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ORIGINALARTICLE

EFFECTIVENESS OF TRANSVERSE ABDOMINIS MUSCLE ACTIVATION USING ABDOMINAL DRAW IN MANOEUVRE IN COMBINATION WITH ANKLE DORSIFLEXION IN TREATMENT OF NON-SPECIFIC LOW BACK PAIN

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Sujith S[1],Jomi John[2],Sreejith P S[3]

Authors:

[2]Assistant Professor, School of Medical Education, Centre for Professional and Advanced Studies, Gandhinagar, Kottayam, Kerala, India

[3]Chief Physiotherapist, Mercy Nursing Home, Karukachal PO, Kottayam, Kerala, India.

Corresponding Author:

[1]Assistant Professor, School of Medical Education, Centre for Professional and Advanced Studies, Gandhinagar, Kottayam, Kerala, India, Mail Id:sujithhavemail@gmail.com

ABSTRACT

Background and Objectives: Low back pain is a commonly confronted orthopaedical problem. Even though in high prevalence, the source of pain is not established in majority of cases, termed nonspecific low back pain. A major factor in genesis and persistence of nonspecific low back pain is instability of spine. Transverse abdominis muscle is attributed to play an important role in stabilization of lumbar spine. The purpose of the study is to find out the effectiveness of abdominal draw in manoeuvre in combination with ankle dorsiflexion in strengthening transverse abdominis muscle and its impact on pain and disability in patients with nonspecific low back pain. **Methods:** 30 subjects who satisfy the inclusion criteria were recruited for the study. Subjects were then allocated to two groups-Group A (control group) and Group B (experimental group), with 15 in each group. Subjects in group A received conventional treatment and group B received experimental treatment of abdominal draw in maneuvers in combination with ankle dorsiflexion along with conventional treatment. Transverse abdominis activation was measured using stabilizer, Pain using Visual analogue scale (VAS) and disability by Oswestry disability index (ODI). **Result:** Post test scores of experimental and control groups of VAS, ODI and Transverse abdominis activation were statistically analyzed using the Mann-Whitney U test and two sample t test. Data analysis showed a statistically significant improvement in VAS and transverse abdominis activation at 1 % level and ODI showed statistically significant improvement at 5% level. **Conclusion:** Low back pain patients who received abdominal draw in manoeuvre in combination with ankle dorsiflexion along with conventional physical therapy showed improvement in transverse abdominis activation, pain as well as disability than control group.

Key words: Low Back Pain, abdominal draw in manoeuvre in combination with ankle dorsiflexion, Transverse abdominis.

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INTRODUCTION

Low back pain is a prevalent orthopedic issue that often leads to disability and places a significant burden on healthcare resources, resulting in substantial societal costs. Epidemiological studies have revealed that approximately 80% of adults will experience low back pain at some point in their lives[1]. The annual incidence of low back pain worldwide among adults is estimated to be 15%, with a point prevalence of 30% [2]. However, the precise prevalence of low back pain remains uncertain. In cases of acute low back pain, the prognosis is generally favorable; nevertheless, up to 10% of individuals develop chronic low back pain. Despite its high prevalence, the cause of low back pain remains elusive in the majority of cases, leading to the term "nonspecific low back pain." Nonspecific low back pain is the most common presentation, accounting for approximately 90% of all cases of low back pain [3,4].

According to current literature, various types of exercises, including flexibility training, general fitness activities, strength and endurance training, coordination exercises, and proprioceptive training, play a significant role in reducing the risk of low back injuries. In response to this evidence, an increasing number of healthcare facilities are adopting exercise programs that focus on strengthening the muscles of the trunk. These programs aim to both prevent and treat low back injuries while enhancing overall performance.

In particular, the abdominal muscles are often emphasized in the treatment of low back pain. Among these muscles, the transverse abdominis has garnered considerable attention [5,6]. The transverse abdominis is the deepest abdominal muscle, with origins at the inguinal ligament, anterior iliac crest, thoracolumbar fascia, lower six costal cartilage. It inserts into various points, including the xiphoid process, Linea alba, pubic crest, pectineal line of the pubis, and blends with the internal oblique muscle[7].

The transverse abdominis muscle encircles the torso in a belt-like fashion, setting it apart from other abdominal muscles. Its unique circumferential orientation makes it particularly effective in increasing intra-abdominal pressure when compared to other abdominal muscles[8]. Notably, research has shown that the transverse abdominis is the first muscle in the torso to activate in both unexpected and self-loaded conditions. When the torso is loaded ventrally, the transverse abdominis is activated before the erector spinae muscle[9]. Additionally, during lower limb movements, the transverse abdominis is activated ahead of other abdominal muscles and prime movers of the hip, underscoring its role in stabilizing the lumbar spine[10].

