Efficacy of Lumbar Stabilization Exercises in the Treatment of Mechanical Low Back Pain

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ABSTRACT

Introduction: *chronic mechanical low back pain (CMLBP) represents a great variety of conditions that causes inappropriate back function. Despite agreement that exercises are effective for patients with chronic low back pain, there is no evidence showing what type of exercise is more effective. The purpose of this study was to compare the effect of lumbar stabilization exercises and combined flexion-extension exercise program on increasing the range of motion of trunk flexion, extension, right bending, left bending; reduction of pain severity and reduction of functional disability.* ***Methodology:*** *thirty male patients participated in this study, they were divided into two groups and each group consisted of 15 patients. The first group received lumbar stabilization exercise program while the second group received combined spinal flexion-extension exercises. Four methods of assessment were used: Modified-modified Schober test was used to measure range of motion of trunk flexion and extension, finger to floor test was used to measure range of motion of lateral trunk bending, visual analogue scale was used to assess pain intensity and Oswestry disability questionnaire was used to assess functional disability.* ***Results:*** *Both groups had significantly less low back pain after treatment and less functional disability ($P<0.05$) but the lumbar stabilization exercise group was more effective in reducing pain and reducing functional disability than the combined spinal flexion-extension group ($P<0.05$). The combined spinal flexion-extension exercise group was more effective in increasing range of motion of lumbar flexion than the lumbar stabilization exercise program ($P<0.05$). There were no significant differences between groups regarding increasing the range of motion of lumbar extension, right trunk bending and left trunk bending.* ***Conclusion:*** *The lumbar stabilization exercises are more effective than the combined flexion-extension exercises in reducing low back pain severity and functional disability and are recommended to be used for patients with chronic mechanical low back pain. Combined spinal flexion-extension exercises are recommended to be used when increasing range of motion of forward flexion is an additional goal.*

Key words: *low back pain, lumbar stabilization, flexion, extension, pain, functional disability, right bending, left bending.*

INTRODUCTION

Chronic mechanical low back pain (CMLBP) represents a great variety of conditions that causes inappropriate back function. It is considered one of the most frequently treated and most costly diseases in modern industrial societies[35]. Omino and Hayashi[27] mentioned that many factors associated with low back pain (LBP) are mechanical. These factors either cause low back problems initially or aggravate them by increasing the risk of recurrence, and are thus important for disability considerations. These factors are slips, trips, and falls, as well as bending and twisting while lifting. They arise accidentally during recreational activities, and are at a high rate among professional personnel such as physiotherapists and nursing staff who handle patients, or drivers who unload trucks.

Mechanical stability of the lumbar spine is an important consideration in low back injury prevention and rehabilitation strategies[5]. Many researchers and clinicians suggested that segmental instability of the lumbar spine is a possible pathomechanical mechanism underlying mechanical low back pain[19,28]. Muscular dysfunction and motor control errors in maintaining spinal stability have been suggested as possible causes of chronic back pain, therefore the control of the spinal equilibrium and mechanical stability requires appropriate muscular recruitment and timing[6].

There is a general consensus that exercises are beneficial in the rehabilitation of low back pain[1,24,25,33]. They have been proven to have great effects regarding increasing strength, mobility, flexibility and relaxation. They also develop coordination and skill and at the same time improve endurance and cardiovascular fitness[20]. However, controversy exists in the literature about improvement outcomes of specific exercise programs[9].

Spinal instability has been linked to the development of low back dysfunction[4], and because dynamic instability of the spine is associated with insufficient strength and endurance of the trunk stabilizing muscles and inappropriate recruitment of trunk muscles[26], physical therapy field has shown many promising advances in back care in the past few years. The most exciting advancement has been in the field of stabilization of the lumbar spine[11]. This management has been focused recently on a specific training of the stabilizing muscles in low back pain patients[8]. Lumbar stabilization exercises are designed to train the specific contraction of the transverses abdominis and internal oblique muscles with coactivation of lumbar multifidi without substitution from large torque producing muscles such as rectus abdominis and external oblique, using the abdominal drawn in maneuver[32]. These exercises are precise isometric contractions involving low levels of maximum voluntary contraction to ensure that there are no patterns of muscular substitution as recommended by O'Sullivan et al.[26]

Despite agreement that exercises are effective for patients with chronic low back pain, there is no evidence showing what type of exercise is more effective[37]. Therefore, there is a great need to compare between different exercise programs that had been proven to be effective in relieving back pain.

Up till now, no study has compared between the specific lumbar stabilization exercise program, as it concentrates on the local muscle system, and the combined flexion and extension program to find out which is more effective in providing faster improvement regarding reduction of pain and functional disability as well as increasing spinal mobility.

MATERIALS AND METHODS

Subjects

Thirty male patients diagnosed as chronic mechanical low back pain participated in this study. Their ages ranged from 21 to 40 years with a mean of 26.83 (±1.05). Their weights ranged from 50 to 90 kg with a mean of 70.37 (± 2.08). Their heights ranged from 160 cm to 182 cm with a mean of 171.6 (± 1.06). Their duration of illness ranged from 3 months to 60 months with a mean of 23.43 (±3.49). Number of sessions ranged from 14 to 18 sessions with a mean of 17.2 (±0.18). They were divided into two experimental groups matched by age. All patients were referred by orthopaedic surgeons who were responsible for the diagnosis of cases based on clinical and radiographic examinations.

