Results of Stability Exercises on Thickness of Deep Abdominal Muscles during Functional Tasks in a Patient with Failed Back Surgery Syndrome, Using Ultrasonography: A Case Report

Seyedeh Hedieh Hoseini Makrani [a*], **Arsalan Ghorbanpour** [b]

a Neuromuscular Rehabilitation Research Center, Semnan University of Medical Sciences, Semnan, Iran; b Department of Physiothetherapy, School of Rehabilitation Sciences, Teheran University of Medical Sciences, Tehran, Iran.

Corresponding Author:** Seyedeh Hedieh Hosseini Makrani, Malek Bldg, Farshadi Street, Salman Farsi Ave, Sari city, Mazandaran province. ***E-mail: hedie.hoseini68@gmail.com; ***Tel***: +989113908160.

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Abstract

Introduction: There is evidence that changes in the deep trunk *m*uscular activity remain in patients with low back pain (LBP) following the lumbar decompression surgery. The purpose of this study was to investigate the effectiveness of stability exercises on the pain, disability and activity of transverse abdominal (TrA) muscle during the voluntary and functional tasks in a patient with the failed back surgery syndrome. **Case Description:** The subject was a 68-year-old woman who underwent the spinal decompression surgery with the high levels of constant postoperative pain and radicular symptoms and disability. She was undergoing the stability exercise for an 8-week period. **Outcomes:** The patient reported the noticeable improvements in her pain and disability following the completion of her stability exercise program. The Remarkable improvement in TrA muscle thickness was also observed. **Conclusion:** This case report indicates short and long-term effect of stability exercises program on pain, disability and, TrA muscle thickness during abdominal hollowing and standing postural task. Therefore, doing stability exercises, as an effective intervention, can be advised for patients with LBP after the lumbar decompression surgery.

Keywords: Low Back Pain, Lumbar Decompression Surgery, Stability Exercise, Transverse Abdominal Muscle, Ultrasonography

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Introduction

Failed back surgery syndrome (FBSS) is defined as a persistent or recurring low-back pain with or without leg pain lasting more than one year, despite of one or more spinal surgery (1). Also, the prevalence of a new surgery following lumbosacral surgeries is considerable and about 17% and 70% of patients still complain of pain after surgery (2). Therefore, the prevention of the pain recurrence and radicular symptoms following surgical procedures is very important.

The abdominal transverse (TrA) muscles are located among the deep trunk muscles, which have a very special role in stabilizing and controlling the movements between the lumbar and lumbar-pelvic segments and that provide active and dynamic stability of the lumbopelvic region in cocontraction with multifidus muscle, pelvic floor muscles, and the diaphragm (3). Regarding the remaining changes in the deep trunk *muscular* activity pattern for patients with LBP following the surgery (4), a treatment which can improve the level of trunk *muscular* activity during tasks and functional activities in patients with low back pain following surgery, is of specific importance to control and prevent the recurrence of this disorder. One of the most important therapeutic interventions in LBP patients is performing therapeutic exercise following the surgery and among the most important functional exercises which is widely used in recent years are stability exercises. Reducing pain, improving functional activity and reducing disability are among the effects observed in investigations after muscle therapeutic exercises in LBP individuals following the surgery (5). In this regard, there has been limited evidence that examined the effect of this type of exercise on the level of deep trunk *muscular* activity in patients with lumbar decompression surgery. However, evidence have shown that changes to the spine activity pattern will remain after spinal surgery (4)

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Table 1. Ultrasound measurement of transverse and measures of pain and disability

	Pre	Post	1 week	2 weeks	3 weeks	4 weeks	5 weeks	6 weeks	7 weeks	8 weeks	6months post intervention
Tra thickness at rest	2.95	3.23	3.24	3.23	3.23	3.23	3.26	3.26	3.25	3.27	3.28
Tra thickness AH	4.23	5.27	5.32	5.35	5.37	5.38	5.48	5.52	5.52	5.56	5.58
Tra thickness Standing	3.78	4.74	4.75	4.75	4.76	4.76	4.77	4.77	4.77	4.78	4.78
Pain	6	1	1	2	1	1	0	1	0	0	0
Disability	8	4	3	3	3	3	2	2	2	2	2

AH: Abdominal Hollowing; Tra: transverse abdominis

Case Presentation

The patient was a 68-year-old woman (height, 173.2 cm; body mass, 87.5 kg; body mass index, 29.23 kg/m2) who underwent surgery with pedicle screw fixation with fusion at L5-S1 level. The patient was referred 1 year after her spinal surgery. She reported high levels of constant postoperative pain, radicular symptoms, and disability with minimal activity as a result of her pain following the surgery.

