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ORIGINAL ARCITLE

TO COMPARE THE EFFECTIVENESS OF CO-CONTRACTION OF ANKLE DORSI FLEXION WITH ABDOMEN DRAW-IN MANEUVER WITH PRESSURE BIOFEEDBACK IN REDUCING PAIN AND ACTIVITY LIMITATION IN MECHANICAL LOW BACK PAIN

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ABSTRACT

Background: *Mechanical low back pain exists in every culture and country and 80 % of all human beings experience mechanical low back pain at some point in their lives. Core stabilization exercises are widely used in treatment and prevention of mechanical low back pain since it decreases pain and improves function. Co-Contraction of ankle dorsiflexion with Abdomen draw-in maneuver with Pressure Biofeedback changes both level of muscle activity and the way that the muscle co-activate to stabilize whole body and spine.ity. There are no studies comparing core stability exercises with biofeedback which is providing feedback during exercise training. Hence this study is intended to find the effectiveness of Co-Contraction of ankle dorsiflexion with Abdomen draw-in maneuver and Core Stabilization Training with Pressure Biofeedback in reducing pain and activity limitation in subjects suffering from mechanical low back pain.*

Objective: *To compare the effectiveness of Co-Contraction of ankle dorsiflexion with Abdomen draw-in maneuver and Core Stabilization Training with Pressure Biofeedback in reducing pain and activity limitation in mechanical low back pain.*

Methodology: *This study included 60 mechanical low back pain students of both genders between age group of 20-25 years. They are randomly divided into 2 groups, Group A and Group B. Group A received core stabilization exercises using pressure biofeedback and Group B received co-contraction of ankle dorsiflexion with abdomen draw-in maneuver using pressure biofeedback. Pain was measured using VAS before intervention and after 2 weeks of intervention. Functional disability was measured using ODI before intervention and after 2 weeks of intervention.*

Results: *There was highly significant difference between the VAS Scores in both groups noted respectively with p values of $P < 0.04$ and $P < 0.01$. In both groups there was highly significant difference between the ODI scores was noted with p=0.04 and P=0.01 respectively. There was highly significant difference between the VAS Scores in the subjects in the co-contraction of ankle dorsiflexion with abdomen draw-in maneuver group i.e. $P > 0.01$ and highly significant difference between the ODI scores in the subjects in group A and B (P 0.001) were note in between group analysis.*

Conclusion: *From the present study, it has been concluded that co-contraction of ankle dorsiflexion with abdomen draw-in maneuver is effective in reducing pain and functional disability in students with mechanical low back pain.*

Keywords: *co-contraction of ankle dorsiflexion with abdomen draw-in maneuver, core strengthening, low back ache.*

INTRODUCTION

low back pain (LBP) is a common musculoskeletal impairment that often is associated with neuromuscular dysfunction of the transversus abdominis (TrA) muscle and spinal instability, affecting activities of daily living and physical activity.[1–3] Epidemiologic evidence has indicated that up to 70% of patients with acute LBP ultimately develop chronic LBP.[4]Chronic low back pain is the most common complaints in the urban society causing to absent from the work and activity limitation. Its health, social and economic burden is hefty. [8] It is 2nd most frequent reason for visit to the physician and 5th ranking cause of hospital admission.[9-10]

Approximately 40% of low back pain patients worry that pain affects their work ability, that it will cripple them, or that it underlies some serious disease. Better understanding of multidimensional aspects has widened our concept of low back pain. There are several causes of low back pain. In a mechanical model, research has implicated pain sensitive vertebral structure such as the intervertebral disc and the zygoapophyseal joints as potential sources of low back pain. Irrespective of the actual source of symptoms, it has been shown that muscles are adversely affected secondary to low back pain. Delayed onset time of TrA feed-forward activation during shoulder movement[5] and altered muscle-activation patterns during locomotion[6] have been identified in patients with LBP as important pathologic markers of abdominal neuromuscular dysfunction. Normally, the neuromuscular system is believed to maintain stability of the lumbar spine by increasing the active and passive stiffness of the deep abdominal and multifidus muscles or modulating muscle co-contraction, which increases the compressive loads.[7]

The basis for this focus is the premise that strong abdominal and back muscles are able to provide support for the lumbar spine.[12]Despite the common acceptance of this principle, systematic reviews have not on the whole supported general trunk muscle strengthening programs.[13] This has led to the development of specific exercise programs designed to protect and support the damaged joints and allow healing of the injured tissues.[14,15] Muscles can be broadly divided into two categories, local and global muscles.[16] The local muscle system includes deep muscles that are attached to the lumbar vertebrae and are capable of directly controlling the stiffness of the lumbar segments.[17] In contrast, the global muscle system encompasses larger and more superficial muscles of the trunk. Their role is to move the spine and to control larger external loads, which occur with normal daily function.

