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EFFECT OF CORE STABILIZATION TRAINING ON ENDURANCE OF TRUNK EXTENSOR AND FUNCTIONAL CAPACITY IN SUBJECTS WITH MECHANICAL LOW BACK PAIN

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ABSTRACT

Study Objectives: *To determine the effect of Core stabilization training on trunk extensor endurance and functional capacity in subjects with mechanical low back pain.* ***Methods:*** *A total of 30 subjects (M: 14, F: 16) were recruited for the study on the basis of inclusion and exclusion criteria after signing the informed consent form. The subjects were then divided into two groups, (Group A= Core Stabilization and Endurance Training & Group B= Endurance Training). All the subjects were asked to perform 5 min warm-up exercise before the intervention. The total duration of the protocol was 6 weeks and frequency of exercise performed is 3 times per weeks.* ***Results:*** *The result of the study demonstrates that both the Groups showed significant improvement when comparison is made within the groups with p=0.001 for both trunk extensor endurance test and functional capacity. However, Group A shows significant improvement between the groups post intervention p=0.023 & p=.000 respectively.* ***Conclusion:*** *From the present study it can be concluded that core stabilization training is effective in increasing trunk extensor endurance and functional capacity in subjects with mechanical low back pain.*

KEY WORDS

Core stabilization training, Endurance training, Trunk extensor endurance, Mechanical low back pain, Trunk Extensor Endurance.

INTRODUCTION

Low back pain is one of the most common and costly smusculo-skeletal pain syndromes affecting up to 80% of people at some point during their lifetime. The re-occurrence rate of low back pain is high and these disorders often develop into a chronic fluctuating problem with intermittent flares.[6] Caring for chronic low back pain, is one of the most difficult and unrewarding problems in clinical medicine, as no approach to diagnose or any form of treatment, has been shown to be clearly definitive or effective. One possible explanation for the inability to identify effective treatment protocols is the lack of success in defining groups of patients who are most likely to respond to a specific treatment approach.[6] For most patients with acute low back , the etiology is thought to be a mechanical cause involving the spine and surrounding structures.[12] A wide range of terms is used for non-specific mechanical causes, including low back strain/sprain facet joint syndrome, sacroiliac syndrome, segmental dysfunction, somatic dysfunction, ligamentous strain and myofascial strain.[3] Biomechanics may be altered due to low back pain or injury to the spine, producing weakness and loss of muscle control, which leads to further injury because the joints are not appropriately supported again, this may result in over- compensation by the pelvis or lower extremities, which will increase the predisposition to chronic injuries.[5] The core has been described as a box with the region of high flexibility around the mid-zone of the abdominals in the front, paraspinal and gluteals in the back, the diaphragm as the roof and the pelvic floor and hip girdle musculature as the bottom.

Therefore, the core serves as a muscular corset that works as a unit to stabilize the body and spine.[1]Panjabi (1992)describe the spinal stabilization system is conceptualized as consisting of three subsystems; passive muscular skeletal subsystem, which includes vertebra facet orientation intervertebral disc, spinal ligament and joint capsules, as well as the passive mechanical properties of the muscles. The active muscular skeletal subsystem consists of muscles and tendons that surround the spinal column. The neural and feedback subsystem consists of various force and motion transducers located in ligaments, tendons, muscles and neural control centers. These passive, active and neural control subsystems - although conceptually separate - are functionally independent. The passive subsystem does not provide any significant stability to the spine in the vicinity of the neutral position. It is towards the ends of the ranges of motion that the ligaments develop reactive forces that resist spinal motion. The active subsystem is the means through which the spinal stabilization system generates forces and provides the required stability to the spine. The magnitude of the force generated in each muscle is measured by the force transducers (signal producing devices) devices) located in the tendons of themuscles.[15]Therefore, this aspect of the tendons may be part of the neural control subsystem. Within the neutral zone of motion, (that part of the range of physiological intervertebral motion, measured from the normal position, within which the spinal motion is produced with a minimal internal resistance - it is the region of high flexibility around the mid-zone of motion) the restraints and control for bending, rotating and shear force are largely provided by the muscles that surround and act on the spinal segment The neural subsystem receives information from the various transducers, determines specific requirements for spinal stability and causes the active subsystem to achieve the stability goal.[16]

