**“A COMPARATIVE STUDY BETWEEN EFFECT OF TRUNK STRENGTHENING EXERCISE VERSUS EFFECT OF LUMBER STABILIZING EXERCISES IN CHRONIC LOW BACK PAIN”**

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**Background**: Low back pain is the most common ailment of the musculoskeletal system. It is characterized by pain and loss of function in form of range of motion of the lumbar spine.

Conventional physiotherapy has been a great choice of treatment for such pain. Recent articles support the use of trunk strengthening and lumbar stabilizing exercises for the treatment of low back pain.

**Objective**: To identify the effectiveness of trunk strengthening and lumbar stabilizing exercises and conventional physiotherapy on pain, Range of motion and functional disability.

**Methodology**: 30 Participants after being screened for eligibility criteria divided into 2 groups by simple random sampling. Group 1 received intervention in the form of trunk strengthening along with their regular training, Group 2 received regular training with lumbar stabilizing exercises over the course of 12 weeks. Effectiveness Parameters were improvement in VAS and OSWESTRY.They were assessed at baseline and at the end of the study. Post intervention data was analysed using SPSS software using t test and ANOVA.

**Result**: There was significant difference in parameters in all the groups from baseline and end of the study (p<0.001).However trunk strengthening along with their regular training was superior to the change of outcomes like VAS and OSWESTRY

**Conclusion**: The result of this study demonstrates that trunk strengthening along with their regular training statistically improves the pain and functional disability with Chronic low back pain.

**Keywords**:, Chronic low back pain, trunk strengthening, lumbar stabilizing exercises, conventional physiotherapy, VAS,OSWESTRY.

**INTRODUCTION**

Low back pain (LBP) – defined as pain and discomfort localized below the costal margins and above the inferior gluteal folds, with or without referred leg pain . It is one of the most common chronic pain conditions encountered in worldwide clinical practice. Lifetime prevalence of LBP is estimated to be >70% in industrialized countries, with a 1‐year prevalence of 15–45% , therefore most individuals will experience LBP at some point during their life. (1,2)

LBP is considered chronic when it persists for 12 weeks or more. It is generally accepted that only a minority of patients report persistent pain after an acute episode. However, a recent systematic review of prospective cohort studies, set in primary care suggests that as many as two‐thirds of patients go on to develop chronic LBP.(3,4,5) Chronic LBP is a disabling and costly condition. Results of the 2010 Global Burden of Disease Study show LBP to be the most common cause of years lived with disability and the sixth leading cause of disability‐ adjusted life‐years worldwide . (4,5,6) Chronic LBP is increasingly considered to be a mixed pain syndrome consisting of both nociceptive and neuropathic components, and it has been suggested that neuropathic components in chronic LBP may be under‐recognized and therefore undertreated. This paper reviews the role of neuropathic mechanisms in chronic LBP and discusses implications for clinical management, with particular focus on currently available pharmacological treatment options.(9,10) Neuropathic LBP is associated with increased likelihood and severity of medical comorbidities, reduced quality of life and higher health care costs , when compared with low back pain without a neuropathic component. In a study in Germany, health care costs in patients with chronic LBP were 67% higher in those with neuropathic pain than in those with nociceptive pain alone, and approximately 16% of the total costs associated with LBP were estimated to be attributable to neuropathic pain. (19,20) Classification of LBP Low back pain is classified on the basis of both the clinical characteristics of a patient and the underlying pathophysiology of the condition. On Spinal Pain suggested classifying patients with LBP into 11 subgroups, of which the first four were based on pain location and the presence or absence of neurological signs: (i) LBP only; (ii) LBP and pain above the knee; (iii) LBP and pain below the knee and (iv) LBP with pain above and below the knee and signs of nerve root involvement. Using this classification, patients with LBP and leg pain and signs of nerve root involvement have been shown to be more severely affected and have a worse prognosis than those with LBP alone (22,23).

The Oswestry Disability Index is an important tool that researchers and physicians use to classify functional disability as a result of LBP , and is considered the ‘gold standard’ of low back functional outcome tools, but does not differentiate between nociceptive and neuropathic components.(24) Mechanisms of neuropathic LBP A number of pathophysiological mechanisms have been implicated in neuropathic LBP . In chronic LBP, neuropathic pain may be caused by lesions of nociceptive sprouts within a degenerated disc (local neuropathic pain), by mechanical compression of the nerve root (mechanical neuropathic root pain), or by the effects of inflammatory mediators arising from a degenerative disc that results in inflammation and damage to the nerve roots .(33)

Various preclinical models have been developed that attempt to mimic aspects of pathophysiological mechanisms that contribute to chronic LBP. These include application of nucleus pulposus material near the lumbar dorsal root ganglia (DRG), chronic compression of the DRG or localized inflammation of the DRG, and nerve growth factor injections into the multifidus muscle.(3,4)These models, which are primarily developed in rats, have many common features including behavioral hypersensitivity of the hind paw, enhanced excitability and spontaneous activity of sensory neurons, and locally elevated levels of inflammatory mediators including cytokines. However, some drugs shown to be effective in preclinical models of neuropathic pain fail in clinical studies, either due to lack of tolerability or testing in heterogeneous groups of patients, highlighting the need for careful selection of patient subgroups in trials of potential neuropathic pain drug therapies. Exercises for low back pain have evolved over the period of time with specific emphasis on the maintaining the spinal stability.(33,34)

These types of lumbar stabilization exercises are aimed at improving the neuromuscular control, endurance, strength of muscles central to maintaining dynamic spinal stability. Since exercise is the main stay of treatment of low back pain prescribed by physical therapist, it is important to determine the type of exercise that is most specific and targeted in management of low back pain.(35)

The core muscles, which are the primary muscle group for maintaining spinal stability , can be divided into two groups according to their functions and attributes. The first group of muscles is composed of the deep core muscles, which are also called local stabilizing muscles. These muscles primarily include the transversus abdominis, lumbar multifidus, internal oblique muscle and quadratus lumborum. The lumbar multifidus is directly connected to each lumbar vertebral segment, and the transversus abdominis and lumbar multifidus activate a co-contraction mechanism. The abdominal draw-in that occurs during contraction provides spine segmental stability and maintains the spine within the neutral zone.In additional, these muscles provide precise motor control and are thus primarily responsible for spinal stability(36) . The second group of muscles comprises the shallow core muscles, which are also known as global stabilizing muscles, including the rectus abdominis, internal and external oblique muscles, erector spinae, quadratus lumborum, and hip muscle groups. These muscles are not directly attached to the spine but connect the pelvis to the thoracic ribs or leg joints, thereby enabling additional spinal control. These muscles produce high torque to counterbalance external forces impacting the spine; thus, this group of muscles is secondarily responsible for maintaining spinal stability.(37)