First experimental group:

This group consisted of fifteen patients who received lumbar stabilization exercises for 18 sessions over three weeks period. Nine sessions were given in the clinic each other day while the other nine sessions were done independently at home.

Second experimental group:

This group consisted of fifteen patients who received combined spinal flexion and extension exercise program for 18 sessions over three weeks period. Nine sessions were given in the clinic each other day while the other nine sessions were done independently at home.

PROCEDURES

Patients were assessed just before and just after the treatment sessions. The assessment procedures included the following items:

Pain assessment

Pain was assessed by using the Visual Analogue Scale (VAS). VAS is a scale that allows continuous data analysis and uses a 10 cm line with 0 (no pain) on one end and 10 (worst pain) on the other end. Patients were asked to place a mark along the line to denote their level of pain[22]. Visual analog scale can give valid data for chronic and experimental pain[30].

Functional Disability

The functional disability was assessed by Oswestrey disability questionnaire. Oswestry disability questionnaire is a valid and reliable tool for measuring functional disability in low back pain patients[12]. It consists of 10 different sections; each one consists of 6 multiple-choice questions of back pain including disability in daily functions and leisure time activities; for each question, the patient selected one sentence out of six that best described his disability. The maximal score is 50 (maximum disability) and the result was taken as a percentage from the total score. Higher scores indicate greater disability. Scores from 0 to 20% indicate minimal disability, scores from 20 to 40 % represent moderate disability, whereas scores from 40 to 60% represent severe disability, scores from 60 to 80 represent crippled disability, and scores from 80 to 100 % represent patients that are confined to bed[12,34].

Range of motion assessment

Assessment of lumbar flexion

The modified-modified Schober flexion technique was used based on the work of Williams[40]. This method is reliable and valid in measuring range of motion of lumbar flexion. The investigator stood behind the standing patient to identify the posterior superior iliac spines, and then an ink mark was drawn along the midline of the lumbar spine horizontal to the posterior superior iliac spines. Another ink mark was made 15cm above the original mark. The tape measure was lined up between skin markings. With the tape pressed firmly against the subject’s skin and while holding the tape measure with fingertips, the distance between superior and inferior skin marks was measured. Then the investigator instructed the patient to bend forward into full flexion and the new distance between superior and inferior skin marks was measured. The change in the difference between marks was used to indicate the amount of lumbar flexion. This test was performed for three consecutive times and the mean value was considered as the lumbar flexion range of motion.

Assessment of lumbar extension

The modified- modified Schober extension technique was used based on the work of Williams et al.[40] The investigator stood behind the standing patient to identify the posterior superior iliac spines, and then an ink mark was drawn along the midline of the lumbar spine horizontal to the posterior superior iliac spines. Another ink mark was done 15cm above the original mark. The tape measure was lined up between the skin markings. With the tape pressed firmly against the subject's skin and while holding the tape measure with fingertips, the distance between superior and inferior skin marks was measured. Then the investigator instructed the patient to bend backward into full extension and the new distance between superior and inferior skin marks was measured as a straight line. The change in the difference between marks was used to indicate the amount of lumbar extension. This test was performed for three consecutive times and the mean value was considered as lumbar extension range of motion.

Assessment of Lateral flexion

Lateral flexion was measured as the distance from the tip of the index finger to the floor at maximal comfortable lateral flexion based on the work of Ponte et al.,[29] The subject was instructed to move as far as possible into lateral flexion. This test was performed for three consecutive times for each side and the mean value for each side was considered as the lateral flexion range of motion.

Treatment procedures

Each patient in both groups received infrared radiation for warming up for 15 minutes followed by exercises.

Protocol of lumbar stabilization exercises

The protocol of lumbar stabilization exercises and the special equipment used in this program were based on the work of Richardson et al.,[32], O'Sullivan et al.[26] and Hagins et al.,[13]. The equipment used is called Stabilizer- Pressure Biofeedback (Fig. 1). It consists of an inflatable trisectional rectangular cushion (23 x 14cm) connected to a pressure gauze (Stabilizer, Chattanooga Pacific Pty. Ltd., Brisbane, Australia). The sections of the cushion communicate with one another and are made from non-elastic material. External force applied to the cushion is reflected as change in air pressure (accuracy, ± 3 mm Hg). The device was placed between the lumbar spine and the treatment table to detect motion in the lumbar spine as progressively more difficult exercises of the lower limbs were performed. Stabilizer pressure biofeedback had been proven to be valid and reliable in quantification of abdominal dysfunction[3].

Fig. (1): The Stabilizer Pressure Biofeedback.

