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ULTRASOUND IMAGING AS A FEEDBACK TOOL TO MEASURE THE EFFICACY OF CORE STABILITY EXERCISES VS SPINAL MOBILIZATION TECHNIQUE IN PATIENTS WITH LOW BACK PAIN. A RANDOMIZED CLINICAL TRIAL

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Abstract:

Objectives: *To compare the effectiveness of core stability exercises versus spinal mobilization on pain, functional ability and muscular thickness in patients with low back pain.*

Method: *The randomized control trial was conducted in Department of Rehabilitation Sciences at Ziauddin Hospital, Clifton Campus, Karachi, Pakistan from October 2017 to august 2018 on a sample of 60 individuals suffering from low back pain. They were randomized in to two equal groups by a lottery method. Group A was treated with spinal mobilization while Group B with core stability exercises whereas data was analyzed by SPSS 21.*

Result: *The mean age of enrolled participants was 43.57±9.60 years, in which 43.3% were male and 56.7% were female. The paired t test was used to analyze the pre-intervention reading of the baseline treatment and post intervention reading of 12 sessions. The participants were divided into two groups in such a way that group A was treated with spinal mobilization and group B with Core stability exercises. The analysis showed that Group B was more effective in improving muscular thickness(p-<0.000), functional ADLS and intensity of pain(p-<0.000) than the other research group.*

Conclusion: *Core stability was more effective then spinal mobilization exercises for the treatment of low back pain.*

Keywords: *Low Back Pain, spinal mobilization, Core stability, Numeric pain rating scale (NPRS), Oswestry Disability Index (ODI).*

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INTRODUCTION:

Low back pain (LBP) is one of the most prevalent conditions in the society today. It has been documented that between 60 to 80 percent of people will experience LBP at some point during their life expectancy [1,2]. It is the major cause of activity limitation in both men and women and is the second most frequent reason after upper respiratory tract infections for the physician visits [3,4]. Approximately 70 to 90 percent of back pain episodes subside within 2 to 3 months of onset but the chances of recurrence remains high[5,6]. There are several primary and secondary reasons that may contribute to the symptoms of low back pain such as degenerative disc disease, compression of nerve roots, musculo-ligamentous injuries, facet joint dysfunction, sacroiliac joint dysfunction, herniation of nucleus pulposus, osteoarthritis, irritation of adjacent nerve roots, spinal stenosis, scoliosis, spondylolisthesis, primary or metastatic cancer, spinal infection, autoimmune disease and any trauma or deformity of the lumbar spine. The condition of low back pain is usually divided into acute (persisting for less than 6 weeks), sub-acute (persisting for 6 to 12 weeks) and chronic low back pain (persisting for more than 12 weeks) [7,8]. The symptoms of acute low back pain are severe or sharp pain that is caused by any injury or trauma of the lumbar spine while chronic low back pain may appear as a deep, achy and burning type of sensation that travels down the legs. These two kinds of low back pain may differ in symptoms but present with similar limitations such as difficulty in sitting, walking, lifting and twisting activities of lumbar spine.

There is a need to understand what the effectiveness of a clinically applicable treatment intervention is for an individual's perception of their back pain [9]. Physical therapy and other form of exercises are usually the first choices of treatment. Some of these regimes gives satisfactory results for a short term while others for a prolonged period of time so, it is important that these exercise programs should be specific and tailored according to the needs, appearance and frequency of the back pain.

RATIONALE OF STUDY

The aim of the study was to compare the effectiveness of Core stability exercises versus spinal mobilization technique for the management of low back pain. This study will not only be beneficial to the patient in terms of managing their pain but also be cost and time effective.

