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Case Report

The Effect of Therapeutic Exercise in Postural Low Back Pain: A Case Report

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Abstract

Postural low back pain (LBP) is a non-specific LBP defined as pain or discomfort in low back areas caused by incorrect posture for ages. Most patients only experience mild and moderate pain from low back pain, however, it can cause chronic pain and disability for several groups. This case report aims to investigate the effect of therapeutic exercise on posture and pain in postural LBP.

A 37-year-old male presented with LBP for 4 months with Numeric Rating Scale (NRS) 7. Physical examination showed impaired posture, wide base gait, limitation ROM of trunk, reduced breathing count test, muscle spasm at upper and lower back areas, positive in Thomas test, Ely test, and hamstring tightness test. The back pain functional scale (BPFS) was 7. The therapeutic exercise program consisted stretching exercises (neck, upper and lower back, hamstring, rectus femoris, iliopsoas muscle), core strengthening, William's flexion, McKenzie's, breathing and chest expansion exercise, alongside proprioceptive exercise. One cycle (eight times) of physical modalities, TENS at paralumbal and USD at paracervical, upper and middle trapezius, rhomboid, sternocleidomastoideus, paralumbal, and insertion of hamstring were given. We evaluated the patient's condition for about 4 months, and the patient showed a good compliance with improvement in pain score, ROM of the trunk, reduced muscle spasm and tightness, improved posture, gait, breathing, and BPFS. The patient can return to do his job again.

This case report is able to demonstrate that therapeutic exercise improves clinical and functional conditions. These findings suggest the clinical implications of therapeutic exercise in patients with postural LBP are beneficial.

Keywords: *exercise, impaired posture, low back pain, non-specific low back pain, posture, posture correction, postural low back pain, therapeutic exercise*

INTRODUCTION

Low back pain can be described as pain between the ribs to the gluteal folds.[1] Some are also referred as low back disorders, because of musculoskeletal disorders in the form of discomfort in the lower back, as well as actual injuries to the lower back.[2] Low back pain can also be understood as one of the musculoskeletal disorders which become the global burden diseases in the world, it caused disability to 64.9 million people in the world, compare with other diseases such as diabetes (38.6 million) and chronic obstructive pulmonary disease (30.6 million) in 2017.[3,4] Approximately one in four adults in the United States has low back pain lasting at least 24 hours in 3 months, with 7.6% experiencing one episode of severe acute low back pain within 1 year. Low back pain has a major effect on quality of life, people more often leave their job because of low back pain. Patient seeking medical consultation from their general practitioner most often suffer moderate to severe pain, impairment of motor, sensory functions, and psychological due to low back pain.[4]

Specific causes of low back pain are usually unidentified. However, most of low back pain are categorized as mechanical, and non-specific. Non-specific low back pain is a constellation of symptoms that cannot be attributed to a known specific pathology (e.g., infection, malignancy, osteoporosis, fracture, structural deformity, inflammatory disorder [e.g., ankylosing spondylitis], radicular syndrome, and cauda equina syndrome). Many factors affect non-specific low back pain, among them biomechanical, psychosocial, physical, environmental, genetic, and cultural factors[5]. Research on the factors of low back pain has revealed both biological and behavioral modifications. On a biological level, low back pain has been linked to disc degeneration, inflammation, atrophy, adipose infiltration, and paraspinal muscle fiber type transition. Low back pain has been shown to be associated with changes in movement, which can be described as changes in motor control (affecting spine posture, stability, and movement) observed at the level of the nervous system [spinal and supraspinal processes] and the

musculoskeletal system (biomechanical mechanisms including muscle activity and kinematics). In addition, psychological factors are significant and non-negligible risk factors for the onset and persistence of low back pain[6].

