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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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INTRODUCTION

The incidence of low back pain (LBP) has been estimated between 4%-56% of the general population per year.[1, 2] Between 60% and 80% of the population will experience LBP during their lives and up to 15% become chronic.[3]LBP is the most frequent cause of disability in individuals less than 45 years and the third leading cause in those who are 45 years and older.[4] LBP is most common between 35-55 years of age but affects people of all ages.[5] In jobs that require an extensive amount of physical effort, 2-5% of the working population is compensated each year for work-related LBP.[6]LBP is second only to the common cold in missed work days in the United States affecting as much as 20% of the work force annually.[7] Annual prevalence rate estimates for LBP range from 41%6 to 65%, while point prevalence rates approximate 30%. Variability in the statistics reported reflects the challenge of performing epidemiology studies with consistent design or variability in the definition of terms.[8] In India incidence of low back pain has been reported to be 23.09% and has a lifetime prevalence of 60- 85%. Low back pain affects men and women equally, with onset most often between the ages 30 to 50 years.[9, 10] In other study performed in 2009, in India 48.32% males and 53.64% females are severely disabled due to low back pain, 45.63% males and 33.77% females are moderately disabled and 3.35% males and 8.68% females are crippled due to low back pain.[11] Low back pain is a symptom of a pain which can be localized between the 12th rib to the inferior gluteal folds (lower back), with or without leg pain from different causes, [12] In patients with low back pain the condition non-specific or mechanical back pain are used to describe an individual whose pathoanatomical a etiology is unknown .The majority cases are non-specific, although in 5%-10% of cases, particular causes are identified.Postural instability consists of alterations in postural control strategies during standing tasks, when responding to an unexpected destabilizing perturbation, or when performing voluntary movements.When the passive structures become pathological, a number of changes turn out that limit their stabilizing ability. Damage to ligaments, the facet joint and capsule, the vertebral endplate[13] and/or the annulus fibrosis result in improved range and changed excellence of motion at the segment.[14] There is an increase in the total area of displacement and path length of the instant axis of rotation[15] which likely results from a bigger neutral zone[16] and there is an modification in the acceleration and deceleration of movement with disc or facet lesions which may pose further challenges to neuromuscular control .This mechanical change result in functional instability of the segment.[17] These mechanical changes result in functional instability of the segment. In LBP, the multifidus muscle demonstrates a lesser cross sectional area,[18] and a moth eaten appearance that can be accomplished to atrophy of type II muscle fibers, structural changes in type I fibers,[19] and distended intramuscular fat.[20] These deficits result in a loss of strength and endurance.[21] The active section is the subsystem principally responsible for providing that stability in the neutral range since the passive subsystem is unproductive in this range.[16] As segmental stabilization is limited by local muscular changes, these deficits can be overcome through superior global muscle activation;[22] Over activity of the global muscles in the form of an inappropriate co-contraction may result in unnecessary compressive forces[23] and finally result in fatigue.[24] A larger confidence on multi-segmental trunk muscles may occur to present instability in non-specific low back pain and even more so in those with clinical instability.[25] As previously established, multiple treatments for low back pain have been attempted with unstable levels of achievement difficult the clinician's accepting of the most suitable method of managing LBP. A clinical prediction rule was developed and validated [26] for determining a subpopulation that would respond favorably to a general sacroiliac manipulation. A beginning clinical calculation rule for instability has also been developed but has not yet been validated prospectively.[27] There are several studies that propose low-back pain (LBP) and dysfunction decrease postural instability and transform proprioceptive function. Compared postural instability characteristics of middle aged non-symptomatic individuals with non specific low back pain. Compared postural instability and psychomotor speeds in individuals with chronic LBP compared to those free from back pain.[28] Whilst there is literature signifying the effects of LBP and dysfunction on postural instability. There is little published research investigating the interaction between manipulation therapy applied to the lower-back and its effects on postural instability. Spinal manipulation is being to return musculoskeletal alignment and optimal balance posture. On the other hand there are a small number of researches to quantify the effects of spinal manipulation on postural instability .[18] It has been proposed that spinal manipulation, when applied to the spinal joints and surrounding musculature, may modify afferent response to the central nervous system to elevate proprioception, build up motor control and improve postural instability.[28] Independently applied, manipulation therapy techniques have been shown to change short-term motor neuron activity, improve performance in proprioception-dependant activities, increase range of motion, change markers of autonomic nervous system activity, and facilitate an instant increase in mean voluntary contraction of the paraspinal muscles.[29] The purpose of this study was to examine the effect of spinal manipulative (high velocity low amplitude thrust) on postural instability in patients with non specific low back pain whether lessening postural instability and pain intensity with improved pressure pain threshold is specific to spinal manipulation or the expectation of receiving spinal manipulation.