The recruitment of the transverse abdominis in the early stages of rehabilitation is a contemporary approach for managing low back pain. This approach is grounded in evidence demonstrating that transverse abdominis activity contributes to spinal control and that dysfunction in the transverse abdominis is observed in individuals with low back pain[11,12]. Recent research has also highlighted the significance of the transverse abdominis in motor control related to both lower limb and upper limb movements. Notably, individuals with low back pain exhibit a lack of anticipatory transverse abdominis recruitment prior to

rapid limb movements, in contrast to healthy subjects [13].

One commonly utilized exercise for core stabilization and the restoration of neuromuscular control in the core musculature of individuals with low back pain is the abdominal draw-in maneuver. Prior studies have demonstrated that the abdominal draw-in maneuver is more effective than other core stabilization techniques in increasing the cross-sectional area of the transverse abdominis muscle[14,15].

The rationale behind incorporating ankle dorsiflexion into the abdominal draw-in maneuver lies in the potential to enhance transverse abdominis recruitment through irradiation. This technique is based on proprioceptive neuromuscular facilitation and aims to selectively increase the involvement of active motor units that may be weakened in the neuromuscular response [16,17].

This study was conducted to assess the effectiveness of the abdominal draw-in maneuver in combination with ankle dorsiflexion. The goal was to restore neuromuscular activation of the transverse abdominis, alleviate pain, and reduce disability in individuals with nonspecific low back pain.

Objectives of the study: To find the effectiveness of abdominal draw in manoeuvre in combination with ankle dorsiflexion to improve transverse abdominis activation in patients with nonspecific low back pain. To find the effectiveness of abdominal draw in manoeuvre in combination with ankle dorsiflexion to improve pain in patients with nonspecific low back pain. To find the effectiveness of abdominal draw in manoeuvre in combination with ankle dorsiflexion to improve disability in patients with nonspecific low back pain.

METHODOLOGY

The study was conducted at the department of physiotherapy, Mercy Nursing Home, Pvt Ltd, Karukachal, Kerala. A total of 30 samples were selected for the study. The study was an experimental study and samples were divided into two groups by purposive sampling method. Duration of the study was 6 months.

Inclusion criteria: Subjects with subacute nonspecific low back pain, both male and female, subjects between 20-40 years, patients who fulfil criteria as on physical activity readiness questionnaire (PAR-Q) were selected for the study.

Exclusion criteria: Pain medications, Pregnancy/delivery within last one year, recent spinal or lower limb injury or surgery, recent history of spinal or lower limb trauma or fracture, neurological manifestations, structural deformities of spine, lower limb length discrepancy, any systemic diseases that prevent active participation in exercise program.

Procedure: 30 subjects who fulfilled the inclusion criteria were selected and divided into two groups Group A and Group B with 15 subjects in each group. Group A (control group) undergoes conventional therapy which included hydrocollator packs for 10 minutes, followed by once daily stretching and strengthening exercises 5 days per week over a three-week period. Exercises included 5 minutes warm up by static cycling, strengthening consisted of partial curl, double knee to chest, alternate arm and leg raise in

quadruped position (all 3 sets of 10 repetitions). Stretching included cat and camel stretch (3 set of 10 repetitions), bilateral gluteus muscle stretch with supine knee to chest (3 stretch with 10 second hold time) and bilateral hamstring stretch forward bending to touch toes with leg elevated (3 stretch with 10 second hold time).

Group B (experimental group) performed abdominal draw in manoeuvre in combination with ankle dorsiflexion along with conventional physiotherapy. Participants were asked to adopt a crook-lying position, with hip and knee joints positioned between 40 and 80 degrees to reduce the lumbar lordosis and a pressure biofeedback unit was placed beneath their fifth lumbar vertebra to monitor lumbar movement during the measurement of abdominal draw in manoeuvre performance. Participants were instructed to draw in their lower abdomen below the navel gently and gradually without moving their upper abdomen or spine, while maintaining a neutral pelvic position to attempt to keep the target pressure range (30 to 70 mmHg). They were then asked to dorsiflex their ankle joint against the resistance provided by a fixed-strap band. This position was maintained for a period of 5 seconds and then released. The same was performed at 3 sets of 10 repetitions with rest period of 2 minutes between sets.

Outcome measures: Stabilizer pressure biofeedback unit[27], Visual analogue scale[28], Oswestry disability index [29].

