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Management of a Patient Lumbar Spinal Stenosis, and Carotid Aneurysm

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The Patient signed an informed consent allowing the use of medical information for this report and received information on the institution’s policies regarding the Health Insurance Portability and Accountability Act.

**ABSTRACT:**

Background and Purpose: Lumbar Spinal Stenosis (LSS) is a clinical syndrome involving a narrowing of the space for the neural and vascular structures to pass. The purpose of this case report describes physical therapy management of a patient with chronic low back due to lumbar spinal stenosis with associated lumbar radiculopathy, status post carotid aneurysm.

Case Description: The Patient was a 60-year-old female with a 20-year history of intermittent back pain and works as a crossing guard. The patient had radiographic evidence of multi level lumbar disc disease with central stenosis and foraminal narrowing most pronounced at L4-L5 and disc protrusion impinging on both the L4 and L5 nerve roots. The patient also has a complex medical background, including right carotid artery aneurysm with coils, depression, and had failed previous physical therapy and chiropractic interventions. A comprehensive therapy regimen including therapeutic strengthening/stretching exercises, manual therapy techniques with neuromuscular reeducation, and education regarding home exercise program and avoidance of provocative positions was utilized.

Outcomes: Oswestry Low Back Pain Questionnaire, Lower Extremity Functional Scale, pain rating, strength, and range of motion improved 30 days after starting treatment. These improvements continued through a reassessment at 90 days.

Discussion: The use of a well thought out comprehensive rehabilitation program consisting of therapeutic exercise, manual therapy, and consistent patient education may
lead to a reduction in pain and improvements in activity tolerance. Due to her history of
the right carotid artery aneurysm, care was taken when prescribing therapeutic
strengthening exercises.\textsuperscript{6,7} Increased blood pressure associated with exercise and
performing a Valsalva maneuver increases the risk of rupturing the repair.\textsuperscript{6, 8, 10, 11} Further
research is warranted to determine the most effective therapeutic protocol for patients
with lumbar spinal stenosis.

\section*{Background and Purpose:}

Lumbar spinal stenosis (LSS) is “a clinical syndrome of buttock or lower
extremity pain, which may occur with or without back pain, associated with diminished
space available for the neural and vascular elements in the lumbar spine.”\textsuperscript{1} There is
extensive research with exercise therapy was found to be more effective in reducing pain
and improving function in patients with chronic low back pain when compared to no
treatment or other conservative treatments.\textsuperscript{2, 3, 4} There is ambiguity in research regarding
the potential benefits of non-operative management coupled with physical therapy
compared to benefits of surgical procedures for patients with low back pain due to
discogenic or stenotic causes.\textsuperscript{5} Typical management of patients with lumbar spinal
stenosis and radiculopathy includes physical therapy interventions and exercise.\textsuperscript{5, 6}

Comorbidities frequently complicate the exercise selection of patients in physical
therapy. One such comorbidity is a carotid artery aneurysm. A carotid aneurysm is a
bulging or ballooning in the wall of the internal or external carotid artery. It is caused
when a portion of the artery wall weakens and with increased pressure the likelihood of
rupturing the aneurysm increases. \textsuperscript{7, 8} Management is dependent on the size and severity of the carotid artery aneurysm. \textsuperscript{7, 8} Patient’s who undergo surgical management for carotid artery aneurysm are placed on exercise restrictions based on the size and location of the aneurysm. \textsuperscript{9, 10, 11, 12}

While exercising, our bodies’ normal response is a slight elevation in blood pressure. This elevation in blood pressure is increased while performing strengthening exercises, especially when the Valsalva maneuver is performed. \textsuperscript{10, 11, 12} A Valsalva maneuver is performed when you forcefully exhale air against a closed airway, thus creating increased blood pressure and pressure within the abdomen. \textsuperscript{6} Several studies report that the systolic blood pressure can rise 40mmHg above resting with a controlled Valsalva maneuver and can spike as high 300mmHg when coughing. \textsuperscript{11, 12}

The purpose of this case report is to display physical therapy management for a patient with low back pain with bilateral lower extremity radiculopathy in the presence of a complex medical background including carotid artery aneurysm.

