

**CORE ACTIVATION AND STRENGTHENING IN A PHYSICAL THERAPY PATIENT WITH  
CHRONIC LOW BACK PAIN AND LUMBAR INSTABILITY: A CASE REPORT**

**By**

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## **Abstract**

**Background and Purpose:** Using the treatment-based classification (TBC) system for the physical therapy management of subjects with low back pain, the following case report follows the physical therapy treatment of a 20-year-old female with chronic low back pain and lumbar instability in an outpatient physical therapy clinic. The primary focus of this case report is on the intervention decisions of the treating PTs. The outcome measures used in this case were the Oswestry Disability Index (ODI), Numerical Pain Rating Scale (0-10), Manual Muscle Testing (MMT), and Prone plank/Side plank endurance tests.

**Case Description:** AR, a 20-year-old female with chronic low back pain and lumbar instability presents to physical therapy with chief complaint of low back pain when standing extended periods.

**Outcomes:** Improvements were seen in all outcome measures despite infrequent attendance due to insurance authorization delays, work-schedule conflicts, and COVID-19 exposure. Most notable improvements were made in Prone/Side plank endurance testing (Prone plank: 48 seconds; Side plank: R 36 seconds, L 31 seconds) and ODI score (4/50, 8% impairment).

**Discussion:** Based on this case report and previous evidence, the recommendations for physical therapy treatment for chronic low back pain with instability should incorporate global core stabilization exercise activities and cardiovascular exercise.

**Key Words:** Chronic low back pain, lumbar instability, core activation, physical therapy

## **Introduction**

Chronic low back pain, one of the most prevalent health conditions in the US, was responsible for the highest number of years lived with disability in both 1990 and 2010 according to the US Burden of Disease Collaborators<sup>13</sup>. Not only has chronic low back pain been a common issue for decades, but the burden on the healthcare system continues to increase as prevalence and disability rises. In 2005 alone, an estimated \$102 billion was spent on healthcare for adults with spinal problems<sup>11</sup>. According to the article by Shmagel et al. which utilized the 2009-2010 National Health and Nutrition Survey (NHANES) to collect data on the epidemiology of chronic low back in the US population, it was found that US adults with chronic low back pain were more likely to be socioeconomically disadvantaged, with prevalence increasing with age and peaking in those in their 40s and 50s<sup>14</sup>.

According to the 2010 article by Beazell et al., lumbar instability can be categorized as either functional/clinical instability or mechanical instability, with the former being characterized by aberrant movement and poor neuromuscular control<sup>2</sup>. The treatment-based classification (TBC) system for low back pain was first established in 1995 by Delitto et al.<sup>5</sup> and was revised/updated by Alrwaily et al. in 2016<sup>1</sup>. This system provides clinicians with a framework (see Figure 1) to determine the most suitable approach (i.e., symptom modulation, movement control, or function optimization) to treat patients with low back pain based on their clinical presentation<sup>1</sup>.

The outcome measures used in this case were the Oswestry Disability Index (ODI), Numerical Pain Rating Scale (NPRS) 0-10, Manual Muscle Testing (MMT), and Prone plank/Side plank endurance tests. The ODI was found to have an MCID of 10 points or 30% improvement<sup>15</sup>. The NPRS was found to have an MCID of 1.5-2.2 in those with low back pain<sup>3</sup> and was the most

sensitive and had the highest retest reliability when compared to the VAS, VRS, and FPS-R for detecting change in pain<sup>7</sup>. MMT was found to have “good reliability and validity for use in those with neuromusculoskeletal dysfunction”<sup>4</sup>. In 471 healthy college-aged individuals (20 years of age), average times for prone plank endurance tests were 124 +/- 72 seconds for males and 83 +/- 63 seconds for females<sup>16</sup>. Prone plank endurance test for 118 office workers with nonspecific subacute low back pain. Scores were reported as 62 +/- 37 seconds for males and 46 +/- 29 seconds for females<sup>6</sup>. Prone and side plank endurance scores were found to be “significantly related to duration of symptoms” in those with chronic LBP<sup>17</sup>.

Interventions were selected based on the 2021 Revision to the JOSPT Clinical Practice Guidelines for the Treatment of Acute and Chronic Low Back Pain<sup>8</sup> and the works of McGill 2015<sup>12</sup> and Kavcic et al<sup>10</sup>. All exercises were directly or indirectly (progressions of exercises based in research) supported by research evidence for the treatment of patients with chronic low back pain with instability/motor control deficits. These exercises focused on global core activation and strengthening. Global core musculature includes the spinal erectors (iliocostalis, longissimus, spinalis, multifidus), quadratus lumborum, rectus abdominis, obliques and latissimus dorsi<sup>12</sup>. According to Kavcic et al., “no single muscle dominated in the enhancement of spine stability, and their individual roles were continuously changing across tasks<sup>10</sup>. Clinically, if the goal is to train for stability, enhancing motor patterns that incorporate many muscles rather than targeting just a few is justifiable”<sup>10</sup>. Additionally, cardiovascular exercise was incorporated based on the research support from Hoffman et al., 2014 for its ability to reduce pain in those with chronic low back pain<sup>9</sup>.