The muscles of the local synergy, which are important for the lumbo-pelvic region, include the segmental lumbar multifidus, the transverses abdominis, the pelvic floor and the diaphragm. There is evidence that low back pain results in an alteration in function of the local muscles, which lose their protective role.[18-20] Disturbances in neuromuscular control have also been frequently connected with chronic low back pain and considered a possible linkage between pain and disability. [22]

A recent focus in the management of chronic low back pain patients has been the specific training of the deep abdominal (internal oblique and transverses abdominis) and lumbar multifidus muscles. The primary role of these muscles is considered to be the provision of dynamic stability and segmental control of the spine.

A number of investigators have cited evidence that supports the use of stabilization exercises for enhancing spinal stability.[25] the local muscles are said to be crucial in this mechanism. This may be because of their contribution to maintaining the position of the spine and their ability to improve trunk endurance. Core stability training is frequently used to improve spinal stability. It has been used for many years in physical therapy and has become popular in fitness settings.[26] it has been speculated that this method of training improves spinal stability and may assist in decreasing the risk of back pain.

Studies that have been done on core stability training demonstrate promise for its effects on the musculature of the trunk[27]. However, previous investigations have not been designed to explore the involvement of the local muscles, which act to stabilize the spine. In addition, the methods of analysis have typically stressed the global muscles through assessments for strength or surface EMG recordings. These measures may not adequately identify improvements in spinal stability brought on by the local muscles. Core stability training that focuses on exercises with a neutral spine may be appropriate for targeting the specific function of the local muscles during the early phases of programming for improving spinal stability[28-29].

Chon et al[30] reported that the co-activation of the ankle dorsiflexors and rectus femoris (RF) muscles effectively augmented the selective activation of the transverse abdominus muscle, as demonstrated by an increased mean electromyographic (EMG) amplitude of the transverse abdominus /internal oblique muscles after the resisted ankle dorsiflexion. The EMG analysis showed that a strong contraction of the dorsiflexion muscles, specifically the tibialis anterior (TA), improved motor recruitment of the transverse abdominus /internal oblique muscles during the ADIM. This finding suggests that cocontraction of the dorsiflexion muscles increases recruitment of the active motor units of the transverse abdominus /internal oblique muscles. Researchers have found that enhanced transverse abdominus neuromuscular control patterns in people with LBP play an important role in functional spinal mobility and back pain.

Both the mechanisms discussed in the above were effective in treating back ache but the evidences for comparison beteen these two were less. The aim of the present study was to compare the effectiveness of Co-Contraction of ankle dorsiflexion with Abdomen draw-in maneuver and Core Stabilization Training with Pressure Biofeedback on pain perception as measure by visual analogue scale, Oswestry Disability Questionnaire for finding level of functional disability in low back pain patients.

METHODOLOGY

A total of 60 subjects were selected for the study on the basis of inclusion and exclusion criteria. The subjects were randomly assigned to Group A and B each comprising 30 subjects. All the patients were recruited from the GSL Medical College campus, Rajanagaram. Only those patients were included who were between 20-25 years of age, presented with Mechanical low back pain. Subjects in both groups were assessed for pain level on the self-reported visual analog scale (VAS) and activity limitation on ODI questionnaire on first and last day. The data we collected for the patients with LBP included onset time, nature and location of symptoms, aggravating and relieving factors, medication, history of surgery, history of back pain or injury, and pain measurements. The clinical assessment criteria for mechanical LBP were assessed by an orthopaedician.

