ਸੰਬੰਧਤ ਸਾਰੇ ਡੇਟਾ ਨਸ਼ਟ ਹੋ ਜਾਣਗੇ.

ਸਵੈ-ਇੱਛਾ ਨਾਲ ਭਾਗੀਦਾਰੀ

ਮੈਂ ਸਮਝਦਾ / ਸਮਝਦੀ ਹਾਂ ਕਿ ਇਸ ਅਧਿਐਨ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਸਵੈ-ਇੱਛਤ ਹੈ ਮੈਂ ਇਸ ਅਧਿਐਨ ਤੋਂ ਕਿਸੇ ਵੀ ਸਮੇਂ ਅਤੇ ਕਿਸੇ ਵੀ ਕਾਰਨ ਕਰਕੇ ਬਿਨਾਂ ਕਿਸੇ ਪੈਨਲਟੀ ਤੋਂ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ .ਨਾਮ, ਪਤੇ ਅਤੇ ਟੈਲੀਫੋਨ ਨੰਬਰ ਵਿਅਕਤੀ ਦੀ ਸੰਪਰਕ ਕਰਨ ਲਈ (ਜੇ ਲੋੜ ਹੋਵੇ) ਇਸ ਅਧਿਐਨ ਦੇ ਸੰਦਰਭ ਵਿੱਚ ਦਿੱਤਾ ਗਿਆ ਹੈ

ਇਸ ਅਧਿਐਨ ਨੂੰ ਮੈਨੂੰ ਵਿਖਿਆਨ ਕੀਤਾ ਗਿਆ ਹੈ, ਮੈਂ ਸਹਿਮਤੀ ਫਾਰਮ ਪੜ੍ਹ ਲਿਆ ਹੈ ਅਤੇ ਮੈਂ ਭਾਗ ਲੈਣ ਲਈ ਸਹਿਮਤ ਹਾਂ. ਮੇਰੇ ਕੋਲ ਇਸ ਦਸਤਖ਼ਤ ਕੀਤੇ ਸਹਿਮਤੀ ਫਾਰਮ ਦੀ ਕਾਪੀ ਹੈ

ਭਾਗੀਦਾਰ ਦੇ ਹਸਤਾਖਰ ਕੰਚਨ ਕੁਮਾਰ ਸਰਕਾਰ

ਤਾਰੀਖ ਪੀਐਚਡੀ ਵਿਦਵਾਨ

APPENDIX-2

(ASSESSMENT FORM)

Serial No……

“Efficacy of spinal manipulation on postural instability and quality of life in patients with non specific chronic low back pain.”

Date ……./……../…….

Name Age years Gender M/F Occupation

Phone no…….....

Address……

Chief complaint:

History of present illness:

History of past illness:

Medical history: Surgical History:

Personal History:

Pain evaluation:

Site: Localized to low back / Generalized / other; Side: Rt./Lt./Central/Other….

Onset: Sudden / Gradual / Insidious ; Duration: _____

Type: Superficial/deep / dull / diffuse/ cramping / sharp / shooting / throbbing.

Aggravating factors:

Relieving factors:

Sensitivity of pain: Algometer-

Pain intensity: According to NPRS-

No pain Moderate pain Worst pain

0 1 2 3 4 5 6 7 8 9 10

On observation: Any deformity of spine: Present /absent.

On palpation: Tenderness: site……..

On examination:

ROM- Sensory- Special test: Straight leg raising test Slump test

APPENDIX-3

(DATA COLLECTION FORM)

Demographic Data:

Name: Weight----------(Kg)

Age: Height----------(cm)

Gender:

Occupation: Email

Phone no: Date-

Control Group/Study Group-1/Study Group-2

Parameter	Pre-Reading	Post-Reading(after 2 weeks of intervention)	Follow up Reading (after 4 weeks)
Pain Intensity (Numeric Pain Rating Scale)			
(Pain Sensitivity) Pressure Pain Threshold	N/s		
Postural Instability (Average centre of foot pressure)	g/cm^2		
Health-related Quality of life measured by EuroQoL Questionnaire			

APPENDIX-4

(MASTER CHART)

Demographic chart

Sr.No	Control Group			Study Group-1			Study Group-2		
	Age	Height	Weight	Age	Height	Weight	Age	Height	Weight
01	23	183	74	22	170	66	40	154	52
02	36	168	71	21	169	63	22	151	55
03	21	180	70	30	157	52	38	155	49
04	20	165	68	40	158	68	20	148	49
05	20	178	59	32	181	72	19	140	52
06	20	175	64	18	152	47	26	173	75
07	21	168	64	20	177	74	38	175	78
08	35	178	80	26	168	73	34	180	82
09	24	178	70	20	170	67	21	170	76
10	37	163	68	18	178	80	26	178	79
11	23	180	75	22	160	70	21	168	73
12	18	180	68	20	168	64	21	173	69
13	24	173	72	24	177	77	36	155	51
14	32	169	70	20	173	75	36	168	67
15	35	161	63	18	158	47	31	147	53
16	31	168	70	19	158	60	42	170	71
17	20	150	57	25	158	52	22	137	46
18	34	168	70	21	165	55	22	170	78
19	29	178	72	24	178	78	24	173	69
20	24	165	67	22	165	64	24	170	68
21	34	170	70	22	180	57	27	175	74
22	24	173	69	22	160	49	55	171	65
23	40	171	75	23	175	62	21	173	70
24	25	148	54	46	175	69	43	135	45
25	26	139	54	21	160	60	25	170	68
26	23	158	57	21	158	59	20	168	65
27	21	178	68	39	158	45	50	173	66
28	27	168	62	22	173	72	26	137	45
29	22	173	71	26	168	55	34	168	69

30	18	180	77	22	163	55	19	175	79
31	22	168	68	20	180	80	21	167	62
32	22	170	72	23	168	55	18	173	65
33	18	177	80	19	157	43	19	168	65
34	27	172	65	20	172	48	24	178	75
35	25	168	82	22	170	55	21	180	74
36	38	181	80	24	160	56	21	175	59
37	20	137	49	20	160	49	21	178	68
38	20	169	71	22	173	64	22	176	80
39	22	178	78	22	150	59	21	173	69
40	20	168	67	23	160	49	35	168	71
41	43	166	61	19	158	51	21	183	74
42	22	171	65	20	168	53	21	160	56
43	21	157	49	26	166	60	35	180	74
44	22	172	67	19	165	65	21	170	67
45	23	170	68	25	143	51	49	160	65
46	56	178	67	20	162.8	70	22	178	75
47	22	169	68	46	146	48	20	180	78
48	30	178	76	22	140	47	34	170	82
49	30	174	72	20	152	60	23	183	82
50	22	150	48	43	146	56	20	170	67
51	21	173	70	22	180	68	22	180	76
52	22	138	42	20	178	69	18	170	60
53	28	179	81	18	168	68	33	160	62
54	36	169	71	45	158	72	45	180	81
55	39	173	69	46	155	64	20	175	65
56	21	166	68	30	172	68	20	157	48
57	22	168	65	29	157	58	22	178	64
58	21	170	71	26	176	68	23	160	55
59	20	174	67	22	155	49	18	183	61
60	19	172	65	31	159	72	25	158	55