Her chief complaint was pain in the right-side low back and leg. She described it as a constant ache on her leg. The pain severity on the right side was graded between a 6 out of 10. The provocative situations for pain were bending or twisting at the waist, standing up from sitting, and prolonged standing. Before surgery, he used to suffer from severe pain, radicular symptoms and disability. The condition had been evolving for around 4 years, despite the conservative therapy included analgesia, muscle relaxants, NSAIDs, and physiotherapy.

Ultrasound measurement of the transverse abdominal muscle thickness

To measure the abdominal muscle thickness, HS-2100V ultrasonographic apparatus made in Japan with a 7.5 MHz linear probe Type B was used. Ultrasonography has several advantages over CT and MRI, which makes it suitable for large-scale studies. Ultrasonography also has no known cumulative biological effects in opposition to CT. So, this method is simple and inexpensive for measuring the muscle thickness (6).

Records were gathered from the right muscle of the body in three positions of lying, abdominal hollowing maneuver, and absolute standing. To measure the thickness of the abdominal muscles by the ultrasonographic apparatus, the middle axillary line of the right side of the body was initially marked in the area between the edge of the iliac crest and the last rib, and then we moved 2.5 centimeters toward the front, and marked this point (7). In all the three test positions, this point which is clearly visible by ultrasonography in the TrA muscle was considered for measuring muscle thickness. The test was performed in lying position once at the end of exhalation, then during abdominal hollowing maneuver, and finally in standing position. To determine the change in the thickness of the abdominal muscles, the thickness of the transverse abdominal muscle was measured in the supine position during resting. Then, the thickness of the muscle was calculated during the abdominal hollowing maneuver during standing position. Finally, to standardize the information, the change of muscle thickness was calculated as the muscle function in a percentage of the muscle thickness in each task, relative to the resting position.

The muscle thickness measurement was performed prior to the exercises, and again at the end of each week after the intervention for an 8-week period.

Pain Assessment

Pain intensity was assessed using the visual analog scale (VAS) that is a 10-cm ungraded line with two anchors. Its left and right anchors represent minimum and maximum intensities of pain, respectively. Pain was rated on a scale of 0 to 10 in which 0 indicated that the patient could not feel any symptoms or pain and could carry out daily life without any problems, while 10 indicated that the subject could not stand the symptoms and do activities of daily living at all because of intolerable pain. The patient was asked to report her current pain intensity on the VAS.

Pain measurement was performed prior to the exercises, and again at the end of each week after the intervention for an 8-week period.

Disability Assessment

Roland-Morris disability questionnaire also was applied to evaluate patient's functional disability. It is a 24-point scale which indicates some limitation in different functional activities of daily living. The

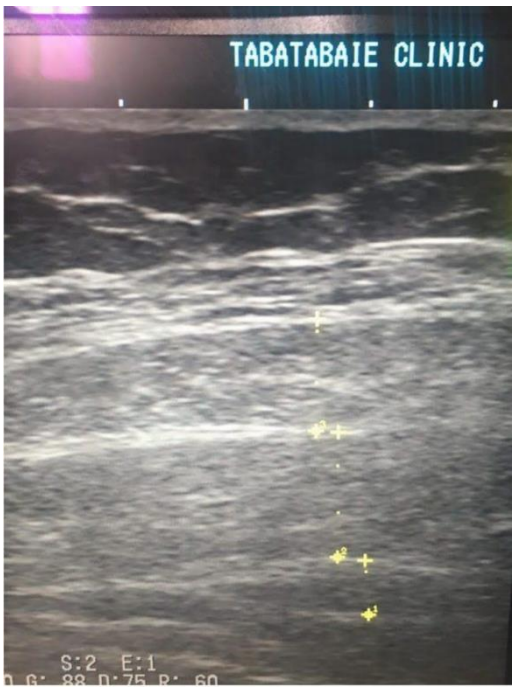

Figure 1. Tra ultrasonography

questionnaire was filled out by the patient to show which items reflected her current condition. Thus, results ranged from 0 (no disability) to 24 (maximum disability). This questionnaire have already been translated into Persian language and its reliability and validity of Iranian version have been approved.