Based on the duration, low back pain is divided into acute low back pain (≤ 6 weeks), sub-acute low back pain (6-12 weeks), and chronic low back pain (≥12 weeks)[7]. The majority of acute and subacute episodes of non-specific low back pain ameliorate significantly within six weeks, and the average pain intensity is moderate after one year. However, two-thirds of individuals with low back pain continue to experience discomfort at three and twelve months[4]. Only 10% to 20% of non-specific low back pain patients develop to chronic low back pain, which causes episodes of excruciating pain, significant physical disability, and activity restriction.[8]

Posture is the alignment of the body's parts while standing, seated, or in a supine position. This is characterized by the position of the joints and body segments, as well as the equilibrium of the muscles that cross the joint. Incorrect posture can be caused by disorders in the joints, muscles, or connective tissues; conversely, incorrect posture can cause discomfort and pain as well as disorders in the joints, muscles, and connective tissues. A large number of musculoskeletal complaints are caused by improper posture practices that are repeated and persistent[9]. Postural low back pain is a non-specific low back pain defined as pain or discomfort in low back areas caused by bad posture for long period of time[10]. Hence, a complete history and physical examination are necessary to determine the cause of low back pain, which can lead to more appropriate therapy and enhance the success of therapy. Eliminate serious medical causes, and determine whether the further diagnostic evaluation is also needed[1]. This case report aims to investigate the effect of therapeutic exercise on posture correction and reduced pain in postural low back pain patient.

CASE REPORT/ CASE SERIES

A 37-year-old male, builder, presented with low back pain for 4 months.

The pain was sharp, intermittent, and radiated from the low back area to his left leg. The pain was worsened by lying to sit, sitting to stand, and walking for about 100 m with Numeric Rating Scale (NRS) 7. The pain was relieved by rest and bent forward. The pain is not affected by coughing and sneezing. If the patient walks, he did not have to stop first and then continue walking again. There were no numbness and no tingling sensation. The patient can feel the sensation of urinate and defecate, and able to hold urinate and defecate.

Physical examination showed impaired posture (forward head, shoulder asymmetry, scapulae retraction, kyphotic at thoracal, straight lumbal, posterior pelvic tilt, flexed at both hip and knee), wide base gait, limitation range of motion (ROM) of trunk (flexion 0-55°, extension 0-15°), reduced breathing count test (20-21-21), muscle spasm at upper and lower back areas (paracervical muscle, upper and middle trapezius, rhomboid, sternocleidomastoideus, paralumbal muscle, quadratus lumborum), positive result in Thomas test, Ely test, and hamstring tightness test. The therapeutic exercise program consisted of stretching exercises (neck, upper and lower back, hamstring, rectus femoris, and iliopsoas muscle), core strengthening exercise, William's flexion exercise, McKenzie's exercise, breathing and chest expansion exercise, alongside proprioceptive exercise. One cycle (eight times, 2 times/week) of physical modalities, transcutaneous electrical nerve stimulation (TENS) at paralumbal and ultrasound diathermy (USD) at paracervical, upper and middle trapezius, rhomboid, sternocleidomastoideus, paralumbal, and insertion of hamstring muscle were given. Back Pain Functional Scale (BPFS) was 7.

After evaluating the patient's condition for about 4 months, the patient had a good compliance of therapy with improvement in pain score (NRS 7 to 2), ROM of the trunk, reduced muscle spasm and tightness, improved posture (head, pelvis, hip, and knee in neutral position), gait, breathing (21-22-21 to 30-31-31), and the Back Pain Functional Scale (BPFS) (7 to 60).

Figure 1. Showed the change in Ferguson's angle in 2 months of therapy. 1st X-Ray examination the Ferguson's angle 25° (a) and after 2 months of therapy examination the Ferguson's angle 30° (b)

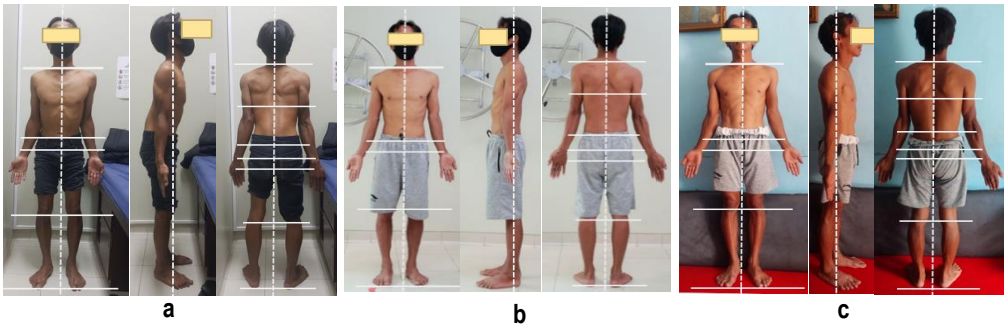

Figure 2. Improvement in patient's posture of the head, pelvis, hip, and knee in neutral position; 1st visited in PM&R outpatient clinic (a), after 3 months of therapy (b), and 4 months of therapy (c)