Patients in this group were taught the lumbar stabilization exercises, the holding time for these exercises increased gradually, in conjunction with pressure biofeedback monitor, to the point where patients became able to perform 10 contractions with 10 seconds holds. According to Hagins et al.,[13] the patient assumed the crook-lying position and raised the pelvis so the investigator placed the pressure transducer under the low back, with midpoint of the transducer with side to side midpoint between the most superior aspects of iliac crests. The patient returned to the crook-lying position and performed alternating anterior and posterior pelvic tilts to settle the spine into a relaxed position, attempting to adopt the neutral position of the spine for that patient, typically producing a small quantity of lumbar lordosis. The investigator pumped up the transducer to 40mm Hg and handed the pressure gauge to the patient, who held the gauge so that it was visible to both patient and therapist. The patient was instructed to do each exercise level without moving the pressure gauge dial. Patient was also instructed not to allow any of the following compensations to occur: posterior pelvic tilt, protrusion of the rectus abdominis or extension of the lumbar spine while maintaining his normal breathing pattern. Once an accurate and sustained contraction of these muscles was achieved, exercises were progressed by applying low loads on the muscles by means of adding leverage through the limbs as suggested by O'Sullivan et al.,[26].

Lumbar stabilization exercise training program

Each of the following exercises was repeated for 15 repetitions, 5 repetitions in 3 sets with one minute rest in between as suggested by Richardson et al.,[32] and Hagins et al.,[13].

1. Abdominal hollowing

Patient was in crook lying position with feet flat on the treatment table. The investigator sat beside the patient with thumbs placed anteriorly and inferiorly to the anterior superior iliac spine, lateral to the rectus abdominis. The patient was instructed to inhale and after exhalation, he was instructed to pull his navel up and backwards (in) towards his back while maintaining his normal breathing pattern with holding this contraction for 10 seconds. The investigator should feel a slow developing tension under his thumbs in the abdominal wall.

2. Quadruped abdominal hollowing

Patient was in a quadruped position on the treatment table with hips, knees, and shoulders flexed 90 degrees, the spine was in the neutral position. The patient was instructed to inhale allowing his abdomen to drop, as he exhaled, he pulled his umbilicus up towards his spine without moving his spine with holding for 10 seconds while maintaining his normal breathing pattern.

3. Unilateral abduction

Patient was in crook lying position. Patient was instructed to contract his lower abdomen while continuing normal breathing pattern. While holding this contraction the patient was asked to abduct his right leg top approximately 45 degrees towards the floor while keeping the other limb motionless with maintaining this contraction for 10 seconds, then to return his right leg to the starting position.

4. Unilateral knee raise

Patient was in crook lying position. The patient was instructed to contract his lower abdominal muscles while continuing to breathe in a normal fashion, while maintaining the contraction, he was asked to raise his right leg towards his chest until it just passes 90 degrees of hip flexion while allowing the knee to flex normally, patient was instructed not to press with his other foot, to keep breathing, not to move his head, neck, or shoulders and to hold for 10 seconds, then to return to the normal starting position.

5. Bilateral knee raise

Patient was in crook lying position. He was instructed to contract his lower abdomen while continuing to breathe in a normal fashion; while maintaining this contraction, he was instructed to raise his right leg towards his chest until it just passes 90 degrees of hip flexion while allowing the knee to flex normally. Then he held his right leg in this position and lifted his left leg in the same way, so both legs were elevated. Then he held this contraction for 10 seconds, then he returned his right leg to the starting position followed by the left.

6. Unilateral heel slide

Patient was in crook lying position. He was instructed to contract his lower abdomen, while continuing to breathe in a normal fashion. While maintaining this contraction, he was asked to raise his right leg towards his chest until it just passed 90 degrees of hip flexion while allowing the knee to flex normally and to hold his right leg in this position and then to lift his left leg in the same way, so both legs were elevated. From this position, he was asked to lower and straighten the right leg and slide his heel along the treatment table till his leg becomes flat, then to slide his heel back to return his leg to the starting position with both hips flexed then lower his leg down back to the plinth.

7. Bilateral heel slide

Patient was in crook lying position. He was instructed to contract his lower abdomen, to continue to breathe in a normal fashion. While maintaining this contraction, he was asked to raise his right leg towards his chest until it just passed 90 degrees of hip flexion while allowing the knee to flex normally and to hold his right leg in this position and then to lift his left leg in the same way, so both legs were elevated. From this position, he was asked to lower and straighten his both legs and to slide his heels along the treatment table till his legs become flat, then to slide his heels back and to return his legs to the starting position with both hips flexed then lower his legs down back to the treatment table.

8. Bilateral heel hover

Patient was in crook lying position. He was instructed to contract his lower abdomen and to continue to breathe in a normal fashion. While maintaining this contraction, he was asked to raise his right leg towards his chest until it just passed 90 degrees of hip flexion while allowing the knee to flex normally and to hold his right leg in this position and then to lift his left leg in the same way, so both legs were elevated. From this position, he was asked to lower his feet toward the treatment table so both heels are approximately 3 inches from the treatment table and not to touch the floor with his feet then straighten his both legs until his knees become straight while keeping them elevated approximately 3 inches from the treatment table. Then he returned his knees slowly towards his chest.

Protocol of combined spinal flexion and extension exercises

The protocol of combined spinal flexion and extension was derived from the work of Williams[39] and Mckenzie[23]. Each exercise was done for 15 repetitions, 5 repetitions in 3 sets with 1 to 2 minutes rest between the sets. For the spinal flexion exercises, each repetition was held for 5 seconds followed by relaxation for 5 seconds. On the other hand, each repetition of the spinal extension exercises was done without holding at the end and the relaxation period between repetitions was just for one second. The following exercises were used.

