Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2019 16(4): 3364-3371. **OPEN ACCESS**

Effect of core training exercises versus Lumbo-Pelvic-Hip complex strength training on the balance in mechanical low back pain patients: comparative study

Ehab Mohamed Kamel [1,3*], Waleed Salah Eldin Mahmoud[2,4], Mohamed Raafat Mohamed Atteya [1,3],Ahmed Maher Gabr[1,5], and Ahmed Abdelmoniem Ibrahim [1,6]

[1] Department of Physical Therapy, College of Applied Medical Sciences, University of Hail, Ha'il, **Saudi Arabia**
[2] Department of Basic Sciences, Faculty of Physical Therapy, Cairo University, Cairo, **Egypt**
[3] Department of Physical Therapy, El Helal Hospital, Cairo, **Egypt**
[4] Department of Physical Therapy and Health Rehabilitation, College of Applied Medical Sciences, Prince Sattam bin Abdulaziz University, Al-Kharj, **Saudi Arabia**
[5] Department of Physical Therapy for Pediatric, Faculty of Physical Therapy, Cairo University, Cairo, **Egypt**
[6] Department of Physiotherapy, Cairo University Hospitals, Cairo, **Egypt**
***Correspondence: ehabkamelpop@yahoo.com** **Received 26-03-2019, Revised: 25-07-2019, Accepted: 12-10-2019 e-Published: 29-10-2019**

Mechanical low back pain (MLBP) is resulting from mechanical stress of the surrounding soft tissues. Study design: A randomized controlled trial. Comparing the effect of core training exercises with lumbo-pelvic-hip complex strength training on the balance in MLBP patients. Methods: twenty -four patients with MLBP assigned equally into two groups, Group A (n = 12) and group B (n = 12), core training and stretching exercises were applied for group A, while lumbo-pelvic-hip complex strengthening and stretching exercises applied for group B, respectively. T- test and paired t- test were used for comparing between the outcome measurements; overall stability index (OSI), antero-posterior stability index (APSI), and antero-medial stability index (AMSI) were measured by a Biodex Balance System.patients after six weeks of core training and lumbo-pelvic-hip complex strengthening exercise have no significant differences between two groups regarding OSI, APSI, and AMSI before and after the training, but there were significant changes within group.Core training or lumbo-pelvic-hip complex strengthening exercises improve the balance in MLBP patients.

Keywords: Mechanical Low Back Pain, Core Training, Lumbo-Pelvic-Hip Complex Strength Training and Balance.

INTRODUCTION

Low back pain (LBP) is the most popular disability concern with the musculoskeletal problems, affecting more than 80-90% of the population with a high tendency for recurrence (Trompeter and Platen, 2017, and Driscoll et al., 2014). Mechanical low back pain (MLBP) is a LBP resulting from mechanical stress of the surrounding soft tissues as ligaments, muscles, disc, facets as well as the spinal nerve root, if it is persisted longer than three months it is considered as chronic MLBP (Pelletier et al., 2015, Bogduk, 2009, and Deyo and Weinstein, 2001).

Chronic low back pain (CLBP) is a burden on the economy due to absence day and low performance as well as seeking for management. Studies demonstrated that CLBP patients have poor postural control, abnormal coordination and, less segmental stabilization which is a

predisposing factor in susceptible injuries as increase the demand on muscle power (Driscoll et al., 2014, Moon, 2013, and Frank et al., 2011).

The management of lumbar segmental instability (LSI) is based on motor control retraining as excessive lumbar vertebrae translation and rotation in sagittal plane has been attributed as an associated factor of (LSI), and LBP, so reduction of these abnormalities improves back pain and stability (Javadian et al., 2015, and Yadav and Deshmukh, 2013).

Stability should be taken into consideration during the rehabilitation process of CLBP as it is the key of controlling the body during static and dynamic situations (Yadav and Deshmukh, 2013). Core training exercises aimed at improving segmental stabilization, motor control training, and the trunk endurance as it enhances the muscles around the trunk which connecting the body parts to each other focusing on improving postural control, functional strength and maintaining body balance (Yadav and Deshmukh, 2013, França et al., 2012, Frank et al., 2011, and Akuthota et al. 2008).

