

Effects of McGill Stabilization Exercise on Pain and Disability, Range of Motion and Dynamic Balance Indices in Patients with Chronic Nonspecific Low Back Pain

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J Babol Univ Med Sci; 19(10); Oct 2017; PP: 21-7

Received: Mar 5th 2017, Revised: May 31th, 2017, Accepted: Jul 23rd, 2017.

ABSTRACT

BACKGROUND AND OBJECTIVE: According to McGill's new therapeutic exercise protocol for the purpose of low back pain treatment, and not investigating these exercises on balance, the present study was performed to aim to investigate the effect of McGill stabilization exercises and conventional physiotherapy exercises on dynamic balance indices, pain, disability and range of motion in patients with chronic non-specific low back pain.

METHODS: Thirty patients with chronic non-specific low back pain were randomly assigned to the McGill stabilization exercises group (n=15) and conventional physiotherapy group (n=15). Participants performed 30 repetitions for each session and three sessions per week for six weeks. In both groups, patients performed the corresponding exercises for six weeks. The visual analog scale (VAS), Quebec Low Back Pain Disability Scale questionnaire, inclinometer and Biodex Balance System were used to measure pain, functional disability, and active thoracolumbar range of motion variables and postural balance indices (Anteroposterior Stability Index, Mediolateral Stability Index, and Overall Stability Index), respectively. The study data were collected before and after training and also all the variables were followed for one month.

FINDINGS: The significant differences were not observed in pain, disability and range of motion between the two groups ($p>0.05$). In the dynamic postural stability variables, in Anteroposterior Stability Index (0.31 ± 0.20), Mediolateral Stability Index (0.23 ± 0.22), and Overall Stability Index (0.41 ± 0.30) significant changes were observed in three indices ($p<0.05$).

CONCLUSION: McGill stabilization exercises may improve more effective dynamic postural balance variables to maintain balance in daily activities such as walking.

KEY WORDS: McGill's Stabilization Exercises, Balance, Pain, Range Of Motion, Disability Low Back Pain.

Please cite this article as follows:

Farajzadeh F, Ghaderi F, Asghari Jafarabadi M, Azghani MR, Eteraf Oskoui MA, Rezaie M, Ghorbanpour A. Effects of McGill Stabilization Exercise on Pain and Disability, Range of Motion and Dynamic Balance Indices in Patients with Chronic Nonspecific Low Back Pain. J Babol Univ Med Sci. 2017;19(10):21-7.

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Introduction

Low back pain is a complex of musculoskeletal disorders or muscular imbalance (1, 2) and one of the most common problems of patients referred to physiotherapy clinics, but still diagnosis and especially the provision of special back pain therapy is a challenge (3). According to studies, 84% of the population at least once in a lifetime and more than 50% of people experience it more than once (2, 3). Lower back pain does not have a specific cause; it is multifactorial and has different causes depending on the type of internal or external injury. One of the causes of low back pain is poor posture when doing things such as sitting, standing up and lifting heavy objects (5).

But 90% of patients with low back pain experience undiagnosed pathologic low back pain that is called nonspecific low back pain (1, 5). Stability is a complex function that involves many neuromuscular paths. In balancing the sensory data from the vestibular system, vision and proprioceptive, the analysis of these inputs in the nervous system and, ultimately, neuromuscular response are involved. An appropriate motor response requires a healthy neuromuscular system and adequate muscle strength to restore the center of gravity to the reliance level. One of the reasons for the loss of balance in patients with low back pain is the disruption of the proprioceptive system.

On the other hand, reducing the strength of the muscles involved in stability and balance can also affect the quality of sensory signals and posture responses. Regarding the studies, separate use of local stabilization exercises in practice is questionable. The function of these muscles is reported in activities that carry a lot of energy and may be harmful (6), and the coordinated function of global and local muscle groups, depending on the task involved, is a better strategy for using muscle co-operation to maintain sustainability (7).

Studies have shown that sustainability is maintained through the activity of muscle groups, with timing and intensity of activity, according to the work task parameters (8). Therefore, muscle coordination training may be a suitable method for improving posture stability and dynamic balance in chronic low back pain patients. According to various theories and studies, the low back pain due to the abnormal movement strategies resulting from changes in neuromuscular control, causes abnormal recruitment of fibers and abnormal levels of muscle activity, resulting

in a loss of muscular balance (7, 8). So far, there are many treatments for patients with non-specific chronic low back pain, one of the most important of which is exercise therapy (5). Based on the segmentation of the muscles into the locally (deep muscle) and the global (superficial) muscles of the spine, stabilization exercises are divided into two groups of local and global stabilizer exercises (9, 10).