MATERIALS AND METHODS

This was an experimental design with convenient sampling method. A total of 80 subjects with LBP were recruited from Out Patient Department (OPD), Department of Physiotherapy, Lovely Professional University campus, Phagwara, Punjab among them 70 subjects were included in the study after basic screening. Participants between the ages of 18 to 50 years, with a history of non specific low back pain at least less than 3 months duration and rated 4/10 on a numeric rating scale(NRS) (0= no pain at all to 10= worst pain imaginable) were included in the study. Participants were excluded with history of injury or surgery of spine, congenital spinal deformity (e.g Spina bifida, Scoliosis, ankylosing spondylitis etc), lumbar radiculopathy or presenting neurological deficit, Contra-indication to manipulations (vertebral malignancy, vertebral-basilar insufficiency, bone infections, fracture), pregnancy. LPU/DAA/EC/1507031/001.

Baseline assessments

All subjects were selected as per inclusion/exclusion criteria after signing a written consent. All subjects completed the remainder of the self report and a physical examination. Self report questionnaires were completed at the baseline examination, demographic data, and average speed of oscillations (Win Track platform) for postural instability, numeric pain rating scale for pain intensity and algometer for pain pressure threshold. The measurements were repeated after 15 days of treatment.

Procedure

The subjects were assigned into two equal groups of 31subjcts each by convenient sampling. Both groups received postural correction and ergonomic advices along with treatment under study for 15 days and then reexamined. The protocol for group A included High velocity low amplitude thrust (HVLA) to the lumbar region of the spine between L1 and L5 vertebrae. The exact level thrust was at the discretion of the treating practitioner determined by the level with the greatest perceivable motion restriction. The HVLA thrust was performed with the patient side lying in a neutral.The protocol for group B included sets of core stability exercises 1. The Plank a) Assume a front-support position resting on subjects fore-arms with shoulders directly over subjects elbows. b) Straighten subject's legs out behind subjects and lift up hips to form a dead-straight line from shoulders to ankles. Subjects should be balanced on fore-arms and toes, with lower abdomen and back working to keep body straight. Hold for 1 minute. 3 repetitions at a time. 2. Oblique Plank a) On side, balance on right fore-arm with shoulder above elbow. b) With legs out straight to the left, lift pelvis so that balance on fore-arm and feet. Body should form a straight line and feel the oblique muscles down the side trunk working to maintain the position. c) Hold for 1 minute then repeat on other side. 3 repetitions at a time. 3. "Superman"a) Balance on the floor on hands and knees. Back should be flat and hips parallel to the floor. b) Raise right arm out in front of subjects and raise left leg out behind subjects, keeping it straight. c) Hold for 30 seconds and then repeat on the other side.3 repetitions at a time.

Outcome measures

Primary outcome that were studied average speed of oscillations for postural instability, numeric pain rating scale for pain intensity and pressure pain threshold for pain sensitivity. The test-retest reliability and validity have been found to be sufficient for use in subjects with non specific low back pain. Average speed of oscillations analysis, numeric pain rating scale and pressure pain threshold scores were measured immediately before the first treatment and subsequently at 15 days after the treatment.

Statistical analysis

Data are presented as mean (standard deviation). SPSS software (version 16.0) SPSS Inc, Chicago was used in all statistical analyses. Paired t test was used for intra group analyses and unpaired t test for inter to determine significant of differences in average speed of oscillations, numeric pain rating scale and pressure pain threshold scores. Statistical significance level was set at $P < 0.05$.

RESULTS

Participants were recruited between May 2015 and February 2016. Out of 80 respondents, 70 subjects met the screening criteria for participation. Follow-up measurements and analyses were performed on the remaining 70 participants who completed the study. There was no significant difference in baseline variables such as age, sex, height, weight, baseline average speed of oscillations, numeric pain rating scale and pressure pain threshold scores between groups (Table no.1, Figure no. 1).