Case Description: Patient History and Systems Review

A 60-year-old female was referred to physical therapy with a complaint of low back pain with bilateral lower extremity radiculopathy. She had a history of intermittent low back pain extending over 20-years, and reports having previous interventions including physical therapy and chiropractic manipulation with minimal long-term effect. She was limited in her housework, garden/lawn-care, work related activities, has difficulty walking more than a quarter-mile, and standing for more than a half-hour. The
The patient was screened for red flags and denies history of recent fracture, cauda equina symptoms, cancer, or pregnancy.

The patient’s medical history included rhinitis, carotid artery aneurysm on the right, hyperplastic colon, hypertension, hyperlipidemia, impaired fasting glucose, osteopenia, depressive disorder, anemia, Vitamin D deficiency, and overweight. Her surgical history included correction for carotid aneurysm. The patient had an MRI performed 1 month prior to starting physical therapy.

**Systems Review:**

The patient presented with impaired cardiovascular/pulmonary system with history of right carotid aneurysm and repair, hyperlipidemia, and hypertension. Global muscle/break testing revealed weakness, and visual assessment revealed poor posture, indicating impaired musculoskeletal system. She also presented with impairments of the neuromuscular system with report of radiculopathy in her lower extremity, and parenthesis along the posterior and lateral aspect of her right foot. She presented with normal affect and cognition and was alert and oriented to person, time, place, and event.

**Clinical Impression #1**

Following the subjective history and systems review it was hypothesized that the patient presented with low back pain and bilateral lower extremity radiculopathy. The patient’s chart included a technician report of the MRI that was performed at an earlier
date revealing multi-level lumbar disc disease with mild to severe central stenosis and mild to nearly severe foraminal narrowing most pronounced at L4-L5. Differential diagnosis included: spondylosis, spondylolisthesis, and lumbar muscular strain. The following tests were planned for the examination: standing postural assessment, goniometry of trunk and bilateral lower extremities, dermatomes, myotomes, deep tendon reflexes, manual muscles testing, palpation, joint mobility and integrity, and straight leg raise.

The patient continued to present as appropriate for this case due to her complicated medical history, duration of low back pain and the associated lumbar radiculopathy that has been ongoing for over a year. The second reason that this case is appropriate is because of patient’s battle with depression and previously failed attempts of physical therapy and chiropractic interventions.

**Test and Measures:**

Dermatome testing revealed decreased sensation in the L5 dermatome on the patient’s right foot. Neural testing of the lumbar spine revealed a positive straight-leg-raise and positive slump test on the bilateral lower extremities. Joint integrity testing revealed pain and hypomobility of the lumbar spinal segments using and anterior posterior glide. Pain and increased radiculopathy into the right lower extremity was noted with joint integrity testing at all lumbar segments. The movement screen for lumbar spinal extension, ipsilateral lateral flexion and contralateral rotation revealed increased lumbar radiculopathy radiating into the right lower extremity. The examination findings were consistent with the initial clinical impression of lumbar spinal stenosis with bilateral
lower extremity radiculopathy. For a full list of test and measures performed and the results please see table 1.

Clinical Impression #2

The findings from the examination data revealed signs and symptoms consistent with the initial impression of low back pain and bilateral lower extremity radiculopathy. The patient is appropriate for this case because of her complicated medical history, duration of low back pain and the associated lumbar radiculopathy.

Based on the results from the examination a plan of care was established consisting of: soft tissue massage/mobilization (STM) to the hypertonic musculature, joint mobilization of lumbar spine and the sacroiliac joint (SIJ) to promote increased segmental mobility to increase her lumbar ROM, stretching to decrease muscular resistance and hypertonicity to allow for a reduction in pain and increase lumbar ROM, strengthening and stabilization exercises to weak musculature surrounding the trunk and lumbopelvic region, and patient education regarding her injury and self-management strategies in regards to decreasing inflammation and muscle hypertonicity.

