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Original Research Article

Effect of Low Back Pain on Anterior Core Muscle Endurance in College Aged Individuals

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ABSTRACT

Low back pain (LBP) is a major health and socioeconomic problem in modern society. Numerous studies have shown a significant decrease in abdominal muscular endurance as well as back extensor muscles endurance in patient with low back pain. The prone bridge test is a valid measure to assess lumbar spine stabilization endurance, activating anterior abdominal muscles. 200 subjects meeting inclusion criteria took part in this study. Subjects were divided into 2 groups: Group 1 (Subjects with low back pain) and Group 2 (Subjects without low back pain). All the subjects performed the prone bridge test. The total duration of holding the test position was recorded. Results showed higher holding time in subjects without low back pain, in boys of both groups and in active subjects of group 2 which were statistically significant. The Prone bridge test is a quick, easy and cost effective method of assessing anterior core muscle endurance.

Key Words: Prone bridge test, low back pain, abdominal muscular endurance, college aged individuals

INTRODUCTION

Low back pain (LBP) is a major health and socioeconomic problem in modern society. [(1)] Nearly 60–80% of the world's population experiences low back pain at least once during their lives. Physical factors such as lifting heavy loads, prolonged static posture and awkward posture, low trunk muscle endurance, psychosocial factors, obesity etc have been found to be associated with LBP. [(1-3)]

The core as described by Akuthota et al (2008) is a muscular box with the abdominals in the front, paraspinals and gluteals in the rear, the diaphragm at the top, and the pelvic floor and hip girdle musculature at the bottom. [(4)]

Core muscles consisting of 29 pairs of muscles of abdominals and lower back, it include abdominals musculature- rectus abdominis, internal and external obliques, transverse abdominis, the paraspinal muscle- erector spinae, multifidus, and semispinalis, back muscles-quadratus lumborum and latissimus dorsi, diaphragm, pelvic floor, and gluteals - maximus, medius and minimus. [(5)]

Most commonly, the core is separated into two systems known as the stabilization (local) system and the movement (global) system. [(4,6,7)] The stabilization system is made up mainly of the transverse abdominis, multifidus, internal oblique, and the quadratus lumborum. [(7,8)] The movement system of the core is primarily comprised of the rectus abdominis, external oblique, and the erector spinae. [(7-9)]

The core muscles act as a bridge that helped transfer force between the upper body and the lower body. [(10)] Core muscles function is important for general health, athletic performance and also prevention and treatment of low back pain. [(11)]

Numerous studies have shown a significant decrease in abdominal muscular endurance as well as back extensor muscles endurance in patient with low back pain. Several types of testing methods, such as static endurance test, active measures of endurance, isokinetic and electromyographic testing are available for measuring core strength and endurance. [12,13]

Of the different available assessment strategies, isometric endurance testing seems to be cost-effective, easy and quick to perform and requires no special equipment in the clinics, so clinicians would choose it to use for measuring trunk muscle endurance. [12,14] Commonly used tests for assessing core muscles function include the sit up test, the Side bridge test, the Supine bridge test, the Prone bridge test (Prone plank), The Biering-Sorensen test, the V-sit Flexor Endurance test etc. [2,5,11,12]

Both the straight-leg and bent-leg sit-up protocols have high muscle challenge using the rectus abdominis, but also a high compression on vertebrae L4 and L5, highlighting why these two exercises may not be the safest exercises to train the movement system of the core. [15]

Ekstrom et al., Lehman et al., and Schellenberg et al. all performed specific research identifying abdominal muscle activation for the prone bridge through surface EMG analysis. Their results show the prone bridge appears to engage the external oblique, [16,17] rectus abdominis, [16,17] and internal oblique [18] enough for endurance training. However, the gluteus medius [17] is only lightly activated by the prone bridge. Jemmett [19] suggests the prone bridge is a good exercise for stabilization, activating the transverse abdominis. Test-retest reliability for the continuous prone bridge test was measured at 0.78. [16]

The prone bridge test is now used as a tool to assess lumbar spine stabilization endurance, [17] and is prescribed for rehabilitation measurements and as a component of exercise programs. [18]

Here in this study we are going to use the prone bridge test because it appears to be well tolerated by asymptomatic and symptomatic (low back pain) participants and is a valid measure of lumbar spine stabilization endurance. [16] This test does not involve an external load (other than body weight), and involves only a static (isometric) position placing minimal compression on the spine when it is performed with neutral spine alignment. [17]

