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Case Report

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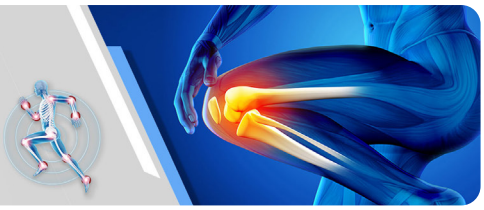

Wall Touch-Single Limb Stance Exercise for Dynamic Gluteus Maximus Activation in a Patient with Chronic Lumbar Radiculopathy: A Case Report

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Abstract

The role of the gluteus maximus (GMax) in low back pain is significant due to its altered stability functions, delayed activation, and connection with the thoracolumbar fascia. While exercises like step-ups, unilateral squats, and deadlifts activate GMax, there is no consensus on the best exercise for gluteal activation in painful conditions. This case report highlights the effectiveness of the Wall Touch-Single Limb Stance (WT-SLS) exercise for dynamic GMax activation in reducing lumbar radiculopathy symptoms. A 38-year-old male with chronic lumbar radiculopathy experienced immediate symptom relief, particularly reduced numbness, after incorporating WT-SLS exercise into his treatment. WT-SLS exercise, combined with a conventional protocol including core strengthening, proved remarkably effective. However, extensive clinical trials are needed to confirm its efficacy in broader patient populations.

Keywords: Exercise; Gluteus maximus; Lumbar radiculopathy; Muscle activation

Introduction

Low back pain (LBP) is one of the commonest reasons for being off-work. Physically demanding occupations, LBP and work-absenteeism are all associated. Lumbar radiculopathy (LR) causes pain radiating from the lower back down the legs, often leading to disability. While various treatments exist for LR, such as traction, exercises, and manual therapy, the role of the gluteal muscles, particularly the gluteus maximus (GMax), is frequently neglected in managing LBP.

GMax often becomes weak and elongated due to sedentary lifestyles and possibly poor posture. Muscle imbalances in the stabilizers of the lumbopelvic region are linked to the onset and worsening of LBP and radicular symptoms. LBP is associated with altered hip extensor recruitment patterns and disrupted lumbo-pelvic rhythm, both of which involve the GMax [1]. This leads to a failed load transfer system, with hamstrings activating early to compensate for weak GMax [2]. Hip muscles, including GMax, are crucial for lumbar segmental stability. GMax helps stabilize hip joint movement, affecting load transfer from the lower limbs to the sacroiliac joint (SIJ) and vertebral bodies [3].

In our previous study, we found that the Wall Touch-Single Limb Stance (WT-SLS) exercise resulted in higher GMax activation compared to other commonly used weight bearing exercises like step-ups and unilateral wall squats [4]. To the best of our knowledge, the effect of WT-SLS in clinical populations has not been studied before. Here, we used this exercise to dynamically activate GMax in a subject with chronic LR.

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Case Description

A 38-year-old male, reported with constant pain in the lower lumbar region radiating to his right lower limb (RLL) till outer two toes, along with numbness in the lateral right leg and foot dorsum for over a year, triggered by lifting. His pain varied in intensity and was moderately irritable, with only temporary relief from previous treatments such as medications and physical therapy.

Recently, he has been experiencing symptoms with prolonged standing and walking activities (>8-10 minutes), [VAS (LBP) at rest: 1, with activity: 3-4; VAS (leg pain) at rest: 4, with activity: 7-8], along with disturbed sleep.

Physical examination revealed severe pain in RLL, at the end range of spinal flexion. The backward bending was painful from midrange onwards, with reproduction of symptoms in RLL, and was suggestive of lumbar extension dysfunction owing to reduced intervertebral mobility. Right side bending was slightly painful. Central posteroanterior (PA) vertebral palpation over L4, L5 showed hypomobility and local pressure pain, with no symptom reproduction. Right Lateral PA (grade II) over L4, L5 reproduced the symptoms in RLL, to a VAS of 7/10. Subjective testing of hip extension recruitment pattern revealed delayed firing of GMax, after hamstring and erectors. Active straight leg raise (SLR) testing was suggestive of ineffective force closure, more on the symptomatic side. Involvement of sacro-iliac and hip joints was ruled out with detailed symptoms history and negative SIJ provocation tests (cluster of Laslett). Further, there was tightness of right piriformis, and left hamstrings. Right hamstrings could not be checked for tightness because of pain provocation.