DISCUSSION

Musculoskeletal disorders are among the most prevalent noncommunicable diseases with advancing age, and epidemiological evidence indicates that the prevalence of low back pain increases from adolescence to age 60 and then declines. A significant percentage of low back pain cases in individuals under 50 years old are nonspecific and have postural or mechanical causes.[11] Posture is a complex pattern of reflexes, behaviors, and adaptive responses to something that resists and resists from being upright or functional by the concerted activity of numerous muscles employed to maintain stability.[12] This case report illustrates, patient under 50 years old, working as a builder. Builder or construction worker renowned for being unhealthy due to the elevated mechanical

nature and rigorous physical labor involved in his work. As nearly 80% of construction workers' working postures were found to be detrimental to their musculoskeletal systems, construction workers are at a greater risk of developing musculoskeletal conditions, such as low back pain, a prevalent problem in the industry. In roughly half of the respondents in the numerous studies of construction workers in Saudi Arabia, Sweden, and India, low back pain was reported. Many manual construction workers may experience low back pain, but they do not disclose it as an injury.[13] The etiology of pain in postural low back pain can be due to the effects of mechanical stress, impaired postural support of trunk muscles, and impaired muscle endurance.[9]

The main goals of rehabilitation in patient low back pain are to control pain, restore function, ensure no future functional deficits occurring, maintain work and productivity, and prevent chronicfication in acute low back pain.[14] Biomechanical parameters have previously been used to identify nonspecific low back pain patients.[5] Spinal posture is frequently emphasized during the evaluation and clinical management of low back pain patients[10]. Vertebrae support the body in an upright position, balance mechanically according to gravity, allow movement, and assist in purposeful movement[9]. Unusual body positions result in atypical pressure and tension on various spinal components, which are regarded as factors that make one more low back pain.[15] The vertebra curve is divided into four parts: two principal curves or posterior curves (kyphosis) in the thoracic and sacral regions, and two compensatory curves or anterior curves in the cervical and lumbar regions. For the vertebral column to withstand the effects of gravity and other external force, curves and flexibility are essential. Gravity exerts pressure on the structures responsible for maintaining the body's upright position, posing an ongoing challenge to stability and effective movement. For a weight-bearing joint to be stable or in equilibrium, the mass's gravity line must pass through the axis of rotation precisely, or there must be a force to counteract the moment caused by

gravity. Generally, standing posture entails four centimeters forward/backward body swing, hence muscles are required to control the swing and maintain balance.[9]

Stability of vertebral posture is affected by inert structures (passive structures/bones and ligaments), active structures (muscles), and neurological control. These three subsystems are interconnected.[9] While the active, neuromuscular components control movement, the passive structures of the spine provide stability, limit and define range of motion, and ensure the neural structures within the spinal canal. Disturbances in one or more of these three stabilizing mechanisms cause spinal segments to move outside of their normal range of motion (the so-called neutral zone), resulting in tissue damage and triggering low back pain. If, for example, the muscle control system exerts sub-optimal stabilizing forces on the spinal column, overload of the joints and soft tissues around the joints is likely to occur, resulting in predominantly nociceptive pain. This diminished muscular control may be the result of diminished neural drive or feedback from the neurologic structures that control the muscles and joints.[16]

Beyond the vertebrae, the principal anatomical structures are the intervertebral disc connecting the vertebral corpus, the anterior longitudinal ligament covering the ventral section of the vertebrae, the posterior longitudinal ligament which is attached to the dorsal cortex of the vertebra, the ligamentum flavum connecting the laminae of the spinal column, the intertransverse ligaments connecting the transversal processes, facet joints are composed of cartilaginous joint surfaces surrounded by facet joint capsules and are the only bony structure that provides passive stability. Due to their anatomical location and unique compositions, each passive structure contributes to the stability of the body during specific movements and under specific loading conditions.[17]