When the core muscles function normally, they can maintain segmental stability, protect the spine, and reduce stress impacting the lumbar vertebrae and intervertebral discs ; hence, the core muscles are also called “the natural brace” in humans . The causes of CLBP are complex, several of which are unknown . One major cause involves the weakening of the shallow trunk and abdominal muscles . Mitigating CLBP and improving mobility typically involves strengthening these muscles . Another cause of CLBP is the weakening of or insufficient motor control of the deep trunk muscles, such as the lumbar multifidus and transversus abdominis.(38)

During physical activities, the trunk muscle tissues ensure the mobility and stability of the lumbopelvic region; thus, changes in trunk muscle activity (particularly in the lumbar multifidus and transversus abdominis) are typically observed in patients with low back pain. Core strength training is directed at training the deep trunk muscles . However, independent training is challenging for CLBP patients despite the existence of numerous core strength training strategies.(39)

Furthermore, no standardized system has been established for analyzing and comparing the results of core strength training and typical resistance training. Therefore, we systematically reviewed relevant studies to explore the effectiveness of various core strength training strategies at alleviating CLBP.(29)Strengthening exercises (STE) are commonly used to treat patients with LBP. Strengthening exercises activate superficial trunk muscles that provide shock absorption of loads and are appropriate for patients with subacute or chronic NSLBP .

These exercises aim to increase strength and control of the global trunk muscles to improve general spinal stability. These exercises could decrease pain and physical disability and increase trunk muscle activity in patients with NSLBP . In the ankle, Docherty and colleagues (1998) suggest that strength training can increase both strength and joint position sense . Strengthening exercise programs may increase gamma motor activity, improve the central mechanisms of motor control, or produce a combination of central and spindle mechanism.(29)

No previous study has reported the effects of strengthening exercises on proprioception related to either the subacute or chronic stages of LBP. Strengthening exercises (STE) are commonly used to treat patients with LBP. Strengthening exercises activate superficial trunk muscles that provide shock absorption of loads and are appropriate for patients with subacute or chronic NSLBP . These exercises aim to increase strength and control of the global trunk muscles to improve general spinal stability.(47)

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No previous study has reported the effects of strengthening exercises on proprioception related to either the sub acute or chronic stages of LBP . Lumbar Stabilizing Exercises for low back pain have evolved over the period of time with specific emphasis on the maintaining the spinal stability. These types of lumbar stabilization exercises are aimed at improving the neuromuscular control, endurance, strength of muscles central to maintaining dynamic spinal stability. Since exercise is the main stay of treatment of low back pain prescribed by physical therapist, it is important to determine the type of exercise that is most specific and targeted in management of low back pain.(50)The core muscles, which are the primary muscle group for maintaining spinal stability, can be divided into two groups according to their functions and attributes. The first group of muscles is composed of the deep core muscles, which are also called local stabilizing muscles. (45)

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**PROCEDURE**

the patients selected by inclusion and exclusion criteria, they would be divided into two groups .Group A and Group B. Group A will be treated with conventional therapy + trunk strengthening exercises and group b will be treated with conventional therapy + lumbar stabilizing exercises group a patients will be treated with trunk strengthening exercises with conventional therapy for three days a week for 12 weeks.

Session time; 45 min

1.Supine hip twist on physio ball lie on your back on loor with hips and knees bent to 90 degrees over a physio ball; draw in abdominal muscles and maintain throughout exercise; slowly and with control, rotate knees to one side keeping hips in contact with the loor; engage obliques to pull knees back to center and repeat on opposite side; repeat 10-20 times on each side.

2.Supine abdominal draw in lie on your back on a table or mat, knees up with feet flat on table/ mat; pull the abs in and push your low back to the table/mat. Repeat 20 times.

3.Abdominal draw in with knee to chest lie on your back on table or mat, draw one knee to the chest while maintaining the abdominal draw in; do not grab the knee with your hand. Repeat 10-20 times each leg.

4.Abdominal draw in with heel slide lie on your back on table or mat, draw the heel back towards the buttock while maintaining the abdominal draw in. Maintain as you return to the start position. Repeat 10-20 times each leg.

5.Abdominal draw in with double knee to chest lie on your back on table or mat, bring both knees to your chest at the same time. Maintain the abdominal draw in throughout the entire exercise. Repeat 10-20 times.

6.Supine twist lie on your back on lord with hips and knees bent to 90 degrees with feet flat on floor; draw in abdominal muscles and maintain throughout exercise; slowly and with control, rotate knees to one side keeping hips in contact with the floor; engage obliques to pull knees back to center and repeat on opposite side; repeat 10-20 times.

7.Prone bridging on elbows lie on your stomach on a table or mat with your forearms/elbows on the table/mat; rise up so that you are resting on your forearms and toes; maintain abdominal draw in; your back should be completely straight; hold this position for 15 sec – 1 min. Progress in increments of 15 seconds. Repeat 5-10 times.

8.Side bridging – on elbow lie on your side with your elbow underneath you; rise up so that you are resting one forearm/elbow and foot on same side; hold this position for 15sec – 1min. Progress in increments of 15 seconds. Repeat 5-10 times. Make sure to complete exercise on both sides.

9.Press ups lie on your stomach on table or mat with legs extended and hands palm down just above shoulders; retract shoulder blades down and in towards the midline of your spine; maintaining that position, lift your chest off of the floor; hold for 3-5 seconds keeping the back of the neck long and making sure front hip bones stay in contact with mat during entire movement.. Repeat 10-20 times.

10.Prone cobra’s lie on your stomach on a table or mat with your arms at your side; lift your head and chest off the table/mat; hold your glutes (buttock muscles) tight and squeeze your shoulder blades together; hold briefly and return to starting position. Repeat 10-20 times.

11.Superman’s lie on your stomach on table or mat with arms and legs extended; retract shoulder blades down and in towards the midline of your spine and draw in abdominal muscles; maintaining this position, lift opposite arm and opposite leg ensuring that your hips stay in contact with the loor; hold for 3-5 seconds and reverse sides. Repeat 10-20 times.

12.Quadruped opposite arm/leg in a quadruped position (on all fours); keep head straight with

knees bent to 90 degrees. Engage your core to keep back straight during entire exercise and use your hamstrings, glutes, and low back muscles to lift your leg straight while simultaneously lifting opposite arm; repeat 10 times each side.

13.Supine butt lift with arms at side lie on your back on table or mat with hips and knees bent to 90 degrees with feet lat on loor and arms palm-down at sides; draw in abdominal muscles and maintain throughout exercise; slowly raise your butt off the table/mat by using your glutes and hamstrings until your torso is in line with thighs; hold for 3-5 seconds. Repeat 10 – 20 times.