Diagnosis:

The patient’s medical diagnosis using the International Classification of Disease (ICD) 9 code was 724.2 low back Pain. The physical therapy practice pattern 4E, Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Localized Inflammation
Prognosis:

Prognosis for a patient with radiographic confirmed spinal stenosis and multi-level lumbar herniation is mixed. Some authors report there is a high incidence of reoccurrence of low back pain.\textsuperscript{15, 16, 17, 18} However, several studies found physical therapy was more effective than no intervention and was better than conservative treatments at reducing back pain and improving function.\textsuperscript{2, 18}

Prognosis for a patient with a repaired carotid artery aneurysm is also mixed. Exercises typically used in a therapeutic strengthening protocol need to be modified in the presence of carotid aneurysm, due to the risk of rupturing the repair.\textsuperscript{6, 7} This risk of rupturing the repair comes with performing an Valsalva maneuver during exercise, which causes an increase in blood pressure.\textsuperscript{6, 8, 10, 11} However, patients are usually able to participate in low-moderate intensity exercises initially, and are able to increase in intensity with close monitoring.\textsuperscript{10}

Given her other comorbidities, chronicity of pain, failure of physical therapy and chiropractic manipulation, the patient’s prognosis was fair. However, there is ample evidence that supports the effect of physical therapy in improving patient outcomes.\textsuperscript{2, 6, 7, 10, 18}

The following long long-term goals were established:

1) By discharge, the patient will tolerate walking for \(\frac{1}{2}\) mile for 1 attempt with patient reporting no increase in back pain or lower extremity radiculopathy to allow her to walk her dog around the full block.
2) By discharge, the patient will tolerate standing for 1 ½ hour with no sitting rest breaks and with patient reporting no increase in symptoms to allow patient to perform daily meal preparation and allow patient to tolerate standing for work.

**Interventions**

Initial interventions focused on pain relief, therefore the initial evaluation and second visit focused on the utilization of electro-therapeutic modalities in combination with a moist hot pack. These treatments were discontinued, as the patient did not experience pain relief with their use.

STM was performed at each session to tight/hypertonic musculature. STM was changed over time based on the patient’s presentation. As treatments progressed, musculature became less hypertonic, and less painful and required less STM. Soft tissue mobilization of the QL in side-lying was performed throughout PT visits. The side-lying QL stretch was initially performed conservatively for a total of a single 1-minute hold on each side (Figure 4). The time was progressed to three 1-minute holds on each side. This slow increase in time was performed to allow the patient to adjust to the stretch and not cause increased pain. As the patients pain and tenderness decreased, the side-lying QL stretch was decreased in frequency. The patient was also able to self manage QL tightness later on in PT visits with the side-lying QL and standing QL stretch.

Joint mobilization was performed to the lumbar segments to improve the mobility of hypomobile lumbar segments. Initially, lumbar mobilization was performed using a segmental distraction with the patient in a side-lying position (Figure 4). As the patients’ segmental mobility improved in the upper lumbar spine, rotational mobilization was incorporated into the treatment (Figure 3). Rotational mobilization was performed to
promote further intersegment up-gilding of hypomobile segments and to gap lower lumbar facets. Joint mobilizations were performed to increase the intervertebral space and reduce the pressure on the nerves to allow for both decreased pain and radicular symptoms (see Table 2 for joint mobilization progression). Stretching was performed to musculature that was hypertonic to increase tissue length. The lumbar PSM’s and piriformis were hypertonic and strong. The patient was given passive stretching to these muscles to promote increased tissue length and decrease pain. Stretching of the hip flexors (iliopsoas and iliacus), hip abductors (TFL, gluteus medius, and gluteus minimus), and hip extensors (gluteus maximus, biceps femoris, semimembranosus and semitendinosus) was performed later in therapy visits. The single knee to chest was initially performed throughout several visits to promote lumbar mobility. This mobility exercise was also given as an HEP. The cat camel exercise was also performed for several visits to promote lumbar mobility. The patient reported slight increase in pain and had difficulty performing the cat camel exercise, so it was removed after the third visit. The supine piriformis stretch was performed intermittently throughout PT visits.