Well-developed core stability allows for efficiency and a decrease in the incidence of overuse injuries.[9] The normal function of the stabilization system is to provide sufficient stability to the spine to match instantaneous varying stability demands made by changes in spinal posture, static and dynamic load.[15] Hicks et al, suggest that core stability system has a role in ensuring spinal stability and according to van Dillin et al. (2001), a decrease in spinal stability places stress and excessive load on the spinal joints and tissues, which eventually results in low back pain.[19]

Control of back pain and prevention of its occurrence can be assisted by enhancing muscle control of the spinal segment through core stability exercises. Therefore, exercise programs, which are based on active rehabilitation, can reduce low back pain intensity, alleviate functional disability and improve core stability and back extension strength, mobility and endurance.[17]

According to Chok et al. (1999), poor endurance of the trunk muscles may induce strain on the passive structures of the lumbar spine, eventually leading to low back pain. Evidence suggests that muscle endurance is lower for people with low back pain than for individuals without low back pain. Due to endurance being less in trunk muscles, fatigue can affect the ability of people with low back pain to respond to the demands of an unexpected load. Fatigue, after repetitive loading, also leads to loss of control and precision, which may predispose an individual to developing low back pain. Therefore, trunk muscle endurance training has been recommended to elevate fatigue threshold and improve performance, thus, reducing disability of the lumbar spine.[4] Endurance training of back extensor muscles, including the multifidus, has long been recognized as a crucial preventative of recurrent low back pain. The function and coordination of the back pain. The function and coordination of the lumbar extensor muscles are often impaired in patients with low back pain.[13]

The role of trunk stabilizers is to retain the musculature; to control, coordinate and optimize function. Trunk fatigue, which occurs during intense training or matches, produces a loss in synchrony between upper and lower extremities, which may cause a reduction in muscle strength. This may in turn prevent a proper transfer of force resulting in inappropriate compensation by the body while performing a particular function.

Dynamic trunk stability training includes building muscle strength, endurance and using neuromuscular control to maintain dynamic trunk stability.[10]

MATERIAL AND METHODS

An experimental study was conducted on 30 subjects (14 male and 16 female) who were recruited from Dolphin (PG) Institute of Biomedical and Natural Science and the community in and around Dehradun based on the inclusion and exclusion criteria and they were divided into two groups after informed consent was obtained. Group A (Core Stabilization and Endurance Training) & Group B (Endurance Training). Pre and post intervention measurement of Trunk Extensor Endurance Test was measured using Prone Double Straight[2]-Leg Raise Test & Functional Capacity was assessed using Modified Oswestry Disability Index[8]. For both the groups 5 min of warm exercise was given before the intervention. The total duration of protocol was 6 weeks and frequency of exercise was 3 times per week.

All the subjects were instructed to perform a warm up program for 5 minute consisting of activities like spot jumping, skipping, and jogging at a self-selected speed. Pre and post intervention reading was taken from both the groups using Extensor muscle endurance test and Modified Oswestry low back pain disability questionnaire. Both groups continued to perform their normal physical daily activities

Protocol for Group A

All subjects in this group received Core stabilization training and Endurance training on a Swiss ball.

1. Lunge Fig 3.4
   - Sets-2
   - Repetition-8
   - Rest-1minute
2. Supine lateral roll. Fig 3.5
   - Sets-2
   - Repetition-8
   - Rest-1minute
3. Abdominal crunch Fig 3.6
   - Sets-2
   - Repetition-8
   - Rest-1minute
4. Supine Russian twist Fig 3.7
   - Sets-2
   - so Repetition-8
   - Rest-1minute

Protocol for Group B: All subjects in this group received Endurance training on a Swiss ball.

1. Bilateral shoulder lifts Fig 3.8
   - Sets-6 s
   - Repeatation-5
   - Rest-1 minute
   - Holding-20s
2. Contra-lateral arm and leg lifts Fig 3.9
   - Sets-2
   - Repeatation-8
   - Rest-1 minute
   - Holding-20sec
3. Bilateral shoulder lifts with hands behind the head Fig 3.10
   - Sets-2
   - Repeatation-8
   - Rest-1 minute
   - sHolding-20sec
4. Bilateral shoulder lifts with arms in full elevation Fig 3.11s
   - Sets-2
   - Repeatation-8
   - Rest-1 minute
   - Holding-20sec

INCLUSION CRITERIA

- Age: 18 to 30years
- Both genders
- Pain confined to lumbar region without radiating to the buttock and lower
- Extremity
- Any one of the following should be positive.
- History of low back pain for more than 6 weeks before the study.
- Had on and off back pain and had experienced at least 3 episodes of low back pain in last 6 months