1- Sit-up exercise

The patient was in crook lying position with the arms lying beside the body. The patient was instructed to raise his head, shoulders and trunk up as much as he could

2- Posterior pelvic tilt

From crook lying position, the patient was instructed to contract his abdomen, his glutei, and raising his buttocks off the treatment table while pressing his lumbar region down to the treatment table.

3- knees to axillae

From crook lying position, the patient was instructed to flex his knees and hips while grasping the knees with his hands, then to draw them to the axillae till the sacrum is off the treatment table.

4- Fingers to toes

From long sitting position, the patient was instructed to touch his toes with his fingers through flexing the trunk while keeping knees extended, the head should be flexed throughout this maneuver.

5- Extension in lying

From prone lying position, patient was instructed to put his palms under his shoulders while trying to extend his elbows raising the upper trunk up while the lower trunk was rested on the treatment table, then to return to the starting position again by flexing his elbows.

6- upper back strengthening

The patient was in prone lying position with arms stretched overhead in a V position and the thumbs are directed upwards with the forearms in midposition, the patient was instructed to lift the right arm upward as much as he could then to lower it. This was followed by doing the same exercise to the left arm.

7- Back extension from prone

From prone lying position with arms rested beside the trunk and the palms facing forwards, the patient was instructed to lift his head, shoulders, and trunk as much as he could.

8- Back extension from standing

The patient was in standing position with the feet slightly apart with his hands at the waist, and the fingers were pointed backward. The patient was instructed to lean backward as far as possible then to return to the neutral position.

RESULTS

1- Comparison between groups before treatment

There was no significant difference between the two treatment groups before treatment ($P > 0.05$) regarding age, weight, height, and duration of illness. Furthermore there was no significant difference between groups before treatment concerning low back pain severity, functional disability and lumbar motions ($P > 0.05$).

2. Low back pain severity after treatment

After treatment Wilcoxon signed ranks test was used to examine within groups differences of low back pain severity. In the lumbar stabilization exercises group, there was a significant difference between before treatment pain severity with a mean of 6.27(±1.52) and after treatment pain severity with a mean of 2.49(±1.12) with (z=3.40, P<0.001) as shown in table (1) and figure (1). In the combined flexion-extension exercises group, there was a significant difference between before treatment pain severity with a mean of 10.25(±1.67) and after treatment pain severity with a mean of 4.08(±1.53) with (z=3.41, P<0.001) as shown in table (1) and figure (1).

Table (1): Low back pain severity: within groups' differences

Variable	Before treatment pain severity	After treatment pain severity	z-value	P-value
Lumbar stabilization group	6.27(±1.52)	2.49(±1.12)	3.40	P<0.001 (Sig.)
Flexion-extension exercise group	10.25(±1.67)	4.08(±1.53)	3.41	P<0.001 (Sig.)

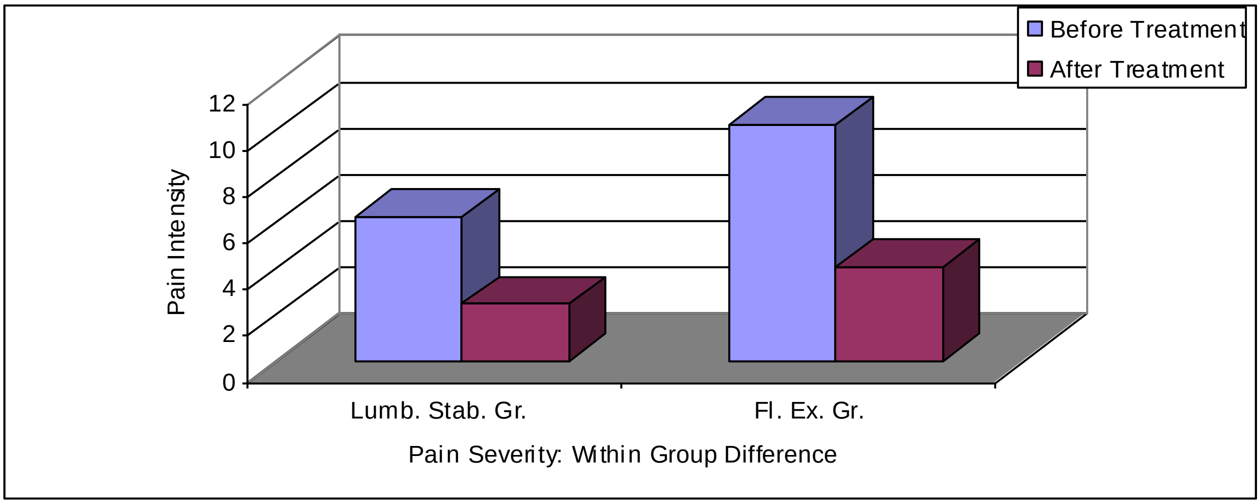

Fig. (1): Back pain severity: within groups differences.

Mann-Whitney test was used to examine the difference between groups regarding low back pain severity. This test revealed a significant difference between groups in favor of the lumbar stabilization group (table 2 &figure 2).

Table (2): Low back pain severity: between groups difference.