Various muscle groups, including the hamstrings and back muscles, are crucial for sustaining posture and preserving balance during movement. While the ligament serves to hold the body together,

these postural muscles prevent the forces of gravity from propelling us forward.[12] There are two categories of active subsystem components: global and local stabilizer muscles. The global stabilizer muscles play an important role in conducting trunk and hip movements, while the local stabilizer muscles have the unique function of stabilizing the segments relative to one another. Local stabilizers typically consist of all deep layer muscles, including the lumbar multifidus, transversus abdominis, pelvic floor muscles, and diaphragm. These deep muscles can perform their stabilizing function in a variety of methods. The lumbar multifidus plays a crucial role in segmental control, particularly during lifting and rotational motions.[18] The role of the lumbar multifidus becomes immediately evident when examining the muscular stabilization of the lumbar spine. The deep fascicles of the multifidus typically span a single segment and are "strategically positioned to provide proprioceptive feedback from the lumbar spine." In contrast, the intermediate fascicles may play a role in regulating intersegmental movement, whereas the superficial fascicles are capable of generating a significant amount of torque in a craniocaudal direction. The multifidus is the most powerful stabilizer of the lumbar spine, and the combined actions of the bilateral multifidi account for over two-thirds of the spine's rigidity in the neutral zone. Chronic low back pain is strongly associated with changes in multifidus, and many patients with low back pain exhibit atrophy of multifidus within days of onset of back pain. Atrophy can occur unilaterally or bilaterally, and bilateral atrophy is commonly observed in patients with unilateral pain complaints. Multifidus changes are proportional to the duration of symptoms in patients with chronic low back pain and are not caused by a change in muscle fiber type.[16] Since the transversus abdominis muscle attaches to the thoracolumbar fascia, it can indirectly increase the stiffness of the lumbar spine. In conjunction with the transversus abdominis, the pelvic floor muscles and diaphragm are responsible for maintaining and increasing intra-abdominal pressure during a variety of

postural duties.[18] The intercostal muscles serve as postural muscles to stabilize and move the ribcage, and breathing has an effect on posture and stability. They function as a dynamic membrane between the ribs to prevent the inhalation and exhalation of soft tissue during respiration. The transversus abdominis muscle's stabilizing function collaborates with the diaphragm in a feed-forward response to rapid arm motions. Prior to rapid arm movement, the diaphragm contracts and intra-abdominal pressure rises regardless of the phase of respiration or the direction of the arm motion. The transversus abdominis muscle and diaphragm are modulated to meet respiratory demands during both inspiration and expiration and to provide spinal stability during repetitive limb movements.[9]

The inhibition of the neuromuscular control system (in the brain and spinal cord) by nociceptive signals (pain) from the vertebrae compromises muscle stability and movement. The proprioceptive feedback from the muscles themselves is altered by a disruption in neural drive. Chronic low back pain is linked to cortical alterations in the brain. Impaired motor control of the multifidus in patients with chronic low back pain is associated with changes in cortical representation of the multifidus and subsequent ability to exert voluntary control, and there is evidence of trunk muscle representation reorganization at the motor cortex in individuals with recurrent low back pain. This reorganization is associated with postural control deficits. Individual fascicles of multifidus are activated by distinct regions of the motor cortex, and motor control training can reverse cortical reorganization in patients with back pain. At least for motor training that focuses on the transverse abdominis, there is evidence that motor training can reverse the pathologic reorganization of neuronal networks in the motor cortex in individuals with recurrent pain.[16]

This case report showed, patient had impaired posture, wide base gait, limited ROM of the trunk, and muscle spasm. As determined by studies of functional activities, during activities such as standing, walking, running, rising from a chair, or

lifting up an object, low back pain patients have a reduced lordotic posture and lumbar spine range of motion compared to healthy controls[6]. Without adequate stabilization of the spine, contraction of the limb-girdle muscles transmits forces proximally and causes spine motions that place excessive stresses on spinal structures and supporting soft tissue.[9] Studies demonstrate a wide variety of muscle activity patterns, ranging from increased lumbar extensor muscle activity to no difference or even decreased activity in low back pain patients compared to healthy controls. Combining kinematic and electromyographic experiments with musculoskeletal modeling reveals increased lumbar spine loading in patients with low back pain, which can be primarily explained by postural adaptations and increased trunk muscle activity. Studies of low back pain patients' postural control demonstrated a delay in the onset of trunk muscle activity in response to both predictable and unpredictable perturbations. These findings suggest that low back pain patients suffer from a variety of motor control impairments, most likely due to interaction deficits between the sensory and motor systems responsible for goal-directed spine posture, stability, and movement.[6] The alignment of the spine and pelvis in a front-to-back view triggers a sequence of spinal reactions. The configuration and positioning of each segment impact the neighboring part to maintain a stable stance while using minimal energy. Having a forward head posture could potentially disrupt the ability to sense repositioning and the neurological control of an upright standing position. The reflex connecting the pelvis and visual guides how the lower body responds to cues from head placement and predictive visual signals. Anomalies in the sagittal alignment of the lower back and pelvis stand out as crucial underlying factors associated with lower back pain.[15] Therefore, it is important to enhance the overall posture, addressing not only the lower back region but also addressing misalignment in the head or upper back. In the context of this study, reducing muscle spasms in the paracervical area, as well as the upper and middle trapezius, rhomboid, and sternocleidomastoid muscles, holds