61	27	174	71	22	168	69	22	187	68
62	19	170	63	23	154	57	28	178	80
63	22	176	70	18	158	42	30	165	63
64	21	180	75	18	157	45	20	180	80
65	20	168	62	21	153	47	24	180	75
66	18	139	45	21	165	69	21	183	83

Study group-1 (Control Group)

Sr.No	Average center of foot pressure	EuroQoL Questionnaire	Pressure pain threshold	Numeric pain rating scale

	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks
01	693	690	688	22	21	20	28	30.65	30.21	9	8	8
02	867	865	863	22	20	20	29.6	29.9	29.9	8	8	8
03	667	665	665	21	21	21	27.32	28.7	28.9	9	7	7
04	761	757	755	23	22	22	24.5	24.5	24.9	10	9	8
05	697	696	695	23	23	23	22.7	23	24.7	8	7	7
06	732	732	732	23	22	22	28.7	28.9	28.9	9	9	9
07	960	944	941	22	22	22	25	27.5	27.7	8	8	7
08	730	723	722	22	21	21	23.8	24.1	25.7	9	8	8
09	721	721	721	22	21	21	27.5	28.5	28.6	9	9	8
10	660	656	656	23	23	23	28	28.1	28.2	9	8	8
11	723	720	714	23	22	22	24	25	27.5	8	7	7
12	689	680	678	24	23	23	26.8	26.8	26.8	8	7	6
13	721	715	590	21	20	20	27	27.1	26.8	9	9	8
14	703	700	701	21	21	21	23	23	23	8	8	8
15	770	765	765	22	21	21	26.81	28.4	28.4	9	8	8
16	712	709	709	23	22	22	23	23.6	23.8	9	7	6
17	696	690	700	21	21	21	25.8	25.9	25.8	10	9	8
18	712	708	707	23	22	22	23	24.8	24.9	8	8	7
19	715	712	697	23	21	21	26.67	27	27.1	9	8	8
20	786	782	782	21	21	21	25.34	25.45	25.45	8	8	7
21	759	758	764	22	20	19	23.68	24	24.7	8	8	8
22	740	740	740	22	21	21	25	26.6	25	9	8	7
23	749	714	726	23	22	21	24.53	24.88	24.84	8	7	7
24	706	685	692	22	22	22	25	26.4	26.9	8	7	6
25	765	764	763	23	22	21	27.49	28	28	9	8	7
26	756	750	750	23	22	22	25.89	27.5	25.88	9	9	8
27	758	730	735	22	21	21	24	25.9	25.1	7	6	6
28	737	736	740	21	20	20	26.7	28.4	27.8	8	6	6
29	699	689	703	22	22	22	23.82	24.55	26.3	8	7	6

30	689	680	687	22	21	20	26.8	26.9	25.2	8	8	7
31	691	683	695	23	22	22	26.59	29.36	29.36	9	8	7
32	765	763	768	23	21	20	23.18	24.91	27.6	8	7	7
33	689	687	695	24	23	23	24	24.99	24.16	9	8	8
34	721	715	729	21	21	21	25	28	28	10	9	6
35	697	694	700	20	19	18	28	29.55	29	8	8	7
36	732	732	744	20	18	17	24.35	25.67	25.67	8	8	7
37	712	699	712	21	20	20	25	26.42	26.4	9	8	8
38	702	697	709	21	21	21	26	27.49	28.67	9	9	8
39	685	685	701	22	22	22	23.8	23.8	23.8	8	8	7
40	754	753	761	22	21	21	26	27.8	27.8	9	7	7
41	698	697	700	23	22	21	25.78	26.9	26.8	8	7	7
42	705	705	715	23	22	22	27.47	29.65	30.27	8	8	7
43	687	672	688	23	22	21	25	25.98	25.76	9	8	8
44	784	687	690	21	20	20	25.23	26.58	29.41	8	7	7
45	748	747	755	21	21	21	24.72	25.3	25.3	9	8	8
46	712	712	719	21	20	19	26	26.6	26.6	9	9	8
47	732	703	722	22	22	22	27.19	27.99	28.1	9	8	7
48	645	634	637	21	20	21	25	28.47	30.35	8	8	8
49	743	742	752	23	22	22	24	25.66	24.59	9	9	8
50	729	697	705	23	22	21	27	29.58	28.5	8	8	8
51	708	708	702	21	20	20	23	25.69	23.55	9	7	7
52	763	731	730	22	21	21	26.82	26.99	26.99	9	8	7
53	689	671	679	22	22	22	23.52	23.56	22.9	8	8	7
54	688	687	689	22	21	21	24	25.38	24.7	8	7	7
55	695	686	689	23	22	20	23.75	23.74	23.1	9	8	8
56	707	694	709	23	22	22	27.38	29.46	28.5	9	8	8
57	685	670	679	22	21	21	23	23.56	23.27	8	8	7
58	744	712	721	21	20	19	24.41	24.41	23.88	9	8	7
59	711	697	698	22	21	20	23.71	23.69	22.1	8	7	7
60	698	698	709	22	21	20	24.1	24.51	25.83	9	8	8

61	717	685	699	21	21	21	26	26	25	8	8	8
62	701	688	700	23	22	21	25.34	25.43	25.21	8	8	8
63	694	689	689	23	23	23	27	27.3	27.5	9	8	8
64	727	711	722	23	22	19	25	25.85	24.29	9	7	7
65	765	764	765	23	22	22	24.58	26.49	23.61	8	8	7
66	766	763	771	24	22	22	23.78	24.56	23.65	9	7	7

Study Group-2

Sr.No	Average center of foot pressure	EuroQoL Questionnaire	Pressure pain threshold	Numeric pain rating scale

	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks
01	598	453	356	21	12	9	42.04	72.29	75.45	8	3	1
02	628	473	341	22	15	9	20.2	50.56	57.39	9	2	1
03	612	487	349	23	9	8	33.02	66.45	74.23	9	3	2
04	641	541	321	22	10	9	38.04	76.5	78.91	8	2	1
05	597	432	328	22	11	8	31.7	87.5	91.67	8	4	1
06	654	521	325	23	14	11	25.3	73.23	78.65	8	2	1
07	624	411	328	23	15	10	27.8	67.45	74.87	8	3	1
08	610	522	301	21	15	10	27.4	77.43	81.45	9	3	1
09	589	518	325	22	10	9	25.45	65.87	71.78	8	2	1
10	609	498	301	22	10	10	31.4	78.9	84.12	9	2	1
11	651	553	331	23	9	9	28.9	75.4	79.48	9	3	1
12	602	519	377	23	11	9	28.75	58.84	65.45	9	3	1
13	632	555	341	21	13	10	25.4	79.48	83.65	9	3	2
14	621	512	317	23	12	9	32.9	87.3	92.41	9	3	0
15	656	503	363	22	12	8	21.84	68.56	73.81	9	2	1
16	670	525	378	22	10	9	26.74	81.09	84.04	8	2	1
17	652	514	359	22	15	8	25.98	78.67	82.33	9	3	1
18	665	510	361	21	11	6	28.8	75.5	79.67	9	2	0
19	684	422	315	23	10	8	27.95	70.75	73.23	8	4	1
20	687	436	309	23	8	8	31.5	68.5	72.56	9	2	1
21	659	499	376	21	9	9	23.5	61.5	65.91	9	3	2
22	687	492	367	23	9	8	28.7	62.5	67.33	9	2	1
23	658	523	359	23	11	7	31.5	58.5	54.71	9	3	2
24	621	523	359	22	10	8	25.7	65.6	68.66	8	2	1
25	693	486	321	22	11	9	27.8	57.5	60.58	8	3	1
26	685	467	372	23	9	8	30.7	62.4	64.69	8	2	1
27	684	527	416	23	15	6	23.7	65.2	69.11	9	4	2
28	654	530	386	21	9	8	32.7	67.5	70.09	9	3	1
29	678	521	423	21	12	8	23.8	68.4	72.89	9	2	0