Variable	Lumbar Stabilization group	Flexion-extension group	z-value	P-value
Pain severity	2.49(±1.12)	4.08(± 1.53)	2.82	P<0.01(Sig)

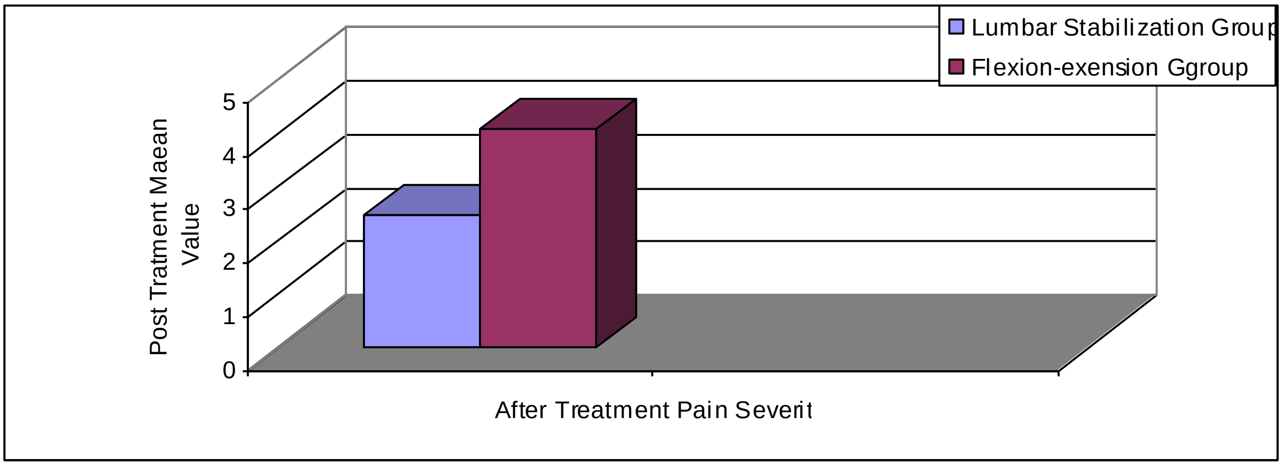

Fig. (2): Low back pain severity: between groups difference.

3- Functional disability and lumbar motions in lumbar stabilization group

After treatment, Paired t-test was used to examine the within group differences of the lumbar stabilization exercises group regarding functional disability, range of motion of lumbar flexion, extension, right and left bending. This test showed that there was a significant reduction of functional disability and non significant changes in lumbar motions (table 3 & Figure 3).

Table (3): Post treatment within group differences in lumbar stabilization exercise group.

variable	Before treatment	After treatment	t-value	P-value
Functional disability	0.38(±0.04)	0.15 (±0.03)	5.54	P<0.001 (Sig.)
Lumbar flexion	7.53(±0.33)	7.90(±0.42)	0.71	P>0.05 (N.S.)
Lumbar extension	1.53(±0.17)	2.27(±0.23)	2.03	P>0.05 (N.S.)
Right bending	45.73(±0.93)	44.30(±1.07)	1.76	P>0.05(N.S.)
Left bending	44.80(±0.90)	44.20(±1.11)	0.76	P>0.05 (N.S.)

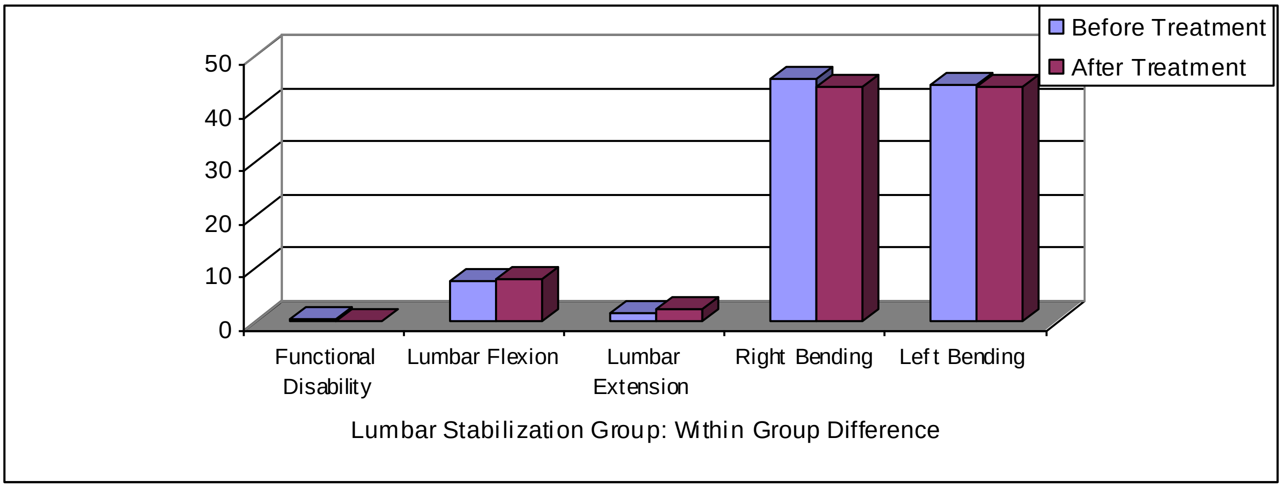

Fig. (3): Lumbar stabilization group: within group differences.