Local stabilizer exercises are designed to improve the function of local muscles for segmentation stability (8). McGill has designed exercises based on the global stability of the lumbar region, improving the level of activity of all the anterior, posterior, and lumbar muscles, in order to increase the stability and coordination without applying excessive force to the lumbar spine (10-13). So far, various studies have been done to determine the effects of stabilization exercises on changes in pain severity, functional disability levels, and the level of lumbar-pelvic muscle activity and balance in static and dynamic situations (13-18) which in a group of studies, stabilization exercises have been shown to increase the level of lumbar activity and improve the level of disability and reduce pain (16, 17, 19, 21).

But in some studies the lack of stabilization exercises and other exercises effect have also pointed (13-15, 18). Regarding the changes in dynamic balance indices, there are some studies to change them in different types of low back pain with different repeatability, but there are few studies regarding the effect of local (not global) stabilization exercises (22-26). Also, limited studies have been done on the effect of these stabilization exercises on dynamic balance variations in functional activities. In a review of the databases, little studies have yet been conducted on the effects of McGill's specific stabilizer exercises compared to other interventions on pain intensity changes and functional disability levels (13). Therefore, the aim of this study was to compare the effect of McGill stabilizer exercises and conventional physiotherapy exercises on dynamic balance indices, pain, functional disability, and active range of flexion and extension in patients with chronic non-specific low back pain.

Methods

This clinical trial study with a clinical trial entry number (1N2015051022202IRCT :) by one-Way Blind Method was done after obtaining the approval of the

Ethics Committee of Tabriz University of Medical Sciences on 30 patients with chronic non-specific chronic low back pain by simple random sampling present at dormitories of Tabriz University, after obtaining a written consent, they were divided into two groups of 15 people in the McGill Stabilization Exercise Group and the conventional physical therapy group. Male and female patients with an average age of 20-40 years, Body Mass Index (BMI) between 20-25 with back pain without any known cause that lasts for less than six months without pain spreading to the Lower limbs and pain less than 4 in Visual Analogue Scale (VAS) in patients with non-specific low back pain and lack of physical therapy programs were included. The diagnosis of non-specific chronic low back pain, back pain for more than three months, the presence of pain between the twelve rib up to the top of the gluteal cords with or without lower limb pain, and the lack of normal stability and spinal coordination failure due to muscle imbalance (4, 5).

In the presence of spinal and abdominal and shoulder, pelvic and lower limb surgery, there are clear postural problems or muscular weakness, with pain or disability in the upper and lower limbs, frequent neurological defects, history of medical conditions and cardiovascular disease, professional athlete, history of using drugs that affect the balance were excluded from the study, and marital status and delivery were considered in women.

Patients' pain intensity was assessed by Visual Analog Scale (VAS) (27). The severity of disability was evaluated by the Quebec Low Back Pain Disability Scale. The questionnaire contains 20 questions about the functional activities of individuals, which is based on the Likert scale (zero score indicates the absence of a problem and the score of five indicates the inability to perform an activity), so the maximum score of the questionnaire is 100 and the minimum score is 20. Validity of this questionnaire was high and its reliability was 0.86 (28).

The Bubble MSD Inclinator goniometer was used to evaluate the active range of flexion and extension and lateral flexion of the lumbar spine to the sides, which has high reliability and repeatability (29). In this method, the patient was first placed in standing position and by placing the goniometer on the T12-L1 vertebrae for flexion and extension, as well as placing it vertically in a linear direction from the Spinous process T9 and T12 for lateral flexion, the active movement range by maintaining a good postural and

the movement range without pain, was evaluated (11). In order to measure the dynamic balance indices in the present study, we used the Biodex Balance System (950-300 balance system SD, 115 vac, 50/60 z) constructed in the USA. The system measures the quantitative internal-external stability index and the anterior-posterior stability index and the overall stability index (29-31).

This system has acceptable repeatability for assessing dynamic postural stability in healthy people and patients with low back pain (30). To test the patient in this device, after the necessary training, the patient stays at the points marked on the circular plate (with 20 ° Tilt on the anatomical plates) with a stability level of 5 and hands are placed across on the chest and three repetitions of the test was done in open eyes condition (31). The training program included six weeks, three times every other day, and at least 30 repetitions of ten seconds of McGill Stabilizer exercises, (including: Curl up, Side Bridge, Bird Dog, with one hand or one leg, and one hand and opposite leg) and conventional physiotherapy exercises (including Single and Double knee to chest exercises, Prone lying with a pilot, One leg sliding, Cycling in supine and Bridging).