30	675	509	386	23	11	7	24.2	75.7	79.33	8	3	1
31	682	488	371	22	11	8	25.9	65.6	70.02	8	2	0
32	671	522	456	22	13	7	21.8	62.3	65.54	9	2	1
33	645	497	366	23	10	8	24.5	71.4	78.04	8	2	2
34	634	489	385	23	8	9	25.8	68.6	70.41	9	3	1
35	685	552	412	23	9	8	21.4	69.5	73.65	9	2	1
36	690	523	397	23	10	8	28.6	65.5	68.61	9	3	2
37	638	496	387	21	11	9	24.8	71	75.8	9	2	1
38	688	488	416	22	12	7	23	68.5	73.91	8	3	0
39	655	512	378	21	14	8	25	69.5	74.51	8	3	1
40	682	507	397	22	12	9	28	73.4	78.55	9	2	1
41	679	491	366	22	12	6	22.8	69.8	73.53	9	4	0
42	610	477	352	22	15	8	22.9	70.5	70.09	9	2	1
43	599	462	355	23	11	7	20.5	66.8	71.32	9	2	0
44	634	521	396	23	8	9	23.2	65.4	76.01	8	3	2
45	625	468	369	21	9	9	21.78	70	69.47	9	2	1
46	678	499	349	21	11	8	23	67	72.87	8	3	2
47	695	456	328	22	14	9	22.88	68.9	72.87	7	3	0
48	610	523	385	22	15	7	25	62.8	67.45	8	2	1
49	649	513	421	21	11	10	27	70	74.54	9	2	1
50	644	517	319	22	14	7	20.8	65.6	69.34	9	3	2
51	633	499	428	22	13	11	23.8	71.8	74.88	8	3	2
52	638	518	456	22	13	7	25	62	65.29	8	2	1
53	681	501	445	22	11	7	20.86	65	69.55	9	2	0
54	649	421	398	21	8	9	22.95	68.2	72.51	9	3	2
55	685	487	412	21	9	9	26	70.5	76.12	8	3	1
56	677	501	432	23	8	6	28	75.8	78.67	8	2	1
57	688	511	421	23	8	6	25.7	67.8	7298	9	3	2
58	745	544	429	23	9	9	22.8	68.6	72.76	8	3	1
59	798	548	415	22	11	8	27	78.7	81.62	7	2	1
60	611	490	401	22	12	8	20.8	73.8	76.12	9	2	0

61	619	543	432	23	11	7	27	68.17	72.43	9	2	1
62	638	507	419	23	10	9	22.8	70.4	76.3	8	2	1
63	685	532	463	23	12	7	22.8	71.28	72.45	9	4	1
64	624	523	471	22	10	9	21	68	70.09	9	2	0
65	674	475	422	21	8	8	22	72	74.51	9	4	1
66	678	504	432	24	9	6	20	74	79.95	8	2	1

Study Group-3

Sr.No	Average center of foot pressure	EuroQoL Questionnaire	Pressure pain threshold	Numeric pain rating scale

	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks	Pre	2 weeks	4 weeks
01	648	612	609	23	15	14	24.12	37.83	41.31	8	4	2
02	678	601	580	20	14	13	23.74	45.32	51.75	9	3	3
03	649	630	624	20	15	14	25.19	36.89	41.65	8	3	3
04	678	623	611	21	16	14	26	39.67	43.71	9	4	3
05	621	610	590	24	14	13	22	38.66	45.11	9	5	2
06	646	591	586	21	13	13	27.71	41.3	49.66	8	3	3
07	632	580	576	22	14	12	25.7	34.57	43.44	9	2	3
08	612	601	589	21	15	13	21.56	45.87	53.27	8	3	3
09	639	611	600	23	14	13	29	53.22	57.56	8	3	3
10	654	629	614	21	15	14	21.51	38.57	43.87	9	4	3
11	668	621	601	23	15	14	24	41.59	51.45	9	4	4
12	689	639	616	23	16	14	21.45	41.78	47.87	8	3	4
13	672	646	640	21	15	14	24	38	43.23	8	4	3
14	657	648	641	21	16	15	23	51.87	45.81	9	3	4
15	677	660	650	24	12	13	21.65	39.45	51.34	8	3	2
16	687	670	661	21	11	10	22.3	41.23	45.87	8	3	2
17	649	612	600	22	16	11	25	38.55	52.76	8	3	1
18	609	589	586	23	15	11	27	37.45	48.61	9	3	1
19	650	612	601	22	13	13	21	44.12	51.33	8	4	3
20	679	606	589	20	12	11	25	37.61	47.61	8	3	1
21	635	608	588	21	10	9	24.65	41.73	51.1	9	4	2
22	672	602	691	23	16	10	27.48	52.49	57.49	9	3	3
23	631	598	593	23	16	14	22	38.56	45.23	8	3	3
24	628	599	589	21	15	14	23	41.21	50.76	9	3	2
25	619	597	580	23	14	13	25	38.55	49.28	8	2	3
26	645	616	610	20	16	14	27.39	35.37	47.39	9	3	3
27	693	623	612	20	16	14	24	45.91	52.67	8	4	2
28	682	633	612	22	15	14	28.45	35.95	45.69	9	2	3
29	627	578	570	21	16	15	23.84	43	55.81	8	3	2

30	618	589	580	23	12	11	25	42.3	47.32	9	2	2
31	644	612	601	22	13	13	24.67	41.84	45.21	9	4	1
32	680	602	597	21	14	13	23	48.39	52.54	9	3	3
33	649	609	600	23	12	11	24.71	46.34	51.43	8	2	3
34	659	612	608	20	10	9	22	38.81	43.67	9	3	2
35	601	589	579	20	16	14	25.87	50.21	54.38	8	3	2
36	638	603	595	21	13	12	28.47	45.32	48.99	9	4	3
37	698	630	632	20	13	11	23.5	35.28	41.87	8	4	4
38	650	620	601	21	14	12	38.8	48.22	54.77	9	2	3
39	655	630	615	21	13	11	20.01	35	42.33	8	4	3
40	731	607	612	21	15	11	25.04	36.78	39.78	9	5	3
41	642	601	598	21	16	13	27.4	35.45	40.12	9	3	3
42	674	611	611	24	16	12	32.3	38.54	43.99	10	3	3
43	697	690	598	21	15	12	24.3	36.85	41.55	9	4	3
44	665	630	621	21	14	13	28.45	39.45	45.39	8	2	2
45	650	622	623	22	13	12	34.8	40.65	41.67	10	4	2
46	640	607	602	22	15	12	29.8	38.69	43.54	9	3	2
47	675	620	620	21	13	12	22.95	35.9	39.78	8	4	1
48	689	612	612	24	12	11	24.98	38.67	43.55	8	4	2
49	670	623	601	21	10	9	32	47.54	59.65	8	3	2
50	644	587	577	23	14	12	25.47	41.32	45.23	9	4	3
51	630	611	599	23	15	12	31.21	42.87	48.56	8	2	3
52	678	608	607	21	12	12	26.5	49.5	55.92	9	4	2
53	659	612	603	23	11	10	30.5	50	54.16	8	2	1
54	656	605	598	21	14	11	28.5	46.5	47.67	10	3	3
55	658	590	570	23	12	10	32.7	50.2	53.77	9	4	2
56	645	611	600	23	11	10	35.7	49.5	53.11	9	2	1
57	691	621	601	21	16	11	28.2	45.7	49.12	8	4	2
58	615	587	570	23	14	11	26.5	47.2	50.32	8	2	2
59	693	620	607	23	13	11	23.6	45.4	48.56	9	4	1
60	652	613	601	23	15	10	22.8	46.3	49.78	9	2	2