4. Functional disability and lumbar motions in the flexion-extension exercise group

After treatment, Paired t-test was used to examine the within group differences of the combined spinal flexion-extension exercise group concerning functional disability, range of motion of lumbar flexion, extension, right and left bending. It was found that there was a significant reduction of functional disability, a significant increase of lumbar flexion and non significant changes in lumbar extension, right and left bending motions (Table 4& Figure 4).

Table (4): Post treatment within group differences in the combined flexion-extension exercise group.

Variable	Before treatment	After treatment	t-value	P-value
Functional disability	0.37(±0.04)	0.26(± 0.03)	3.59	P<0.01 (Sig)
Lumbar flexion	5.30(±0.67)	7.80(±0.43)	3.72	P<0.01 (Sig)
Lumbar extension	2.20(±0.39)	2.67(±0.32)	1.28	P>0.05 (N.S.)
Right bending	47.20(±1.20)	46.40(±0.88)	0.94	P>0.05 (N.S.)
Left bending	48.30(±0.27)	46.47(±1.00)	1.69	P>0.05 (N.S.)

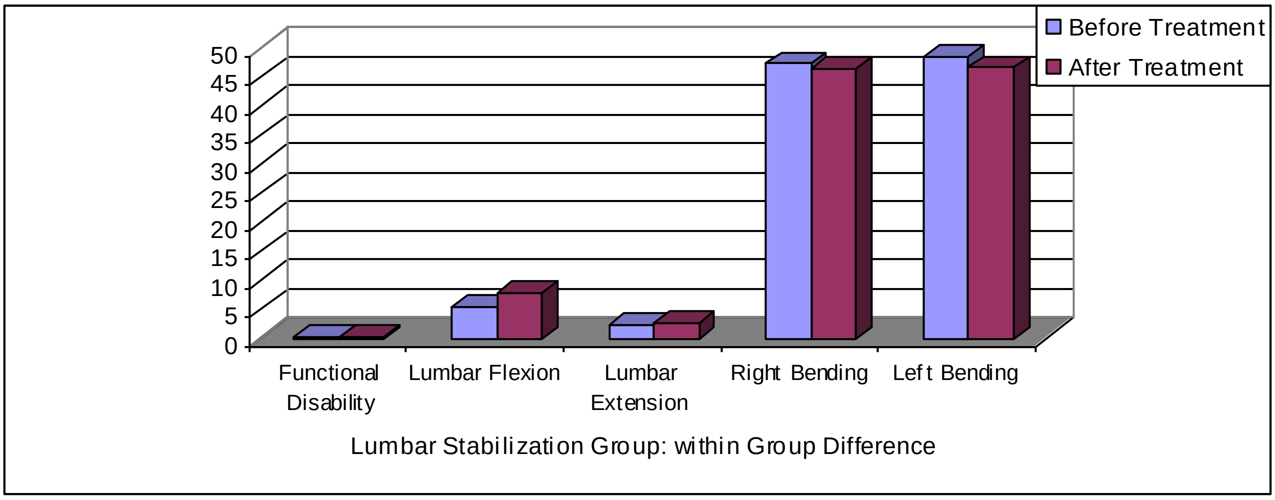

Fig. (4): Flexion-extension group: within group differences.

5. Between groups comparison for the functional disability and lumbar motions after treatment

After treatment, unpaired t-test was used to compare between groups regarding functional disability and lumbar motions. This test demonstrated a significant decrease of functional disability in the lumbar stabilization group more than the flexion-extension group. It also showed that there was a significant increase of lumbar flexion motion in the combined flexion-extension exercise group more than the lumbar stabilization exercise group. On the other side, there was no significant differences between groups for lumbar extension, right and left bending motions (Table 5& Figure 5).

Table (5): Functional disability and lumbar motions: between groups differences.

Variable	Lumbar Stabilization group	Flexion-extension group	t-value	P-value
Functional disability	-0.23(±0.04)	-0.11(± 0.03)	2.42	P<0.05 (Sig.)
Lumbar flexion	0.36(±0.52)	2.46(±0.66)	2.49	P<0.01 (Sig.)
Lumbar extension	0.73(±0.36)	0.43(±0.34)	0.61	P>0.05 (NS)
Right bending	1.40(±0.79)	0.80(±0.85)	0.51	P>0.05 (NS)
Left bending	0.60(±0.79)	1.80(±1.07)	0.91	P>0.05 (NS)