Every week, patients were trained and were under investigation for weekly follow-up exercises. All of the study data were recorded before and after the exercises within six weeks and then one month as follow-up after stopping training was continued. All stages of evaluation and education of patients in the biomechanical laboratory of Imam Reza Hospital in Tabriz were performed. For data analysis, SPSS software version 16 and independent T-tests and two-way ANOVA with repeated measurements were used as a repeated measures ANOVA and $p < 0.05$ was considered significant.

Results

Demographic characteristics of the two groups of McGill stabilization exercises and conventional physiotherapy exercises, except for age, were not significantly different (table 1). Analysis and evaluation of the results showed that the obtained data had acceptable repeatability, which were, respectively, in pain variables (ICC=0.765), disability (ICC=0.970), active motion flexion (ICC=0.981), extension (ICC=0.970), left lateral flexion to right (ICC=0.957) and lateral left ventricular flexion (ICC=0.965),

anterior-posterior stability index (ICC=0.781), internal-external stability index (ICC=0.801) and the overall stability index (ICC=0.763). The mean values of pain severity and disability levels were decreased in both groups but the results did not show significant differences between the two groups. Also, the mean values of flexion motor range in the conventional physiotherapy exercise group and the extension motor

range, lateral flexion to the right and left in the McGill stabilization exercise group were increased, but the results did not show a significant difference between the two groups (table 2). The results of the dynamic balance indices of patients in the three anterior-posterior stability indexes, internal-external stability and overall stability in the study showed that there is a significant difference between the two groups (table 3).

Table1. Demographic data in two groups of McGill stabilizer exercises and conventional physiotherapy exercises

Variable	McGill stabilizer exercises	conventional physiotherapy exercises	P-value
Age (year)	23.8±3.52	20.93±1.22	0.009
Height (cm)	171.8±8	171.2±7.01	0.99
Weight (kg)	70.53±10.92	69.73±12.66	0.13
Duration of disease (month)	16±6.42	14.93±6.46	0.96

Table2. Comparison of mean pain, disability and motor range of flexion, extension and lateral flexion to right and left

Variable	McGill stabilization exercise			conventional physiotherapy exercise			F	P
	Before studying	After studying	One month follow up	Before studying	After studying	One month follow up		
Pain	29.53±4.85	25±4.9	22.67±6.3	28.26±6.54	26.53±7.87	24.86±7.73	1.292	0.283
Disability	25.6±9.69	22.4±9.03	22.07±7.44	30.07±11.65	28±10.16	26.27±10.34	0.479	0.622
Flexion	92.22±14.25	94.96±14.87	95.07±14.36	94.28±13.46	97.67±12.39	98.22±13.15	0.162	0.779
Extension	27.84±7.34	30.33±5.88	30.8±6.16	32.18±8.42	33.62±8.27	33.56±8.01	1.007	0.352
Lateral flexion to right	27.28±6.61	31.73±5.92	30.87±5.17	29.93±8.36	32.73±7.31	32±6.73	0.419	0.576
Lateral flexion to left	29.53±7.97	32.49±7.18	31.78±7.33	30.02±8.35	31.89±7.53	32.49±7.26	0.526	0.513

Repeated measures ANOVA test; No significant improvement in pain, disability and motor ranges

Table3. Comparison of the Balance Indices of the Biodex Balance System

Variable	McGill stabilization exercise			Conventional physiotherapy exercise			F	P
	Before studying	After studying	One month follow up	Before studying	After studying	One month follow up		
Anterior-posterior stability index	0.7±0.7	0.31±0.2	0.3±0.19	0.5±0.67	0.45±0.68	0.45±0.64	3.767	0.048
Internal-external stability index	0.27±0.25	0.23±0.22	0.26±0.24	0.23±0.19	0.25±0.29	0.21±0.19	7.862	0.003
Overall Stability Index	0.82±0.76	0.41±0.3	0.41±0.29	0.62±0.68	0.58±0.7	0.52±0.66	5.042	0.02

Repeated measures ANOVA test; Significant improvement in the variables of dynamic balance indices

Discussion

Dynamic balance indices were significantly different between the two groups after exercise and after one month follow up, but pain variables and disability levels did not show any significant difference with decreasing mean scores. The results of this study were consistent with Koumantakis et al (14), Cho et al (15), and Cairns et al. (18). These studies showed that stabilizing exercises are not superior to other exercises and therapeutic interventions; however,

Cho and et al. suggested that optimal pain and function changes after performing more stabilization exercises could improve the coordination of the lumbar muscle units (15). Ammar et al. research is one of the few studies in which was investigated the effects of McGill stabilizer exercises in comparison with conventional exercises on pain and level of function of low back pain patients, considering the more favorable coordination between lumbar muscles during exercise,

improved pain and function in the McGill stabilizer training group (13). This study was not consistent with the study by Akodu et al. (16), Hwangbo et al (17), Rhee et al (19), and Wang et al. (20).