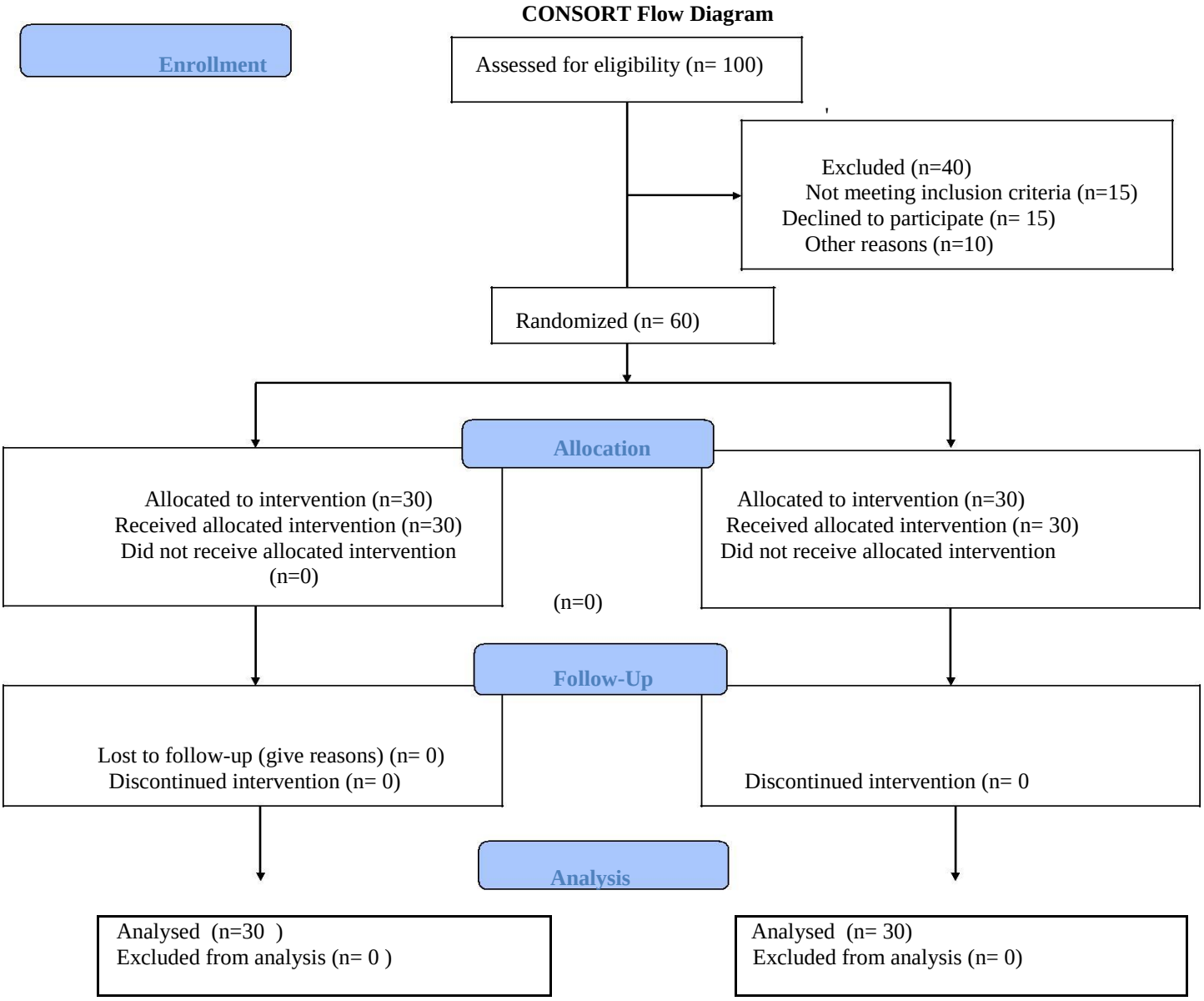
OBJECTIVES

To study the efficacy of core stability exercises versus spinal mobilization on pain, muscular thickness and ADLs of the person suffering with low back pain.

METHODOLOGY:

The randomized control trial was conducted in the Department of Rehabilitation Sciences at Ziauddin Hospital, Clifton Campus, Karachi, Pakistan from October 2017 to august 2018 on a sample of 60 individuals of both genders with in the age of 18 to 70 years suffering from low back pain. The sample size was calculated by a WHO Software named as "sample size determination in health sciences". A previous study conducted in American College of Rheumatology, June 2012 "A Systemic Review of the global prevalence of low back pain" was considered as a sample to calculate the sample size. By considering 95% of confidence level the Sample size was taken as n= 60[14]. In this study 60 Individuals were equally divided in to two groups in such a way that the control group named as group A was treated with spinal mobilization while the experimental group known as group B with Core stability exercises.