Core strength training is more effective than typical resistance training for alleviating CLBP, and its influence on patients' performance should be hired in the rehabilitation programs, but their efficacy should be cleared on the patient performance especially in the multi-level tasks which need the support of the body (Boucher et al., 2016, and Chang et al., 2015).

The fact that the lumbo-pelvic-hip muscles are in the optimal condition improve trunk stability and muscle coordination, consequently reduce and avoid risks that lead to balance disturbances and LBP (Chang et al., 2017).

Training the core muscles has been hypothesized as an intervention for improving balance. However, there is a lack of current scientific evidence to support this claim. Therefore, the aim of the present study was to compare the effect of core training exercises with lumbo-pelvic-hip complex strength training on the balance in mechanical low back pain patients.

MATERIALS AND METHODS

Sitting:

The study was conducted in King Khalid Hospital, Hail, Kingdom of Saudi Arabia, from September 2018 to February 2019.

Subject:

Twenty-four male patients with MLBP, their age ranged from 45 to 50 years, body mass index (BMI) extended from 25 to 29, and randomly divided into two equal groups: group A (GA) received core training and stretching exercises, while group B (GB) received lumbo-pelvic-hip complex strengthening exercise, in addition to stretching exercises.

The patients were excluded from the study if they had a history of any neurological disorder, cardiovascular disease, diabetes, ankylosing spondylitis, neoplasms, diseases of the viscera and other significant spinal pathology.

Instrumentation:

A Biodex Balance System was utilized to indicate balance outcomes. The overall stability index (OSI), anteroposterior stability index (APSI), and mediolateral stability index (MLSI) were recorded with a Biodex Balance System (SD 950-340, Biodex Medical Systems, Inc., Shirley, NY, USA).

Procedure:

All patients had to sign a consent form to have eligibility for participation. A verbal explanation of the study plan and importance was explained to every participant in the study. In addition, during the time of the study, the participants were not taking any medical therapy.

The balances were measured pre and post the treatment intervention for both groups with closed eyes through the Biodex system.

Both groups performed stretching exercises in form of knee to chest, and forward trunk reaching exercise from long sitting and cross sitting position. Also, all participants conducted warming up exercise in form of cycling for total time 15 minutes. Exercises were performed for six weeks (first 6 stages only as illustrated in Appendix 1), as we focused on the muscular activation in the static situations more than dynamic one. The sessions were conducted twice weekly, each session lasted for 60 minutes and each exercise was performed ten times, the exercise progressed gradually from easy to difficult. In addition, the participants performed the exercises three times daily at home (Javadian et al., 2015, and Koumantakis et al., 2005). Group A received core stability exercises including abdominal hollowing and simultaneous contractions of multifidus and pelvic floor muscles in different positions such as supine, prone, quadruped, bridging, kneeling, sitting and standing. For more progression, the movements

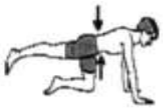
of the limbs were added to exercise while the patients were asked to maintain the neutral curvature of the lumbar spine. Group B performed lumbo-pelvic-hip complex strengthening exercises such as bridging, and leg cycling in supine position, heel slides, leg slides and trunk curl (Javadian et al., 2015, and Koumantakis et al., 2005) (Appendix 1).