61	656	602	590	21	15	12	28.4	49.8	52.65	8	4	3
62	630	618	613	22	11	10	29.6	48.9	49.67	9	5	2
63	696	616	614	22	12	10	22.8	49.5	51.78	9	4	1
64	605	595	599	21	11	10	25.9	44.9	47.89	10	2	2
65	667	626	627	24	16	12	27.6	50.3	54.9	9	3	3
66	686	630	639	23	14	12	23.7	48.9	52.56	8	4	2

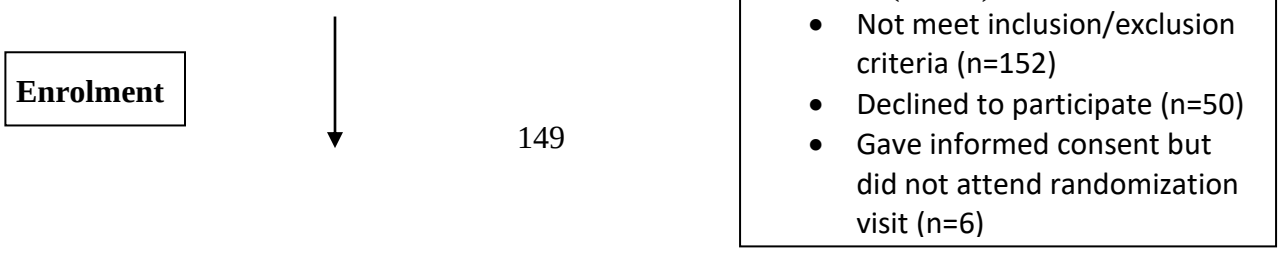
APPENDIX-5

(TREATMENT PROTOCOL)

A total 198 patients were selected on the basis of inclusion and exclusion criteria. The patients have received both verbal and written information about the study and then the interested patients were requested to sign the informed consent.

The patients were assigned into three groups by systemic random sampling, each group 66 patients. All patients in the study received 2 weeks of treatment. The control group was received supervised exercise therapy with ergonomic advice (EA) alone, 45 minutes per day for 2 weeks, study group 1 was received spinal manipulation (SM) with ergonomic advice (EA), 45 minutes per day for 2 weeks, and the Study Group 2 was received core stability exercise (CSE) with ergonomic advice (EA), 45 minutes per day for 2 weeks. Pre-test reading of postural instability was measured by Win Track, pain intensity was evaluated by numerical pain rating scale (NPRS), quality of life was evaluated by euroQoL questionnaire, and pressure pain threshold was measured by digital algometer.

The intervention was of 2 weeks then post readings were recorded again after the intervention and follow up after 4 weeks.



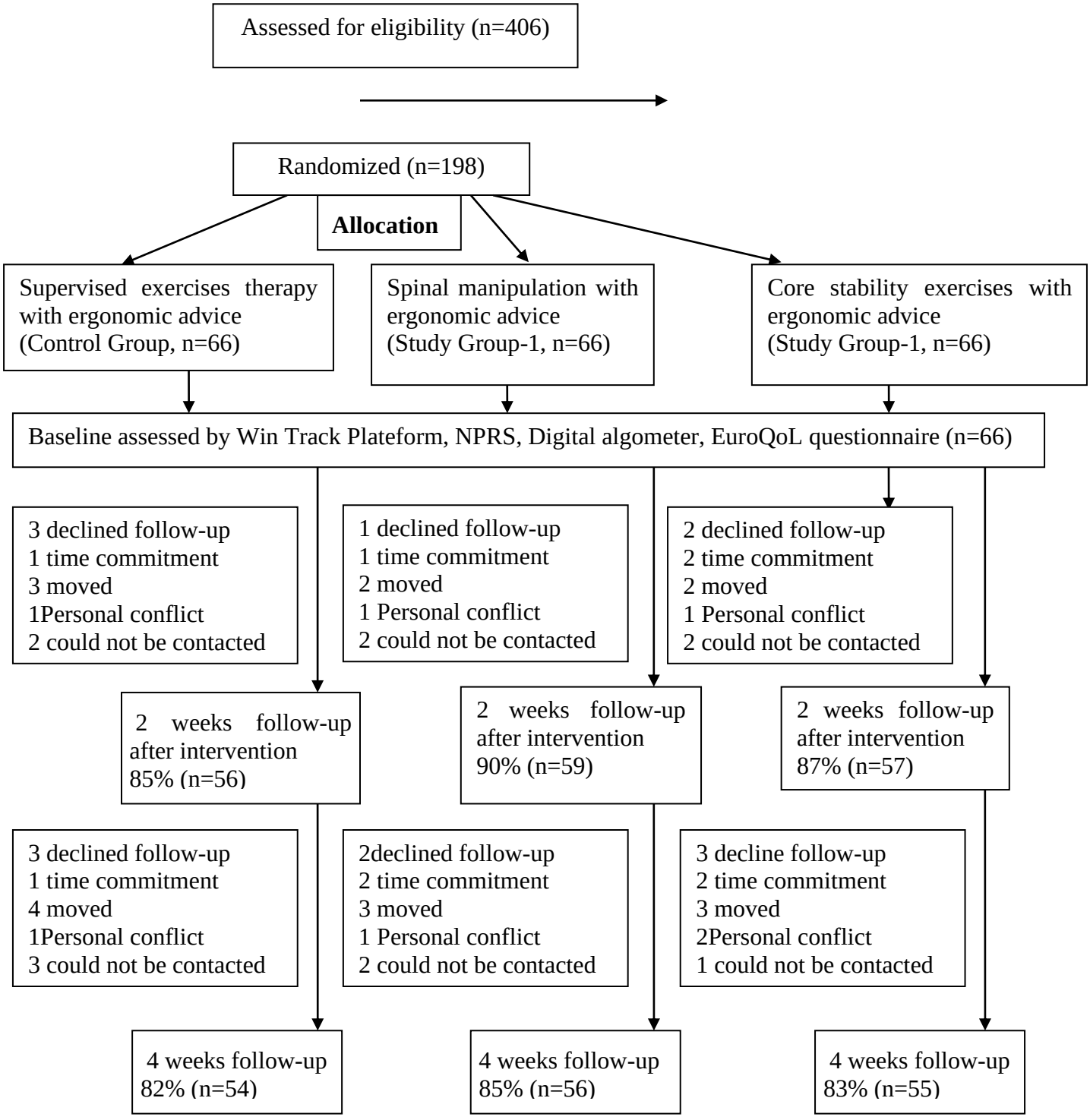


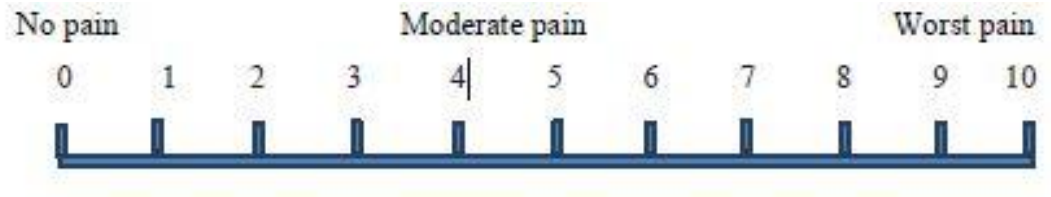
Figure 4.1 Study participant's flowchart.