## **Case Description**

The patient, AR, is a 20-year-old Caucasian female who presents to outpatient physical therapy with a chief complaint of central low back pain that has been bothering her off and on since 2016, when she experienced more severe and more frequent episodes of pain while playing in high school band. AR's pain has improved since then but can still flare up to 10/10 when standing for long periods at work. She reports occasional pain near the sacrum and left hip also. AR denies numbness/tingling and bowel/bladder changes. AR has an unremarkable past surgical and medical history. She reports seeing a chiropractor in 2017 for her low back pain but has not had any recent appointments. She reports that her chiropractic visits "helped a lot".

## **Examination**

After obtaining the subjective information as mentioned above, the examination was performed. AR presents with mechanical low back pain, hypermobility, decreased motor control, and anterior trunk weakness resulting in increased pain with standing/sustained positions. Based upon clinical findings and subjective report, she is most appropriate for the movement control/stabilization category of TBC system for treatment of low back pain<sup>1</sup> and would benefit from activities to improve core stability, hip strength, and motor control. AR would benefit from physical therapy twice a week for five weeks to address previously mentioned impairments and improve ability to complete daily activities without pain. All aspects of the examination can be seen in Table 1.

## **Intervention**

Based on subjective report and clinical findings, AR best fit the stability category of the TBC system for low back pain<sup>1</sup>; therefore, interventions were provided to improve lumbar stability through global core activation/stabilization and strengthening activities. Additionally, due to the chronicity of pain in this case, cardiovascular exercise was included in each treatment session to address chronic pain. According to the 2021 Revision to the JOSPT Clinical Practice Guidelines for the Treatment of Acute and Chronic Low Back Pain, there is Grade A evidence for the use of “trunk muscle activation and movement control exercise,” “moderate-to high-intensity exercise,” and “trunk coordination, strengthening and endurance exercises to reduce LBP and disability” in those with chronic low back pain with movement control impairments<sup>8</sup>. In accordance with McGill, 2015, activities that focused on abdominal bracing were found to be more effective than ‘drawing in’ or ‘hollowing’ at improving spinal stability<sup>12</sup>. Additionally, exercises to enhance stability of the spine should target the core musculature in various positions<sup>10</sup>. At initial evaluation, three exercises were provided for AR’s home exercise program (HEP). With the initial focus on neuromuscular reeducation, the HEP targeted the hips, abdominals, and spinal stabilizers to improve proper activation of the global core musculature. The initial treatment session incorporated elements of neuromuscular reeducation and therapeutic exercise with progressions from mat activities to dynamic movements in weight bearing with continued emphasis on core activation in various planes/positions. As AR progressed through treatments 2-4, cardiovascular exercise increased in both intensity and duration, and exercises included various elements of stability, strengthening, and endurance to enhance the resiliency of the hip/core/trunk musculature. The last treatment session AR was seen for was a progress note; therefore, only thirty minutes of exercise was completed. See Table 2 for intervention timeline.

## **Outcomes**

Initially, AR had poor endurance, but she progressed well with all interventions and demonstrated improvement in all outcome measures at the time of the progress note at visit 5. Most notable improvements were made in prone and lateral plank endurance tests and in the Oswestry Disability Index, showing improvements in both physical performance and patient perception of function. AR was not seen for one month following initial evaluation while waiting for insurance authorization. Additionally, prior to the progress note on visit 5, AR was unable to attend PT treatments for two weeks due to changes in her work schedule and being exposed to COVID-19. Although these delays limited the number of treatment sessions, the interventions were progressed as tolerated, and AR was able to quickly build upon the foundational movements in her HEP from the initial evaluation. Despite only having 3 full treatment sessions, AR stated being “more aware” and having “better control” of her pelvic position during daily activities. See Table 3 for all patient outcome measures.



## **Discussion**

AR demonstrated improvement in all outcome measures (see Table 3) despite the low number of treatment sessions; therefore, it is relatively safe to say the intervention types and dosing were appropriate for this patient. By progressing quickly from mat activities to more functional movements while still targeting the global core, AR was able to apply her new sense of body awareness and control to activities in her daily life and reduce the intensity of her low back pain. Additionally, AR was challenged in a multitude of positions and planes of movement, thus the core musculature was activated in various magnitudes and directions, and applicability to daily tasks was enhanced. The combination of neuromuscular reeducation and therapeutic exercise focusing on activation and strengthening of the global core was sufficient in improving trunk muscle endurance and reducing disability related to low back pain and function. If the subject had been treated on a more regular occasion and for a longer period, additional exercises targeting the global core stabilizers that included components of cardiovascular fitness (i.e., TABATA, EMOM, etc.) to ensure additional cardiovascular training for treating chronic pain would have been included in her treatment program.