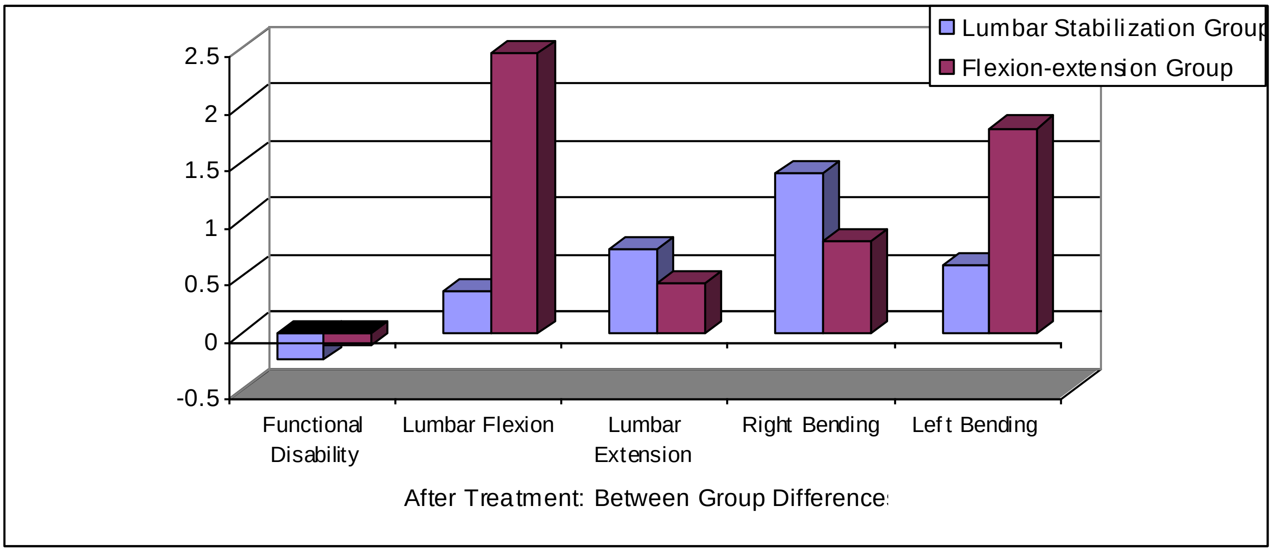

Fig. (5): Functional disability and lumbar motions: between groups differences.

DISCUSSION

The results of this study revealed that both the lumbar stabilization exercise program and the combined flexion-extension exercise program were effective in reducing pain severity and functional disability in chronic mechanical low back pain patients. The lumbar stabilization exercise program was more effective than the combined spinal flexion- extension program in reducing pain severity and functional disability. The flexion-extension exercise program was more effective than the lumbar stabilization exercise program in increasing the lumbar flexion range of motion. There were no significant differences between groups regarding increasing the range of motion of trunk extension, right bending and left bending.

It has been found that lumbar stabilization exercise program was difficult for most of patients at the early training sessions, most of them tried to hold their breath to control abdominal contraction but with the investigator instructions to maintain their normal breathing patterns and with repetitions, it was possible to coactivate lumbar multifidus and transverses abdominis without holding breath. Training with the pressure biofeedback was helpful as a feedback for the patient to maintain his lumbar lordosis without movement to ensure no substitution by global trunk musculatures. However, the patients could not do appropriately the home exercise program at early training sessions because of lacking of this instrument at home for each patient. There are several studies that trained the patients by the lumbar stabilization exercise programs without using the pressure biofeedback instrument as Lindgren et al.,[21] and Hagins et al.,[13]. In this current study most of patients in the lumbar stabilization exercise group reported decrease in their pain symptoms associated with activities of daily living after 12 sessions. After 18 sessions these patients reported significant reduction in pain severity and functional disability. The investigators suggest that more sessions may be necessary for most of patients for more pain relief. On the other hand, the combined flexion extension exercise program was easy for all patients during sessions and at home as it does not require any instrumentation.

There was a significant decrease in pain severity in the lumbar stabilization group. These findings are supported by the findings of Hides et al.,[15], O'Sullivan et al.[26] and Taimela et al.,[36]. These finding are also supported by Richardson and Jull[31] who proposed that the specific submaximal training of lumbar stability muscles of the lumbar spine and integration of this training into functional tasks decrease both pain and functional disability in those suffering from mechanical low back pain. The lumbar stabilization exercise program concentrates on the local muscle system that had been proven to be affected in low back pain population. Several studies had highlighted the presence of dysfunction in multifidus muscle[15,21] and in the deep abdominal muscles especially the transverses abdominis muscle[16]. It had been shown that there is a clear link between altered slow motor unit recruitment and development of chronic low back pain status[7] therefore using this type of exercises would help in normal motor unit recruitment pattern and thus reducing pain and functional disability. In the combined flexion-extension exercise group there was a significant decrease in low back pain severity. This particular finding is supported by White[38] and Johanssen et al.,[17].

Regarding functional disability, in the lumbar stabilization group there was a significant decrease in functional disability, this finding is supported by the findings of Hides et al.,[15], O'Sullivan et al.,[26] and Taimela et al.,[36]. In the combined flexion-extension exercise group there was a significant decrease in functional disability supporting the findings of White[38] and others[2,14,18,33] who reported that flexion-extension exercise program was effective in reducing functional disability. This finding is also supported to some extent by Johanssen et al.,[17] who found that dynamic endurance exercises for the abdominal and back muscles with stretching was effective in reducing functional disability.

Regarding the range of motion of lumbar flexion, in the lumbar stabilization group there was no change in the range of motion of lumbar flexion. This finding is supported by the findings of O'Sullivan et al.,[26] but is contradicting to Hides et al.,[15]. This contradiction might be attributed to the stage of illness in both of Hides' study and our current investigation. Hides' study had been carried out on acute low back pain patients while our study as well as O'Sullivan study[26] was carried out on chronic low back pain patients. In the combined spinal flexion-extension exercises there was a significant increase of the lumbar flexion range of motion. The increase of trunk flexion range of motion in the combined spinal flexion-extension exercises group was expected because some of these exercises are designed to increase the flexibility and mobility of the trunk, while the lumbar stabilization exercises did not include any exercises designed to increase spinal mobility but instead they concentrate on stable pain free positions without any movement[3,13].

