



EFFECTS OF THERAPEUTIC BALL EXERCISES VERSUS CONVENTIONAL EXERCISES ON ABDOMINAL MUSCLE ENDURANCE IN SUBJECT WITH NON-SPECIFIC LOW BACK PAIN

Physiotherapy

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ABSTRACT

Background: The prescription of exercise such as therapeutic ball exercises and abdominal strengthening exercises as a conservative treatment found to be effective in reducing pain and improving muscle endurance in patients with non-specific low back pain. There are no studies proven which method of exercise is more effect over other. This study is intended to find out the effects of therapeutic ball exercises versus abdominal strengthening exercises in improving the abdominal muscle endurance in patients with non-specific low back pain.

Material And Method: An experimental study design was conducted on 30 male patients with non-specific low back pain, and they were randomly divided in two groups. Group -I was treated with therapeutic ball exercises and Group -II was treated with conventional abdominal strengthening exercises for 8 weeks. Both the groups were assessed with Sit-up test for abdominal muscle endurance before and after the treatment.

Result: Group -I who received therapeutic ball exercises scored significantly higher score on sit-up test when compared to Group -II when analyzed using independent 't' test at $p < 0.05$.

Conclusion: Therapeutic ball exercises found to be more effective on improving the abdominal muscle endurance in patients with non-specific low back pain when compared to the subjects treated with conventional abdominal strengthening exercises.

KEYWORDS

Non-specific low back pain, low back pain, therapeutics ball exercises, conventional abdominal strengthening exercises, abdominal muscle endurance, sit up test.

INTRODUCTION:

Non-specific low back pain (NSLBP) is defined as low back pain not attributable or recognizable, known specific pathology. It is estimated that, the annual worldwide LBP incidence in adults to be 15% and the point prevalence to be 30%. Various studies found that NSLBP is a very common problem among adolescents, with an incidence that is the highest in the third decade of life. The lifetime prevalence of non-specific low back pain (NSLBP) in industrial countries is at 84%. Approximately 85% of such back pain is classified as non-specific. The symptoms of NSLBP pain are pain, stiffness, spasm, and reduced range of movement. According to Nowotny et al and Caffaro RR et al, poor or altered posture can lead to mechanical and NSLBP^{1,2}. Static muscle load and flexion of the lumbar spine have been postulated as risk factors for LBP development; thus, prolonged sitting or sitting in an abnormal posture can aggravate LBP. This can put extra strain on ligaments, muscles and tendons causing them to become overstretched and painful^{3,4}.

Strong abdominal muscles can help reduce back pain caused by soft tissue injury or back muscle strain. Consequently, exercises that strengthen these core muscles should be a part of a balanced back/abdominal exercise program⁵. Developing strong abdominal muscles help prevent back pain caused by poor posture. Since abdominal muscles are the front anchors of spine, if they are weak, then the other structures supporting the spine will have to work harder and hence causes back pain⁶. By developing good abdominal muscle endurance, back pain can be reduced. Conventional abdominal strengthening exercises and therapeutic ball exercises are found to be effective in improving the abdominal endurance and strength⁷.

Conventional abdominal muscles exercises builds muscle strength by intense muscle isolation which makes them a popular exercise for people trying to get six-pack abs and on continuous repetition of these exercises over a period of time, the endurance of the muscles are improved⁸. A strong abdominal muscle helps in improving performance with certain sports, back pain, and for withstanding abdominal impacts (e.g., taking punches). This also makes them ideal for strengthening core, which includes lower back muscles and oblique muscles which supports the frontal area of spine⁹. Vispute SS et al, concluded in his study that Conventional abdominal strengthening exercises like abdominal crunch, supine leg lift, oblique crunch and bicycle crunch performed on floor has shown to improve the abdominal muscle strength and endurance¹⁰.