14.Supine butt lift with arms across chest lie on your back on table or mat with hips and knees bent to 90 degrees with feet lat on loor and arms across chest; draw in abdominal muscles and maintain throughout exercise; slowly raise your butt off the table/mat by using your glutes and hamstrings until your torso is in line with thighs; hold for 3-5 seconds. Repeat 10 – 20 times.

15.Supine single leg butt lift lie on your back on table or mat with hips and knees bent to 90 degrees with feet flat on floor and arms palm-down at sides; draw in abdominal muscles and maintain throughout exercise; lift one leg so that thigh is perpendicular to the floor and knee is bent to 90 degrees; slowly raise your butt off the table/mat by using your glutes and hamstrings until your torso is in line with thigh; hold for 3-5 seconds. Repeat 10-20 times on each leg.

16.Supine single leg marching lie on your back on table or mat with hips and knees bent to 90 degrees with feet flat on floor and arms palm-down at sides; draw in abdominal muscles and maintain throughout exercise; slowly raise your butt off the table/mat by using your glutes and hamstrings until your torso is in line with thigh; alternate raising right leg followed by left leg off table/mat into hip flexion while maintaining proper alignment. Repeat 10-20 times each side.

17.Abdominal draw in, seated on physioball begin by sitting on physioball with your spine straight, knees at 90 degrees and your hands on your hips. Your feet should be shoulder width apart; draw in abdominal muscles and maintain this position for 3 – 5 seconds. Repeat 10 – 20 times.

18.abdominal draw in, seated on physioball, add marching begin by sitting on physioball with your spine straight, knees at 90 degrees and your hands on your hips. Your feet should be

shoulder width apart; draw in abdominal muscles and maintain this position throughout exercise. Begin by slowly raising your right knee into hip lexion and hold for a 3 -5 second count; keeping hips level than bring knee down to starting position; repeat on opposite side. Repeat 10-20 times.

**GROUP B patients will be treated with lumbar stabilizing exercises with conventional theray for three days a week for 12 weeks . Session time ; 45 min**

1.Abdominal draw in with feet on the ball lie on your back on table or mat with hips and knees bent to 45 degrees and your feet flat on the medicine ball; draw in abdominal muscles and maintain throughout exercise; hold for 3-5 seconds. Repeat 10 – 20 times.

2.Abdominal draw in with feet on the ball- add movement lie on your back on table or mat with hips and knees bent to 45 degrees and your feet flat on the medicine ball; draw in abdominal muscles and maintain throughout exercise; hold for 3-5 seconds. As you tilt your hips back raise your butt about 2 to 3 inches maximum off the floor. Hold this position for 3 – 5 seconds; slowly bring your butt back to start. Repeat 10 -20 times.

3.Supine dead bugs lie on your back on table or mat with arms perpendicular to loor and hips and knees bent to 90 degrees; draw in abdominal muscles and maintain throughout exercise; extend one arm above head while simultaneously lowering the opposite foot to the loor; contract abdominal muscles to bring arms and legs back to starting position; repeat on opposite side. Repeat 10-20 times.

4.Rolling like a ball in a tucked position draw in abdominal muscle maintain balance; hold for 1-2 sec. Than roll on to your shoulder blades, and back into starting position. Repeat 10- 20 times.

5.Prone bridging on elbows with single leg hip extension lie on your stomach on a table or mat with your forearms/elbows on the table/mat; rise up so that you are resting on your forearms and toes; maintain abdominal draw in; your back should be completely straight; now extend hip/leg upwards and hold, one leg at a time; alternate legs. Repeat 10-15 times each side.

6.Side bridging- add single leg hip abduction lie on your side with your elbow underneath you; rise up so that you are resting on your one forearm/elbow and your foot; hold this position while lifting your hip/leg at your side up and down. Lift leg up and down 15-20 times each side.

7.Quadruped opposite arm/leg, add cuff or dumbbell weights start in a quadruped position (on all fours), head straight with knees bent to 90 degrees and hands on the mat. Make sure you add a cuff weight to your ankle, and/or hold a small dumbbell weight in opposite hand for progression. Tighten your hamstrings, glutes, and low back and lift to straighten your leg and opposite arm while maintaining proper alignment. Repeat 10-20 times alternating sides.

8.Abdominal crunches on physioball start by having your hips just off the physioball. Keep your feet about shoulder width apart, and place your hands across your chest. Draw in abdominal muscles and maintain, crunch forward and lift your shoulder blades of the ball. Hold at the top for 1 – 2 sec. And lower back down to starting position. Repeat 10 – 20 times.

9.Abdominals crunches on physioball with rotation start by having your hips just off the physioball. Keep your feet about shoulder width apart, and place your hands across your chest. Draw in abdominal muscles and maintain, crunch forward and lift your shoulder blades of the ball. As you get halfway up twist your body to one side. Hold for 1 – 2 sec. At the top, and as you uncurl and lower back down to starting position; alternate sides. Repeat 10 – 20 times.

10.Bridging with head on physioball shoulder blades are aligned at the top and middle of the ball with arms across chest. Your feet are placed on the ground shoulder width apart; and your thighs should be parallel with the ground. Draw in abdominal muscles; engage glutes and hamstrings to maintain straight line from neck to knees. Hold this position for 3 – 5 sec. Then slowly relax and repeat 10-20 times.

11.Supine bridging on physioball lie facing upward on loor with knees straight, feet resting on physioball, arms at sides; draw in abdominal muscles and maintain throughout exercise;

slowly lift your butt off loor until trunk is parallel to thighs; hold for 3-5 seconds; slowly return to starting position. Repeat 10-20 times.

12.Abdominal draw in, seated on physioball with leg extension begin by sitting on physioball with your spine straight, knees at 90 degrees and your hands on your hips. Your feet should be shoulder width apart; draw in abdominal muscles and maintain this position throughout the exercise. Begin by slightly lifting your right or left knee and perform a leg extension hold for 3 -5 second count; keeping hips level then alternate repeating on opposite side. Repeat 10 – 20 times on each side.

**DIFFICULT:**

1.Prone bridging- “around the world” lie on your stomach on table or mat with your forearms on the table/ mat; rise up so that you are resting on your forearms and toes; maintain abdominal draw in; your back should be completely straight; hold this position while stepping to side with left leg/toe, followed by right leg/toe, left arm/hand, and right arm/hand. Repeat entire sequence 3-5 times.

2.Side bridging- add single leg hip abduction with hip lexion/extension movement lie on your side with your elbow underneath you; rise up so that youare resting on one of your forearm/elbow’s and your foot; maintain this while lifting your top leg and kicking it forward and then back. Repeat 5-10 times. Switch sides.

