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Case Report

Physiotherapy Section

Combined Effects of Wall Squat and Treadmill Walking Exercises on Pain and Functional Disability in Non Specific Chronic Low Back Pain: A Case Report

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ABSTRACT

Low Back Pain (LBP) is the most prevalent musculoskeletal condition worldwide, significantly affecting daily functioning and quality of life. It is mostly non specific in about 90% of cases, where there is no identifiable disease or structural reason to explain the pain. Physiotherapists play a key role in managing patients with chronic LBP. They use various strategies to alleviate pain, enhance pain tolerance, reduce stress on the lumbar region, strengthen lumbar stabilisers and improve functional abilities. Numerous studies have demonstrated the positive effects of isometric strengthening and aerobic exercise in chronic pain conditions. In this context, the authors present a case of a 22-year-old female patient, demonstrating the positive benefits of a combination of wall squat and treadmill walking exercises to improve pain and functional disability in a patient suffering from non specific chronic LBP.

Keywords: Aerobic exercise, Closed kinematic chain exercise, Isometric exercise, Quality of life

CASE REPORT

A 22-year-old female patient presented with a complaint of lower back pain for more than six months, without any history of trauma. She also reported difficulty in performing daily activities, such as sitting or standing for long durations and washing clothes. The pain was gradual in onset, described as a dull aching type and localised to the lower back region, with no radiating pain. Aggravating factors included prolonged sitting, lifting heavy weights (such as a bucket of water), bending forward and prolonged standing. The relieving factors were lying in a supine position and resting. The patient did not had any other medical history.

Informed consent was obtained from the patient prior to commencing the examination. The initial assessment was conducted by performing motor examination, including the range of motion of the lumbar spine and bilateral hip joints and muscle strength testing using Manual Muscle Testing (MMT) for lumbar flexors, extensors, and lower extremities, such as hip and knee muscles [1]. This was followed by special tests, such as single leg raise test and slump test, to rule out intervertebral disc prolapse [2], as well as a Sacroiliac Joint (SIJ) special test cluster, which involved distraction, thigh thrust, Gaenslen's test, compression and sacral thrust for ruling out SIJ dysfunction [3], all conducted by the researcher.

Clinical clues and red flags, such as widespread neurological signs, traumatic fracture, vascular signs, pathological fracture, systemic infections, unexplained weight loss, fatigue, severe night pain and constant progressive non mechanical pain, were assessed to rule out any underlying specific pathology [4]. No radiological investigations were conducted, as none of the special tests related to intervertebral disc prolapse or SIJ dysfunction were positive, and none of the red flags were present. Based on the findings, the patient was diagnosed with non specific chronic LBP, without any involvement of neurological structures, underlying specific disease, or dysfunction in the SIJ.

Physiotherapy Interventions

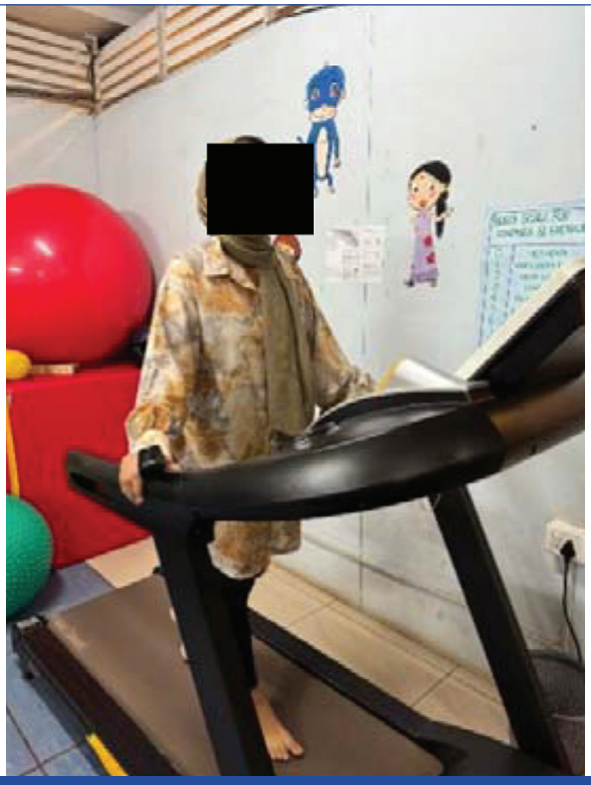
The treatment protocol included wall squats and treadmill walking.