Subjects Age between 20 to 25 years who are having LBP within the 6 to 12 months before the study. A current pain level ranging from 5 to 8 of 10 on the self-reported visual analog scale (VAS) were selected. Patients complaining Pain when standing or sitting for a long time, Pain upon trunk flexion (or occasionally extension) Pain when driving long distances or getting in and out of a car were included in this study. Osteoporosis, Structural deformity, Systemic inflammatory disease, Nerve root compression, Facet osteophytes, history of spinal surgery and history of Fractures were excluded from study.

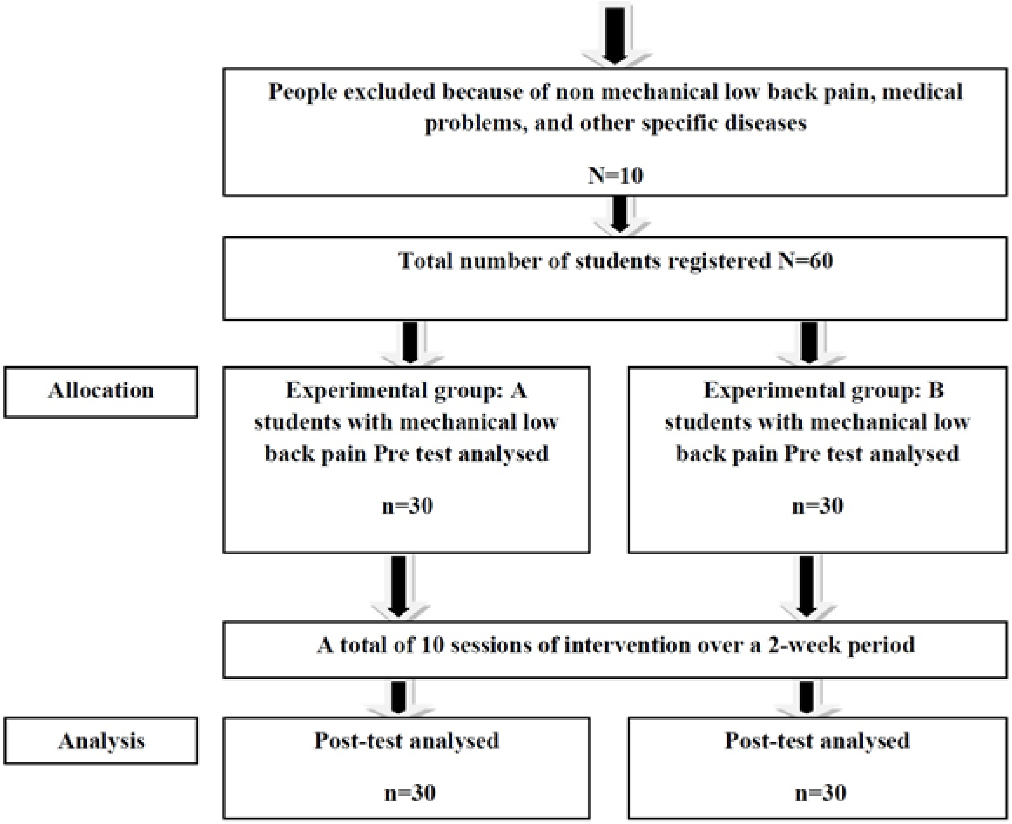

Fig 1: The flow chart

PROCEDURE

EXERCISING METHOD

Exercise program was held five times per week, two weeks in total. Stretching and breathing exercise were carried out as a warm up, Co-Contraction of ankle dorsi flexion with ADIM and core stabilization training as a main program, and stretching and breathing exercise as a cooling-down. In order to make the number of times and set identical, each exercise was held ten times ten sets. The contents and methods of the specific exercise program contents and methods of the specific exercise program are the following (Table 1).

GROUP	CC ADIM n=30	CSE N=30	INTENSITY	FREQUENCY
Warm-up		stretching and breathing		5/a week
Main Ex's	co-contraction With ADIM	curl-up Rt sided bridge Birddog	10 reps, 10sets 10 reps, 10sets 10 reps, 10sets	5/a week 5/a week 5/a week
Cool down		stretching and breathing		5/a week

Table 1: exercise programs used in both groups

CC ADIM: CO-CONTRACTION OF DORSI FLEXION ANKLE WITH ADIM

CSE: CORE STABILIZATION EXERXISES

INTERVENSION FOR GROUP A

Curl-up

Subjects bend right-side knee to 90 degrees from the supine position, and put hand below the lumbar region in order to prevent spine from moving. Give directions to move head and shoulder slowly from the ground, and curl the upper limbs up with the thoracic vertebral region as an axis. Both sides of the straight muscle of abdomen showed an active response when compared with the other abdominal muscles (Kavcic et al., 2004).