Therapeutic strengthening exercises were performed to musculature that was identified as weak during the time of PT by the use of the manual muscle tests and functional tests. The following muscles were weak the core/abdominal muscles (upper/lower abdominals, oblique’s, and transverse abdominis), hip flexors (iliopsoas and iliacus), hip abductors (TFL, gluteus medius, and gluteus minimus), and hip extensors (gluteus maximus, biceps femoris, semimembranosus and semitendinosus) (Figure1). Core/abdominal strengthening was performed from visit 1 to visit 7 utilizing pelvic
neutral (PN) and activation of transverse abdominis and pelvic floor musculature. This was changed to abdominal stiffening at visit 8 (Figure 2). PN with transverse and pelvic floor activation was also removed from the patient’s HEP and replaced at visit 9 (Figure 2). The abdominal strengthening exercises were changed to abdominal stiffening after updated research was discovered supporting the activation of all abdominal muscles together instead of isolating individual muscles like the transverse abdominis\textsuperscript{24,25}. See table 2 for exercise progression.

Core strengthening was the primary intervention in the patient’s plan of care. Abdominal strengthening exercises were performed throughout therapy sessions. The lumbar stabilization progression started by teaching PN in a supine position. Pelvic neutral is a position where the least amount of stress is placed on the lumbar spine.\textsuperscript{23} PN is initially determined by therapist palpation of rocking the pelvis anteriorly and posteriorly. Once the patient is able to maintain PN, activation of transverse abdominis is taught by visualization of drawing in an imaginary bead behind the navel towards the buttock area. Once proper muscle activation was achieved, she was asked to replicate the activation with a timed hold. Drawing the imaginary bead in toward the buttock area allows for co-contraction transverse abdominis, multifidus, internal/external oblique’s, and pelvic floor muscles.\textsuperscript{23} Activating the transverse abdominis in isolation is only possible at very low levels as it was designed to co-contract with the internal oblique.\textsuperscript{24,25} Recruiting larger spinal stabilizers is achieved by performing abdominal stiffening of all the abdominal muscles.\textsuperscript{24,25} Prior to performing abdominal stiffening exercises the patient was educated on the Valsalva maneuver is and on how to avoid performing this maneuver due to risk of rupturing her carotid aneurysm (Figure 1, Figure 2). The
exercises were modified to allow for a gentle contraction that allowed for stiffening of abdominal muscles with breathing (Figure 2). The patient was also monitored for any signs indicating she was not tolerating the change in exercise, including headache, dizziness, and lightheadedness. Strengthening of the gluteal muscles was also a large component to the exercise plans. Hypertonic hip-flexors due to prolonged sitting can cause reciprocal inhibition to the gluteal muscle causing them to be hypoactive.

Prolonged hypertonic hip-flexors leads to increased pressure on the disk and closing off the intervertebral foramen, thus pinching the nerves and causing more pain and radiculopathy.\textsuperscript{24,25} See Table 2 for abdominal strengthening progression.

**Outcomes:**

The patient received a total of 20 physical therapy treatment sessions over the course of 90 days. Treatment frequency was two visits per week of 60 minutes over eight weeks, and one visit per week for 45-minute sessions for four weeks. Her Oswestry Low Back Pain Questionnaire scores at the time of discharge indicated significant improvements in how her function (Table 1). Her Lower Extremity Functional Scale scores at discharge also indicated significant improvement (Table 1). Improvements were noted in physical therapy special tests; at discharge she demonstrated a negative slump test, negative straight leg raise (SLR) test, and normal sensation in the L5 dermatome.

All physical therapy goals were met by discharge. Overall pain decreased from 8/10 to 2/10 using the visual analog scale (VAS), and the patient reported being able to manage her radicular symptoms by performing her home exercises/stretches and resting at the onset of symptoms (Table 1). As indicated, she was able to perform all daily activities with improvement of standing tolerance from 30 minutes with onset of radicular
symptoms to standing 2 hours before the onset of radicular symptoms. Her walking
tolerance improved from ¼ mile to over 1 mile. Finally and most important, she was able
to return to her job as a crossing guard.