EXCLUSION CRITERIA

- History of lumbar spinal surgery.
- History of spinal or pelvic fracture
- History of hospitalization for severe trauma or injury from accident
- History of systemic disease like arthritis, tuberculosis

- History with malignancy, rheumatoid arthritis, ankylosing spondylitis, disc
- herniation and neurological problem involving the lumbar spine
- Physical therapy for low back pain within last six month
- People undergoing regular exercise protocol in gyms

INSTRUMENTATION

- couch
- Stop watch
- 5cm 2 burst resistant gym bal

OUTCOME MEASURES

- Extensor muscle endurance test (EET)
- Prone double straight-leg raise test2

The subject's position is prone with hips extended, the hands underneath the forehead and the arms perpendicular to the body. The subject is then instructed to raise both legs until knee clearance will be achieved. The examiner monitored knee clearance by sliding one hand under the thighs. The time will record in seconds, and the test will be terminated when the subject was no longer able to maintain knee clearance. (ICC-0.83)

- Modified Oswestry Low Pack Pain Disability Index(MODI)

Purpose: The ODI is a disease-specific disability measure is used to establish a level of disability, stage a patient's acuity status1, and monitor change over time

Scoring:

a. The ODI is made up of 10 questions. Each question is scored from 0 (highest level of function) to 50 (lowest level of function).
b. If a patient does not respond to every section, clinician can calculate a 'percentage of disability' on the basis of total point
c. The point total from each section is summed and the then divided by the total number of questions answered and multiplied by 100 to create a percentage disability. The scores range from 0-100% with lower scores meaningless disability.
d. Typically all items are filled out so you can just add up the score from each section and double it to get the final percentage score.

Measurement characteristics: The measurement characteristics of the ODI are good to excellent. Test-Retest ICC (2.1) 0.83 - 0.94 (1-14 days) 2 and 0.90 over 4 weeks in a group of patients judged stable. The minimal clinically important difference for the Oswestry is 8 – 12 percentage point13

Data was analysed using statistical package of social sciences SPSS software (version 16.0). The arithmetic mean and standard deviation of age were calculated.

Pair t-test was used for data analysis within the group A and group B for Extensor muscle endurance test.

Pair t-test was used for data analysis within the group A and group B for Modified Oswestry Low Back Pain **Disability Index**

Independent t-test was used for data analysis between the group A and group B for Extensor muscle endurance test.

Independent t-test was used for data analysis between the group A and group B for Modified Oswestry Low Back Pain Disability Index

The p value was set at (<0.05)

RESULTS AND DISCUSSION

Mean age of the subjects was 23.13333+- 2.416215 Group A and 23.66667+- 2.554175 for Group B Table & Fig 5.1

Within group comparison of EET scores reveal a significant difference for both the groups.p=.000 for group A and p=.000 for group B Table & Fig 5.2

Within group comparison of MODI scores reveal a significant difference for both the groups.p=.000 for group A and p=.000 for group B Table & Fig 5.3

Between groups comparison of EET scores reveal a significant difference post intervention with group A having higher means compared to Group B Table & Fig 5.4

Between groups comparison of MODI scores reveal a significant difference post intervention with group A having lower means compared to Group B Table & Fig 5.5

Results of the study showed that there is improvement in trunk extensor endurance and functional capacity after the intervention in both the groups. When compared between the groups

statistically significant difference was found in isometric hold time and functional capacity. Group A (Trunk Extensor Endurance & Core Stabilization) showed more improvement when compared to Group B (Trunk Extensor Endurance).

DISCUSSION

According to Moffroid, Progression of loading through postural changes produces increases in endurance time of the back extensors, as measured by the Sorensen Test. These postural progressions increase the load moment on the spine and thereby stress the erector spinae muscles, multifidus and others.[14] In addition adoptive changes occur in skeletal muscle during endurance training ie, slower rate of glycogenolysis, slower rate of lactate production during submaximal exercise occurs due to raise in the lactate threshold both in absolute and relatives terms ie, O_2 uptake(VO_2) at LT and vo2 max at LT, increased mitochondrial enzyme activity and increase capillary density.[7]

Therefore, it is reasonable to expect increased endurance of trunk extensor muscle in all subjects who underwent endurance training. Richardson found that individual with low back pain exhibits delayed activation of the transversus abdominis muscle when compared with normal individual. Low back pain patient have an impaired ability to consciously contract transversus abdominis and this is an important component of abdominal stability training.[17]