There was no motor deficit, but a mild sensory deficit (light touch) of nearly 30% (subjective) over the right L5 and S1 dermatome, with no evidence of upper motor neuronal affliction. The passive right SLR (measured with half-circle goniometer) was limited to 40° owing to pain which initiated in lower leg posterolaterally, increased in intensity and extended more distally (till toes) and proximally (up toward posterior thigh) on addition of the sensitization components of ipsilateral hip adduction and internal rotation. Left passive SLR was limited to 65° with sensation of ipsilateral hamstrings stretch. Slump and prone knee bending test were negative. Palpation revealed tenderness over the lower lumbar region and right buttock. Mild muscle guarding was present in bilateral paraspinals in the lumbar region (R>L).

MRI findings were suggestive of protruded intervertebral disc at L4-5 and L5-S1 levels, with no significant reduction in canal diameter. Table 1 describes the examination findings.

Table 1: Examination findings at baseline.

Measure	Baseline finding
Painful Active spinal range of motion (if any)	Extreme lumbar flexion
	Mid- to extreme lumbar extension (with paraesthesia)
	Right lumbar side-flexion
Palpation	Tenderness over the lower lumbar region and right buttock
PAIVMs	Hypomobile L4-L5 on central posteroanterior (PA) vertebral palpation and local pressure pain, with no symptom reproduction.
	Right Lateral PA (grade II) over L4, L5 reproduced the symptoms in RLL.
Muscle delayed firing (subjective- palpatory during movement)	Gluteus maximus after hamstrings and spinal erectors
Muscle tightness	Right piriformis
	Left hamstrings.
	Right hamstrings could not be checked for tightness because of pain provocation.
Dermatome Affected	L5-S1 (Light touch)
Myotome (Motor deficit)	None
Deep tendon Reflexes (bilateral)	Normal
Passive SLR	Left-65^0
	Right -40^0
Bilateral Slump test	Negative (-)
Bilateral Prone knee bending test	Negative (-)
SI joint provocation tests (bilateral) (Cluster of Laslett)	Negative (-)
MRI findings	Protruded intervertebral disc at L4-S1 levels (no significant reduction in canal diameter).
PAIVMs: Passive Accessory Intervertebral Movements, SLR: Straight Leg Raise	

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Procedure

Initially aiming to reduce pain, the patient was treated with hot fomentation, deep transverse friction, and muscle energy technique for his right piriformis, followed by Maitland's right lateral PA (Grade II) over L4 and L5 till centralization. This resulted in a mild pain decrease (VAS 3/10) but no change in SLR status. The home program included positioning advice, relative rest, prone extension exercises, and gentle self-stretching of the right piriformis. Two days later, the patient reported no change in symptoms, and a re-examination showed the same findings.

Building on previous treatments and addressing his posteriorly tilted pelvis and apparent buttock wasting, the patient was prescribed the WT-SLS exercise for dynamic activation of the right GMax (5-7 second holds for 5 repetitions, or as tolerated). In an upright standing position (facing 45° to the wall, weight on the symptomatic side with hip in external rotation, left leg in 90-90 hip-knee flexion, and knee touching the wall), he was instructed to elongate his trunk while maximally contracting the GMax isometrically (Figure 1). Immediately after this, he reported significantly reduced numbness, now only in the distal leg, and resting leg pain decreased to 1/10. Encouraged by this improvement, he was advised to do another 5 reps, which were added to his home exercise program (7-10 reps, 3-4 times a day), as per his comfort and tolerance.