These studies reported that stabilizing exercises significantly reduced pain and improved disability compared to other exercises. In the present study, the pain and disability variables were not significantly different between the two groups. Considering the adaptability of the muscles over time, one of the reasons for this difference could be considered due to the low exercise time and sample size. Therefore, according to the results of the present study and the results of other studies, it can be concluded that in this study, McGillan stabilizing exercises in patients with non-specific chronic low back pain due to intolerable pain during daily functional activities or because of non-implementation Special activities to prevent pain in the lumbar region may not be different from other conventional exercises from the perspective of therapeutic effects.

Also, despite the increase in the mean of flexion motion in the conventional physiotherapy group and the mean values of extension motor range, lateral flexion to the right and left in the McGill stabilizer training group, there was no significant difference between the two groups. Cho and colleagues concluded that the periodic stabilization exercises reduced pain and increased motion range, and one of the most important reasons was the practice of straight leg raising as a stabilizing exercise (21).

According to previous studies, patients with chronic low back pain have lower muscular tolerance, weaker balance stability and instability in the frontal plate and lower stability limits compared to healthy people (22, 25, 31). In the present study, with performing exercises in the anterior-posterior stability balance indices, internal-external stability, and overall

stability, there was a significant difference between the two groups. These results indicate an improvement in the body's dynamic balance following the implementation of the Global McGill Stabilizer Exercise. This study was consistent with Yaghoobi et al. (22), Mahjur et al (23), Salavati et al (25), and Karimi et al. (24, 26).

In these studies was stated that stabilizing exercises with different operating conditions improve the balance by improving the balance stability indices. The Salavati et al study found that in non-specific patients with low back pain, were due to defects in somatosensory and proprioceptive injections and abnormal changes in postural coordination and control and stabilizer exercises can improve the postural coordination and control (25).

In the present study, there was a significant difference in the internal-external stability index (right and left) compared to other indices, which, according to McGill and colleagues, could be indicative of coordinated activity of quadratus lumabrum with other muscles (10, 12). Therefore, the McGill stabilizer exercises may improve the balance during functional conditions by improving lumbar muscle coordination compared to conventional physiotherapy. We can mention the low sample size and time constraints as the limitations of this study. Regarding the results of the study, it seems that the use of stabilization exercises for six weeks can improve the dynamics of postural stability and improve balance during functional conditions.

Acknowledgments

Hereby, we would like to thank the Research Council of Tabriz University of Medical Sciences and patients participating in this research for cooperation in the investigation.