Fig 2: the participant performing curl-up exercise.

Right side Bridge

From the reclining posture, subjects bend knees to 90 degrees, put right elbow to the ground. Support shoulder and knees with the body trunk without the rotation of body. One side of back extensor muscle and abdominal muscle showed an active response during this exercise (McGill, 2002).

Fig 3: the participant performing right side bridge exercise.

Birddog

Subjects stretch left arm and right leg in a row simultaneously from the four-foot position. Both sides of multifidus muscles, EO, and thoracic erector muscle showed an active response during this exercise (Kavcic et al, 2004).

Fig 4: the participant performing bird dog exercise.

Fig 5: the participant performing transverse abdominus activation with pressure biofeedback.

INTERVENSION FOR GROUP B

For the Co-contraction of dorsi flexion ankle with ADIM training, each participant was instructed to lie in supine position to hook-lying position, with the hip joint to 40 degrees and knee joint to 80 degrees, put the cushion below knee joint and give direction to the subjects to pull the navel deeply to the lumbar region. At this time, subjects were controlled to maintain contraction while keep breathing lightly, to contract slowly, also to not move pelvis and chest while exercising (Richardson et al., 1999).

Fig 6: the participant performing cocontraction ankle dorsiflexion with Abdomen draw-in maneuver.

A pressure Bio feedback was placed under the fifth lumbar vertebra and was inflated to 40 to 70 mm Hg. Next, the participant was instructed to draw in his or her navel gradually and maintain the target pressure without any pelvic motion. For ADIM and added cocontraction training, the participant was instructed to perform ADIM and then to co-contract the TA and RF muscles against static resistance (with 50% MVIC of the TA), which was induced by a fixed-strap band. If the participant correctly performed ADIM and cocontraction training without pelvic rotation or compensatory upper chest elevation with overexertion, the training was considered successful. The proper performance of ADIM and cocontraction was confirmed by visual inspection.

Fig 7: the participant performing cocontraction ankle dorsiflexion with Abdomen draw-in maneuver using pressure biofeedback.

DATA ANALYSIS AND RESULTS

	Age group(YEARS)	%
Group A	20-21	36.66%
	22-23	40%
	24-25	23.33%
Group B	20-21	56.66%
	22-23	33.33%
	24-25	10%

Table 2: Distribution of study samples according to age in group A and group B

GENDER	Group A	%	Group B	%	Total	%
Male	14	46.66	10	33.33	24	40
Female	16	53.33	20	66.66	36	60
Total	30	100.00	30	100.00	60	100.00

Table 3: Distribution of study samples according to male and female in group A and group B

Group	Pre Treatment		Post Treatment		p-value	Inference
	Mean	SD	Mean	SD		
Group A CSE	7	0.83	3.66	1.29	0.04	Significant
Group B CC ADIM	7	0.83	3.03	0.84	0.01	Significant

Table 4: Pain Relief after treatment in two groups.

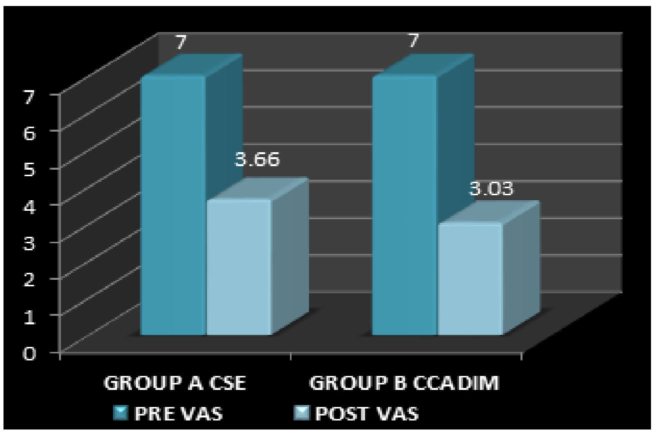

Figure 8: Comparison of group A and group B with respect to pain scores of pre vas and post vas means in mechanical low back pain