After the written consent was taken each individual was enrolled for duration of three weeks. The participants were treated with hot pack and Tens for first 20 minutes and then the intervention was applied. The readings of pre-and post-treatment sessions for pain, functional disability and muscle thickness were calculated on the numeric pain rating scale, Oswestry Disability Index (ODI) and RUSI while the data was analyzed on SPSS 21.


CONSORT Flow Diagram
Enrollment
Assessed for eligibility (n= 100)
Excluded (n=40)
Not meeting inclusion criteria (n=15)
Declined to participate (n= 15)
Other reasons (n=10)
Randomized (n= 60)
Allocation
Allocated to intervention (n=30)
Received allocated intervention (n=30)
Did not receive allocated intervention (n=0)
Allocated to intervention (n=30)
Received allocated intervention (n= 30)
Did not receive allocated intervention
(n=0)
Follow-Up
Lost to follow-up (give reasons) (n= 0)
Discontinued intervention (n= 0)
Discontinued intervention (n= 0
Analysis
Analysed (n=30)
Excluded from analysis (n= 0)
Analysed (n= 30)
Excluded from analysis (n= 0)

RESULT:

The mean age of enrolled participants was 43.57±9.60 years, in which 43.3% were male and 56.7% were female. According to the assessment of pre and post values by NPRS, ODI and Ultrasound imaging both techniques showed improvement but the outcomes displayed by Group B (Core stability exercises) was statistically significant in terms of pain management for a prolonged period of time, improvement in functional abilities and increase in muscular cross-sectional area as compared to Group A (spinal mobilization).

Table 01: Gender Distribution and Group Distribution

	Frequency	**Percent**
Male	**26**	**43.3%**
Female	**34**	**56.7%**
Total	**60**	**100%**
	Frequency	**Percent**
Spinal Mobilization	**30**	**50%**
Core stability	**30**	**50%**
Total	**60**	**100%**

According to the results group B treated with core stability exercises displayed better outcomes in terms of pain management, improvement in functional abilities and increase in muscular cross-sectional area as compared to group A.

Table 02: NPRS

Group		**Mean**	**Std. Deviation**	**P-value**
Spinal Mobilization	**Pre**	**7.42**	**0.84**	**0.000**
	post	**3.88**	**1.13**	
Core stability	**Pre**	**7.47**	**1.35**	**0.000**
	Post	**3.12**	**0.88**	

Figure 01:

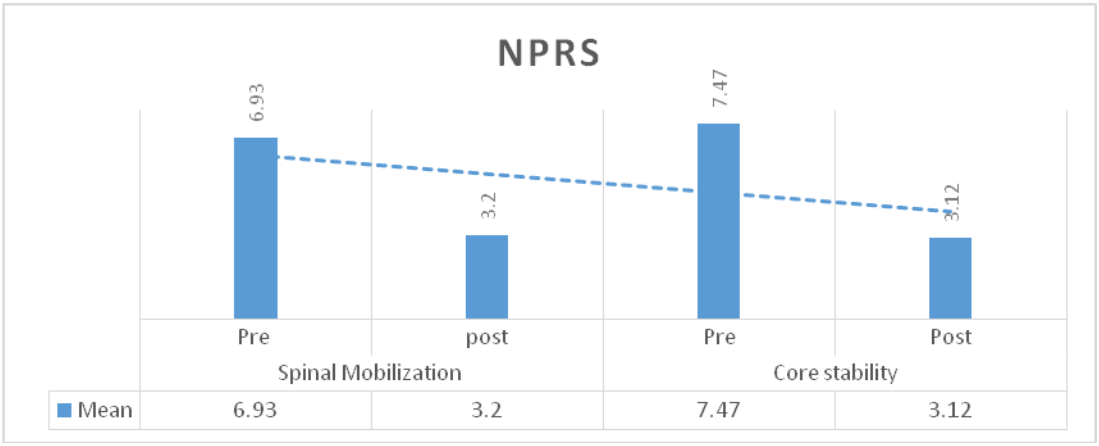


Table 2 & figure 01 display that there was a difference in pre and post values of pain in both groups but the values in group B (Core stability) were more statistically significant as compared to group A (spinal mobilization).