Therapeutic ball exercise consists of Core stability and abdominal strengthening exercises performed using therapeutic ball also

recommended to be an effective exercise of improving abdominal strength and endurance as the body responds naturally and automatically to this instability to keep balanced on the exercise ball. Over time, the muscles used to keep in balance on the exercise ball become stronger¹¹. According to Cosio-limathe et al, the group that performed abdominal and back strengthening exercises on the therapeutic ball would show greater stability than the control group who performed the same exercises on the floor. Exercises when performed on therapeutic ball stresses the core muscles more than a linear plane and unstable surface than performed on the floor, and thus engage the core muscles, improves trunk stability and balance thereby improving the core muscle strength and endurance¹².

The prescription of exercise such as therapeutic ball exercises and abdominal strengthening exercises as a conservative treatment found to be effective in reducing pain and improving muscle endurance in patients with non-specific low back pain¹³. There are no studies proven which method of exercise is more effect over other. This study is intended to find out the effects of therapeutic ball exercises versus abdominal strengthening exercises in improving the abdominal muscle endurance in patients with non-specific low back pain. Hence, the objective of this study is to find the comparative effect of therapeutic ball exercises versus conventional exercises on abdominal muscle endurance in subject with NSLBP.

MATERIALS AND METHOD:

An experimental study design was conducted on 30 male subjects who were clinically diagnosed with NSLBP. As this study involved human subjects, the ethical clearance was obtained from the ethical committee of the institution as per the ethical guidelines of bio medical research on human subjects. The study was conducted in GPRC outpatient department, Bangalore.

Subjects included in the study were male, age 25-45 years clinically diagnosed with NSLBP. Subjects who had degenerative spinal disorder, radiculopathy, history of fracture, BMI above 30, positive SLR, specific low back pain were excluded. Subjects who met inclusion criteria were informed about the study and a written signed consent was taken. Selected subjects based on inclusion criteria were randomly divided into two groups namely Group -I and Group -II. All the subjects were clearly instructed about the purpose of the study and the importance of exercise in daily life before starting a training session. Baseline measurements of abdominal endurance of all the subjects were measured using sit-up test (fig 1).

In group - I, 15 male subjects were participated and instructed to do 10

repetitions of therapeutic ball exercises of 3 sets with a rest period of 3 minutes. The treatment consisted of four techniques of therapeutic ball exercises, supine stomach crunch on ball (fig 2), oblique crunch on ball (fig 3), ball lift (fig 4), and supine leg rotation with ball (fig 5). These exercises were performed for 5 days a week, for 8 weeks. And they were followed by proper warm-up and cool down. For group - II, 15 male subjects were participated and instructed to do conventional abdominal exercises on floor for 3 sets of 10 repetitions each. The techniques under conventional methods were modified sit-ups (fig 6), side sit-ups (fig 7), bilateral leg lift (fig 8) and bicycle crunch (fig 9). These exercises were performed for 5 days a week for 8 weeks and followed by proper warm-up and cool down. During the training session, all the subjects of group -I and group -II were instructed to perform 5-minute spot walking and free hand exercises before and after the abdominal strength training as a warm-up and cool down exercise under the supervision of the therapist. At the end of eighth week of the training session, abdominal muscle endurance of all the subjects participated were measured through sit-up test (fig 1) and this was considered as post test data. Pre and post-test values of abdominal muscle endurance of both the groups were taken for statistical analysis.



Fig1- Group -I subject performing sit up test



Fig 2: Group -I subject performing supine stomach crunch on therapeutic ball.