The average VAS score in Group A CSE on 1st day was 7.00, which was reduced to an average of 3.66 on last day (After 2 weeks) of the treatment. There was highly significant difference between the VAS Scores in the subjects in the Core stabilization exercises i.e. $P < 0.04$

The average VAS score in Group B CC ADIM on 1st day was 7.00, which were reduced to an average of 3.03 on last day (After 2 weeks) of the treatment. There was highly significant difference between the VAS Scores in the subjects in the co-contraction of ankle dorsiflexion with abdomen draw-in maneuver group i.e. $P < 0.01$.

Group	Post Treatment (Mean)	SD	P value	Inference
Group A CSE	3.66	1.29	0.01	Significant
Group B CC ADIM	3.33	0.85		

Table 5: comparison of pain relief between two groups.

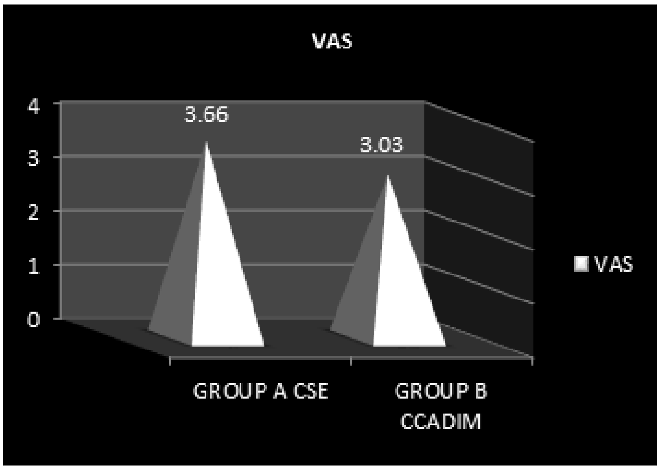

Figure 9: Comparison of group A and group B with respect to pain scores of post vas means in mechanical low back pain

There was highly significant difference between the VAS Scores in the subjects in the co-contraction of ankle dorsiflexion with abdomen draw-in maneuver group i.e. $P > 0.01$

Group	Pre Treatment		Post Treatment		p-value	Inference
	Mean	SD	Mean	SD		
Group A CSE	15.16	1.96	8.13	2.72	0.04	Significant
Group B CC ADIM	15.13	2.06	6.33	1.51	0.01	Significant

Table 6: Mean changes in functional disability - Oswestry Disability Index

Improvement in functional disability was indicated in terms of improvement in Oswestry Disability Index. For that initial and post treatment score was noted on 1st and last day (After 2 weeks) of the treatment in all the subjects. However the difference between two scores was considered for analysis of the difference between the two groups.

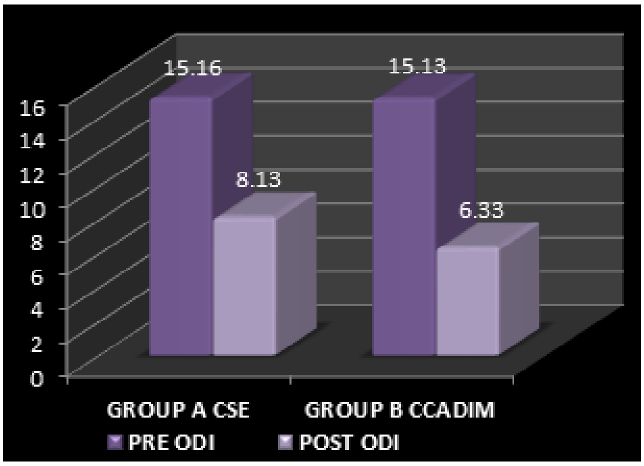

Figure 10: Comparison of group A and group B with respect to means of Functional disability – Oswestry Disability Index in mechanical low back pain

In Group A CSE, the average ODI score on 1st day was 15.16 and on last day (After 2 weeks) of the treatment were 8.13.There was highly significant difference between the ODI scores in the subjects in group A (p=0.04).In Group B CC ADIM, the ODI scores on 1st day was 15.13 and on last day (After 2 weeks) of the treatment were 6.33.There was highly significant difference between the ODI scores in the subjects in Group B (P=0.01).