3.Quadruped opposite arm/leg on “half foam rollers” lie facing down in quadruped position (on all fours), head straight with knees bent to 90 degrees and hands on the half foam rollers. Tighten your hamstrings, glutes, and low back and lift your leg to straighten it along with opposite arm; repeat 10 times each side.

4.Seated russian twist with medicine ball in a seated v position on a table or mat with a medicine ball in your hands, twist your body to one side and then the other while maintain v position. Repeat 10-20 x.

5.Seated on physioball, russian twist with medicine ball seated on physioball with feet planted; hold medicine ball out in front of you; maintain abdominal draw in while twisting your body side to side. Repeat 10-20 times.

6.Bridging with head on Physio ball position shoulder blades on physio ball with hands on hips; extend hips until parallel to ground by engaging Glutes, hamstrings, and core. Lift one

foot off the ground and extend leg while keeping hips level; alternate legs. Repeat 10-20 times. All the pre and post data of outcome measures would be kept safely for analyzing .

**RESULT AND DATA INTERPRETATION**

Analysis from which 15 were in the Group A (Trunk Strengthening) and 15 were in the Group B (lumbar stabiliser).

Analysis Pre- test and Post test score within and between the values of groups are given with intervention of the result of the study.

The sample consisted of both male and female there were 11 males and 19 females. The following chart shows the gender distribution in the sample.

|  |  |  |
| --- | --- | --- |
| VARIABLE | GROUP A | GROUP B |
| Mean± SD | Mean± SD |
| AGE | 31.33± 5.13 | 29.67± 6.60 |
| GENDER (MALE: FEMALE) | 3:2 | 7:8 |

Figure 2: Mean age and Male: Female Ratio

Following are the values of the variables pre and post interventions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VARIABLE |  | MEAN | SD | P |
| FFI | PRE | 6.06 | 2.26 | <0.05 |
| POST | 2.53 |  |
|  |  |  |  |  |
| ESWT | PRE | 60.66 | 22.67 | <0.05 |
| POST | 25.33 |  |

**GROUP 1** : MEAN AND SD of Trunk strengthning group pre and post variables

The mean and SD are 6.06 and 2.26 for VAS and for OSWESTRY they are 60.66 and 25.33 respectively. The p value being less than 0.05 it shows statistically significant difference

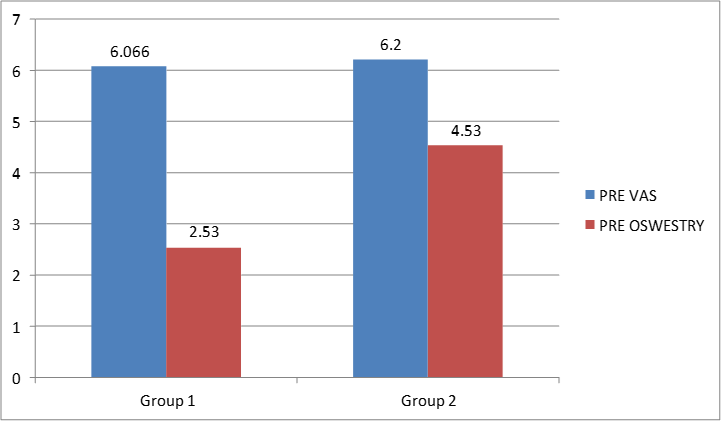


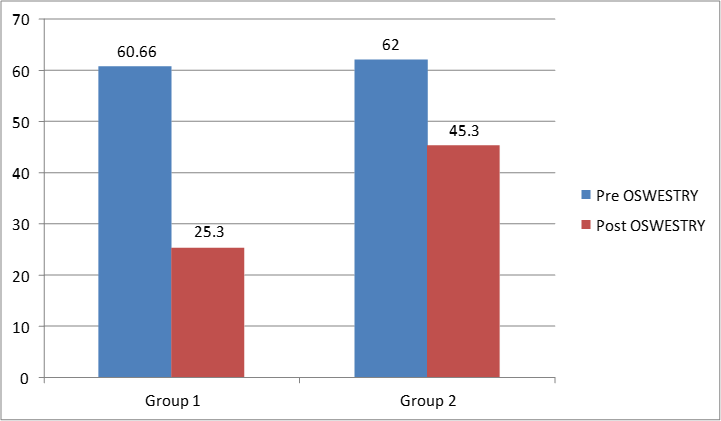
Figure 3: Mean difference in VAS and Oswestry in score in both the groups.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VARIABLE |  | MEAN | SD | P |
| VAS | PRE | 6.2 | 0.29 | <0.05 |
| POST | 4.5 |  |
| OSWESTRY | PRE | 62 | 2.99 | <0.05 |
| POST | 45.33 |  |

GROUP 2: : MEAN AND SD of lumbar stabilization group pre and post variables

The mean and SD are 6.2 and 4.5 for VAS and for OSWESTRY they are 62 and45.33 respectively.

The p value being less than 0.05 it shows statistically significant difference.



**WITHIN GROUP:**

**GROUP A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VAS** | **N** | **MEAN** | **SD** | **MEAN DIFF.** | **DF** | **T** | **P** | **RESULTS** |
| **PRE**  **TEST** | **15** | **6.06** | **2.2** | **4** | **14** | **1.76** | **0.00** | **SIG.** |
| **POST TEST** | **15** | **4.53** | **3.4** | **4** | **14** | **1.76** | **0.00** | **SIG.** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **OSWESTRY** | **N** | **MEAN** | **SD** | **MEAN DIFF** | **DF** | **T** | **P** | **RESULTS** |
| **PRE TEST** | **15** | **62.66** | **20.95** | **4** | **14** | **1.76** | **0.00** | **SIG.** |
| **POST TEST** | **15** | **45** | **34.9** | **4** | **14** | **1.76** | **0.00** | **SIG.** |

INTERPRETATION: From the values obtain by performing the students t test on the sample within the groups. The obtain mean for Pre-test and Post-test are 6.06 and 4.53. Whereas for OSWESTRY they are 62.66 and 45 respectively. The T value being 1.76 and p is <0.05 showing statistical significant difference. There has been statistical significant improvement in both the outcomes post intervention.

**GROUP B:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| VAS | N | MEAN | SD | MEAN DIFF. | DF | T | P | RESULTS |
| PRE  TEST | 15 | 5.73 | 4.6 | 4 | 14 | 1.76 | 0.03 | SIG. |
| POST TEST | 15 | 4.53 | 3.4 | 4 | 14 | 1.76 | 0.03 | SIG. |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| OSWESTRY | N | MEAN | SD | MEAN DIFF | DF | T | P | RESULTS |
| PRE TEST | 15 | 62 | 217 | 4 | 14 | 1.76 | 0.00 | SIG. |
| POST TEST | 15 | 45.3 | 340 | 4 | 14 | 1.76 | 0.00 | SIG. |

**INTERPRETATION**: From the values obtain by performing the students t test on the sample within the groups. The obtain mean for Pre-test and Post-test are 5.73 and 4.53. Whereas for OSWESTRY they are 62.66 and 45.3 respectively . The T value being 1.76 and p is <0.05 showing statistical significant difference. There has been statistical significant improvement in both the outcomes post intervention.