Performance of exercises on unstable surfaces like Swiss ball has been shown to increase the activity of the rectus abdominis changes in muscle activity and force output and may be another way of potentially altering neuromuscular recruitment pattern[17]

Spinal instability occurs generally as a result of delayed recruitment of core muscle/local muscle like transversus abdominus, multifidus and core stabilization training address these core muscle thereby increase spinal stability.[17]

Study by Kimitake Satoand Monique Mokha has shown that core stabilization training let to an increase in 5000meter run time performance. The proposed mechanism was that subjects who underwent core stabilization were conscious of using their core muscle to stabilize their running form. A similar mechanism may exist in our study where by subjects who underwent core stabilization training were able to stabilize their form better during performance of prone double leg raise test, thereby resulting in longer hold times than subjects who only underwent endurance training.[18]

So over all core stabilization training So over all core stabilization training increases muscle activation (transversus abdominus lumbar multifidus), alters neuromuscular control and also increases spinal stability, leading to decreased pain which may have led to the increased isometric hold time and functional capacity in group A subjects as compared to subjects in group B.

Table 5.1 Comparison of mean value for age between group A and B

DEMOGRAPHIC	GROUP A		GROUP B	
	Mean	SD	Mean	SD
AGE	23.13333	2.416215	23.66667	2.554175

Fig 5.1 Demographic data of Mean and SD of age for Group A for Group B

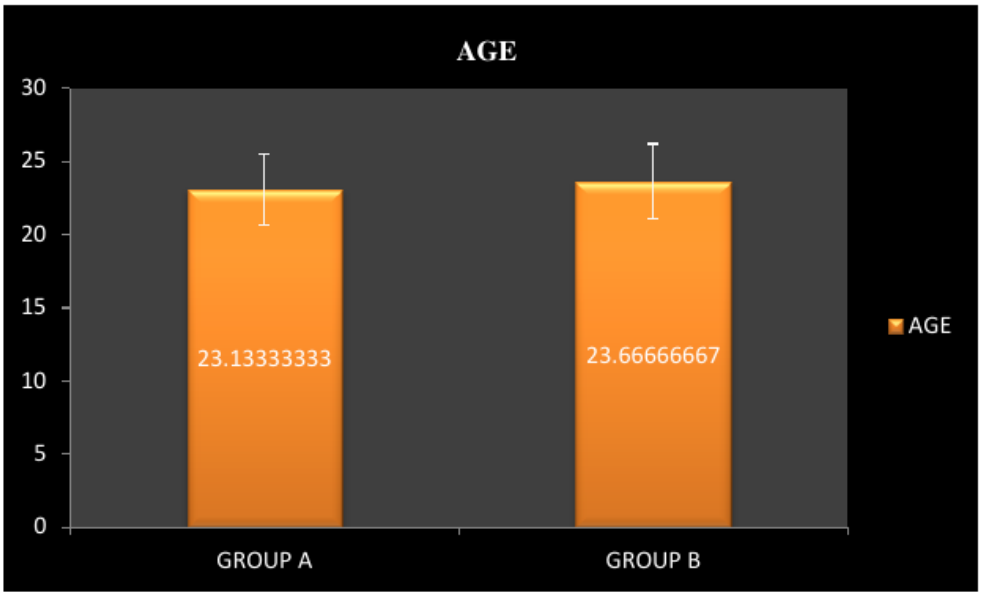

Table 5.2 Comparison of Pre and Post EET score for Group A and Group B

VARIABLE	MEAN		SD		t	p
	PRE	POST	PRE	POST		
GROUP A	36.2000	48.6667	7.62702	7.20780	-22.283	.000
GROUP B	33.8667	42.2667	7.88187	7.36271	-21.654	.000