Table: 03A: Oswerty Disability Index (ODI) questionnaire

Pain intensity		Mean	Std. Deviation	P-value
Spinal Mobilization	Pre	4.13	1	0.00
	post	2.16	0.8	
Core stability	Pre	4.5	0.9	0.00
	Post	2.8	0.76	
Personal care				
Spinal Mobilization	Pre	3.24	1.15	0.00
	post	2.04	0.75	
Core stability	Pre	3.47	1.59	0.00
	Post	2.12	0.83	
Lifting				
Spinal Mobilization	Pre	4.27	1.5	0.00
	post	2.4	1.08	
Core stability	Pre	4.97	1.29	0.00
	Post	2.96	0.73	
Walking				
Spinal Mobilization	Pre	3.6	0.93	0.00
	post	2.16	0.8	
Core stability	Pre	4	1.08	0.00
	Post	2.5	0.76	

Table 3A display that there was a difference in pre and post values of ODI Scale Variables in both groups but the values in group B (Core stability) were more statistically significant as compared to group A (spinal mobilization).

Table: 03B: Oswerty Disability Index (ODI) questionnaire

Sitting		Mean	Std. Deviation	P-value
Spinal Mobilization	Pre	4.03	0.85	0.00
	post	2.56	0.82	
Core stability	Pre	4.33	1.02	0.00
	Post	2.8	0.57	
Standing				
Spinal Mobilization	Pre	3.97	1.03	0.00
	post	2.6	0.95	
Core stability	Pre	4.33	1.12	0.00
	Post	2.72	0.72	
Social Life				
Spinal Mobilization	Pre	4	1.11	0.00
	post	2.52	0.87	
Core stability	Pre	4.43	0.87	0.00
	Post	2.88	0.66	
Traveling				
Spinal Mobilization	Pre	3.5	0.86	0.00
	post	2.28	0.84	
Core stability	Pre	3.67	0.84	0.00
	Post	2.4	0.65	

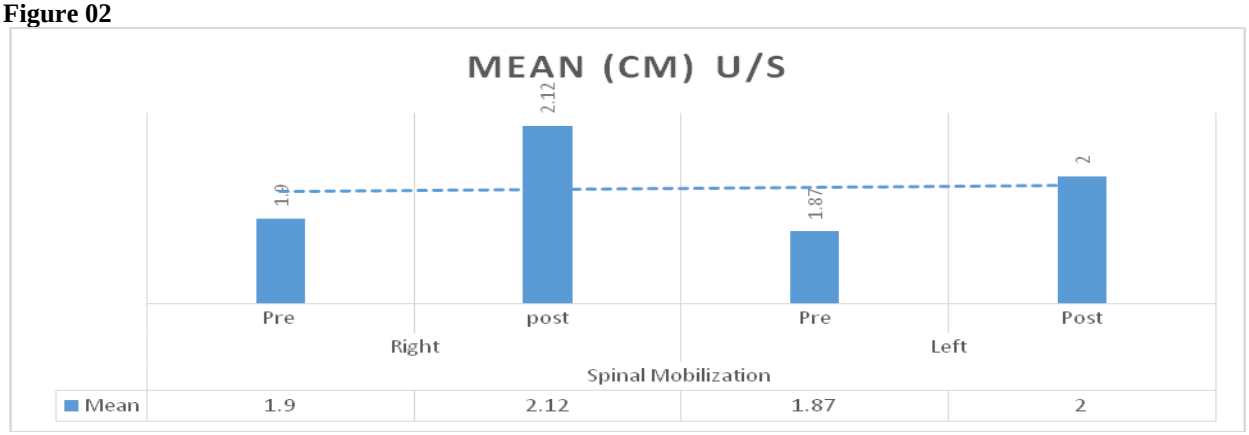
Table 3B display that there was a difference in pre and post values of ODI Scale Variable in both groups but the values in group B (Core stability) were more statistically significant as compared to group A (spinal mobilization).