**BETWEEN THE GROUPS:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TEST | N | MEAN | SD | MEAN DIFF. | DF | T | P | RESULTS |
| GROUP  A | 30 | 35.33 | 126.6 | 18.67 | 28 | 1.76 | 0.03 | SIG. |
| GROUP B | 30 | 16.66 | 238.0 | 18.67 | 28 | 1.76 | 0.03 | SIG. |

**INTERPRETATION**: From the values obtain by performing the students t test on the sample within the groups. The obtain mean for Pre-test and Post-test are 35.33 and 16.66.The T value being 1.76 and p is <0.05 showing statistical significant difference. There has been statistical significant improvement in both the outcomes post intervention.

**12. RESULT OF THE STUDY:**

Thus the results of this study demonstrate that trunk strengthening along with conventional physiotherapy exercise statistically improves the chronic low back pain in terms of VAS and OSWESTRY..

**DISCUSSION**  
For this study 30 subjects were taken. Randomization was done by simple chit method in to 2 groups Group A (Trunk strengthening Exercise), Group B (Lumbar stabiliser).Group A was given Trunk strengthening Exercise for three days a week for 12 weeks in phasic manner, Group B was given lumbar stabiliser exercises three days in a week for 12 weeks in form of ROM, Strengthning, Balance and Gait training.

The groups in this study were heterogeneous groups with both male and female population, future studies could be done taking up a homogenous samples with literature review suggests that the incidence of low back pain is more in females than in males.

Both the treatment techniques in the study showed significant improvement in VAS (Visual Analogue) and Oswestry Scale. During this study following the treatment sessions the conditions improved markedly. It was noted secondarily that much milder words were being used to describe the pain and discomfort following treatments.

Group 1 showed statistical significant effect in the pain, range of motion and disability. Thus Trunk Strengthening training with conventional therapy as an adjunct can be said to be the best treatment of choice for the.

This study results are in contrast with the results of Susan C Slade et.el [2005] Trunk strengthening appears effective compared with no exercise. Increasing exercise intensity and adding motivation increase treatment effects. Trunk strengthening, compared with aerobics or McKenzie exercises, showed no clear benefit of strengthening. It is unclear whether observed benefits are due to tissue loading or movement repetition.

This studies results are in accordance to the study of Trunk muscles-strengthening exercise were used byRyo Kitagawa, Satoshi Kato et.el. [2020] in treating chronic low back pain . The strengthening exercise using the device with easy stretching was effective in improving the NRS of CLBP, abdominal trunk muscle strength, physical function, and QOL. This new exercise program using the novel device is effective in the treatment for CLBP.

According to Takemasa R et.el.[1995] they carried out the study " Trunk muscle strength in and effect of trunk muscle exercises for patients with chronic low back pain" and concluded

increasing trunk muscle strength was extremely effective in patients of Group 2, in which decreased trunk muscle strength was a major factor in chronic low back pain.

Effectiveness of Strengthening Exercises for chronic Low Back Pain was studied by Nor Azizah Ishak et.el. [2016 . They treated patients with strengthening exercises with conventional therapy and discovers that Strengthening exercise is a beneficial treatment for people with LBP in reducing pain intensity, disability, and improved functional performances.

Several forms of therapeutic exercises are used in clinical practice for patients with LBP. In addition, lumbar stabilizing exercises can reverse pain-related restructuring in the motor cortex, enhance muscle behavior and retrain the important function of local trunk muscles for neuromuscular control of spinal stability.

There are evidences that states that the Stabilization exercises may reduce pain and disability, improve proprioception, successfully modify postural impairments, and improve the stability index in patients with LBP . According to Jee Hyun Suh , et.el. [2019] lumbar Stabilizing exercises significantly improved chronic LBP. stabilization exercises significantly improved muscular endurance of back muscles. Moreover, SEs also improved the core stability. It is also worth noting that patients in the SE groups were much more compliant than those in the other exercise groups. This study suggests that lumbar SE should be recommended to patients with chronic LBP because they help not only to relieve back pain but also to prevent chronic back pain through the improvement of muscle endurance.

MohammadBagher Shamsi et.el. [2016] used lumbar stability exercises with general exercises in the patients with chronic low back pain was shown to be more effective than only conventional therapy for reduction of pain.

Ottar Vasseljen et.el. [2012] researched the effect of Effect of core stability exercises of deep abdominal muscles in chronic low back pain and found that Abdominal muscle onset was largely unaffected by 8 weeks of exercises in chronic LBP patients. There was no association between change in onset and LBP. Large individual variations in activation pattern of the deep abdominal muscles may justify exploration of differential effects in subgroups of LBP. Management of chronic low back pain with lumbar stabilization exercises was reviewed by

Christopher J Standaert et.el. [2008] , who concluded that lumbar stabilizing exercises helps patient to develope endurance and core stability which in turn reduces chronic low back pain.

This earlier carried out results give evidence for the improvement in pain and disability in lumbar stabiliser groups too. These studies have seen significant improvements in physical activity without increased risk of injury. Usually, the combination of various treatments, including pharmacotherapy, physiotherapy, and orthotic devices are used to maintain biomechanical parameters, physiological patterns, and at last for wound healing.