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## Tables and Figures

<b>Table 1: Examination Findings</b>		
<b>Observation</b>	<b>Posture:</b> Increased lordosis in standing, slight increase in kyphosis, elevated R shoulder	
<b>Lumbar Spine Motion</b>	<b>Quantity/Quality of Motion</b>	
Flexion	Within normal limits, but lack of trunk lumbar flexion curvature	
Extension	Excessive extension, with hinge point at lumbosacral junction	
Right Sidebending	Within normal limits	
Left Sidebending	Within normal limits	
<b>Joint Mobility</b>	<b>End-Feel</b>	<b>Symptoms</b>
Sacral Rocking	Hypermobile	No change
Segmental Rocking	Hypermobile	No change
SIJ Mobility	Hypermobile	No change
Hip Mobility	Greater hip ER vs IR	No change
Thoracic Mobility	Hypermobile	No change
<b>Manual Muscle Test</b>	<b>Right Strength</b>	<b>Left Strength</b>
Hip Abductors	5/5	5/5
Glute Max	4/5, with lumbar extension	4/5, with lumbar extension
Posterior Glute Med	4/5	4/5
Anterior Glute Med	4-/5	4-/5

Hip External Rotators	4+/5	4+/5
Hip Internal Rotators	4/5	4/5
<b>Special Tests</b>	<b>Right</b>	<b>Left</b>
Supine Bent Knee Fall Out/Marching	Positive	Positive
Beighton's Criteria for Ligament Laxity	9/9 factors positive	9/9 factors positive
<b>Trunk Endurance Tests</b>	<b>Time (seconds)</b>	
Prone Plank	21 seconds, with lumbar hyperextension and increased thoracic kyphosis	
Lateral Plank	Right: 21 seconds  Left: 13 seconds	
<b>Patient Self-Reported Outcome Measures</b>	<b>Outcome/Score</b>	
Oswestry Disability Index (ODI)	13/50 = 26% impairment	
Numerical Pain Rating Scale	Current: 2-3/10 low back pain  At worst: 10/10 low back pain	

<b>Table 2: Interventions</b>	
Visit #	Interventions
1/HEP	<b>NMRE:</b> BKFO: 5 sec holds, 2 min with YTB   Supine marching, 2 min   Quadruped with alternating UE reach, 2 min