APPENDIX-6

(ASSESSMENT TOOLS)

Numeric Pain Rating Scale (NPRS)

Instruct the patient to choose a number from 0 to 10 that best describes their current pain. 0 would mean 'No pain' and 10 would mean 'Worst possible pain'.



Win-Track Force Platform (Medicaptures Technology, France)

-is a reliable and valid method to check the plantar pressure, postural instability.

-Size: 1610 mm (Length) x 652 mm (Width) x 30 mm (Height).

-Thickness: 9 mm.

-Dimension and number of sensors: 7.8X7.8 mm^2 and 12288 sensors.

-Acquisition Frequency: up to 200 images per second.

Figure 6.1 Win-Track Force Platform

Weight: was measured in kilogram (kg) using weight machine.

Height: was measured in centimeter (cm) using inch tape.

Foot Size: was measured in inches (cm) using a ruler where the subjects was in standing position.

Digital Algometer (Jagson scientific Industries, Ambala, India)

This device consists of around probe (1 cm^2) vertically to the patient's skin and pressure was applied at a rate of 5 Newton/second.

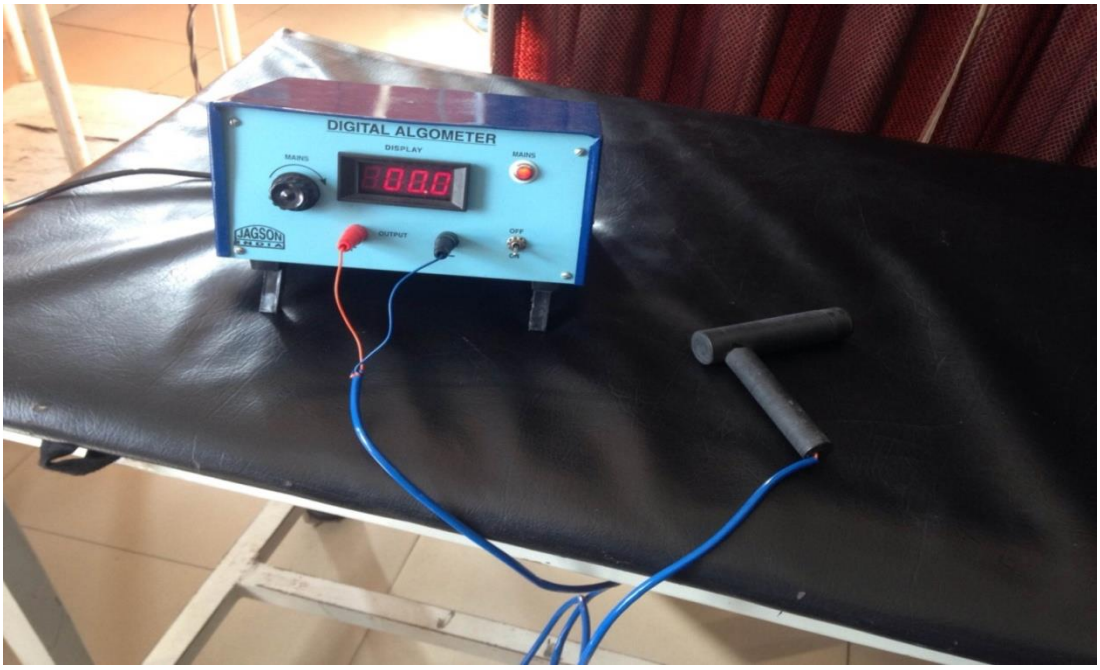


Figure 6.2 Digital algometer

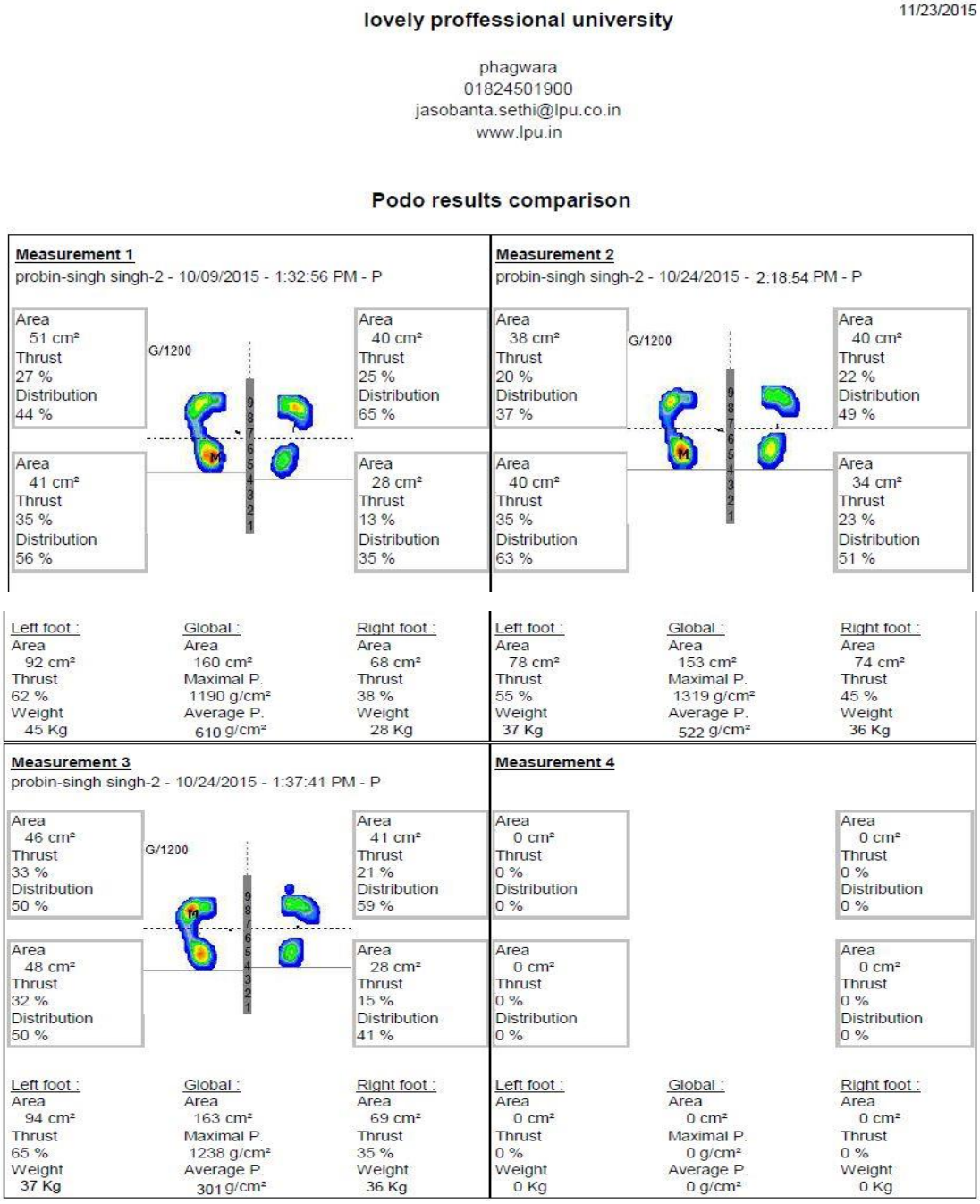


Figure 6.3 Average center of foot pressure results comparison sheet

APPENDIX-7

EUROQOL QUESTIONNAIRE

Health-related Quality of life measurement form (EuroQoL Questionnaire)