Fig 3: Group -I subject performing oblique crunch on ball



Fig 4: Group -I subject performing Supine ball lift

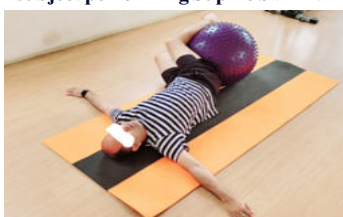


Fig 5: Group -I subject performing supine leg rotation with ball



Fig 6: Group -II subject performing modified sit-ups



Fig 7: Group II subject performing side sit-ups



Fig 8: Group -II subject performing bilateral leg lift



Fig 9: Group -II subject performing bicycle crunch

Outcome measures:

Abdominal endurance was measured using one-minute timed sit-up test which is found to be a valid and reliable method^{14,15}. Performance of this test was in accordance with the methods outlined by Bianco A. et al. Participants were instructed to lie flat on their backs, feet touching the ground and knees flexed to 90° with arms crossed over their back. Their feet were held in place by the examiner. The participants then raised their trunk until their elbows touched their knees. This motion was followed by lowering their trunk until their scapula touched the floor. This was recorded as one sit-up. The participants were instructed to do as many sit-ups as possible in one minute. Number of sit-ups counted and recorded^{6,17}.

STATISTICALMETHODS:

Descriptive and inferential statistical analysis has been carried out in the present study. Outcome measurement was measured and presented as mean SD. The data was analyzed by using 't' test to find significance of interventions used within groups and independent 't' test was used to find out significance between the groups with the values of sit-up test.

RESULTS:

This study was done on 30 subjects, 15 subjects each to therapeutic ball exercises group and 15 to conventional abdominal strengthening exercises group. Table 1 shows the value of 't' as 31.567 for group-I and 't' as 21.313 for group -II for the Pre and Post values of sit-up test scores which is significant improvement $p < 0.05$ within the groups. Table 2 shows the value of $t' = 0.2273$ at $p < 0.05$ for the pretest scores of sit up test between group -I and group -II. It shows that there are no significant variations between the pre-test scores of abdominal muscle endurance showing the homogeneity of the groups. When the post-test

values of a sit up test compared between the groups the value of 't' was found to be 1.97 which is significant at $p < 0.05$.

Table-1: pre to post test values of sit up test within group I and group II

		Mean	SD	't' Value	'P' Value
Group -I	Pre-Test	9.86	0.74	31.567*	<0.05
	Post Test	17.2	1.08		
Group -II	Pre-Test	9.93	0.88	21.313	<0.05
	Post Test	16.46	1.45		

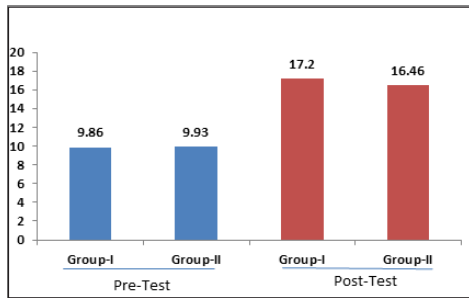
*Calculated 't' Value is significant at $p < 0.05$ with $df = 14$ (table 't' Value = 1.761) for both group I and group II

Table-2: Pre and Post Test Values of Sit Up Test between Group I and GROUP II.

	Study group	Mean	SD	't' Value	'P' Value
Pre-Test	Group -I	9.86	0.74	0.2273	<0.05
	Group -II	9.93	0.88		
Post test	Group -I	17.2	1.08	1.97*	<0.05
	Group -II	16.46	1.45		

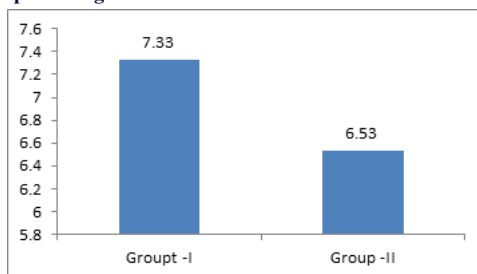
*Calculated 't' Value is significant at $p < 0.05$ with $df = 28$ (table 't' Value = 1.701).

Graph-1: Mean values of pre and post test values of abdominal muscle endurance group-I and group-II using sit-up test scores



The above graph shows the value of mean improvement for the parameter of abdominal muscle endurance assessed using sit-up test. It shows a greater improvement in NSLBP subjects of group -I treated using therapeutic ball exercises when compared to the subjects of group -II treated using conventional abdominal strengthening exercises.