Table 1
Baseline characteristics of the study sample

Group N=70	Age	Height	Weight	Baseline average speed of oscillations score (Postural instability)	Baseline algometer score (Pressure pain threshold)	Baseline NPRS score (Pain intensity)
SM	23.7±6.4	1.67±8.24	60.06±11.81	5.22±49.76	27.79±4.64	8.6±0.49
Core Stability ex.	25.1±7.5	1.73±8.54	71.63±10.98	6.9±82.56	28.55±5.17	8.43±0.56

SM-Spinal Manipulation

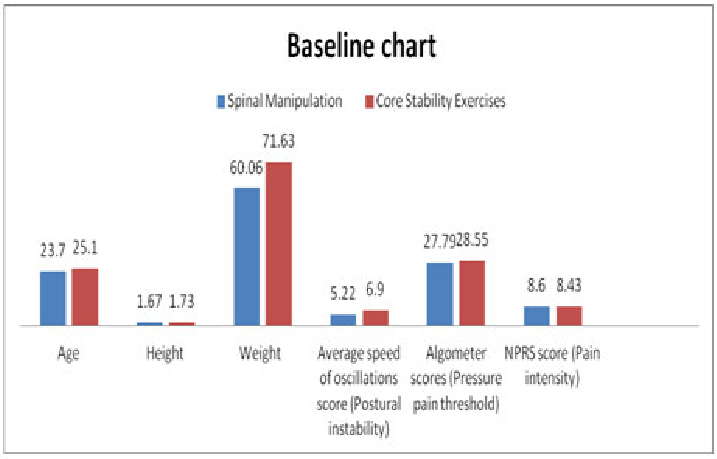

Figure 1
Baseline chart (Spinal manipulation- SM, Core Stability exercises-CSE)

Age distribution
Age of the participants in the study was between 18 to 50 years. The mean age of the participants in group A. was 23.7±6.4 and the mean age of participants in group B was 25.1±7.5. The difference in mean age of two groups was statistically not significant (p= 0.185). (Table no.1, Figure no1)

Height
Mean height of group A was 1.67±8.24 centimeters and mean height of group B was 1.73±8.54 centimeters. The difference in mean height of two groups was statistically not significant (p= 0.095). (Table no. 1, Figure no1)

Weight
The mean weight of the participants in Group A was 60.06±11.81 where as the mean weight of the participants in Group B was 71.63±10.98. The difference in mean weight of two groups was statistically not significant (p= 0.176). (Table no.1, Figure no.1)

Table 2
Outcomes (means and SDs) and effects of intervention (mean within-group differences)

Intra group analysis Group-A	**Average speed of oscillations score (Postural instability)**		**Algometer scores (Pressure pain threshold)**		**NPRS score (Pain intensity)**	
	Pre	Post	Pre	Post	Pre	Post
	5.22±49.76	4.62±50.29	27.79±4.64	69.78±8.28	8.6±0.49	2.03±0.62
P-value	.000		.000		.000	
Intra group analysis Group-B	**Average speed of oscillations score (Postural instability)**		**Algometer score (Pressure pain threshold)**		**NPRS score (Pain intensity)**	
	Pre	Post	Pre	Post	Pre	Post
	6.9±82.56	6.27±80.06	28.55±5.17	44.37±5.75	8.43±0.56	3.97±0.71
P-value	.000		.000		.000	

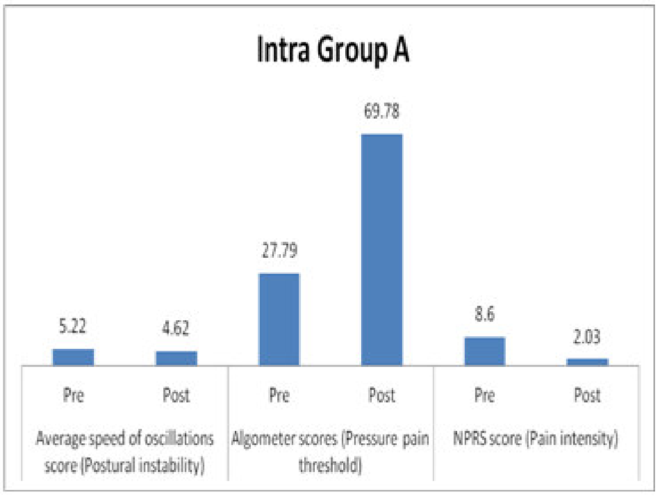

Figure 2a

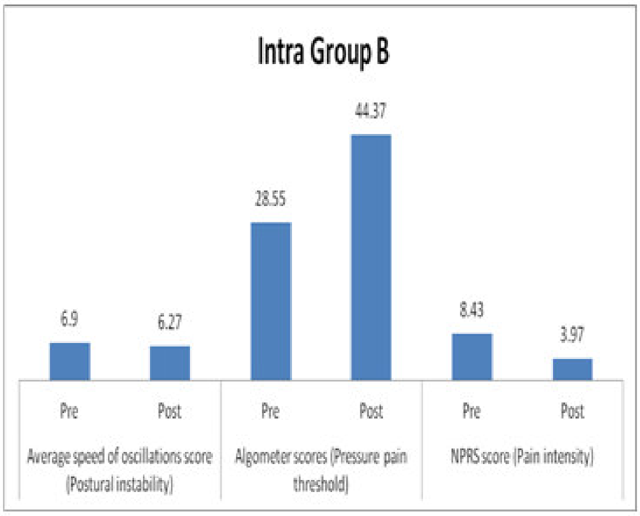

Figure 2b

Table 3
Comparison between group A and B

Group	Average speed of oscillations score (Postural instability)	Algometer score (Pressure pain threshold)	NPRS score (Pain intensity)
A	4.62±50.29	69.78±8.28	2.03±0.62
B	6.27±80.06	44.37±5.75	3.97±0.71
P value	.000	.000	.000