**REFERENCES**

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| 1.Koes BW, can Tulder M, Ostelo R, et al. Clinical guidelines for the management of low back pain in primary care: an international comparison. Spine 2001; 26: 2504- 2513.  2.McGuirk B, King W, Govind J, et al. The safety, efficacy, and cost-effectiveness of evidence-based guidelines for the management of acute low back pain in primary care. Spine 2001; 26: 2615-2622.  3.R. Baron,A. Binder,N. Attal,R. Casale,A.H. Dickenson,R‐D. Treede, et al. Neuropathic low back pain in clinical practice . European Journal of Pain, London, England 2016 jul ; 861-873 .  4.Nachemson A, Jonsson E, editors. Neck and back pain: the scientific evidence of causes, diagnosis, and treatment. Philadelphia: Lippincott, Williams and Wilkins, 2000.  5.van Tulder MV, Goossens M, Waddell G, Nachemson A. Conservative treatment of chronic low back pain. In: Nachemson A, Jonsson E, editors. Neck and back pain: the scientific evidence of causes, diagnosis, and treatment. Philadelphia: Lippincott, Williams and Wilkins, 2000: 271-30  6.van Tulder M, Malmivaara A, Esmail R, Koes B. Exercise therapy for low back pain. A systematic review within the framework of the Cochrane Collaboration Back Review Group. Spine 2000; 21: 2784-2796  7.. Schwarzer AC, Aprill CN, Derby R, et al. The prevalence and clinical features of internal disc disruption in patients with chronic low back pain. Spine 1995; 20: 1878- 1883.  8.van Kleef M, Barendse GAM, Kessels A, et al. Randomized trial of radiofrequency lumbar facet denervation for chronic low back pain. Spine 1999; 24: 1937-1942.  9.Bogduk N. The sources of low back pain. in: Jayson M.I.V. The Lumbar Spine and Back Pain. Churchill Livingstone, Edinburgh1992: 61-88  10.Borenstein D.G. Wiesel S.W. Boden S.D. Low Back Pain: Medical Diagnosis and Comprehensive Management. ed 2. WB Saunders, Philadelphia1995: 181-589  11.Braddom R.L. Conservative approach to uncomplicated back pain. Physical Medicine Rehabilitation: State of the Art Reviews. 1995; 9: 619-640  12..Damkot D.K.Pope M.H. Lord J. et al. The relationship between work history, work environment, and low-back pain in men. Spine. 1984; 9: 395-399  13.Frymoyer J.W. Back pain and sciatica. N Engl J Med. 1988; 318: 291-300  14.From the Centers for Disease Control and Prevention, Prevalence of disabilities and associated health conditions among adults—United States, 1999. JAMA 2001;285  (12) 1571- 1572  15..Ricci JAStewart WFChee ELeotta CFoley KHochberg MC Back pain exacerbations and lost productive time costs in United States workers. Spine 2006;31 (26) 3052- 3060  16..Rubin DI Epidemiology and risk factors for spine pain. Neurol Clin 2007;25 (2) 353- 371 17. van Tulder MKoes BBombardier C Low back pain. Best Pract Res Clin Rheumatol 2002;16 (5) 761- 775 | 17.IJzelenberg WBurdorf A Patterns of care for low back pain in a working population. Spine 2004;29 (12) 1362- 1368  18.Molano SMBurdorf AElders LA Factors associated with medical care-seeking due to low-back pain in scaffolders. Am J Ind Med 2001;40 (3) 275- 281  19.Carey TSEvans ATHadler NM et al. Acute severe low back pain: a population-based study of prevalence and care-seeking. Spine 1996;  20.M Friedrich et al. Combined exercise and motivation program: effect on the compliance and level of disability of patients with chronic low back pain: a randomized controlled trial Arch Phys Med Rehabil (1998)  21.Beith ID, Kemp A, Kenyon J, et al. Identifying neuropathic back and leg pain: a cross-sectional study. Pain 2011; 152: 1511–1516.  22.Lamb SE, Hansen Z, Lall R, et al. Group cognitive behavioural treatment for low- back pain in primary care: a randomised controlled trial and cost-effectiveness analysis. Lancet 2010; 375: 916–923.  23.Andersson GB. Epidemiological features of chronic low-back pain. Lancet 1999; 354: 581–585.  24.Gutke A, Ostgaard HC and Oberg B. Pelvic girdle pain and lumbar pain in pregnancy: a cohort study of the consequences in terms of health and functioning. Spine (Phila Pa 1976) 2006; 31: E149–E155.  25Scholich SL, Hallner D, Wittenberg RH, et al. The relationship between pain, disability, quality of life and cognitive-behavioural factors in chronic back pain. Disabil Rehabil 2012; 34: 1993–2000.  26.Hayden JA, van Tulder MW, Malmivaara A, et al. Exercise therapy for treatment of nonspecific low back pain. Cochrane Database Syst Rev 2005; 3: CD000335.    27.Wang X, Zheng J, Liu J, et al. Effect of core stability training on patients with chronic low back pain. HealthMED 2012; 6: 754–759.  28.Hodges PW. Core stability exercise in chronic low back pain. Orthop Clin North Am 2003; 34: 245–254.  29.Sjo¨dahl J, Kvist J, Gutke A, et al. The postural response of the pelvic floor muscles during limb movements: a methodological electromyography study in parous women without lumbopelvic pain. Clin Biomech (Bristol, Avon) 2009; 24: 183–189.  30.Cammu H, Van Nylen M and Amy JJ. A 10- year follow-up after Kegel pelvic floor muscle exercises for genuine stress incontinence. BJU Int 2000; 85: 655–658.  31.Bronfort G, Maiers MJ, Evans RL, et al. Supervised exercise, spinal manipulation, and home exercise for chronic low back pain: a randomized clinical trial. Spine J 2011; 11: 585–598.  32Akuthota V, Ferreiro A, Moore T, et al. Core stability exercise principles. Curr Sports Med Rep 2008; 7: 39–44. |