Under each heading, please tick the **ONE Box** that best describes your health **TODAY**

MOBILITY

1. I have no problems in walking about
2. I have slight problems in walking about
3. I have moderate problems in walking about
4. I have severe problems in walking about
5. I am unable to walk about

SELF-CARE

1. I have no problems washing or dressing myself
2. I have slight problems washing or dressing myself
3. I have moderate problems washing or dressing myself
4. I have severe problems washing or dressing myself
5. I am unable to wash or dress myself

USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)

1. I have no problems doing my usual activities
2. I have slight problems doing my usual activities
3. I have moderate problems doing my usual activities
4. I have severe problems doing my usual activities
5. I am unable to do my usual activities

PAIN / DISCOMFORT

1. I have no pain or discomfort
2. I have slight pain or discomfort
3. I have moderate pain or discomfort
4. I have severe pain or discomfort
5. I have extreme pain or discomfort

ANXIETY / DEPRESSION

1. I am not anxious or depressed
2. I am slightly anxious or depressed
3. I am moderately anxious or depressed
4. I am severely anxious or depressed
5. I am extremely anxious or depressed

APPENDIX-8

ETHICAL COMMITTEE APPROVAL

INSTITUTIONAL HUMAN ETHICAL COMMITTEE

Lovely School of Physiotherapy and Paramedical Sciences

Lovely Professional University, Punjab

Ph: +91-1824-444515 E-mail: info@lpu.co.in

Chairperson: **Dr. H S Gill** **Deputy Chairman:** **Mr. S. Micheal Raj** **Members:** **Dr. Shivani Tandon** **Dr. Naresh Kundra** **Dr. N K Gupta** **Ms. Meenu Chopra** **Mr. Dharminder Singh Dhillon** **Dr. Sasmita Kar** **Sardar Nagina Singh** **Member Secretary:** **Ms. Rati**	LPU/IEC/PTY/004 Date: 16th November, 2016 To Mr. Kanchan Kumar Sarker Ph.D. Scholar, Department of Physiotherapy, Lovely Professional University, Punjab. Dear Sir/Mam, The Ethical committee has studied the Research Proposal submitted by Mr/ Ms/ Mrs. Kanchan Kumar Sarker Research Topic: **Efficacy of Spinal Manipulation on Postural instability and Quality of life in patients with Chronic non specific low back pain** It has been decided to afford **Ethical clearance** to this study. Thanking You. Your Sincerely, **Dr. H S Gill** (Chairperson) **Mr. S. Micheal Raj** (Deputy Chairman) **Ms. Rati** (Member Secretary)

LIST OF PUBLICATION ARTICLES AND CONFERENCE CERTIFICATE

Accepted E-mail from Journal of Natural Science, Biology and Medicine

(6th September 2019)

From: JNSBM <editor.jnsbm@journalonweb.com>
To: "jasobantsethi@yahoo.co.in" <jasobantsethi@yahoo.co.in>
Sent: Tuesday, 17 September, 2019, 05:26:08 pm IST
Subject: [JNSBM]:Decision on your article:JNSBM_101_19

If you cannot see this page properly, please **click here.**

Dear Dr. Sethi,
The Editorial Board of Journal of Natural Science, Biology and Medicine is pleased to inform you that your manuscript entitled Comparative clinical effects of spinal manipulation, core stability exercise and supervised exercise on pain intensity, segmental instability and health-related quality of life among patients with chronic non-specific low back pain: A randomized control trial, with manuscript number JNSBM_101_19, is acceptable for publication in the Journal.
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With warm personal regards,
Yours sincerely,
The Editorial Team
Journal of Natural Science, Biology and Medicine

Book Publisher International

F. No. SDI/BP/1226/559
Dated on 03-August-2019

To
Jasobanta Sethi[1]* Kanchan Kumar Sarker[2], Umasankar Mohanty[3]

1Professor & Director, Amity Institute of Physiotherapy, Amity University, UP, Noida, India.

2Research Scholar, Department of Physiotherapy, Lovely Professional University, Punjab, India.

3Manual Therapy Foundation of India, Mangalore, Karnataka, India.

**Corresponding Author*

Subject: Acceptance letter for manuscript (2019/BP/1226) as a book chapter of Current Trends in Medicine and Medical Research Vol. 5

Dear Dr. Jasobanta Sethi,

We are pleased to inform that your manuscript (Ref. no. **2019/BP/1226**) entitled "**Spinal Manipulation on Segmental Instability, Pain Sensitivity and Health- Related Quality of Life in Chronic Non-specific Low Back Pain**" is ACCEPTED for publication **as a book chapter in the following book: Current Trends in Medicine and Medical Research Vol. 5**

Thank you for submitting your manuscript in **Current Trends in Medicine and Medical Research Vol. 5**

Thanking you.

Dr. M. Basu
Chief Managing Editor
Book Publisher International
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Original Article

Physiotherapy Section

Effect of Spinal Manipulation on Pain Sensitivity, Postural Sway, and Health-related Quality of Life among Patients with Non-specific Chronic Low Back Pain: A Randomised Control Trial

KANCHAN KUMAR SARKER[1], JASOBANTA SETHI[2], UMASANKAR MOHANTY[3]

ABSTRACT

Introduction: Spinal manipulation is a technique of specific directed manual thrust which has been effective in aligning a spinal segment, maintaining normal range of motion and reducing pain. Recent studies have reported on management of pain and improvement of quality of life of patients suffering from mechanical low back pain.

Aim: To analyse the effectiveness of Spinal Manipulation-High-Velocity Low Amplitude Thrust (SM-HVLA) on pain sensitivity, postural sway and quality of life in patients with Chronic Non-Specific Low Back Pain (CNSLBP).

Materials and Methods: This randomised controlled trial was conducted on a sample size of 90 patients with chronic non-specific low back pain (with duration of pain more than three months) recruited from Outpatient Department, Department of Physiotherapy, Lovely Professional University, Phagwara, Punjab, India. Participants were divided into three groups, namely Control Group, Study Group-1, and Study Group-2. Control group received supervised exercise with ergonomic advice (n=30), whereas SM-HVLA thrust with ergonomic advice (n=30), and study group-2 received core stability exercise with ergonomic advice (n=30). Primary outcomes were postural sways (centres of foot pressure) measured by Win Track Platform, and pain sensitivity measured by pressure pain threshold (digital algometer) and quality of life measured by EuroQoL questionnaire score at two weeks and four weeks. Univariate analysis of variance (ANOVA) with post-hoc Tukey's multiple comparison tests was carried out to examine treatment effects and the relationship between groups changes across outcome measures.