Discussion:

Long-term outcomes for someone with low back pain vary with some authors reporting a high incidence of reoccurrence of low back pain. Several studies found functionally disabling recurrence rates ranging from 8% at 3 months, 58% at 2 years, and 72% at 5 years follow-ups. Studies have also demonstrated a high reoccurrence rate of back pain within a year of receiving treatment with an average of 1.5 per person. However, a randomized control trial found no statistical significance in motor recovery at a 1 year follow up for those who received lumbar spinal surgery as compared to prolonged conservative treatment. A systematic review also found there to be no significant difference in improvement in the Oswestry back index for patients who underwent spinal surgery versus a non-operative group. Several studies also found physical therapy was more effective than no intervention and was better than conservative treatments at reducing back pain and improving function.

The patient in this case report presented with multi-level disk disease, spinal stenosis with bilateral lower extremity radiculopathy, history of right carotid aneurysm with coiling, and 20-year history of intermittent low back pain. She had previously been treated for a prolonged period of physical therapy consisting of stretching and strengthening exercises and chiropractic manipulation to address her low back pain with both being unsuccessful in addressing her pain.
After failed attempts of previous interventions and talking with the patient, it was thought she had not been taught how to properly manage her symptoms. Additionally, the previous program did not incorporate functional strengthening exercises of adequate intensity to allow her to return to daily activities. Due to her history of the right carotid artery aneurysm, care was taken when prescribing therapeutic strengthening exercises.\textsuperscript{6,7} Increased blood pressure associated with exercise and performing a Valsalva maneuver increases the risk of rupturing the repair.\textsuperscript{6,8,10,11} The patient was monitored throughout the treatment sessions for signs of dizziness, lightheadedness, and to ensure a Valsalva maneuver was not performed. Core strengthening was initiated at the initial visit and was maintained throughout the treatment session. Core strengthening initially included lumbar stabilization exercises with a focus of transverse abdominis contraction in PN. These exercises were initially selected due to lower levels of isometric contraction and reduced risk of increasing the patient’s blood pressure.\textsuperscript{11,17,23} Core strengthening exercises were progressed and updated to abdominal stiffening exercises to recruit and activate all components of the core and trunk musculature.\textsuperscript{24,25}

STM was performed from the initial visit through visit 14 which allowed reductions in muscular hypertonicity and pain. In contrast to the previous episode of care, which involved mechanical lumbar traction, joint mobilizations and traction were performed manually to individual lumbar segments. Traction was performed at L5-S1 at the initial visit through week 3 to reduce the pressure. This provided instant pain relief for the patient when performed, and reduced her radicular symptoms. As radicular symptoms decreased, grade II-III joint mobilizations were added at week 3 and were progressed to grade III-IV at week 5.
Neuromuscular re-education was applied to the multifidus of the joint to promote stability of the segment after joint mobilization at week 5. Activation of the multifidus musculature in the lumbar spine increased in both strength and activation time from weeks 5-20 as evidence by palpation. In contrast to previous treatment, functional tasks were incorporated into the interventions at week 5 and were continued until discharge. Functional tasks involved primary homemaking tasks to promote body and spinal safety awareness. The results of this case report suggest that a combination of therapy consisting of STM, segmental mobilization with neuromuscular re-education, and a progressive therapeutic exercise program with focus on abdominal stiffening and gluteal strengthening in the treatment of lumbar spinal stenosis and radiculopathy. With appropriate precautions, exercise may be safely performed in the presence of a repaired carotid aneurism.

As with any case report, we cannot infer cause and effect between the abdominal stiffening, segmental joint mobilization, and neuromuscular re-education, and the clinical improvement of the patient. However, the chronicity of her symptoms suggests that these interventions were a likely contributing factor for her clinical improvement. Further research is warranted to determine the most effective therapeutic protocol for patients with lumbar spinal stenosis.