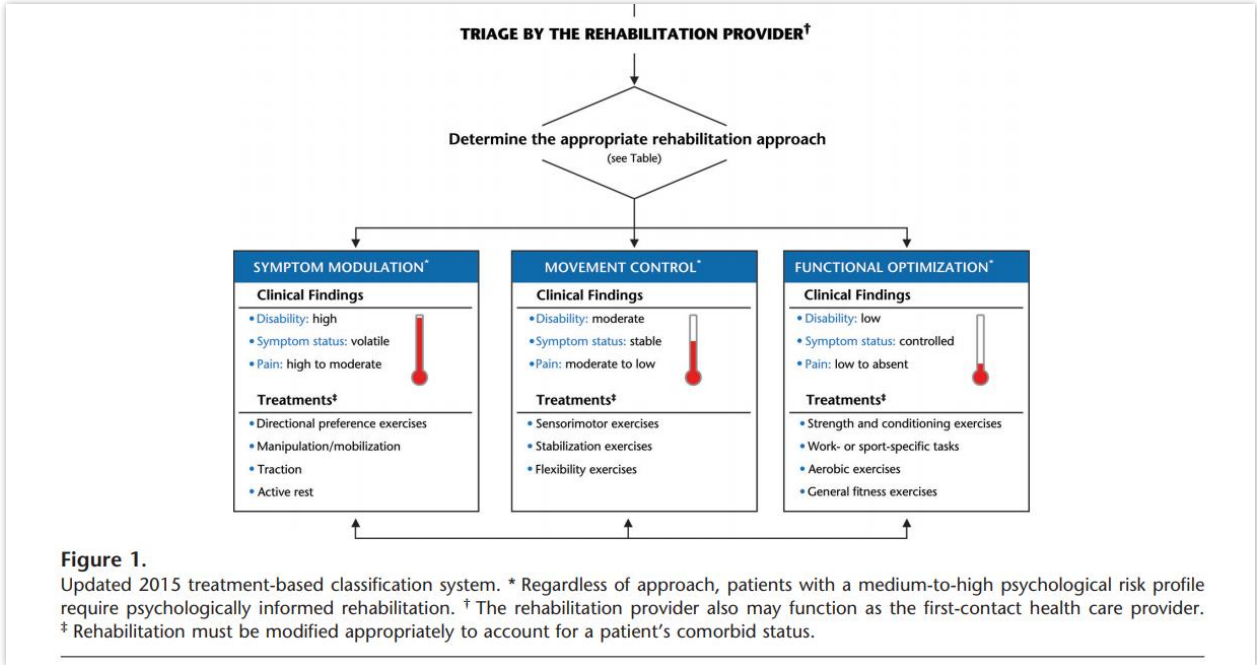
Insurance authorization took 1 month from initial eval to first treatment session	
2	<p><b><u>NMRE:</u></b> Abdominal bracing 5 sec hold, 3 min   Brace with bridge 5 sec hold x20 reps            Quadruped cat/camel 2 min   Quadruped alt arm raises 2x5 reps ea   Supine alternating          hip flx iso 10 sec holds, 2 min   Shuttle squats maintaining neutral spine 33#, 3 min  </p> <p><b><u>TherEx:</u></b> TBE x 8 min lvl 2   BKFO RTB 15x ea side   Side clams x15 ea side            Dynamic warm up: marching, butt kicks, sidesteps 30' x 2 laps ea, working on keeping          pelvis level</p>
3	<p><b><u>NMRE:</u></b> Quadruped cat/camel 2 min   Quadruped bird dog 10x ea, 5 sec holds   Dead          bugs 3x30 sec   Lunge iso with 4# medball chops 2x10 reps ea leg</p> <p><b><u>TherEx:</u></b> Bike lvl 3, 10 min   Dynamic warm up: marching, figure-4 foot-taps, hip          openers, sidesteps with RTB around knees   Pallof Press 2x10 reps ea with red sport          cord   Stir the pot 2x10 reps ea with red sport cord</p>
4	<p><b><u>NMRE:</u></b> Quadruped cat/camel 2 min   Quadruped bird dog 10x ea, 5 second holds            Dead bug 3x30 sec with swiss ball   Lunge iso with 4# med ball chops 2x10 reps ea leg            Single leg eccentric heel taps from stair 2x8 reps ea   2-stair step up with oppos UE pull          down with BTB working post oblique sling</p> <p><b><u>TherEx:</u></b> Bike 10 min lvl 3   Dynamic Warmup: marching, figure-4 foot-taps, hip          openers, dynamic hamstring stretch/sciatic mobilizer 30'x 2 laps ea   Monster walks          with no money iso with YTB 30' x 2 laps   Pallof press with red sport cord 2x10 reps ea            Stir the pots with red sport cord 30 sec CW/30 sec CCW 2x ea direction   Front plank          2x30 sec</p>

Patient missed 2 weeks of appointments due to work schedule change, COVID exposure.	
5/PN	<p>Performed progress note retesting.</p> <p><b>NMRE:</b> Quadruped cat/camel 2 min   Quadruped bird dog 20x ea, 5 second holds    Dead bug 3x45 sec with swiss ball   Lunge iso with 4# med ball chops 2x10 reps ea leg    Single leg eccentric heel taps from stair 3x8 reps ea</p> <p><b>TherEx:</b> Bike 10 min lvl 3   Monster walks with no money iso with YTB 30' x 2 laps    Stir the pots with red sport cord 30 sec CW/30 sec CCW 2x ea direction</p>

<b>Table 3: Patient Outcome Measures</b>				
<b>Visit #</b>	<b>ODI</b>	<b>Numerical Pain Rating Scale</b>	<b>MMT</b>	<b>Endurance Test</b>
1	13/50, 26%  impairment	Current: 2-3/10  LBP  Worst: 10/10	Hip Abductors: R 5/5, L 5/5  GMax: R 4/5, L 4/5 (with compensatory lumbar ext noted)  Post glut med: R 4/5, L 4/5  Ant glut med: R 4-/5, L 4-/5  Hip ER: R 4+/5, L 4+/5  Hip IR: R 4/5, L 4/5	Prone Plank: 21  seconds (lumbar extension and increased kyphosis)  Lateral plank: R 21  seconds, L 13  seconds



Insurance authorization took 1 month from initial eval to first treatment session				
2		Current 2/10 LBP		
3		Current 2/10 LBP		
4		Current 2/10 LBP		
Patient missed 2 weeks of appointments due to work schedule change, COVID exposure.				
5/ PN	4/50, 8% impairment	Current 1/10 LBP  Worst: 7/10	Hip Abductors: R 5/5, L 5/5  GMax: R 4/5, L 4/5  Post glut med: R 4/5, L 4/5  Ant glut med: R 4/5, L 4/5  Hip ER: R 4+/5, L 4+/5  Hip IR: R 4/5, L 4/5	Prone plank: 48 seconds  Lateral plank: R 36 seconds, L 31 seconds



**Figure 1: Treatment-based classification system for low back pain<sup>1</sup>**