MATERIAL AND METHODOLOGY

STUDY DESIGN - Cross sectional study
SAMPLE DESIGN - Convenient sampling
SAMPLE SIZE - 200 subjects
STUDY SETTING – Pioneer Medical Campus, Vadodara
STUDY DURATION - 4 Months

INCLUSION CRITERIA

- Age group 18 to 25 years
- Both female and male subjects
- Willing to participate

EXCLUSION CRITERIA

- Undergone orthopedic surgery due to a spine-related problem
- Individuals with inflammatory low back pain
- Any musculoskeletal disorder such as recent fracture, joint instability
- Any neuromuscular disorder such as traumatic brain injury, CV stroke
- Vestibular dysfunction
- If they could not perform the exercise
- Individual not able to understand command

MATERIALS

- Yoga Mat
- Stopwatch
- Weighing machine
- Measuring tape

PROCEDURE

Ethical clearance was obtained from institutional review board. All the subjects meeting inclusion criteria took part in this

study. They signed a consent form and then brief assessment was taken for each subject, in which physical activity(PA) levels were estimated with the following self reported daily activity scale: sedentary = 0, low active = 1, active = 2 and very active = 3, as defined by institution of medicine (2005).

Participants select a sedentary daily activity score when PA levels consist of only performing activities of daily living with no exercise or other leisure activities. Participants select a low active PA rating when consistently performing light exercise and leisure activities such as walking (eg, 2-3 mph) approximately 45 minutes a day. Participants select an active PA score when consistently performing a combined total of approximately 75 minutes of leisure activities (eg, walking 2-3 mph) and moderate exercise such as cycling leisurely each day. Lastly, participants select a very active PA rating when performing heavy or vigorous exercises like aerobics, swimming and jogging (eg, 10 min miles) for approximately 60-75 minutes a day.

Then 200 subjects were divided into 2 groups: Group 1 and Group 2

Group1- 100 Subjects with low back pain.

Group2- 100 Subjects without low back pain

Following a brief technique demonstration and detailed instruction, subjects were tested individually. All the subjects performed the prone bridge test as follow.

The subjects assumed test position as shown in figure 1, with elbows in contact with the ground such that humerus formed a perpendicular line to the horizontal plane, directly beneath the shoulders, the forearms were in neutral position and hands were directly in front of the elbows.

The participants assumed a rigid anatomical body position so that only their forearms and toes support the body. This position is characterized by a phalangeal extension, neutral ankle position, knee, hip extension and neutral spinal position.

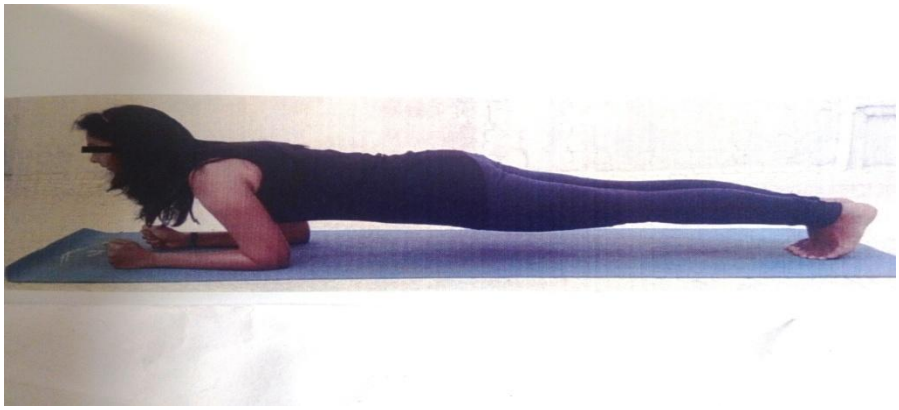

Figure 1: Prone Bridge Test

The participant was instructed to statically hold this position as long as possible and verbal cues were provided to the participant to promote form adherence.

When subject assumed the proper position, the investigator started the stop watch.

The test was terminated when,

1) The participants fatigue or voluntarily stopped the test.

2) The participant fails to maintain the proper position.

3) The participants report ill effects from the test (headache, dizziness, pain not associated with fatigue etc.)

Participants were provided cues during the test as technique faltered away from the accepted position. Test was terminated by the investigator when two consecutive corrective cues given to the participant did not result in an adequate correction in form.

At the conclusion of the test, the total duration of holding the test position was recorded for each participant.