On the alternate day visit, he reported significant reduction in leg numbness and no foot numbness. His VAS scores were: LBP at rest: 0, with activity: 3; leg pain at rest: 2, with activity: 4-5. He felt much better and symptom-free after the new gluteal exercise, performing it 6-7 times daily. He could sit comfortably for 15 minutes and walk for 20 minutes. His SLR improved to 60° (right), and 70 (left). The right lateral PA (grade II) over L4 and L5 reproduced symptoms with a VAS of 5/10. The treatment session remained the same, with the addition of bilateral GMax activation exercises at home (10 reps, 4-5 times a day).

Figure 1: WT-SLS exercise representation.

By the fourth session, the patient reported significant improvement, following his exercise schedule with ease. He no longer experienced numbness in his RLL or resting leg pain, though activity-related pain increased to a maximum of 3/10 on the VAS. The subsequent treatment focused on a graded core muscle strengthening program, continued WT-SLS exercises, and daily walking at a self-selected pace for cardiovascular conditioning.

On the 14th day re-assessment, the patient reported no resting pain or numbness, with mild leg pain (VAS 1-2/10) during activity. There were no symptoms reproduced with movement, although there was a mild end-range stretch in the hamstrings with spinal flexion. Right SLR improved to 80° (with only mild stretch sensation over the posterior thigh at end range) and left to 90°. Sensory deficit was absent now. Hip extension recruitment pattern showed improvement, with optimal pattern restored. The patient was much more comfortable during daily activities and at work, with undisturbed sleep. He could now walk for 30 minutes without pain or numbness. Emphasis was placed on patient education and rehabilitation, including correct ergonomics at work and home. Strengthening exercises were further progressed.

During the week 6 visit, the patient had achieved full and normal function without pain, could walk at a fast pace for 45 minutes, and reported an improvement in quality of life. Spinal flexion-extension exercises on a Swiss ball were added to his program, and advice regarding long-term management was provided. He was permitted to start light sporting activities, with a small warm-up session including stretching and lumbo-pelvic stability exercises. Pain progress and case management strategies are detailed in Tables 2 and 3, respectively.

Table 2: Subject's Pain progress.

Visual analogue scale (VAS) for Pain	Baseline value	Day 3 (before session)	Day 3 (after session)	Day 5	Day 7	Day 14
Lower lumbar region (Rest)	1	1	1	0	0	0
Lower lumbar region (Activity)	3-4	3	3	3	0	0
Right Lower Limb (Rest)	4	4	1	2	0	0
Right Lower Limb (Activity)	7-8	7	5	4-5	3	1-2

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Table 3: Case Management.

Day/follow-up	Regimen description
Day 01-02	
Pain management	Hot fomentation (15-20 minutes) followed by deep transverse friction and muscle energy technique for his right piriformis, and then Maitland's right lateral PA over L4, L5 (at grade II for pain relief) was given till centralization, all to mild decrease in pain (VAS 3/10)
Home advice	Advice on positioning, relative rest, extension exercises in prone, and gentle self-stretching of right piriformis.
Day 03-04	
Re-examination	Postural component was assessed.
Exercise for postural corrections and home advice	Dynamic activation of right GMax (WT-SLS): 5-7sec hold for 5 repetitions, or as per tolerance was added along with previous exercise and the same exercise was prescribed for home (7-10 reps/3-4 times a day).
Day 05-13	
Same as above	Same as above, along-with addition of WT-SLS exercise bilaterally now at home- 10 reps/ 4-5 times a day, then focused on a graded core muscle strengthening program along with WT-SLS and daily walk at self-selected pace for cardiovascular conditioning
Follow-up (post-2 week)	
Home advice	Emphasis on patient education and he was taught correct ergonomics for use at his workplace and at home. Strengthening exercises were then progressed further
Follow-up (post-6 week)	
Home advice	Spinal flexion-extension exercises on swiss ball were added to his program and advice regarding long term management was given. Also, the patient was allowed to initiate light sporting activities, with a small warm-up session prior, including all his stretching and lumbo-pelvic stability exercises.