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6) Magee DJ. Orthopedic Physical Assessment. Elsevier Health Sciences; 2008


26) Furlan A. Massage for low-back pain. Cochrane Database Of Systematic Reviews [serial online]. May 10, 2010;(6)Available from: Cochrane Database of


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<td>Oswestry Low Back Pain Questionnaire: 24%</td>
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<td>Same as previous</td>
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<td><strong>Trunk and Hip Mobility</strong></td>
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<td>Hip Flexion: 4+/5 on right, 4/5 on left</td>
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<td>• STM/release per findings&lt;br&gt;• Side-lying side-bend QL stretch/mobilization&lt;br&gt;• Segmental Traction L5-S1</td>
<td>• Single knee to chest&lt;br&gt;• Supine lumbar stabilization PN in HL (<em>)&lt;br&gt;• Glute bridge (</em>)&lt;br&gt;• Cat-Camel&lt;br&gt;• Supine piriformis stretch</td>
<td>• Patient was educated on examination findings and diagnosis&lt;br&gt;• Supine single knee to chest&lt;br&gt;• Lumbar stabilization PN in hook-lying (*)&lt;br&gt;• Supine piriformis stretch</td>
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<td>Sessions 5-8, Weeks 3-4</td>
<td>• As previous Added&lt;br&gt;• SL lumbar segmental rotation in flexion grade II-III mobilization (initiated cranially) L3-L4 L4-L5 B/L with neuromuscular re-education.</td>
<td>• Supine Glute Bridge with Theraband® (<em>)&lt;br&gt;• ¼ squat with and without yellow Theraband® (</em>)&lt;br&gt;• QL stretch&lt;br&gt;• ½ Hip flexor stretch kneel&lt;br&gt;• Abdominal stiffening with and without curl-up (*)</td>
<td>• Log walking hours&lt;br&gt;• Log onset of pain and activities prior to pain&lt;br&gt;• Side-lying QL stretch&lt;br&gt;• Supine lumbar stabilization PN (progression) in hook-lying single leg march&lt;br&gt;• Side-lying hip abduction&lt;br&gt;• Supine piriformis stretch</td>
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<td>Sessions 9-12, Weeks 5-6</td>
<td>• As previous added&lt;br&gt;• Side-lying lumbar segmental rotation in flexion Grade IV mobilization (initiated cranially) L3-L4, L4-L5 B/L, and Grade III L5-S1 on right with neuromuscular re-education</td>
<td>• ¼-½ squat with/without weight (<em>)&lt;br&gt;• Supine abdominal stiffening with curl-up (</em>)&lt;br&gt;• Monster walk with green Theraband® (*)&lt;br&gt;• Standing QL stretch&lt;br&gt;• ½ kneel hip-flexor stretch antagonist glute contraction&lt;br&gt;• Functional task training for homemaker activities</td>
<td>• Standing QL stretch&lt;br&gt;• Supine abdominal stiffening with curl-up (Update and Progression)&lt;br&gt;• ½ kneeling hip flexor stretch with antagonistic glute contraction&lt;br&gt;• Monster walks with yellow Theraband®(*)</td>
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<td>Sessions 13-16, Weeks 7-8</td>
<td>• As previous</td>
<td>• As previous added&lt;br&gt;• ½ goblet squat with yellow Theraband® (*)</td>
<td>• As previous</td>
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<td>Sessions 17-20, Weeks 9-12</td>
<td>• As previous&lt;br&gt;• Added general traction</td>
<td>• As previous</td>
<td>• Patient was discharged with an HEP program and advised to continue to progress her walking and strength exercises</td>
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<td>Discharge</td>
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(*) Indicates a Valsalva maneuver was not performed during the exercise.
Neuromuscular re-education was applied to the multifidus muscle of the joint to promote stability at the segment after joint mobilization (week 5). The patient decreased the activation time and increased the strength of the multifidus muscles from weeks 5-20 as evidenced by palpation.

Prior to performing abdominal stiffening exercises, the patient was educated on; what a Valsalva maneuver are, contraindications to performing the maneuver, and improper techniques related to the maneuver. When performing a Valsalva maneuver, the patient's blood pressure can elevate, increasing the risk of rupturing the repaired aneurysm.6, 7, 10, 11, 12 The exercises were modified to allow the patient to breath in/out while performing a gentle contraction/stiffening of the abdominal muscles. The patient was also monitored for any signs and symptoms of increased headache, dizziness, or lightheadedness, as this would indicate she was not tolerating the exercise modifications.

Neuromuscular re-education was applied to the multifidus muscle of the joint to promote stability at the segment after joint mobilization (week 5). The patient decreased the activation time and increased the strength of the multifidus muscles from weeks 5-20 as evidenced by palpation.