Statistical Analysis

Statistical analysis consisted of Z test ($p < 0.05$) to assess the difference in the prone bridge test hold time between two groups, between boys and girls in group 1 and also in group 2. Effect of activity level on test duration was also examined with Z test for both groups. Here subjects were divided into two groups to assess effect of activity level: non active subjects (PA level 1,2) and active subjects (PA level 3,4). SPSS software and Microsoft excel were used for data analysis.

RESULTS

Table I shows comparison of the prone bridge test hold time (PBHT) between group1 and group 2, where the PBHT was more in subjects without low back pain. Table II and table III show comparison of the PBHT between boys and girls in group 1 and group 2 respectively. The PBHT was more in boys of both groups. Table IV and table V shows comparison of the PBHT between active and non active subjects in group1 and group 2 respectively, where the difference is statistically not significant in group 1 and highly significant in group 2.

Table: I - MEAN PRONE BRIDGE TEST HOLD TIME FOR GROUP 1 AND GROUP 2

Group 1 Mean ±SE (second)	Group 2 Mean ±SE (second)	z value	p value	Results
33.93±1.545	51.03±2.908	5.193	< 0.001	Highly Significant

TABLE: II- MEAN PRONE BRIDGE TEST HOLD TIME BETWEEN BOYS AND GIRLS IN GROUP 1

Boys Mean ±SE (second)	Girls Mean ±SE (second)	z value	p value	Results
46.65±2.481	30.13±1.638	5.019	< 0.001	Highly significant

TABLE: III- MEAN PRONE BRIDGE TEST HOLD TIME BETWEEN BOYS AND GIRLS IN GROUP 2

Boys Mean ±SE (second)	Girls Mean ±SE (second)	z value	p value	Results
81.33.±10.38	44.38±2.146	5.576	<0.0001	Highly significant

TABLE: IV- MEAN PRONE BRIDGE TEST HOLD TIME BETWEEN ACTIVE AND NON ACTIVE SUBJECTS IN GROUP 1

Non active Mean ±SE (second)	Active Mean ±SE (second)	z value	p value	Results
33.43±1.516	50.00±15.57	1.851	>0.05	Not significant

TABLE: V- MEAN PRONE BRIDGE TEST HOLD TIME BETWEEN ACTIVE AND NON ACTIVE SUBJECTS IN GROUP 2

Non active Mean ±SE (second)	Active Mean ±SE (second)	z value	p value	Results
48.52±2.687	90.33±18.89	3.617	< 0.001	Highly significant

DISCUSSION

Primary purpose of this study was to find effect of low back pain on anterior core muscles endurance. In this study, the prone bridge test was used to assess core muscles endurance.

In previous studies to assess anterior core muscles endurance the sit-up test and curls- up tests were used, but it produces compression on lumbar spine, so here the prone bridge test was used. This test does not involve an external load (other than body weight), and involves only a static (isometric) position placing minimal compression on the spine when it is performed with neutral spine alignment. [(17)] It is convenient for the patient and therapist both. [(11)]

Total 200 subjects were assessed in present study, where 23% were boys and 77% were girls in group 1 and 18% were boys and 82% were girls in group 2. The mean age was 21.46 yrs and 19.56 yrs in group 1 and 2 respectively.

In this study, significantly lowered PBHT was found in subjects with low back pain compared to subjects without low back pain. Even previous researches had found impaired function of low back and core musculature in individuals with low back pain or injury. [(20-24)]

The mean (±SE) duration found for the PBHT was 51.03±2.908 seconds for subjects without low back pain which is lower than values suggested in other studies. The reason may be that such studies were

not performed in India and more than 75% subjects were females in this study.

Sarah L. strand (2014) et al, found statistically significant difference between gender for mean duration of the test in seconds where males showed higher duration than females. [(11)] Similar results were found in this study.

According to physical activity, 91% sedentary, 6% low active and 3% active subjects were found in group 1 whereas 68% sedentary, 26% low active and 6% active subjects were present in group2. The physical activity level significantly affects the PBHT. In this study, statistically significant higher PBHT was found in active subjects in group 2 and no significant difference in test duration of active and non active subjects was found in group 1.

These results were supported by previous researches that core endurance is affected in subjects with LBP. Physical activity has correlation with increased core endurance.

Limitations

- Small sample size
- Only college aged individuals were involved
- Effect of BMI was not assessed

CONCLUSION

The prone bridge test hold time is more in subjects without low back pain, in boys of both groups and in active subjects of group 2. The Prone bridge test is a quick, easy and cost effective method of assessing anterior core muscle endurance.

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Conflict Of Interest: NONE

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