Fig 5.2 Comparison of Pre and Post EET score for Group A and Group B

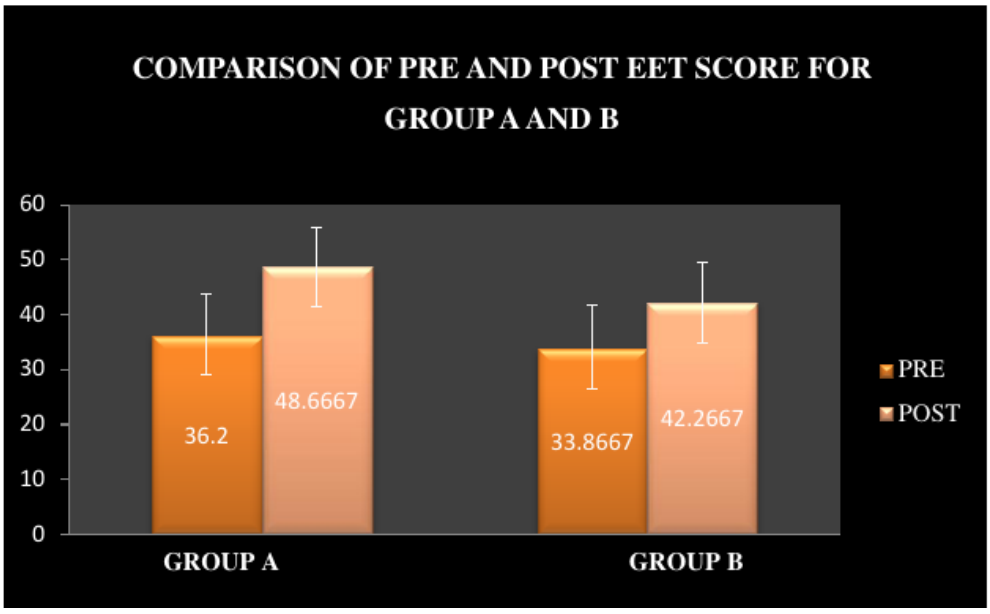

Table 5.3 Comparison of Pre and Post MODI score for group A and group B

VARIABLE	MEAN		SD		t	p
	PRE	POST	PRE	POST	47.438	.000
GROUP A	24.2667	3.6667	1.62422	.72375		
GROUP B	24.3333	5.2000	1.63299	.86189	37.825	.000

Fig 5.4 Comparison of Pre and Post EET score between Group A and B

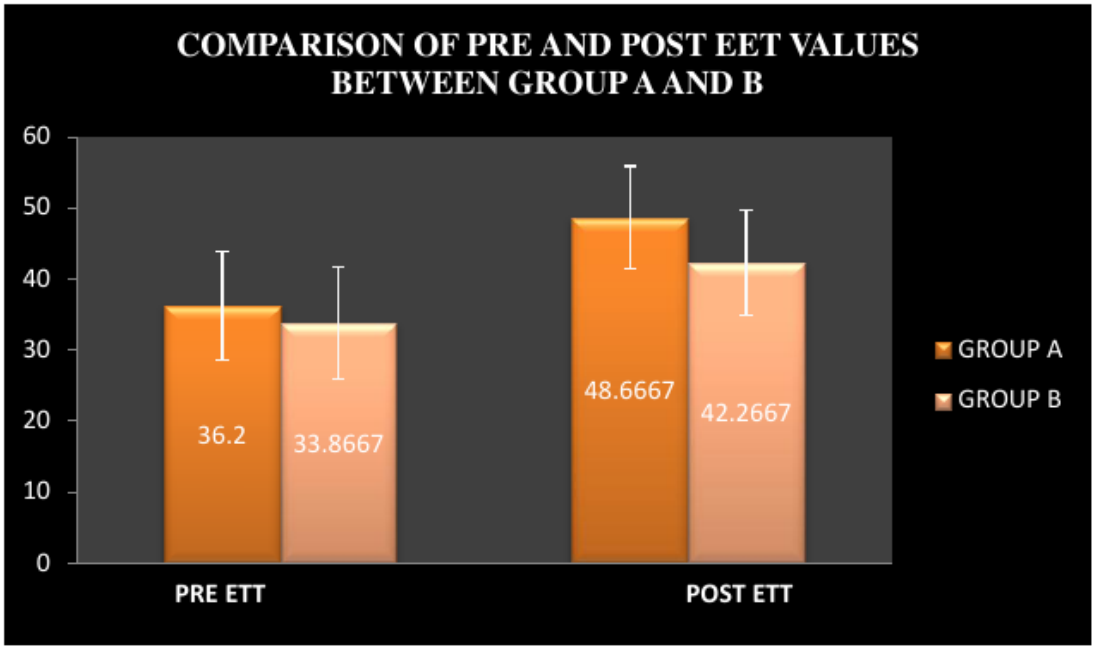

Table 5.5 Comparison of Pre and Post MODI score between Group A and Group B

VARIABLE	MEAN		SD		t	p
	GROUP A	GROUP B	GROUP A	GROUP B	-.112	.912
PRE	24.2667	24.3333	1.62422	1.63299		
POST	3.6667	5.2	0.72375	0.86189	-5.277	.000