significance.

Many spinal and extremity disorders and functional restrictions arise from improper posture. Frequently, the primary symptoms can be minimized or even eliminated by addressing the underlying postural stresses. Management of posture impairment can be done by (1) increasing awareness and posture control of the patient, the aim is to develop proprioception of spinal positioning, safe movement, and postural control; (2) allowing the patient to persistent and repeated effects of posture disturbance on pain and function, followed by the patient's ability to improve posture; (3) increasing the range of motion of certain structures that affect alignment and mobility; and (4) improving muscle performance through stabilization, muscle endurance, and strength training. Activation of the stabilizing musculature is then reinforced when progressing to muscular endurance and strengthening exercises, when performing aerobic exercises, and when practicing functional activities throughout the rehabilitation process, with the hope that stabilizing muscle activation will become automatic during all daily activities and functional challenges.[9,19]

Additionally, in postural rehabilitation approaches, the diaphragm muscle and the patient's respiration control are given significant weight,[20] diaphragmatic exercise is sometimes required.[21] Studies have shown that diaphragm training increases not only the thickness of the diaphragm, but also the thickness of other stabilizer muscles, such as the transversus abdominis and multifidus muscle, leading to a significant reduction in pain.[18] This is consistent with the findings in this case, which showed that the pain scale decreased after the breathing count test showed improvements.

Occasionally, pelvic floor exercises are also required[21] as the pelvic floor is an essential component of the muscles that stabilize the core[22]. The pelvic floor consists of muscles that connect the anterior pelvis pubis to the posterior tailbone and ischial tuberosities. The pelvic floor muscles play a crucial role in stabilizing the lumbar region through appropriate muscle activation. This forms the root of the

abdominal cavity and increases intra-abdominal pressure during various daily activities. The abdominal muscles contract in response to the contraction of the pelvic floor muscles, which contract in response to both a "hollowing" and "bracing" abdominal order, and the abdominal muscles can also activate the pelvic floor muscles.[23]

Many patients with low back pain must participate in employment or community activities. The diversity and complexity of the patient's living and working environments may also affect postural control.[24] Improper seating, such as half-buttock sitting, bending toward the steering wheel, lack of head support, and unnecessary lateral twisting, can cause low back pain in drivers by compressing the lumbar structure. Frequent drivers require an ergonomic evaluation of driving postures and preventative measures to reduce the incidence of musculoskeletal disorder.[11] Different muscles are predominantly stimulated, depending on the seating posture, based on the body's position while seated.[25] According to research comparing the activity of trunk muscles based on posture, slouched sitting substantially reduces the activity of the internal obliques/transversus abdominis compared to upright sitting.[26,27] Postural variations can reduce spinal loads and spinal shrinkage, prevent muscle fatigue through alternating motor unit activation, and prevent damage to the posterior aspect of the annulus pulposus by means of low magnitude dynamic movements.[28] According to this case, as a builder especially installing brick and ceramic. His job was squatting for a long time and carrying a heavy object. Educating the patient about the ergonomic position during work is important.

CONCLUSION

This case report was able to demonstrate that therapeutic exercise improves clinical and functional conditions. The presence of exercise and good patient compliance can improve posture and reduce low back pain. The patient's function was improved and the patient was able to do his job again. These findings suggest the clinical

implications of therapeutic exercise in patients with postural LBP are beneficial.

DISCLOSURES

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Conflict of interest

The authors declare that there are no conflicts of interest.

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Author Contribution

All authors have contributed to all processes in this case report, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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