Results: For all three treatment groups, outcomes improved after two weeks of treatment. The group received spinal manipulation with ergonomic advice had slightly better outcome than the supervised exercise with ergonomic advice group at two weeks (between-group difference) in pain sensitivity (p=0.001); Postural sway (p=0.001); quality of life (p=0.01) as well as at four weeks (between-group difference): pain sensitivity (p=0.001); postural sway (p=0.001); quality of life (p=0.01).

Conclusion: The spinal manipulation with ergonomic advice is effective in treatment of chronic non-specific low back pain. This is an economic model of back care in clinics can be practised widely.

Keywords: Core stability exercise, High velocity low amplitude thrust, Supervised exercise

INTRODUCTION

Chronic Non-Specific Low Back Pain (CNSLBP) is defined as pain located between the costal margin and buttocks and lasts for longer than three months while particular causes of low back pain are unknown, accounting for <15% of all back pain cases [1]. About 85% of patients with isolated LBP cannot be given a specific pathoanatomical diagnosis. NSLBP has been defined as tension, soreness, and/or stiffness in the lower back region for which it is impossible to recognise a specific cause of the pain [2]. The condition has a high incidence and prevalence which has been explored in various systematic studies. Reviews explored that the lifetime incidence of LBP was >70% and one-year prevalence ranges 15% to 45% with point prevalence averaging 30% [3].

Here is an effort to check the impact of spinal manipulation connected with CNSLBP on which a great number of management reports have been recommended by European guidelines for the management of CNSLBP [4]. These guidelines hold up the use of spinal manipulation with high-velocity low amplitude thrust in patients with chronic low back pain suggest that spinal manipulation is probably useful [5] and cost-effective when applied alone or in combination with other techniques compared to common practitioner care or universal physical therapy [4].

While mechanisms responsible for the therapeutic effects of Spinal Manipulation (SM) remains unclear for patients with non-specific low back pain, different theories and mechanisms of action for spinal manipulation are still under conversation [6]. Manual therapists, osteopaths, and chiropractors are significantly oriented by biomechanical and physiological mechanism where mechanical forces are applied to specific vertebral regions may modify segmental biomechanics by releasing trapped menisci lesions, reducing adhesions and distortions of the annulus fibrosus [5]. This mechanism of action enables the vertebral segments to progress in a bigger range of motion and would diminish the mechanical pressure on paraspinal muscles, thus reducing pain and distress. However, the mechanisms underlying the effects of SM appears to be more difficult than a simple biomechanical oriented model and explained between a combination of biomechanical and non biomechanical effects [7].

Patients with low back pain have altered postural sway compared to healthy persons. It is hypothesised that the reduced proprioceptive perception originated from muscle or joint mechanoreceptors can be a reason of changed postural sway [8] as well as impaired quick-fix memory that leads to detain in processing postural control information [9].

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Effect of Spinal Manipulation on Specific Changes in Segmental Instability, Pain Sensitivity and Health-Related Quality of Life among Patients with Chronic Non-specific Low Back Pain- A Randomized Clinical Trial

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Authors' contributions

This work was carried out in collaboration between all authors. Author KKS wrote the protocol, performed the statistical analysis, wrote the first draft of the manuscript and managed the literature searches. Author JS designed the study and prepared the final draft of manuscript. Author UM, the guide, managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Purpose: Chronic non-specific low back pain (cNSLBP) is quite common as seen every day in clinics. Therefore, we assessed the effectiveness of spinal manipulation (High-Velocity Low-Amplitude Thrust) on segmental instability, pain sensitivity, and quality of life among patients with chronic non-specific low back pain.

Subjects and Methods: This study is a randomized clinical trial with 100 patients aged between 18 and 60 years suffering from non-specific low back pain for at least 3 months of duration. 50 subjects

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EFFECT OF SPINAL MANIPULATION ON POSTURAL INSTABILITY IN PATIENTS WITH NON SPECIFIC LOW BACK PAIN

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ABSTRACT

Nonspecific back pain is common, disabling, and costly. Therefore, we assessed effectiveness of spinal manipulation (OMT) in the management of nonspecific low back pain (LBP) regarding postural instability (PI), pain pressure threshold (PPT) and pain intensity. The purpose of this paper is to describe the methodology of an experimental clinical trial examining the effectiveness of spinal manipulative in patients with non specific low back pain. 70 participants with non specific low back pain were distributed in two groups. 1st Group was treated with spinal manipulation high velocity low amplitude (HVLA) thrust where 2nd Group treated with Core stability exercises and both groups received common ergonomic advices. The outcome measures were checked with postural instability using win track software and platform, pressure pain threshold by digital algometer and pain intensity by numeric pain rating scale. Both groups have shown after fifteen days improvement where as significant improvement has been seen in group 1st compared to group 2nd. The present clinical study indicates that spinal manipulation which was more effective than core stability exercises in reducing postural instability, pain intensity and increasing pressure pain threshold in patients with non specific low back pain.

KEY WORDS: **Non-specific low back pain, spinal manipulation, postural instability, pain intensity, pressure pain threshold.**

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Effects of spinal manipulative therapy on postural stability and quality of life among patients with non-specific low back pain- a randomized clinical trial

Kanchan Kumar Sarker, MPT, (PhD)[a*]; Umasankar Mohanty, PT., PhD[b]; Jasobanta Sethi, PT., PhD[c]; Senthil P Kumar, PT., PhD[d].

ABSTRACT

Background and Objectives: Non-specific low back pain (NSLBP) is prevalent in 80% of low back pain patients and is multi-dimensional illness. Lumbar spine dysfunction has been shown to increase postural instability (PI). It has been hypothesized that applying spinal manipulation (SM) to the lumbar spine may have an effect on improving postural instability. The aim of this study was to investigate the effectiveness of SM applied to the lumbar spine on PI as measured by average speed of oscillations on a Wintrack platform measurement system.

Material and methods: 60 participants with NSLBP were grouped to Group A treated with SM high velocity low amplitude (HVLA) thrust and Group B treated with Core stability exercises (CSE) Conveniently. The outcome measures were checked with PI using win track platform, pain intensity using numeric pain rating scale, pressure pain threshold (PPT) by using algometer and EuroQoL questionnaire for quality of life.

Results: After 15 days of treatment both groups have shown the improvement in average speed of oscillations, pain intensity and PPT. Significantly higher improvement has been seen in group A compared to the group B.

Conclusion: The present clinical trial has provided the evidence to support the use of spinal manipulation (HVLA thrust) was more effective than core stability exercises in reducing average speed of oscillation and pain intensity, and increasing PPT and quality of life among patients with NSLBP.

Key words: manual therapy, low back pain, trunk control, proprioception.