RESULTS

Group A (Control group)

Outcome measure	Score	Mean	N	Mean Rank		Sum of Rank		Z	P Value
				Negative	Positive	Negative	Positive		
VAS	Pre	58.93	15	8.00	0.00	120.00	0.00	3.409	.001
	Post	33.87							

Table 1: Wilcoxon signed rank test with group A on VAS

Outcome Measures	Mean		standard deviation		t value	p value
	pre-test	post test	pretest	post test		
ODI	30.22	22.16	2.575	5.230	6.475	.000
TRANSVERSE ABDOMINIS ACTIVATION	4.93	6.33	2.017	2.257	-5.501	.000

Table 2: Paired t test with group A on ODI and Transverse abdominis activation

Group B (Experimental group)

Outcome measure	Score	Mean	N	Mean Rank		Sum of Rank		Z	P Value
				Negative	Positive	Negative	Positive		
VAS	Pre	58.73	15	8.00	0.00	120.00	0.00	-3.41	.001
	Post	27	15						

Table 3: Wilcoxon signed rank test with group B on VAS

Outcome Measures	Mean		standard deviation		t value	P value
	pre-test	post test	pretest	post test		
ODI	30.2518	17.407	6.542	5.934	12.125	.000
TRANSVERSE ABDOMINIS ACTIVATION	5.07	8.67	1.534	1.345	-16.837	.000

Table 4: Paired t test with group B on ODI and Transverse abdominis activation

Comparison between both groups

Outcome measure	Group	N	Mean Rank	Sum of Rank	U	Significance
VAS	A	15	19.60	294.00	51.000	.010
	B	15	11.40	171.00		

Table 5: Mann Whitney U test comparison between group A and B on VAS

Outcome Measures	Group	N	Mean	Standard deviation	T value	P value
ODI	A	15	22.163	5.230	2.328	.027
	B	15	17.407	5.934		
Transverse Abdominis Activation	A	15	6.33	2.257	-3.439	.002
	B	15	8.67	1.345		

Table 6: Two sample t test comparison between group A and B on ODI and Transverse abdominis activation

DISCUSSION

The study used an experimental approach to find out the effectiveness of abdominal draw in manoeuvre in combination with ankle dorsiflexion in the treatment of low back pain. The sample for study included 30 subjects. The subjects were randomly allocated into two groups. Group-A (Control group) and Group-B (Experimental group), consisting of 15 subjects each. Each subject was explained about procedure of intervention and possible risks involved. A written informed consent from each subject was obtained. Subjects in group A received conventional therapy and that in group B received abdominal draw in manoeuvre in combination with ankle dorsiflexion along with conventional therapy. All subjects well tolerated the interventions given and no one was dropped out of the study. Pain was assessed using visual analogue scale, disability using Oswestry disability index and transverse abdominis activation using stabilizer pressure biofeedback unit. All outcome measures were collected before and after the intervention protocol.

On statistical analysis using Wilcoxon signed rank test, mean pretest VAS score for control group was 58.93 and mean post test score for control group was 33.87. Z value was -3.409, significance level .001. Result shows that there is significant difference in VAS scores between pre and post test values at 1% level for VAS scores of control group.

On statistical analysis using Wilcoxon signed rank test, mean pretest VAS score for experimental group was 58.73 and mean post test score for experimental group was 27. Z

value was -3.41, significance level .001. Result shows that there is significant difference in VAS scores between pre and posttest values at 1% level for VAS scores of experimental groups.

On statistical analysis using paired t test the pre and post ODI scores of control group were 20.22 and 22.16, respectively. T value was 6.475 and p value .000. Result shows that pre ODI score differ significantly from post ODI score at 1%level of significance. There is significant improvement in control group.

On statistical analysis using paired t test the pre and post ODI scores of experimental groups were 30.2518 and 17.407, respectively. T value was 12.125 and p value .000. Result shows that pre ODI score differ significantly from post ODI score at 1%level of significance. There is significant improvement in experimental group.

On statistical analysis using paired t test the pre and post Transverse abdominis activation scores of control group were 4.93 and 6.33, respectively. T value was -5.501 and p value .000. Result shows that pre-Transverse abdominis activation score differ significantly from post Transverse abdominis activation score at 1%level of significance. There is significant improvement in control group.

On statistical analysis using paired t test the pre and post Transverse abdominis activation scores of experimental groups were 5.07 and 8.67, respectively. T value was -16.837 and p value .000. Result shows that pre-Transverse abdominis activation score differ significantly from post Transverse abdominis activation score at 1% level of significance. There is significant improvement in experimental group.

The posttest VAS scores of controls and experimental group were evaluated using Mann Whitney U test, the mean rank for control group was 19.60 and for experimental group was 11.40 and sum of rank for control group was 294.00 and experimental group 171. The U value was 51 and significance level was .010. Which is statistically significant at 1% level. This indicates improvement in pain in experimental group over control group at 1% level of significance.

The posttest ODI scores of controls and experimental group were evaluated using 2 sample t test, the mean for control group was 22.163 and for experimental group was 17.407 and t value 2.328. The p value was .027. Which is statistically significant at 5% level. This indicates improvement in disability in experimental group over control group at 5% level of significance.