Appendix 1

Week	Stabilization–Enhanced Exercise Group Isolated lumbar stabilizing muscle training	General Exercise–Only Group Classic abdominal and back extensor training
1	*Development of the perception of the isolated isometric specific contraction of the stabilizing muscles*	*Stage 1*
	Transversus abdominis muscle from: 4-point kneeling and lying positions, trying to hollow the lower abdomen 	Upper and oblique abdominals from lying position: with knees straight (hands filling space between low back and exercise mat) and knees bent 
	Multifidus muscle from: stepping activity while standing and raising contralateral arm, trying to feel the contraction of the opposite-side multifidus muscle or from sitting position with therapist's hands over the muscle 	Back extensors: lifting trunk to neutral from prone position with pillow under stomach and arms by the side  Coordination: pelvic tilting from lying, sitting, and standing positions
2	*Precise repetition of the isolated isometric-specific co-contraction of the stabilizing muscles, increasing their contraction time*	*Stage 2*
	Transversus abdominis and multifidus muscles together from: sitting and standing positions 	Upper and oblique abdominals from lying position: with knees straight, knees bent Back extensors: lifting trunk to neutral from prone position with pillow under stomach and arms by the side Exercises performed as illustrated for stage 1
	Integration of lumbar stabilizing muscle activity into light dynamic functional tasks	
3	*Control of neutral lumbopelvic postures*	*Stage 3*
	Isolated movement of adjacent body areas, maintaining lumbar spine stability (ie, moving only hip or thoracic spine) 	Abdominals from lying position: heel slides, lower abdominal crunches  Back extensors: bridging, lifting trunk to neutral from prone position and arms in elevation 

(Continued)

Appendix 1 (continued)

Week	Stabilization-Enhanced Exercise Group	General Exercise-Only Group
4	*Control of neutral lumbopelvic postures and aggravating postures* Stabilizing muscle isometric co-contractions with addition of external load to lumbar spine Hip horizontal abduction, heel slides, leg slides from crook-lying position Aggravating postures* 	*Stage 4* Abdominals from lying: heel slides, leg slides, lower abdominal crunches Back extensors: bridging, lifting trunk to neutral (prone position with arms elevated), single-leg extensions from prone and 4-point kneeling positions  
5	*Lumbopelvic control during movements and aggravating movements* Sitting on unstable base of support (hip extension movement only, lumbar spine only, thoracic only), 3-plane movement, co-contractions during normal-speed walking and other activities* 	*Stage 5* Abdominals from lying position: straight leg lifts toward ceiling, cycling exercises, leg slides, lower abdominal crunches Obliques: hip lift from side-lying position Back extensors: as in stage 4  
	Integration of lumbar stabilizing muscle activity into heavy-load dynamic functional tasks	
6	*Isometric co-contractions with addition of heavier external loads to lumbar spine* Bridging exercise, co-contractions during leg cycling from supine position, single-leg extensions from 4-point kneeling position  	*Stage 6* Abdominals from lying position: full abdominal crunches, straight leg lifts toward ceiling, cycling exercises, leg slides Obliques: hip lift from side-lying position Back extensors: alternate arm/leg extensions from 4-point kneeling and lying positions, single-leg bridging Swiss ball coordination exercises: alternate arm/leg lifts sitting on ball  

Statistical analysis:

Statistical analyses were carried out by IBM SPSS (Statistical Package for Social Sciences (SPSS), Version 23, Chicago, IL). All data were expressed as mean ±SD and normally distributed checked by Shapiro-Wilk test. Independent samples t-test was conducted to show changes in continuous demographic data between groups. Paired t-test and Independent samples t-test were utilized to investigate the effects of core muscle stability training exercises on the balance within and between groups respectively. A priori α significant level was set at $p < 0.05$.

The demographic characteristics of the participants at baseline were collected and there were no statistically significant differences observed among both groups as shown in (Fig. 1).

The scores of the overall stability index (OSI), antero-posterior stability index (APSI), and antero-medial stability index (AMSI) showed no significant difference after six weeks of training when two groups compared to each other as shown in (figure 2). Within groups, the scores of OSI, APSI, and AMSI after six weeks of training were significantly different ($p=0.008$, $p=0.001$, and $p=0.000$ respectively) in GA. While in GB, p values were 0.006, 0.007 and 0.003 respectively.