Regarding the lumbar extension range of motion in the lumbar stabilization group there was no change in the range of motion of lumbar extension after treatment. This finding is supported by O'Sullivan et al.,[26] who reported no change in lumbar extension range of motion. On the other hand this finding is contradictory to Hides et al.,[15] who assessed the lumbar extension range of motion by a two-inclinometer method and found an increase in lumbar extension range of motion in the lumbar stabilization exercise group. This controversy may be due to the fact that Hides' study had been carried out on acute low back pain patients while our current study included only those with chronic low back pain.

Concerning the range of motion of lumbar extension, there was no significant difference before and after treatment in the combined spinal flexion-extension exercise group. This finding is identical to that of Elnaggar et al.,[10] who found no change in lumbar extension range of motion after treatment with flexion or extension spinal exercises.

Regarding the range of motion of lateral trunk bending in the lumbar stabilization group there was no change in the range of motion of lateral trunk bending. This finding is contradictory to the finding of Hides et al.,[15] who reported an increase in the lateral trunk bending to the right and left sides in lumbar stabilization exercise group. This conflicting result may be due to the different measuring tools used in Hides' study and in our study in which we used a simple tape method.

These results are not surprising because lumbar stabilization exercises did not include any mobility exercises for the trunk but they concentrated on stable pain free positions without any movement. Therefore it is logical that this type of exercises did not increase the spinal mobility.

Concerning the range of motion of lateral trunk bending in the combined spinal flexion-extension group, there was no significant difference after treatment. This finding is supported by Ponte et al.,[29] and Elnaggar et al.,[10]. Ponte et al.,[29] measured the lateral flexion as the distance between index finger to the floor. They found that the range of motion of lateral flexion was not changed after treatment. Elnaggar et al.,[10] also found the same result regardless of the different methodology used in their work. This may be attributed to the fact that the combined spinal flexion-extension exercise program used in this current study as well as in other previous mentioned studies did not include any exercises which could affect the coronal mobility.

Finally we can conclude that lumbar stabilization exercises are more effective than the traditional combined spinal flexion-extension exercises in relieving pain and reducing functional disability. The combined spinal flexion-extension exercise is more effective in increasing the range of motion of lumbar flexion and neither lumbar stabilization exercises nor the combined spinal flexion extension exercise program was effective in increasing the trunk extension, right bending and left bending range of motion.

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الملخص العربي

فعالية تمرينات التثبيت القطني في علاج ألم أسفل الظهر الميكانيكي

ألم أسفل الظهر الميكانيكي المزمن يعتبر واحدا من أكثر الأمراض المُعالجة و المكلفة في المجتمعات الصناعية الحديثة و مع الاتفاق على أن التمرينات فعالة في علاج مرضى ألم أسفل الظهر الميكانيكي المزمن ، إلا أنه لا يوجد دليل على نوعية التمارين الأكثر فاعلية .
الغرض من هذه الدراسة هو المقارنة بين تأثير تمرينات التثبيت القطني وتمرينات ثنى وفرد العمود الفقري على تقليل شدة الألم وتقليل العجز الوظيفي وزيادة مدى حركة ثنى الجذع للأمام والخلف وللجانبين الأيمن والأيسر . وقد أجريت هده الدراسة على ثلاثين مريضا يعانون من ألم أسفل الظهر الميكانيكي المزمن حيث قسمت العينة إلى مجموعتين و قد تكونت كل مجموعة من خمسة عشر مريضا. تم علاج المجموعة الأولى بتمرينات التثبيت القطني التي تتكون من ثمانية تمرينات للعضلات الداخلية المثبتة العمود الفقري . أما المجموعة الثانية فقد تم علاجها بتمرينات ثنى و فرد العمود الفقري . تم قياس شدة الألم و العجز الوظيفي وحركات العمود الفقري في كلتا المجموعتين .
أثبتت نتائج الدراسة انخفاض شدة ألم أسفل الظهر والعجز الوظيفي في كلتا المجموعتين بعد العلاج إلا أن تمرينات التثبيت القطني كانت أكثر فاعلية في تخفيف الألم وتخفيف العجز الوظيفي من تمرينات ثنى وفرد العمود الفقري .
بالإضافة إلى دلك وجد أن تمرينات ثنى وفرد العمود الفقري كانت أكثر فاعلية في زيادة مدى حركة ثنى الجذع للأمام عن مجموعة تمرينات التثبيت القطني . أثبتت النتائج أيضا عدم وجود فرق بين المجموعتين بشأن زيادة مدى حركات فرد العمود الفقري وميل الجذع لليمين ولليسار .
الاستنتاج: تمارين التثبيت القطني أكثر فاعلية في تقليل ألم المريض والعجز الوظيفي ويجب استخدامها لمرضى ألم أسفل الظهر الميكانيكي المزمن. تمارين ثنى و فرد العمود الفقري يجب أن تستخدم عندما يكون زيادة مدى ثنى الجذع للأمام هدفًا إضافيًا .