The posttest Transverse abdominis activation scores of control and experimental group were evaluated using 2 sample t test, the mean for control group was 6.33 and for experimental group was 8.67 and t value -3.439. The p value was .002. Which is statistically significant at 1% level. This indicates improvement in transverse abdominis muscle activation in experimental group over control group at 1% level of significance.

There is statistically significant improvement in Transverse abdominis activation, pain and disability in patients who underwent abdominal abdominal draw in manoeuvre in combination with ankle dorsiflexion along with conventional therapy than control group who received conventional therapy alone. Null hypothesis is rejected.

This study accords with studies of Seung Chul Chong et al study 'Efffect of the abdominal draw in manoeuvre in combination with ankle dorsiflexion in strengthening the transverse abdominis muscle in healthy young adults: A preliminary randomised controlled study[17] that transverse abdominis muscle strengthening occurs with abdominal draw in manoeuvre in combination with ankle dorsiflexion.

As per available literature drawing in of lower abdominal wall may be the best method for recruitment of transverse abdominal muscle with least activity of other abdominal muscles[18]. Isometric contraction of transverse abdominis as in abdominal draw in manoeuvre while maintaining the spine in neutral position should help reeducate stabilizing role of this muscle. Neurophysiologically it can be extrapolated that augmented and selective improvement in muscle activity of transverse abdominis may be the result of energy outflow or propagation from tibialis anterior muscle to transverse abdominis via a long and elastic anterior fascia connection when ankle dorsiflexion was added to abdominal draw in manoeuvre. Abdominal draw in manoeuvre in combination with ankle dorsiflexion increase transverse abdominis recruitment through irradiation, a proprioceptive neuromuscular facilitation technique used to selectively increase the number of active motor unit recruitments involved or weakened in neuro muscular response[17,19,20,21].

There are various mechanisms by which transverse abdominis recruitment helps relieve back pain. Transverse abdominis contribute to intersegmental stability through fascial tensioning or by generation of intra-abdominal pressure or a combination of both. The generation of segmental stability can be explained based on hierarchical model that the central nervous system controls segmental stability and orientation of spine independently during limb movements[22,23].

A biomechanical model suggests that strengthening of transverse abdominis adds stability to sacroiliac joint thus augments stability of sacroiliac joint. Almost flat sacroiliac joint is protected against dislocation by strong ligamentous system, but this ligamentous system is liable to creep under prolonged load. This emphasis the requirement of an additional muscular force that act against the shear force and press the sacrum between the ilia. The extra muscle activity is called self-bracing. Several muscles with a transverse orientation can produce forces that cross the sacroiliac joints in the appropriate direction to produce force closure which include transverse abdominis, the middle part of the internal oblique abdominis, the piriformis, and the coccygeus muscles. The considerable effect on sacroiliac joints compression of transversely oriented muscle force follows from two aspects: The sacroiliac joints cavity is almost parallel to the sagittal plane, while the transverse abdominis force acting on the ilia is perpendicular to the sagittal plane. And the abdominal muscle force produces a counterclockwise moment with respect to the sacroiliac joints. A clockwise moment for equilibrium can be realized by tension in the stiff interosseous sacroiliac ligaments. Because the lever arm of these ligaments is considerably smaller than the lever arm of the transverse abdominis, a force magnification mechanism exists, that is joint reaction force is much greater than the muscle force. This mechanical action of transverse abdominis reduces laxity at sacroiliac joint[7,24,25,26].

The result of the present study revealed that both groups demonstrated significant reduction in pain, improvement in functional ability and increase in transverse abdominis strength, but it was more noted in experimental group who received abdominal draw in manoeuvre in combination with ankle dorsiflexion. Hence the discussion can be concluded; as abdominal draw in manoeuvre in combination with ankle dorsiflexion along with conventional treatment is effective in reducing pain, improving functional ability and improving transverse abdominis strength. Abdominal draw in manoeuvre in combination with ankle dorsiflexion can be used as simple, cost-effective adjunct to conventional treatment in patients with low back pain.

The study accuracy would have increased if conducted for longer duration and on more sample size, only transverse abdominis muscle function was considered in the study which is only one among the integral factors contributing to low back pain. Future research should be attempted to evaluate the effect of transverse abdominis activation on specific low back pain conditions as in sacroiliac joint dysfunctions.

Ethical Clearance: Ethical clearance was obtained from School of Medical Education, Gandhinagar, Kottayam, Kerala

Conflict of interest: There was no potential conflict of interest to conduct this study Fund for the study: Self-funded study

CONCLUSION

The study proves that abdominal draw-in manoeuvre in combination with ankle dorsiflexion along with conventional physical therapy is more effective than conventional physical therapy alone in improving transverse abdominis activation, improve pain and disability in patients with nonspecific low back pain.

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