Table 4: Ultrasound

Group			Mean (CM)	Std. Deviation	P-value
Spinal Mobilization	Right	Pre	1.60	0.57	0.000
		post	1.88	0.60	
	Left	Pre	1.60	0.55	
		Post	2.00	0.60	
Core stability	Right	Pre	1.87	0.43	0.000
		Post	2.40	0.40	
	Left	pre	1.77	0.43	
		post	2.24	0.43	

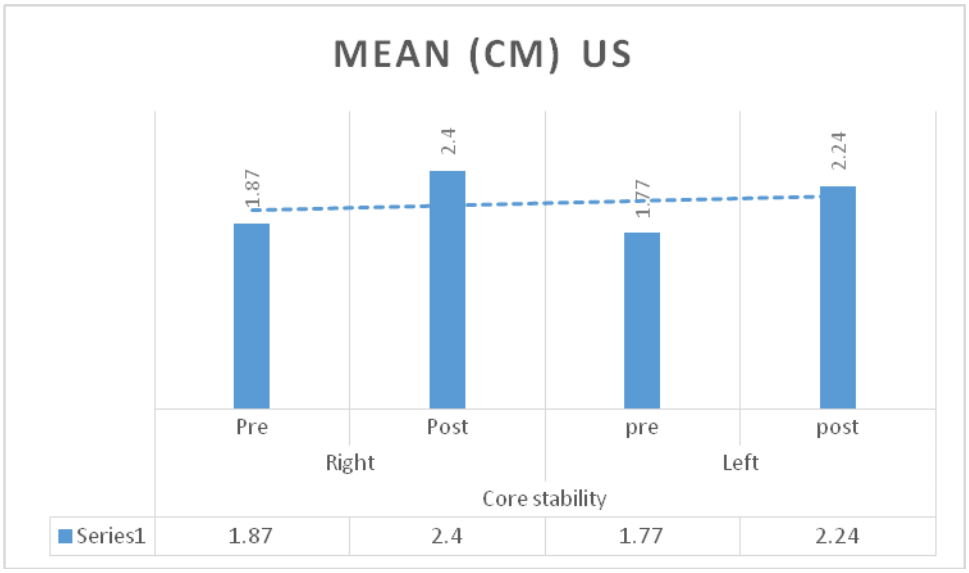
Table 04: According to this table there was a significant difference between pre and post values of muscular thickness in group B.

Figure 02



This graph displays that there was a difference in pre and post values of muscular thickness in group A (spinal mobilization).

Figure 03:



This graph displays that there was a difference in pre and post values of muscular thickness in group B (Core stability).

A: pretreatment value **B: pretreatment value**

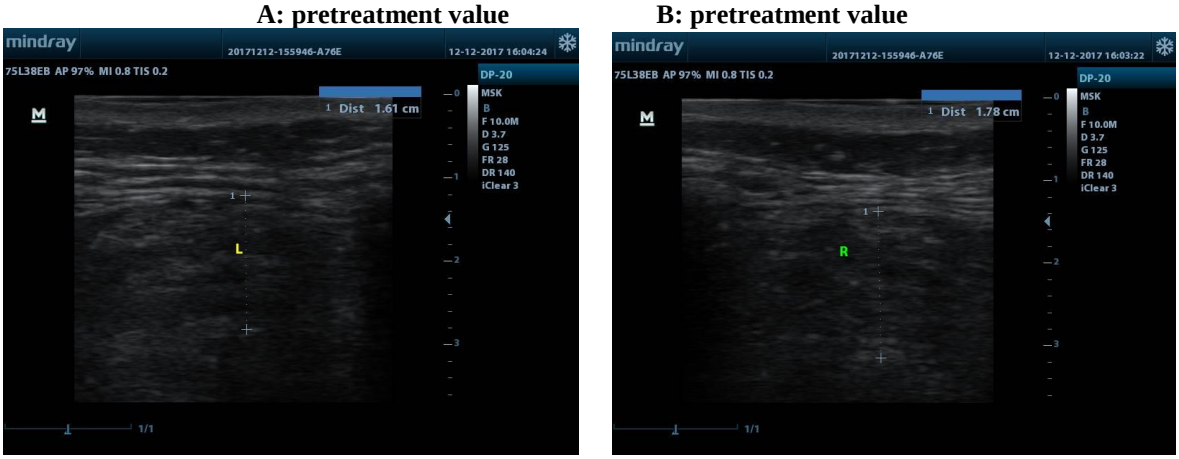


Image (A) and (B) shows the pretreatment values of muscular thickness of Group A (spinal mobilization) and Group B (Core stability).