References

1. Balagué F, Mannion AF, Pellisé F, Cedraschi C. Non-specific low back pain. *The Lancet*. 2012;379(9814):482-91.
2. Ershad N, Kahrizi S, Parnianpour M, Azghani MR, Kazemnejad A. Evaluation of postural stability while holding dynamic load in nonspecific low back pain patients. *RJMS*. 2012;19(98):28-36. [In Persian].
3. Taghipour Darzi M, Ebrahimi Takamjani E, Salavati M, Mobini B, Zekavat H. Comparison between dupuis and panjabi methods in calculating translation and rotation of lumbar vertebrae in flexion extension radiography. *J Babol Univ Med Sci*. 2008;3(44):15-24. [In Persian].
4. Wand BM, O'Connell NE. Chronic non-specific low back pain—sub-groups or a single mechanism?. *BMC Musculoskelet Disord*. 2008;9(1):1-15.
5. Wong AY, Parent EC, Funabashi M, Stanton TR, Kawchuk GN. Do various baseline characteristics of transversus abdominis and lumbar multifidus predict clinical outcomes in nonspecific low back pain? A systematic review. *Pain*. 2013;154(12):2589-602.
6. Lederman E. The myth of core stability. *J Bodyw Mov Ther*. 2010;14(1):84-98.
7. McGill SM, Grenier S, Kavcic N, Cholewicki J. Coordination of Muscle activity to assure stability of the lumbar spine. *J Electromy Kinesiol*. 2003;13(4):353-9.
8. Ting LH, Macpherson JM. Ratio of shear to load ground-reaction force may underlie the directional tuning of the automatic postural response to rotation and translation. *J Neurophysiol*. 2004;92(2):808-16.
9. Akuthota V, Nadler SF. Core strengthening. *Arch Phys Med Rehabil*. 2004;85:86-92.
10. McGill SM. Stability: from biomechanical concept to chiropractic practice. *J Can Chiropr Assoc*. 1999;43(2):75-88.
11. Hicks GE, Fritz JM, Delitto A, McGill SM. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil*. 2005;86(9):1753-62.
12. McGill SM. Low back stability: from formal description to issues for performance and rehabilitation. *Exerc Sport Sci Rev*. 2001;29(1):26-31.
13. Ammar TA. McGill Exercises versus Conventional Exercises in Chronic Low Back Pain. *Life Sci J*. 2012;9(2):393-7.
14. Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. *Phys Ther*. 2005;85(3):209-25.
15. Cho I, Jeon C, Lee S, Lee D, Hwangbo G. Effects of lumbar stabilization exercise on functional disability and lumbar lordosis angle in patients with chronic low back pain. *J Phys Ther Sci*. 2015;27(6):1983-5.
16. Akodu AK, Tella BA, Olujobi OD. Effect of stabilization exercise on pain and quality of life of patients with non-specific chronic low back pain. *African J Physioth Rehabil Sci*. 2015;7(1-2):7-11.
17. Hwangbo G, Lee CW, Kim SG, Kim HS. The effects of trunk stability exercise and a combined exercise program on pain, flexibility, and static balance in chronic low back pain patients. *J Phys Ther Sci*. 2015;27(4):1153-5.
18. Cairns MC, Foster NE, Wright C. Randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain. *Spine*. 2006;31(19):670-81.
19. Rhee HS, Kim YH, Sung PS. 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. *Med Sci Monit*. 2012;18(3):174-89.
20. Wang XQ, Zheng JJ, Yu ZW, Bi X, Lou SJ, Liu J, et al. A meta-analysis of core stability exercise versus general exercise for chronic low back pain. *PloS One*. 2012;7(12):52082.
21. Cho HY, Kim EH, Kim J. Effects of the CORE exercise program on pain and active range of motion in patients with chronic low back pain. *J Phys Ther Sci*. 2014;26(8):1237-40.
22. Mahjur M, Hashemi Javaheri, Ariamanesh ASH, Khoshraftaryazdi N, Enferadi E. The Short effects of two spinal stabilization exercise on balance tests and limit of stability in men with non-specific chronic low back pain: randomized clinical trial study. *Arch Rehabil*. 2012;13(1):102-13. [In Persian].
23. Mahjur M, Hashemi Javaheri SA, Ariamanesh ASH, Khoshrafter N, Enferadi A. Effects of stability exercises in water on pain intensity and balance indexes in subjects with nonspecific chronic low back pain. *Med-Surg Nurs J*. 2014;3(2):107-13.
24. Karimi N, Ebrahimi I, Ezzati K, Kahrizi S, Torkaman G, Arab AM. The effects of consecutive supervised stability training on postural balance in patients with chronic low back pain. *Pak J Med Sci*. 2009;25(2):177-81.

25. Salavati M, Akhbari B, Takamjani IE, Bagheri H, Ezzati K, Kahlaee AH. Effect of spinal stabilization exercise on dynamic postural control and visual dependency in subjects with chronic non-specific low back pain. *J Bodyw Mov Ther.* 2016;20(2):441-8.
26. Karimi N, Talimkhani A, Mosallanezhad Z, Arab AM, Keshavarz R. The effects of consecutive supervised functional lumbar stabilizing exercises on the postural balance and functional disability in low back pain. *Iranian Rehabil J.* 2014;12(2):21-7. [In Persian].
27. Safdari S, Khayambashi K, Ghasemi GA, Falah A. Effects of selected core stabilization exercise protocol on pain and functional disability in subjects with chronic non-specific low back pain. *Jo Res Rehabil Sci.* 2014;10(1):56-66.
28. Mousavi SJ, Parnianpour M, Mehdian H, Montazeri A, Mobini B. The oswestry disability index, the roland-morris disability questionnaire, and the quebec back pain disability scale: translation and Validation Studies of the Iranian Versions. *Spine.* 2006;31(14):454-9.
29. Henry SM, Hitt JR, Jones SL, Bunn JY. Decreased limits of stability in response to postural perturbations in subjects with low back pain. *Clin Biomech.* 2006;21(9):881-92.
30. Karimi N, Ebrahimi I, kahrizi S, Torkama G. Reliability of postural balance evaluation using the Biodex balance system in subjects with and without low back pain. *Pak J Med Sci.* 2008;22:25-31.
31. Karimi N, Ebrahimi I, kahrizi S, Torkaman G. Evaluation of postural balance using the biodex balance system in subjects with and without low back pain. *Pak J Med Sci.* 2008;3:372-7.