RESULTS

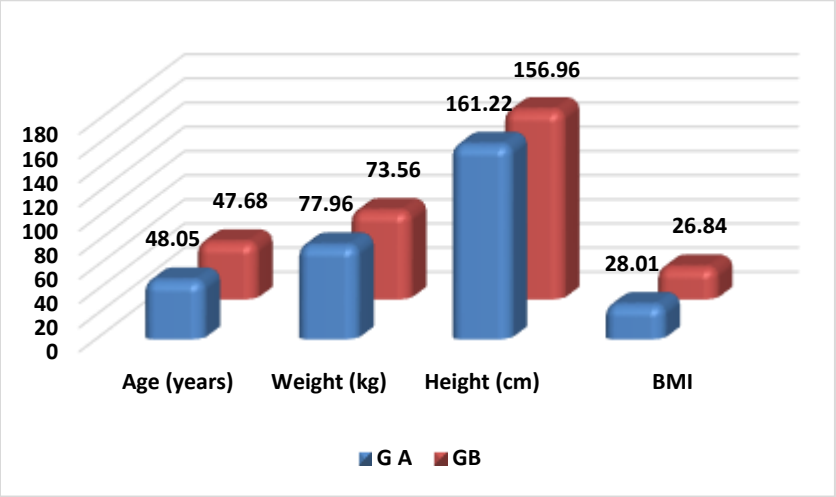


Figure 1: Demographic data of the study population.

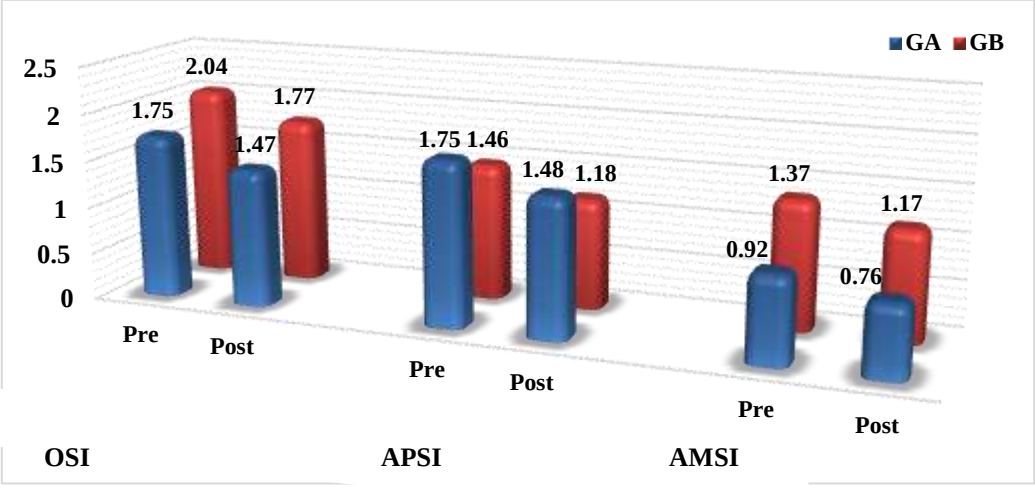


Figure 2: Differences of OSI, APSI, and AMSI.

DISCUSSION

The present study was conducted to determine the comparison between core muscle stability exercises and lumbo-pelvic complex strength training on the balance in MLBP patients.Thus, the first 6 stages of prescribed exercies done by Koumantakis et al., (2005) was selected to achieve the core muscle activation in different static situations with exclusion all other effects during dynamic one, while the same condition was applied on the group.

There were no significant differences between two groups regarding OSI, APSI, and AMSI before and after the training, but there were significant changes within group, this implys that core training has the same impact of strengthening exercises on the balance.

Various studies proved the differences between LBP patients and normal subjects concerning the impact of mechanical back dysfunction on proprioception, coordination, motor control, spinal stability and balance (Sung and Leininger, 2015, Sung et al., 2012, and Sung et al., 2010). However, a previous study stated that the stability in LBP patients increases with the eye open while decreased when closed as a response to unknown strategies for pain avoiding (Sung and Leininger, 2015), thus, our study was conducted with the eyes closed.

In the present study, the findings within groups come in agreements with that of Rhee et al. (2012), who reported significant improvement in the balance due to the stabilizing exercises. Carpes et al., (2008), reported considerable improvement in the balance and pelvic kinematics that resulted from the strengthening exercises.