C: post treatment value **D: post treatment value**

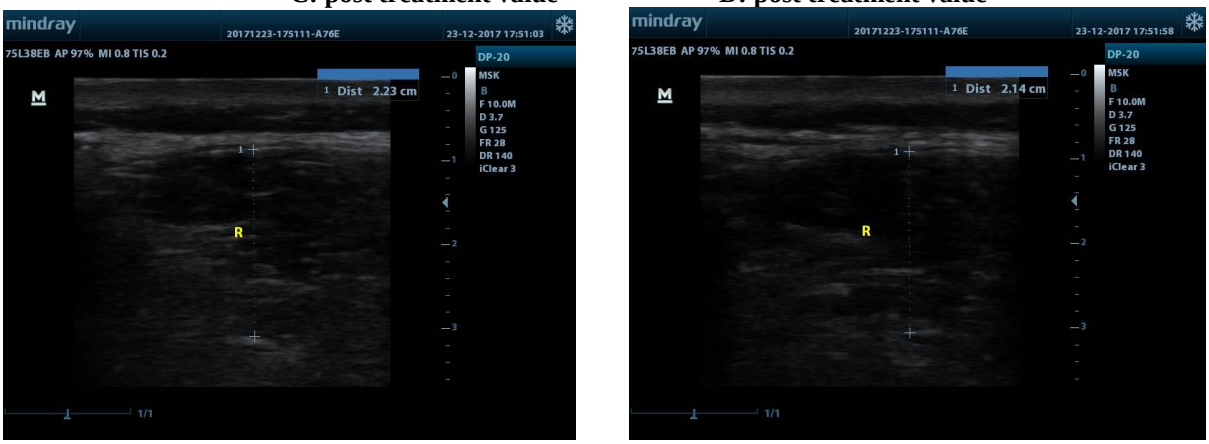


Image (C) and (D) display the post treatment values of muscular thickness of Group A (spinal mobilization) and Group B (Core stability).

DISCUSSION:

The aim of this study was to investigate the effects of core stability exercises versus spinal mobilization technique in patients with acute, sub- acute and chronic low back pain. Spinal mobilization is a common intervention that is being used by physiotherapists to reduce pain, stiffness and functional disability. As described by previous studies this technique gives instant results by reducing pain and increasing lumbar motion immediately after the session such as Chiradejnant et al. reported a 36% reduction in pain after performing spinal mobilization exercises in patients of nonspecific low back pain while Goodsell et al. concluded that after spinal mobilization the average pain of patients reduced by a total of 33%. This present study evaluated the rehabilitative effects of spinal mobilization and concluded that though it has immediate effects by decreasing pain and spinal stiffness but the results remains only for short-time period.

According to the results of this study almost all of the participants of Group A experienced immediate reduction in pain and stiffness after the procedure was performed but after few days they returned with the complain of similar intensity of pain. The reoccurrence rate of back pain was very high in Group A as compared to the other group. This explains that although spinal mobilization can instantly reduce pain and stiffness in the patients of low back pain but is unable to maintain the results for a longer period of time.

Wong et al conducted a pilot study to evaluate the effects of core stability exercises on the pain intensity, functional abilities and activation of trunk muscles in individuals suffering from acute, sub-acute and chronic low back pain. In this study participants were divided in to two groups in which one was treated with static stretching while the other with core stability exercises. He concluded on the

basis of results that core stability exercises enhance the ability of tranversus abdominis and multifidus muscle that in turn reduce pain and improve functional abilities in the patients of low back pain[16]. According to biomechanical theory weak muscles causes irritation of the lumbar spine by stimulating pain sensitive areas. These continued stimulations cause central sensitization and muscle spasm that leads to chronic pain. The core stability exercise program is based on the contraction of transversus abdominis that helps in the strengthening of spinal muscles and enhance lumbar stability by maintaining the balance of spinal region. The results of this study suggests that core stability exercises increase the strength of core muscles that in turn reduces pain, spasm, irritation, functional disability and improve the control of spine and pelvis [17].

The results of this present study supports the theory of above mentioned researches that core stability is an effective form of exercise that reduce intensity of pain and improve functional ability of the patients that suffers from acute, sub-acute and chronic low back pain. Core stability exercises helps in restoration of coordination and balance of trunk muscle to improve function of lumbar spine and pelvis in order to improve the posture of individuals suffering from this condition.