Group	Post Treatment (Mean)	SD	P value	Inference
Group A CSE	8.13	2.72	0.001	Significant
Group B CC ADIM	6.33	1.51		

Table 7: Mean changes in Functional disability – Oswestry Disability Index

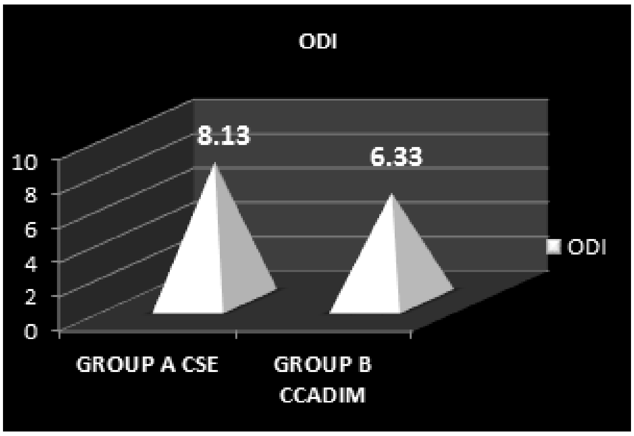

Figure 11: Comparison of group A and group B with respect to means Functional disability – Oswestry Disability Index in mechanical low back pain,

There was highly significant difference between the ODI scores in the subjects in group A and B (P 0.001).

DISCUSSION

This study was aimed to find out the outcomes of core stabilization exercises and co-contraction of ankle dorsiflexion with abdomen draw-in maneuver using pressure biofeedback in reducing pain and functional disability in mechanical low back pain students.This study included

60 mechanical low back pain students of both genders between age group of 20-25 years. They are randomly divided into 2 groups, Group A and Group B. Group A received core stabilization exercises using pressure biofeedback and Group B received co-contraction of ankle dorsiflexion with abdomen draw-in maneuver using pressure biofeedback. Pain was measured using VAS before intervention and after 2 weeks of intervention. Functional disability was measured using ODI before intervention and after 2 weeks of intervention.

Present study was focused on reducing pain and Functional disability in mechanical low back pain students. Most of the previous studies stated that in mechanical low back pain students there was muscular imbalance due to muscular atrophy.Low back pain can cause muscle atrophy and inhibit muscle firing which leads to altered spinal mechanism causing increased dysfunction.[41]

To treat chronic mechanical low back pain, core stabilization exercises are beneficial in reducing pain and functional disability. co-contraction of ankle dorsiflexion with abdomen draw-in maneuver using pressure biofeedback is beneficial in reducing pain and functional disability.[32]In the present study, co-contraction of ankle dorsiflexion with abdomen draw-in maneuver using pressure biofeedback group showed significant improvement in reducing pain ($p=0.01$). And there was also significant improvement in reducing functional disability ($p=0.001$).

Recent studies of back pain found that the decrease of muscle mass can be the main cause of the symptom, so that the stability of the muscles around the spine and the stability of trunk are being emphasized (Kim, 2008). Muscles around the spine contributes in stabilizing, and the imbalance of muscle induces overload to spine while moving waist (Grabiner et al., 1992). As a result, it damages the musculoskeletal system, leading to pain. Rather than the direct damage of spine, instability of it, such as the weakening of the deep muscles, is the main cause of the pain since they contributes in stabilizing spine by surrounding it (Hodges, 2003)[28]. Generally, illnesses occurring to the musculoskeletal system can be treated with the preservative therapy such as exercising program, excluding the case where surgery is needed. The purpose of lumbar region strengthening exercise for the back pain increases the stability and mobility of the surrounding tissues by stabilizing the posture, also it increases the lower limb muscles strength and muscle endurance (Yoon et al., 2010).