The spinal stability is depending on the surrounding musculatures (global and intrinsic muscles) of the back where it is a combination of these muscles co-contraction (Marshall and Murphy, 2005, Behm et al., 2002, and McGill, 2001). Balance training regimen is not impacted by certain muscle activation, all the muscles of the trunk are working together to achieve the best performance and increase the postural control, so it was recommended that the para spinal, abdominal, and gluteal muscles should be included in the training programs (McGill et al. 2003, and Nadler et al., 2002).

The imbalance of neuromuscular control could occur in the case of strengthening the back extensors neglecting the flexors of the trunk and hip joint. Consequently, postural stability is affected substantially due to imbalance training between muscle groups (Kollmitzer et al., 2000). Activation and training of the lumbo–pelvic–hip complex muscles gave a better and effective way in improving postural control and equilibrium more than training the back extensors only (Carpes et al., 2008, and Willson et al., 2005).

Many studies proved that core stability and lumbo-pelvic-hip training exercises enhance the strength of the back and pelvic muscles, improve balance, increase coordination and joint sense in the subjects with low back pain (Nowotny et al., 2018, Oh et al., 2017, Rhee et al., 2012, and Carpes et al., 2008). The current study revealed that core stability exercise was recommended as an effective intervention in improving balance and postural equilibrium as lumbo-pelvic-hip complex strength training.

CONCLUSION

Based on our results, both core stability and lumbo-pelvic-hip complex strengthening exercises improve the balance, and they have almost the same effect in patients with mechanical low back pain.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

REFERENCES

Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2008, January). Core stability exercise principles. Current Sports Medicine Reports.

Behm, D.G., Anderson, K., Curnew, R.S. (2002). Muscle force and activation under stable and unstable conditions. Journal of Strength Conditioning Research, 16, 416–422.

Bogduk, N. (2009, December 15). On the definitions and physiology of back pain, referred pain, and radicular pain. Pain.

Boucher, J. A., Preuss, R., Henry, S. M., Dumas, J. P., & Larivière, C. (2016). The effects of an

8-week stabilization exercise program on lumbar movement sense in patients with low back pain. BMC Musculoskeletal Disorders, 17(1).

Carpes, F. P., Reinehr, F. B., & Mota, C. B. (2008). Effects of a program for trunk strength and stability on pain, low back and pelvis kinematics, and body balance: A pilot study. Journal of Bodywork and Movement Therapies, 12(1), 22–30.

Chang, M., Slater, L. V., Corbett, R. O., Hart, J. M., & Hertel, J. (2017). Muscle activation patterns of the lumbo-pelvic-hip complex during walking gait before and after exercise. Gait and Posture, 52, 15–21

Chang, W.-D., Lin, H.-Y., & Lai, P.-T. (2015). Core strength training for patients with chronic low back pain. Journal of Physical Therapy Science, 27(3), 619–622.

Deyo, R.A. & Weinstein, J.N. (2001). Low Back Pain. The New England Journal of Medicine, 344, 363-370.

Driscoll, T., Jacklyn, G., Orchard, J., Passmore, E., Vos, T., Freedman, G., … Punnett, L. (2014). The global burden of occupationally related low back pain: Estimates from the Global Burden of Disease 2010 study. Annals of the Rheumatic Diseases, 73(6), 975–981.

França, F. R., Burke, T. N., Caffaro, R. R., Ramos, L. A., & Marques, A. P. (2012). Effects of muscular stretching and segmental stabilization on functional disability and pain in patients with chronic low back pain: A randomized, controlled trial. Journal of Manipulative and Physiological Therapeutics, 35(4), 279–285.

Frank, C., Kobesova, A., & Kolar, P. (2011). Dynamic neuromuscular stabilization & sports rehabilitation. The International Journal of Sports Physical Therapy, 23(1), 279–280

Javadian, Y., Akbari, M., Talebi, G., Taghipour-Darzi, M., & Janmohammadi, N. (2015). Influence of core stability exercise on lumbar vertebral instability in patients presented with chronic low back pain: A randomized clinical trial. Caspian Journal of Internal Medicine, 6(2), 98–102.