Along with other factors good posture is an important element in managing, preventing, or facilitating recovery from recurrent episodes of LBP. The range of lumbar lordosis plays an important role in this condition because it alters according to the posture which is directly proportional to the changes in acceleration. Core stability exercises facilitate this mechanism by improving acceleration which in turn will increase the available range by which lordosis is able to accommodate axial compressive forces. However, this would not be true if there was structural trunk stiffness caused by underlying natural pathology such as natural degenerative changes. It is commonly believed that core stability is essential for the maintenance of an upright posture and especially for movements such as lifting that requires extra effort.

Paul S. Sung et al conducted a study in 2003 to examine the effects of CSE intervention on the levels of disability [18]. In this study forty-six individuals were divided in such a way that twenty-five participants were in the CSE intervention group (average age of 47.7±8.9 years) while the other twenty-one in the SFE group (average age of 53.1±9.0 years). Each group participated in the specific exercise intervention program for 4 weeks while continuing their present activities and exercise regimes. The disability and fatigue levels were measured by Oswestry Disability Index (ODI) and a modified Sorensen test. The results of this study revealed that disability level significantly decreased in the CSE intervention group but no change was detected in the muscle fatigability of either group whereas Ferreira et al 2006 compared the impact of general and core stability exercises on the patients suffering from chronic LBP. According to VAS and Roland Morris Disability Questionnaire core stability exercise group showed a marginally better outcome than the general exercise group after 8 weeks of treatment. It was a high-quality and clinically relevant study but comparison was made difficult due to the enrollment of varied group of subjects (including patients with disc herniation, arthritis, and muscle pain) [19].

According to the results of this study Core stability exercises displayed better outcomes in terms of pain, disability, multifidus cross-sectional area and functional range of motion as compared to spinal mobilization. Core stability exercises not just decreased pain but maintained it for a longer duration of time by increasing the muscular thickness of multifidus muscle in order to limit the reoccurrence rate of low back pain.

NPRS, ODI and RUSI were selected on the basis of strict criteria for the assessment of pain, functional ability and muscle thickness. NPRS is a valid and reliable scale to measure pain intensity that can be administered both verbally and in writing with a simple set of scoring. ODI is currently considered as a gold standard for measuring degree of disability and estimating quality of life in a person with low back pain whereas ultrasound imaging was used for assessing the muscle thickness of lumbar multifidus muscle. Clinically it is used to assess any abnormality, changes during recovery and biofeedback during the re-education of muscular contractions.

Along with assessing pain, functional ability and muscle thickness the variables mentioned in this study were compared to give a better view of the outcomes generated by two groups. The personal care in group B (Core stability) increased by 22 %, lifting improved by 33%, walking enhanced by 25 %, sitting increased by 26%, standing improved by 27%, social life enhanced by 25% and travelling improved by 21% as compared to group A (spinal mobilization).
This present study concluded on the basis of results that core stability is a better, easy and potent method to reduce the symptoms of low back pain. Along with

reducing pain, improving functional ability and increasing muscular thickness this technique helps in minimizing the reoccurrence rate of low back pain.

LIMITATIONS

The limitations of this study includes small sample size, inability to remove all possible sources of bias, there was no indication for how long a rest period should be maintained between the exercise regimes and both groups received therapeutic exercises thus, it may be difficult to separate the effects of these 2 therapies or the additive effect of CSE intervention as compared to regular therapeutic exercises.

CONCLUSION:

Core stability exercises were effective in reducing pain, improving functional disability and increasing cross-sectional area of multifidus muscle as compared to Spinal mobilization technique.

Disclaimer: This research is the part of PhD thesis in the field of musculoskeletal system. As there is no registration authority in Pakistan it has been registered with Ziauddin University with a trial no **0381017SAPT**

Conflict of Interest: The author declare that they have no conflict of interest.

Funding: None (this study was did not taken any grant).

Compliance with Ethical Standards

- **Disclosure of potential conflicts of interest**
- **Ethical Approval**
- **Informed consent**

Disclosure of potential conflicts of interest

Ethical Approval: All procedure performed in studies involving human participants were in accordance with the ethical standards of the institution and national research committee.

Informed consent: Informed consent was obtained from all individual participants included in the study

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