Graph-2: Mean difference of sit-up test scores between group -I & group-II using.



The above graph shows the value of mean improvement for the parameters of abdominal endurance assessed using sit-up test. It shows a greater improvement in NSLBP subjects of group -I treated with therapeutic ball when compared with subjects in group-II treated with conventional abdominal strengthening exercises.

DISCUSSION:

The purpose of this study was to examine the effects therapeutic ball exercises versus conventional abdominal exercises on patients with NSLBP, measured by the one-minute timed sit-up test. This study was done on 30 subjects who had NSLBP and were split into two Groups namely, group -I and group -II consisting of 15 each.

The statistical analysis showed considerable increase in the mean value for group -I at 7.33, whereas the mean value for group -II was at 6.53 on one -minute timed sit-up test. There are significant differences found within the experimental group from pre- to posttest on both

assessments and the significant differences between both groups for the abdominal endurance test at the time of the posttest. This proved that the subjects who received therapeutic ball exercises had a better outcome than conventional abdominal strengthening exercises thereby improving the abdominal muscle endurance in patients with NSLBP.

The subjects receiving therapeutic ball exercise had a better improvement in their muscle endurance due to exercising in labile surface where the therapeutic ball gave a challenge to the subject by maintaining the stability and balance on the ball. Therapeutic ball engages the stabilizer muscles in the core and forces the body to improve balance to complete the exercises and can also be beneficial in keeping a healthy posture¹⁸. The current study showed that therapeutic ball exercise might be an effective intervention in improving abdominal endurance in patients with NSBP. Research shows that there is a significant improvement of torque of spinal flexors and extensors, lumbar flexibility and pain reduction with both floor exercises and Swiss ball exercises. The findings of study suggest that there is a significant difference between floor exercises and Swiss ball exercises¹⁹.

In Conventional abdominal exercises, such as abdominal curl-up (crunch) or sit-up exercises, as a person raises the head and shoulders off the floor from a supine position toward a sitting position. Sit-up exercises have been proven to be effective in activating the rectus abdominis and internal and external oblique musculature, hence improves the abdominal muscle strength^{20,21}. Abdominal muscular endurance and strength and torso balance are important for trunk stability, appropriate posture, and body movements during sports. The conventional abdominal exercises and are often used to develop abdominal muscular endurance and strength. However, these floor exercises primarily strengthen the hip flexors and only minimally affect the core abdominal muscles since they are performed on a linear plane.²²

This study implies that the therapeutic ball exercises are effective in improving the strength and endurance of abdominal muscles as the therapeutic ball supports the lower back and maintains proper form throughout the movement while discouraging over extension of the lower back. Exercising on ball creates a momentum which puts spine in a compromising position hence challenges the balance and stability and forces the stabilizing muscles of the core to engage and recruit more muscle fibers and improve activation by 24 to 38% based on EMG readings. Although there is evidence to suggest that the Swiss ball provides a training stimulus for the rectus abdominus^{23,24}.

The limitations of the study are influence of the severity and duration of NSLB not considered, level of pain not measured, only male subjects were taken. Further studies suggested the effects using similar techniques in both male and female subjects and with other problems of the back. In this study, subjects were tested for only abdominal muscle endurance using sit-up test alone, similar studies using other objective and standard measures like Electromyography, dynamometer, ABTEST can be considered²⁵. Further studies can also be done to compare the effect of therapeutic ball exercises with other form of core strengthening exercises. This study can further be extended to other parameters like functional disabilities.

CONCLUSION:

This study can be concluded by stating that both group -I, who received therapeutic ball exercises and group -II, who received conventional abdominal exercises received beneficial effect in improving the abdominal muscle endurance in patients with NSLBP. When both the treatment regimens were taken into consideration for significance, all therapeutic ball exercises had superior hand in improving the abdominal endurance of NSLBP patients than the conventional abdominal strengthening exercises.

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CONFLICT OF INTEREST: None

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