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| --- | --- |
| 33.Willson JD, Dougherty CP, Ireland ML, et al. Core stability and its relationship to lower extremity function and injury. J Am Acad Orthop Surg 2005; 13: 316–325.  34.Kumar S, Sharma VP, Shukla R, et al. Comparative efficacy of two multimodal treatments on male and female sub-groups with low back pain (part II). J Back Musculoskelet Rehabil 2010; 23: 1–9 .  35.Davies JE, Gibson T, Tester L. The value of exercises in the treatment of low back pain. Rheumatol Rehabil. 1979; 18:243–247. PMID: 160072.  36.Martin PR, Rose MJ, Nichols PJ, Russell PL, Hughes IG. Physiotherapy exercises for low back pain: process and clinical outcome. Int Rehabil Med. 1986; 8:34–38. PMID: 2942511.  37.Dettori JR, Bullock SH, Sutlive TG, Franklin RJ, Patience T. The effects of spinal flexion and extension exercises and their associated postures in patients with acute low back pain. Spine (Phila Pa 1976). 1995; 20:2303–2312. PMID: 8553118.  38.Graves JE, Pollock ML, Foster D, Leggett SH, Carpenter DM, Vuoso R, et al. Effect of training frequency and specificity on isometric lumbar extension strength. Spine (Phila Pa 1976). 1990; 15:504–509. PMID: 2144914.  39.Ferreira ML, Ferreira PH, Latimer J, Herbert RD, Hodges PW, Jennings MD, et al. Comparison of general exercise, motor control exercise and spinal manipulative therapy for chronic low back pain: a randomized trial. Pain. 2007; 131:31–37. PMID: 17250965.    40.Cynn HS, Oh JS, Kwon OY, Yi CH. Effects of lumbar stabilization using a pressure biofeedback unit on muscle activity and lateral pelvic tilt during hip abduction in sidelying. Arch Phys Med Rehabil. 2006; 87:1454–1458. PMID: 17084119.  41.Sanderson PL, Todd BD, Holt GR, Getty CJ. Compensation, work status, and disability in low back pain patients. Spine (Phila Pa 1976). 1995; 20:554–556. PMID: 7604324.  42..Cairns MC, Foster NE, Wright C. Randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain. Spine (Phila Pa 1976). 2006; 31:E670–E681. PMID: 16946640.  43..Robinson ME, Greene AF, O'Connor P, Graves JE, MacMillan M. Reliability of lumbar isometric torque in patients with chronic low back pain. Phys Ther. 1992; 72:186–190. PMID: 1533939.  44.KP Barr, M Griggs, T Cadby Lumbar stabilization: A review of core concepts and current literature, part 2 Am J Phys Med Rehabil, 86 (2007), pp. 72-80  45.O Shirado, K Kaneda, T Ito Trunk muscle strength during concentric and eccentric contraction: A comparison between healthy subjects and patients with low back pain J Spinal Disord, 5 (1992), pp. 175-182  46.DM Carpenter, BW Nelson Low back strengthening for the prevention and treatment of low back pain Med Sci Sports Exerc, 31 (1999), pp. 18-24  47.Balagué F, Mannion AF, Pellisé F, Cedraschi C. Non-specific low back pain. Lancet. 2012;379:482–491.  48Ferreira PH, Ferreira ML, Maher CG, Herbert RD, Refshauge K. Specific stabilisation exercise for spinal and pelvic pain: a systematic review. Aust J Physiother. 2006;52:79–88.  49.Burton AK, Balagué F, Cardon G, Eriksen HR, Henrotin Y, Lahad A, Leclerc A, Müller G, van der Beek AJ COST B13 Working Group on Guidelines for Prevention in Low Back Pain. Chapter 2. European guidelines for prevention in low back pain: November 2004. Eur Spine J. 2006;15(Suppl 2):S136–168.  50.Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C, et al. The global burden of low back pain: estimates from the global burden of disease 2010 study. Ann Rheum  Dis. 2014;73(6):968–974. doi: 10.1136/annrheumdis-2013-204428. [PubMed] [CrossRef] [Google Scholar]  Hoy D, Bain C, Williams G, March L, Brooks P, Blyth F, et al. A systematic review of the global prevalence of low back pain. Arthritis Rheum. 2012;64(6):2028–2037. doi: 10.1002/art.34347. [PubMed] [CrossRef] [Google Scholar]  52.Chou R. Low back pain (chronic) Am Fam Physician. 2011;84(4):437–438. [Google Scholar]  53Deyo RA, Weinstein JN. Low back pain. N Engl J Med. 2001;344(5):363–370. doi: 10.1056/NEJM200102013440508. [PubMed] [CrossRef] [Google Scholar]  54.Ehrlich GE. Low back pain. Bull World Health Organ. 2003;81(9):671–676. [PMC free article] [PubMed] [Google Scholar]  55Shumway-Cook A, Horak FB. Assessing the influence of sensory interaction of balance: suggestion from the field. Phys Ther. 1986;66(10):1548–1550.  doi: 10.1093/ptj/66.10.1548. [PubMed] [CrossRef] [Google Scholar]  56 Horak FB, Macpherson JM. Postural orientation and equilibrium. In: Shepard J, Rowell L, editors. Handbook of physiology, section 12. Exercise: regulation and integration of multiple systems. New York: Oxford University; 1996. pp. 255–  292. [Google Scholar]  57.Chiba R, Takakusaki K, Ota J, Yozu A, Haga N. Human upright posture control models based on multisensory inputs; in fast and slow dynamics. Neurosci  Res. 2016;104:96–104. doi: 10.1016/j.neures.2015.12.002. [PubMed]  [CrossRef] [Google Scholal]  58.Han J, Waddington G, Adams R, Anson J. A proprioceptive ability underlying all proprioception tests? Response to tremblay. Percept Mot Skills. 2014;119:30–34. doi: 10.2466/10.23.24.PMS.119c16z2. [PubMed] [CrossRef] [Google Scholar]  59.Tong MH, Mousavi SJ, Kiers H, Ferreira P, Refshauge K, van Dieën J. Is there a relationship between lumbar proprioception and low back pain? A systematic review with meta-analysis. Arch Phys Med Rehabil. 2017;98(1):120–136.  doi: 10.1016/j.apmr.2016.05.016. [PubMed] [CrossRef] [Google Scholar]  60.Newcomer KL, Laskowski ER, Yu B, Larson DR, An KN. Repositioning error in low back pain; comparing trunk repositioning error in subjects with chronic low back pain and control subjects. Spine. 2000;25(2):245–250. doi: 10.1097/00007632- 200001150-00017. [PubMed] [CrossRef] [Google Scholar  61.O’Sullivan PB, Burnett A, Floyd AN, Gadsdon KM, Logiudice JM, Miller DM, et al. Lumbar repositioning deficit in a specific low back pain  population. Spine. 2003;28(10):1074–1079.  doi: 10.1097/01.BRS.0000061990.56113.6F. [PubMed] [CrossRef] [Google Scholar]  62.van Dieën JH, Moseley GL, Hodges PW. Motor control changes and low back pain: cause or effect. Spinal control: the rehabilitation of back pain. State of the art and science. Edinburgh: Elsevier/Churchill Livingstone; 2013. pp. 207–218. [Google Scholar]  63.Brumagne S, Diers M, Danneels L, Moseley GL, Hodges PW. Neuroplasticity of sensorimotor control in low back pain. J Orthop Sports Phys Ther. 2019;49(6):402–  414. doi: 10.2519/jospt.2019.8489. [PubMed] [CrossRef] [Google Scholar] | 64.Moseley GL, Hodges PW. Reduced variability of postural strategy prevents normalization of motor changes induced by back pain: a risk factor for chronic trouble? Behav Neurosci. 