Kollmitzer, J., Ebenbichler, G.R., Sabo, A., Kerschan, K., Bochdansky, T, (2000). Effects of back extensor strength training versus balance training on postural control. Medicine and Science in Sports and Exercise, 32 (10), 1770–1776.

Koumantakis, G. A., Watson, P. J., & Oldham, J. A. (2005). Trunk Muscle Stabilization Training Plus General Exercise vs General Exercise Only, 85(3), 209–225.

Marshall, P.W., Murphy, B.A.. (2005). Core stability exercises on and off a Swiss ball. Archives of Physical Medicine and Rehabilitation, 86, 242–249.

McGill, S. M., Grenier, S., Kavcic, N., & Cholewicki, J. (2003). Coordination of muscle activity to assure stability of the lumbar spine. Journal of Electromyography and Kinesiology, 13(4), 353–359.

McGill, S.M., 2001. Low-back stability: from formal description to issues for performance and rehabilitation. Exercise and Sports Science Review 29, 26–31.

Moon, H. J., Choi, K. H., Kim, D. H., Kim, H. J., Cho, Y. K., Lee, K. H., … Choi, Y. J. (2013). Effect of lumbar stabilization and dynamic lumbar strengthening exercises in patients with chronic low back pain. Annals of Rehabilitation Medicine, 37(1), 110–117.

Nadler, S.F., Malanga, G.A., Bartoli, L.A., Feinberg, J.H., Prybicien, M., Deprince, M. (2002). Hip muscle imbalance and low-back pain in athletes: influence of core strengthening. Medicine and Science in Sports and Exercise, 34 (1), 09–16.

Nowotny, A. H., Calderon, M. G., de Souza, P. A., Aguiar, A. F., Léonard, G., Alves, B. M. O., … da Silva, R. A. (2018). Lumbar stabilisation exercises versus back endurance-resistance exercise training in athletes with chronic low back pain: protocol of a randomised controlled trial. BMJ Open Sport & Exercise Medicine.

Oh, S. I., Moon, B., Ryu, J. J., Kim, S. H., & Yoo, K. T. (2017). Effects of core stabilization and combined exercises on stable and unstable surfaces on balance and body alignment in young, healthy women. Research Journal of Pharmacy and Technology, 10(9), 3098–3102.

Pelletier, R., Higgins, J., & Bourbonnais, D. (2015). Is neuroplasticity in the central nervous system the missing link to our understanding of chronic musculoskeletal disorders? BMC Musculoskeletal Disorders, 16(1).

Rhee, H. S., Kim, Y. H., & Sung, P. S. (2012). A randomized controlled trial to determine the effect of spinal stabilization exercise intervention based on pain level and standing balance differences in patients with

low back pain. Medical Science Monitor, 18(3), CR174–CR181.

Sung, P. S., & Leininger, P. M. (2015). A kinematic and kinetic analysis of spinal region in subjects with and without recurrent low back pain during one leg standing. Clinical Biomechanics, 30(7), 696–702.

Sung, P. S., Lee, K. J., & Park, W. H. (2012). Coordination of trunk and pelvis in young and elderly individuals during axial trunk rotation. Gait and Posture, 36(2), 330–331.

Sung, P. S., Yoon, B., & Lee, D. C. (2010). Lumbar spine stability for subjects with and without low back pain during one-leg standing test. Spine, 35(16).

Trompeter, K., Fett, D., & Platen, P. (2017, June 1). Prevalence of Back Pain in Sports: A Systematic Review of the Literature. Sports Medicine. Springer International Publishing.

Willson, J.D., Dougherty, C.P., Ireland, M.L., Davis, I.M.. (2005). Core stability and its relationship to lower extremity function and injury. Journal of the American Academy of Orthopaedic Surgeons, 13 (5), 316–325.

Yadav, A. O., & Deshmukh, K. G. (2013). Effectiveness of Core Muscle Stabilization Training on Dynamic Balance in Mechanical Low Back Pain Patients. Indian Journal of Physiotherapy and Occupational Therapy - An International Journal, 7(3), 34.