Fig 5.5 Comparison of Pre and Post MODI score between Group A and B

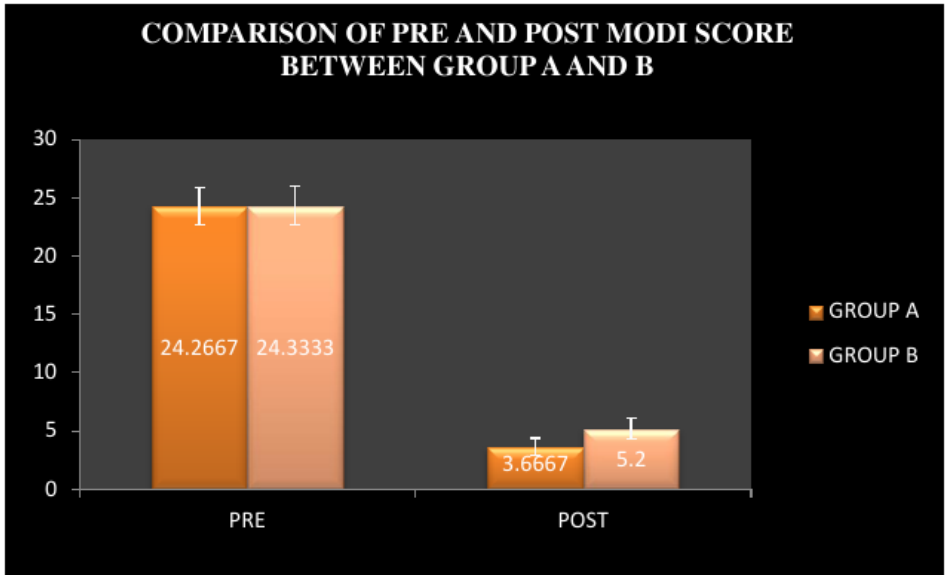

Fig 3.4 Lung exercise

Fig 3.5 Supine lateral roll exercise

Fig 3.6 Abdominal crunch exercise

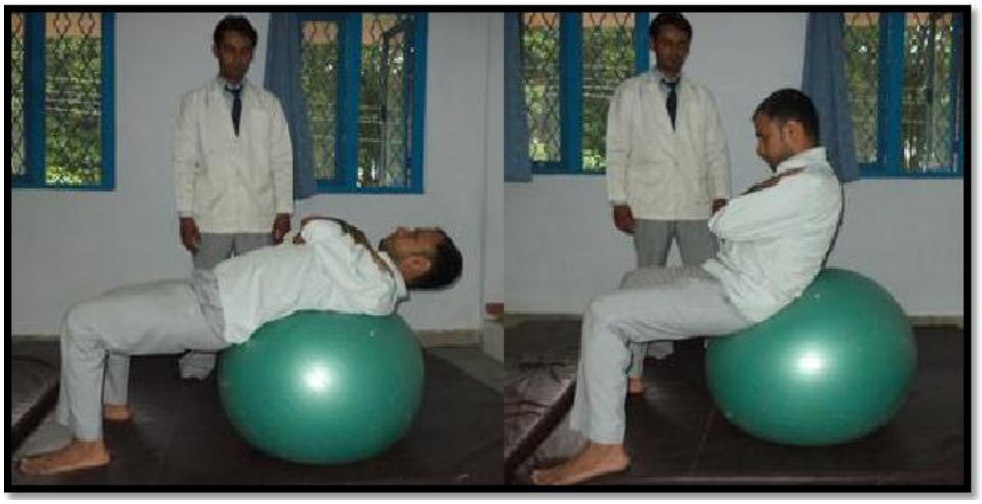

Fig 3.7 Supine Russian twist exercise

Fig 3.8 Bilateral shoulder lifts exercise

Fig 3.9 Contra-lateral arm and leg lifts exercise

Fig 3.10 Bilateral shoulder lifts with hands behind the head exercise

Fig 3.11 Bilateral shoulder lifts with arms in full elevation exercise

CONCLUSION

From the present study it can be concluded that core stabilization training is effective in increasing trunk extensor endurance and functional capacity in subjects with mechanical low back pain.

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