Core training is one of the methods to stabilize the trunk; it provides stability by resisting to the influence of gravity in order to enable humans to maintain erect posture. Core muscles include spine, abdomen, and pelvis and so on which helps extremity muscles to accomplish functional movements without the excessive stress on spine (Kisner and Colby, 2002). Park (2012) reported that chronic LBP patient's lumbar extensor muscle strength has improved due to 12-week core training, and also the stability has improved 4.9 percent, in terms of lumbar region's centre of gravity after the training. In the study of Lee (2009), he reported that the measured time of lumbar region muscle strength has changed 39.90 into 42.84 which show significant improvement after the 8-week core training. Teyhen (2005) found that the core muscles have activated up to 109 percent after the lumbar region stabilizing training by using ultrasonic imaging.

In case of abdominal drawing-in maneuver, Hodge et al. (2003) reported that the thickness of Internal oblique and Transverse Abdominis has increased whereas the thickness of EO has decreased when the objects were healthy. In the study of Beazell et al. (2006), they compared the changed ratio between healthy objects and LBP patients, that the thickness of Internal oblique and Tra has increased less among LBP patients. However, the thickness of EO has changed and the thickness of Tra has changed 0.43±0.02 cm into 0.46±0.03 cm in this study in case of abdominal drawing-in maneuver.

The study of Cho (2010) examined the influence of closed kinetic chain and core exercise over the chronic LBP youth soccer player's muscle strength, flexibility, balance and pain. Each exercise program showed significant difference, but core training was more effective between groups. In terms of muscle thickness, external oblique and transvers abdominus showed more change during abdominal drawing-in maneuver while Internal oblique showed more change during core training. In terms of Oswestry disability Index (ODI), ankle dorsiflexion group showed more change. These results show that abdominal drawing-in maneuver is more effective in terms of muscle thickness of external oblique / transvers abdominus, and ODI. On the other hand, core training is more effective in terms of the muscle thickness of Internal oblique. This study was conducted to find out the change made in ODI and thickness of abdominal muscles after carrying out abdominal drawing-in maneuver and core training for 4 weeks sampling 20 people hospitalized in for chronic LBP. As a result, there was significant effect on the decrease of ODI between two groups and there was also a change occurred in the muscle thickness of Internal oblique / external oblique and transverse abdominus when it was measured by musculoskeletal ultrasonic imaging.

Our findings suggest that the ADIM followed by the cocontraction technique stimulates the selective recruitment of the transverse abdominus. Previously, the cocontraction technique had been studied only in healthy people rather than injured people. We used pressure bio feedback to determine a participant's ability to activate or contract the transverse abdominus using changes in the muscle activation. McMeeken et.al [31] investigated the relationship between muscle activity of the transverse abdominus during the ADIM using fine-wire ODI and VAS reported a strong correlation of the 2 measures. Chon et al, who investigated the effect of core stabilization on muscle thickness during ADIM combined with resisted ankle dorsiflexion treatment. The pre-test differences in baseline muscle thickness between groups implied that patients with LBP had either atrophy or neuromuscular inhibition in the abdominal muscles. However, increased activation of the previously inhibited transverse abdominus after training suggests the positive benefits of ADIM and the cocontraction technique in patients with LBP.[5,40] Moreover, the effect of adding cocontraction to ADIM training seemed to be more advantageous for patients with LBP than for the control participants. As shown, the second transverse abdominus / Internal oblique EMG peak amplitude was greater after the cocontraction was applied.

This finding suggests that the co-contraction was associated with improvements in the transverse abdominus activation, supporting the potential therapeutic efficacy of this novel technique. Researchers have shown that increases in transverse abdominus muscle thickness were associated with improved lumbar stiffness or spinal stability, contributing to pain reduction in people with LBP. Investigators have proposed that the recurrence of LBP is associated with delayed timing of the transverse abdominus.[41] In EMG Our clinical evidence demonstrated the potential efficacy of the combined cocontraction and ADIM technique for sequential motor recruitment and muscle thickness in the abdominal muscles of healthy adults and adults with chronic LBP. Treatment with the combined technique (cocontraction) effectively increased transverse abdominus muscle thickness in the LBP group. Our findings suggest that the ADIM followed by the cocontraction technique stimulates the selective recruitment of the transverse abdominus.

CONCLUSION

From the present study, it has been concluded that co-contraction of ankle dorsiflexion with abdomen draw-in maneuver is effective in reducing pain and functional disability in students with mechanical low back pain. co-contraction of ankle dorsiflexion with abdomen draw-in maneuver is effective than core strengthening exercises in treating patients with low back ache.

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