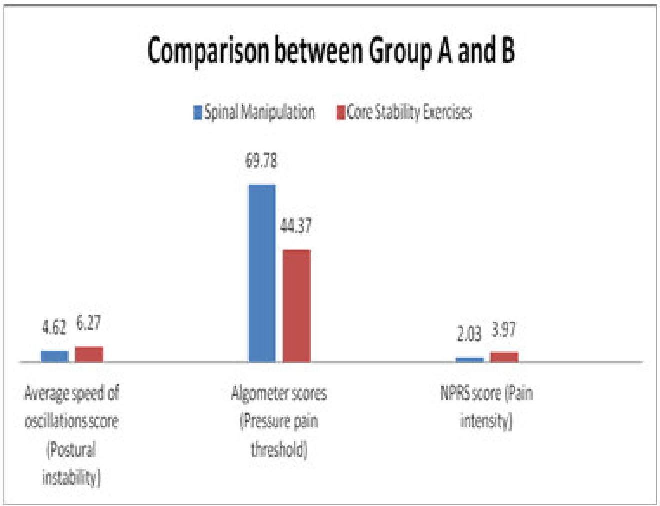

Figure 3
Comparison between group A and B

Outcome measurement
Changes in average speed of oscillations scores for postural instability

In Group A, the mean of postural instability on pre session on the first day was 5.22±49.76, which was reduced to a mean of 4.62±50.29 after 15days post treatment. The p value by paired't' test was found to be < 0.05 which is statistically significant. (Table no.2, Fig. no.2a) In Group B, the mean of postural instability on pre session on the first day was 6.9±82.56, which was reduced to a mean of 6.27±80.06 after 15days post treatment. The p value by paired't' test was found to be < 0.05 which is statistically significant. (Table no.2, Fig.No.2b).On comparing the pre session and post session the results between the two groups using unpaired t test revealed that there was statistically significant difference seen with p value less than 0.05 between group A and B indicating that there was improvement in postural instability of both the groups with better improvement seen in subjects of group A. (Table no.3, Fig. no.3)

Changes in algometer scores for pressure pain threshold

In Group A, the mean of pressure pain threshold on pre session on the first day was 27.79±4.64 , which was reduced to a mean of 69.78±8.28 on day. The p value by paired't' test was found to be < 0.05 which is statistically significant. (Table no.2, Fig. no.2a) In Group B, the mean of pressure pain threshold on pre session on the first day was 28.55±5.17, which was reduced to a mean of 44.37±5.75 after 15days post treatment. The p value by paired't' test was found to be < 0.05 which is statistically significant. (Table no 2, Fig. No.2b). On comparing the pre session and post session the results between the two groups using unpaired t test revealed that there was statistically significant difference seen with p value less than 0.05 between group A and B indicating that there was improvement in pressure pain threshold of both the groups with better improvement seen in subjects of group A. (Table no. 3, Fig. 3).

Changes in pain intensity though numeric pain rating scale (NPRS)

In the Group A, the mean NPRS score on pre session on the first day was 8.6±0.49, which was reduced to a mean of 2.03±0.62 after15 sessions of treatment. The p value by paired t test was found to be < 0.05 which is statistically significant. (Table no.2, Fig. 2a).In Group B, the mean NPRS score on pre session on first day was 8.3 ± 0.6, which was reduced to a mean of 4.0± 0.73 after 15days of post treatment. The p value by paired't' test was found to be <0.05which is statistically significant (Table no.2, Fig. no. 2b). On comparing the pre session and post session, the results between the two groups using unpaired 't' test revealed that there was statistically significant difference seen between group with p value less than 0.05. Since average improvement is more in group A as compared to group B, we can consider group A better in reduction of pain (Table no.3, Fig. no.3).