Discussion

This case study aimed to show that a comprehensive manual therapy approach, emphasizing the dynamic activation of GMax, can effectively improve outcomes in LR patients. The patient here experienced significant relief from low back and lower extremity symptoms after just a few repetitions of WT-SLS exercise. The immediate reduction in numbness and pain suggested that sub-optimal GMax activation was likely causing his symptoms, and addressing this was beneficial.

The optimal recruitment pattern for movement involves the sequential firing of stabilizer muscles (first local, then global), followed by global mobilizers (GM). For hip extension, this sequence should be GMax, then hamstrings, and finally erector spinae. Disruption of this sequence, often due to chronic back pain [1] or postural issues, results in faulty patterns. When local stabilizers are dysfunctional, global stabilizers (GS) take over; if GS are also dysfunctional, GM become overactive. Chronic LBP and lower extremity injuries can lead to delayed and reduced glute activation with hamstring and low back compensation [5,6]. In LBP, hip extension is often initiated by hamstrings or erector spinae instead of GMax [7]. Even after LBP resolves, altered firing patterns in GMax may persist, compromising pelvic stability [8].

In our patient, the obliterated lumbar lordosis and posteriorly tilted pelvis (PTP), which according to postural considerations, is generally accompanied with underactive GMax and overactive hamstrings pulling the pelvis down due to its attachment on the ischial tuberosity. Subjective testing of hip extension confirmed that hamstrings were compensating as GM due to the underactive GMax. Dynamic GMax activation exercises corrected the motor control dysfunction, reducing hamstring overactivity and re-establishing the proper muscle recruitment pattern, thereby correcting the pelvic tilt.

Sagging glutes and PTP from tight hamstrings can compress the sciatic nerve and reduce glutes stabilization. Optimal GMax activation reduces the piriformis spasm and neural compression underneath, explaining the immediate reduction in lower extremity numbness and pain. EMG studies have shown that the strongest GMax contractions occur with muscle setting by isometric contraction, external rotation, abduction with resistance, and vigorous hyperextension in an erect posture [9]. Thus, a dynamic exercise was designed to activate GMax, addressing both its stabilizing and movement roles. Unilateral stance exercises were included to engage the gluteus medius, minimus, and the upper part of GMax to resist gravity's hip adduction torque.

Exercises such as step-ups, unilateral bridges, quadruped leg lifts, single limb squats, and single-limb deadlifts engage all major functions of GMax, including single-leg balance, stability of the lumbo-pelvic region, hip extension or eccentric control of hip flexion, and result in high levels of glute activation [10]. However, these exercises can be difficult to perform in the presence of pain. Therefore, the WT-SLS exercise was chosen for dynamic GMax activation in a unilateral stance. This exercise has been shown to achieve higher recruitment and peak amplitude in normal populations compared to other exercises like single-leg wall squats and step-ups [4]. Additionally, GMax contraction impacts the posterior oblique sling by pulling on the lower end of the thoraco-lumbar fascia, which helps stabilize the vertebral column through the tightening of this thick connective tissue layer. Gluteal contraction tightens this fascia, thereby, helping to stabilize the vertebral column.

Targeting GMax muscle strengthening/activation can be

helpful in patients with LR and should be included in future trials. Also, our team is exploring the benefit of WT-SLS exercise along with other exercise regimens in patients of knee osteoarthritis. Future studies should consider randomized and cohort trials in different conditions of lumbar and lower limb pain for actual benefit of this exercise, using measures like electromyography or real-time ultrasonography.

Conclusion

This case report suggests that dynamic gluteal activation, particularly using the WT-SLS exercise, can significantly reduce symptoms of LBP or lumbar radiculopathy when combined with standard treatment. However, further extensive research, is needed to validate these findings and confirm the benefits and mechanisms of this approach.

Limitations

The primary constraint lies in the type of study design. Being a single case report, the findings lack generalizability. Moreover, due to the presence of a multi-modal intervention regime and the lack of certain outcome assessments such as kinesiophobia and quality of life, it becomes challenging to render the effect obtained to the impact of the WT-SLS exercise alone. Additionally, these limitations indicate avenues for exploration and consideration in future research endeavors.

Statements and Declarations

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