Disability measurement was performed prior to the exercises, and again at the end of each week after the intervention an 8-week period.

Therapeutic interventions:

The patient performed stretching exercises for 15 minutes at the beginning of each session to warm up and prepare before the main exercises, and also did that for 10 minutes at the end of each session to cool down. She completed the 8-week stability exercise sessions including 3 sessions per week and each session approximately 60 minutes. She learned the abdominal hollowing exercise by the oral instructions and the therapist's contact feedbacks which continued until the subjects could do it in a satisfactory state. Stability exercises consisted of 10 exercises which each item aimed at strengthening the deep trunk muscles. All exercises were performed according to certain rules such that in the abdominal hollowing, inhale and exhale and slowly and softly draw the lower abdomen part, lower than the navel, without moving the upper abdominal part, waist and pelvis. The exercises were progressive and over time, the number of exercises were increased. The exercise also were started from static to dynamic conditions.

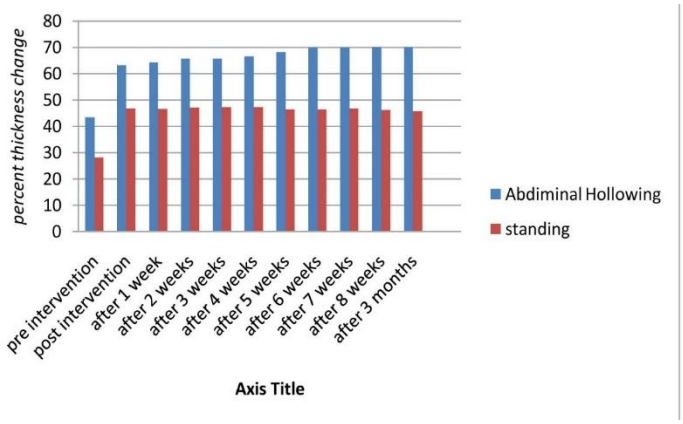

Figure 2. Tra percent thickness change

Result

Measures of pain and disability

Outcomes of pain and disability are provided in Table 1. Clinically, a noticeable improvements in pain and disability following the completion of her stability exercise program was reported. After 3 month following the intervention, the patient reported no pain along with the minimum disability.

Muscle thickness changes

TrA muscle thickness values are provided in Table 1. Percent of muscle thickness change during activation for the TrA during the abdominal hollowing and standing positions are presented in Figure 1. Remarkable improvement in TrA muscle thickness was observed following the completion of her stability exercise program.

Discussion

The findings of the current study indicated positive effects of stability exercise on the pain and disability in a subject with FBSS. Studies by Demir *et al.* and Mannion *et al.* on the effect of stability exercises were conducted on clinical observations and severity of pain and disability following lumbar surgeries, which reported improvements in symptoms following these exercises (5, 8). Nevertheless limited evidence has shown positive effect of stability exercise on TrA *muscular* activity in patients with LBP (9). According to our knowledge and investigation, no study has yet been investigated the effects of stability exercise on the TrA muscle activity in patients with FBSS.

The findings of the current study indicated positive effects of stability exercise on the TrA *muscular* activity in the

abdominal hollowing and standing positions. Evidence showed that standing postural tasks can aggravate the pain in patients with LBP (10). Furthermore, there are evidences that the level of deep trunk *muscular* activity is lower in the standing position for patients with LBP compared with healthy individuals (11). So, an intervention which can increase the function of these muscles in standing postural tasks will be very valuable in patients with LBP. The results of the present study showed that stability exercise could increase the activity of the TrA muscle during standing position, as well as abdominal hollowing condition and then it can increase the efficiency of patients with LBP after lumbar spine surgery in performing the standing tasks.

Some studies which investigated the effect of stability exercise on the severity of pain and disability following lumbar surgeries are consistent with the findings of the current study (5, 8).

Conclusion

The results of this study indicated that stability exercise could improve the activity of the TrA muscle during abdominal hollowing and standing positions in a patient who underwent lumbar surgery. Therefore, using this intervention, as an effective intervention, can be advised for patients with LBP following lumbar decompression surgery.

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Both authors made substantial contributions to the conception, design, analysis, and interpretation of data.

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