2006;120(2):474–476. doi: 10.1037/0735- 7044.120.2.474. [PubMed] [CrossRef] [Google Scholar]  65.Jacobs JV, Henry SM, Nagle KJ. People with chronic low back pain exhibit decreased variability in the timing of their anticipatory postural adjustments. Behav  Neurosci. 2009;123(2):455–458. doi: 10.1037/a0014479. [PMC free  article] [PubMed] [CrossRef] [Google Scholar]  66.Hodges PW, Cholewicki J. Functional control of the spine. Movement, stability and Lumbopelvic pain. Kidlington: Elsevier; 2007. [Google Scholar]  67.Panjabi MM. A hypothesis of chronic back pain: ligament subfailure injuries lead to muscle control dysfunction. Eur Spine J. 2006;15(5):668–676. doi: 10.1007/s00586- 005-0925-3. [PMC free article] [PubMed] [CrossRef] [Google Scholar]  68.Hlaing SS, Puntumetakul R, Wanpen S, Boucaut R. Balance control in patients with subacute non-specific low Back pain, with and without lumbar instability: a cross- sectional study. J Pain Res. 2020;13:795–803. doi: 10.2147/JPR.S232080. [PMC free article] [PubMed] [CrossRef] [Google Scholar]  69.Hides J, Stokes MJ, Saide M, Jull GA, Cooper DH. Evidence of lumbar multifidus muscle wasting ipsilateral to symptoms in patients with acute/subacute low back pain. Spine. 1994;19(2):165–172. doi: 10.1097/00007632-199401001-  00009. [PubMed] [CrossRef] [Google Scholar]  70.Hodges PW, Holm AK, Hansson T, Holm S. Rapid atrophy of the lumbar multifidus follows experimental disc or nerve root injury. Spine. 2006;31(25):2926–2933.  doi: 10.1097/01.brs.0000248453.51165.0b. [PubMed] [CrossRef] [Google Scholar]    71.Hodges PW, Danneels L. Changes in structure and function of the back muscles in low back pain: different time points, observations, and mechanisms. J Orthop Sports Phys Ther. 2019;49(6):464–476. doi: 10.2519/jospt.2019.8827. [PubMed]  [CrossRef] [Google Scholar]  72.Hodge PW, Tucker K. Moving differently in pain: a new theory to explain the adaptation to pain. Pain. 2011;152(3):S90–S98.  doi: 10.1016/j.pain.2010.10.020. [PubMed] [CrossRef] [Google Scholar]  73.Pengel HM, Maher CG, Refshauge KM. Systematic review of conservative interventions for subacute low back pain. Clin Rehabil. 2002;16(8):811–820. doi: 10.1191/0269215502cr562oa. [PubMed] [CrossRef] [Google Scholar]  74.Vleeming A, Schuenke MD, Danneels L, Willard FH. The functional coupling of the deep abdominal and paraspinal muscles: the effects of simulated paraspinal muscle contraction on force transfer to the middle and posterior layer of the thoracolumbar fascia. J Anat. 2014;225(4):447–462. doi: 10.1111/joa.12227. [PMC free  article] [PubMed] [CrossRef] [Google Scholar]  75.Tsao H, Druitt TR, Schollum TM, Hodges PW. Motor training of the lumbar paraspinal muscles induces immediate changes in motor coordination in patients with recurrent low back pain. J Pain. 2010;11(11):1120–1128.  doi: 10.1016/j.jpain.2010.02.004. [PubMed] [CrossRef] [Google Scholar]  76Kim TH, Kim EH, Cho HY. The effects of the CORE programme on pain at rest, movement-induced and secondary pain, active range of motion, and proprioception in female office workers with chronic low back pain: a randomized controlled trial. Clin Rehabil. 2015;29(7):653–662. doi: 10.1177/0269215514552075. [PubMed]  [CrossRef] [Google Scholar]  77.Tsao H, Hodges PW. Persistence of improvements in postural strategies following motor control training in people with recurrent low back pain. J Electromyogr Kinesiol. 2008;18(4):559–567. doi: 10.1016/j.jelekin.2006.10.012. [PubMed] [CrossRef] [Google Scholar]  78.Hoffman SL, Johnson MB, Zou D, Harris-Hayes M, Van Dillen LR. Effect of classification-specific treatment on lumbopelvic motion during hip rotation in people with low back pain. Man Ther. 2011;16(4):344–350.  doi: 10.1016/j.math.2010.12.007. [PMC free article] [PubMed] [CrossRef] [Google Scholar]    79.Salavati M, Akhbari B, Takamjani IE, Bagheri H, Ezzati K, Kahlaee AH. Effect of spinal stabilization exercise on dynamic postural control and visual dependency in subjects with chronic non-specific low back pain. J Bodyw Mov  Ther. 2016;20(2):441–448. doi: 10.1016/j.jbmt.2015.10.003. [PubMed]  [CrossRef] [Google Scholar]  80.Comerford MJ, Mottram SL. Movement and stability dysfunction–contemporary developments. Man Ther. 2001;6(1):15–26. doi: 10.1054/math.2000.0388. [PubMed] [CrossRef] [Google Scholar]  81.Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. Phys Ther. 2005;85(3):209–225.  doi: 10.1093/ptj/85.3.209. [PubMed] [CrossRef] [Google Scholar]  82.Docherty CL, Moore JH, Arnold BL. Effects of strength training on strength development and joint position sense in functionally unstable ankles. J Athl Train. 1998;33(4):310. [PMC free article] [PubMed] [Google Scholar]  83.Crowe A, Matthews PBC. The effects of stimulation of static and dynamic fusimotor fibres on the response to stretching of the primary endings of muscle spindles. J Physiol. 1964;174(1):109–131. doi: 10.1113/jphysiol.1964.sp007476. [PMC free article] [PubMed] [CrossRef] [Google Scholar]  84Appleberg B, Bessou P, Laport Y. Effects of dynamic and static fusimotor - ɤ fibres on the responses of primary and secondary endings belonging to the same spindle. J Physiol. 1965;177(1):29–30. [Google Scholar]  85.Puntumetakul R, Chalermsan R, Hlaing SS, Tapanya W, Saiklang P, Boucaut R. The effect of core stabilization exercise on lumbar joint position sense in patients with subacute non-specific low back pain: a randomized controlled trial. J Phys Ther  Sci. 2018;30(11):1390–1395. doi: 10.1589/jpts.30.1390. [PMC free article] [PubMed] [CrossRef] [Google Scholar]  86.Boucher JA, Preuss R, Henry SM, Dumas JP, Larivière C. The effects of an 8-week stabilization exercise program on lumbar movement sense in patients with low back pain. BMC Musculoskelet Disord. 2016;17(1):1–8. doi: 10.1186/s12891-016-0875-  4. [PMC free article] [PubMed] [CrossRef] [Google Scholar]  87.Kong YS, Cho YH, Park JW. Changes in the activities of the trunk muscles in different kinds of bridging exercises. J Phys Ther Sci. 2013;25(12):1609–1612.  doi: 10.1589/jpts.25.1609. [PMC free article] [PubMed] [CrossRef] [Google Scholar]    88Kong YS, Jang GU, Park S. The effects of prone bridge exercise on the Oswestry disability index and proprioception of patients with chronic low back pain. J Phys Ther Sci. 2015;27(9):2749–2752. doi: 10.1589/jpts.27.2749. [PMC free  article] [PubMed] [CrossRef] [Google Scholar] |