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INTRODUCTION

Low back pain is a major health crisis in both developed and rising countries. Low back pain results in socio-economic losses, health and clinical troubles, not only for persons issue but also for countries, because low back pain causes obstacles to occupation or occupation nonattendance and increases economically workable load of treatment and reimbursement. So, epidemiological study holds significant position in accepting low back pain and how to avoid low back pain.[1]

While important heterogeneity exists along with low back pain epidemiological studies preventive the facility to evaluate and collection data, estimates of the 1 year incidence of a first-ever incident of low back pain range between 6.3% and 15.4%, while estimates of the 1 year incidence of any episode of low back pain range between 1.5% and 36%. In health capability- or clinic-based studies, incident drop at 1 year ranges from 54% to 90%; On the other hand, most studies do not show whether the phase was continuous between the baseline and follow-up time point(s).The majority people who experience activity limiting low back pain go on to have frequent episodes. Estimates of repetition at 1 year range from 24% to 80%.[2]

A lot of epidemiological research on low back pain has been conducted overall. This study is essential to distinguish the past, present and future of low back pain, and in obtaining epidemiological data agreed that a lot of information in helping to inquire about out and explain a variety of problems of low back pain. Low back pain is an ordinary problem that the majority people incident at some point in their lifetime. Low back pain is more ordinary between the ages of 25 and 64 years[4], whereas it can turn out in all age ranges. The prevalence of low back pain peaks between ages 35 and 55.[5] This is calculated to reproduce the effort force and high prevalence in the age between 30 and 50 is reported (European Foundation for the

Certificates No. 173896

Certificate of Participation

This is to certify that Prof./Dr./Mr./Ms. K. K Sahker

has **Presented E-poster/Oral presentation on** Comparative clinical effect's of spinal manipulation, core stability exercise and supervised exercise on pain intensity SI & HRQL PT & CNSLBP: RCT.

presentation in International Conference of Pharmacy (ICP-2019) on the theme of " Pharmacy: Realigning the focus on health" held on 13 -14th September 2019 organized by School of Pharmaceutical Sciences, Lovely Professional University, Punjab in a collabration with Indian Pharmacy Graduates' Assocaition (IPGA) Phagwara chapter.

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has participated in Poster Presentation / Paper Presentation in the ***"International Conference on Expanding Domains of Physiotherapy"*** *held from 12th to 13th April 2019, organized by School of Physiotherapy and Paramedical Sciences, Lovely Professional University, Punjab.*

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This is to certify that

Dr/Mr/Ms/Prof. KANCHAN KUMAR SAHA

actively participated in OMPTCON 2018 organized by AOMPT at auditorium, Faculty of Engineering, Jamia Millia Islamia, New Delhi, on 11th March 2018 (10 contact hours).

- ☑ Participant (delegate)
- ☑ Presenter (Paper/Poster)
- ☐ Participant (Chair)
- ☐ Student volunteer

Prof Senthil P Kumar, Organizing Chairman | Dr [illegible], PT, Co-organizing Chairman | Dr Neeraj Kumar, PT., Organizing Secretary | Dr Ridwana Sanam, PT., Joint Organizing Secretary

In collaboration with:

Center for Physiotherapy and Rehabilitation Sciences,

Jamia Millia Islamia
A Central University
(NAAC Accredited 'A' Grade)

Gold Sponsor: KR Physiotherapy

6th INTERNATIONAL CONFERENCE OF PHYSICAL THERAPY-AIIMS 2017

THEME : "EXPANDING HORIZONS OF PHYSIOTHERAPY"

Organized by

Neuro-Physiotherapy Unit, Neurology Department AIIMS, New Delhi

Certificate of Participation

This is to certify that

KK SARKER *has presented*

Scientific Paper titled ***Effect of spinal manipulation on specific changes in segmental instability, pain sensitivity and quality of life among chronic non-specific low back pain - A RCT***

in senior paper category at International Conference of Physical Therapy AIIMS 2017 at Jawahar Lal Auditorium, All India Institute of Medical Sciences, New Delhi, India on 9th - 10th December, 2017

Prof. Kameshwar Prasad
Organizing Chairman

Prof. A.G.K. Sinha
Chairman Scientific Committee

Dr. Rajeev Aggarwal
Organizing Secretary

54th Annual Conference of the IAP, Shirdi-2016

The Indian Association of Physiotherapists

Theme: Let's Unite for Professional Development

Date: 19th, 20th, 21st February, 2016

54th Annual Conference

Certificate

This is to certify that

Kanchan Kumar Sarkar.

has presented a Scientific Paper / Poster titled

Effect of Spinal Manipulation Therapy on postural Instability Among Patients with Non Specific Low back Pain.

He / She has participated / secured _____

in 54th Annual Conference of IAP

held at Pushpak Resort, Shirdi, Maharashtra

on 19th, 20th & 21st February, 2016.

Dr. Umasankar Mohanty IAP President	**Dr. Ketan Bhatikar (PT)** Organizing Chairman	**Dr. Mahendra Shende (PT)** Organizing Secretary
Dr. Abhijit Diwate (PT) Jt. Organizing Secretary	**Dr. Keerthi Rao (PT)** Convener	**Dr. Suvarna Ganvir (PT)** Chairman, Scientific Session

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INSTITUTIONAL HUMAN ETHICAL COMMITTEE

Lovely School of Physiotherapy and Paramedical Sciences

Lovely Professional University, Punjab

Ph: +91-1824-444515 E-mail: info@lpu.co.in

LPU/IEC/PTY/004
Date: 16th November, 2016

To

Mr. Kanchan Kumar Sarker
Ph.D. Scholar,
Department of Physiotherapy,
Lovely Professional University,
Punjab.

Dear Sir/Mam,

The Ethical committee has studied the Research Proposal submitted by Mr/ Ms/ Mrs. Kanchan Kumar Sarker

Research Topic: **Efficacy of Spinal Manipulation on Postural instability and Quality of life in patients with Chronic non specific low back pain**

It has been decided to afford **Ethical clearance** to this study.

Thanking You.

Your Sincerely,

Dr. H S Gill	**Mr. S. Micheal Raj**	**Ms. Rati**
(Chairperson)	**(Deputy Chairman)**	**(Member Secretary)**

LOVELY PROFESSIONAL UNIVERSITY

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Division of Academic Affairs

LPU/DAA/EC/1507031/001

Dated: 31st July 2015.

Kanchan kumar Sarker

Village: Shibpur, P.O. Tulshighat

P. S. & Distt-Gaibandha-5700,

Bangladesh.

Subject: Letter of Candidacy for Ph.D.

We are very pleased to inform you that the Department Doctoral Board has approved your candidacy for the Ph.D. degree on 19th Feb 2015 by accepting your thesis research proposal titled:

"Efficacy of spinal manipulation on postural instability and quality of life in patients with chronic non specific low back pain", supervised by Dr. Umasankar Mohanty, Professor, at Manual Therapy Foundation of India (R.), Mangalore, Karnataka, and Co-supervisor by Dr. Jasobanta Sethi, Professor, at Lovely Professional University, Phagwara, Punjab.

As a Ph.D. candidate you are required to abide by the conditions, rules and regulations laid down for Ph.D. degree students of the University, and amendments, if any, made from time to time.

We wish you the very best in completing your thesis research requirements in the near future. Please do not hesitate to contact us in case you have questions about the rules and regulations of the University.

Signature

Jalandhar-Delhi G.T. Road (NH-1), Phagwara, Punjab (India)-144411

Ph : +91-1824-444386 Fax : +91-1824-506111 E-mail : academic.affairs@lpu.co.in website : www.lpu.in