DISCUSSION

The present clinical trial was conducted to find the effect of spinal manipulation on postural instability in subjects with non specific low back pain. Results of this study were focused on postural instability reduction, pain relief, and increase pressure pain threshold score. It was noticed that there was improvement in all the above parameters in both groups.In this study, the intra-group mean values of postural instability were analysed, it was found statistically significant in both groups after end of 15 days, but when comparison was done intergroup, statistically significant difference was found between groups. Spinal manipulation therapy proved to be better in improving postural instability after end of 15 days. Although there is growing evidence of manual therapy techniques may produce therapeutic benefits and performance enhancement by reducing postural instability and improving postural control. This finding supports the study of Fryer (2003).[30] Significant relief of pain was noted in both groups over sessions for 15 days. When the intra-group mean values of numeric pain rating scale were analyzed it was found statistically significant in both groups pre to post intervention; and post intervention at the end of 15 days, but when comparison was done intergroup, statistically significance difference was found between the two groups in relieving pain. Spinal manipulation proved superior in terms of reduction of pain. In the present study reduction in pain level, as quantified by the NPRS, with the application of both spinal manipulations (HVLA thrust) and core stability exercises are consistent with the findings of previous studies indicating both the techniques have effectively reduced low back pain.For instance, manipulation and general exercise therapy improves pain and disability and reduces the number of sick days in patients with non specific low back pain.[31] Large reviews conclude that there is strong evidence for the effectiveness of manipulation as a treatment for low back pain. This finding supports the study of Airaksinen O, (2006).[32] Significant increase of pressure pain threshold (PPT) was noted in both groups complete treatment for 15 days. When the intra-group mean values of PPT were analyzed it was found statistically significant in both groups pre to post intervention; and post intervention at the end of 15 days, but when comparison was done intergroup, statistically significance difference was found between the two groups in increase PPT. Spinal manipulation (HVLA thrust) proved superior in terms of increase of PPT.Numerous studies have considered the immediate effects of manual therapy interventions upon neurophysiological responses shows specific changes in pain sensitivity. This finding supports the study of Joel E. Bialosky et al (2014).[33] It is interesting to consider what changes may have occurred during both treatment procedures. Both mechanical and neurophysiologic mechanisms have been described to explain pain reduction and improved mobility following joint motion or mobilization, and it is conceivable that both mechanisms played a role in the findings of the present study. For example, passive motion has been reported to selectively stretch contracted tissues without damaging healthy adjacent tissues.[34] Biomechanical changes caused by the manipulation are thought to have physiological consequences by means of their effects on the inflow of sensory information to the central nervous system.[35]By releasing trapped meniscoids, discal material or segmental adhesions, or by normalizing a buckled segment, the mechanical input may ultimately reduce nociceptive input from receptive nerve endings in innervated paraspinal tissues. This would be consistent with the observation that spinal manipulation is not painful when administered correctly. In addition, the mechanical thrust could either stimulate or silence non nociceptive, mechano sensitive receptive nerve endings in paraspinal tissues, including skin, muscle, tendons, ligaments, facet joints and inter vertebral disc.[36] Substantial evidence demonstrates that spinal manipulation evokes paraspinal muscle reflexes and alters motoneuron excitability. The effects of spinal manipulation on these somatosomatic reflexes may be quite complex, producing excitatory and inhibitory effects whereas substantial information also show that sensory input, especially noxious input, from paraspinal tissues can reflexively elicit sympathetic nerve activity, knowledge about spinal manipulation's effects on these reflexes.[37] Recent studies have estimated that 14% of the United States population or more suffer from pain related to joints and the musculoskeletal system.[38]Muscular injuries are a common cause of disability in the population, and muscle problems are the most common cause of low back pain. There were a lot of reports about postural instability and impaired balance control in patients with low back pain.[39] Low back pain presents a serious health care problem and produces a huge burden on society. Simple, safe, physical treatment procedures such as spinal manipulation with ergonomic exercise could be of great value. This provides a low cost, easy means of treatment in subjects with non-specific low back pain.This study has several limitations: small sample size, range of motion could not measure in this study, Subjects could not be followed up after the study, duration of the study was short and the strict inclusion criteria used in the present study limit the generalizability of the results to all low back pain populations.The study can be done on large sample size, it would be challenging if the study is done with the inclusion higher percentage of disability level, a long-term follow up study should be done to know the long term effectiveness of spinal manipulation (High velocity low amplitude thrust) and the study can be measured on range of motion.

CONCLUSION

In conclusion, the present randomized clinical trial provided evidence to support the use of spinal manipulation (HVLA thrust) and core stability exercises in reducing postural instability, relieving pain intensity and improving pressure pain threshold in subjects with non-specific low back pain. In addition, results supported that spinal manipulation (HVLA thrust) was more effective in reducing postural instability, pain intensity and improving pressure pain threshold in subjects with non-specific low back pain.

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