Wall squat [5]: The patient was instructed to stand upright with their back against the wall, with hips and knees flexed to 90°, feet parallel and shoulder-width apart, and hands by their sides. The patient was asked to hold this position for a total of three minutes, with frequent breaks. The patient participated in three sessions of wall squats per week, every alternate day, for a total of four weeks, to avoid potential carryover effects from pain sensitivity [Table/Fig-1].

[Table/Fig-1]: Wall squat exercise.

Treadmill walking: The patient was instructed to walk on the treadmill, maintaining 50-60% of their maximum heart rate for 20

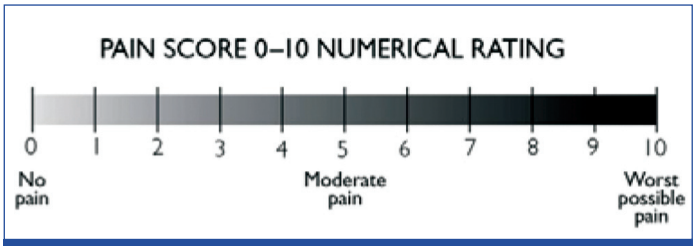
minutes. The maximum heart rate for this patient, according to Karvonen's formula, was 198 beats per minute (bpm). Therefore, the 50-60% target heart rate during treadmill walking was maintained between 100-110 bpm, which was monitored using a universal pulse oximeter [Table/Fig-2]. The patient participated in three sessions of treadmill walking per week, every alternate day, for a total of four weeks [6,7].



[Table/Fig-2]: Treadmill walking.

OUTCOME MEASURES

Numerical Pain Rating Scale (NPRS): The NPRS is possibly the most widely used scale for quantifying pain severity in clinical settings. It is an 11-point numeric scale that starts at 0 and ends at 10, where 0 signifies no discomfort and 10 denotes the worst pain possible [Table/Fig-3] [8]. Assessments were conducted at baseline and after four weeks of interventions. At baseline, the patient reported a pain intensity of 8/10, which was reduced to 4/10 following the treatment.



[Table/Fig-3]: Numeric Pain Rating Scale (NPRS).

Functional disability: Functional disability was assessed using the Oswestry Disability Index (ODI) scale. The ODI is a patient-completed questionnaire that provides a subjective percentage score reflecting the degree of function (disability) in activities of daily living for individuals recovering from LBP. It is a valid, reliable and responsive condition-specific assessment tool [9]. Assessments were conducted at baseline and after four weeks of interventions. At baseline, the functional disability score was 28%, indicating moderate disability, whereas following the treatment, it improved to 4%, reflecting minimal disability.

The outcome measures used to assess the patient's progress in the pre- and postintervention phases are shown in the table below [Table/Fig-4].

Outcome measures	Preintervention	Postintervention
NPRS	8/10	4/10
ODI Scale	28%	4%

[Table/Fig-4]: The pre- and postintervention outcomes.
NPRS: Numeric pain rating scale; ODI: Oswestry disability Index

DISCUSSION

Low back and neck pain were the second leading cause of Years Lived with Disability (YLD) for young adults aged 20-24 years, according to the Global Burden of Disease (GBD) Study [10]. According to the World Health Organisation (WHO), about 90% of cases present as non specific LBP. However, in 6-8% of patients, symptoms may persist beyond three months, leading to chronic pain [11]. This study described a case of a 22-year-old female patient suffering from non specific chronic LBP for six months, characterised by severe pain and a moderate level of functional disability assessed using the NPRS and ODI scales, respectively. After four weeks of intervention using isometric strengthening exercises and aerobic exercise, the patient reported significant improvement, with a decrease in the severity of her symptoms. Both outcome measures indicated a positive response regarding the patient's condition.

Rhyu HS et al., conducted an experimental study on 60 subjects with LBP and divided them into three groups. After six weeks of the LBP I-Zer isometric protocol compared with a mat exercise protocol, it was found that isometric exercise showed positive effects in reducing pain intensity and improving muscle activity [12]. In the current case report, similar results were observed after four weeks of combined alternate days of wall squats and treadmill walking, which aimed to reduce pain and disability in a patient with chronic non specific LBP.

A study conducted by Jeong JG and Park JC, evaluated the impact of wall squat exercise on the thickness of trunk muscles, involving 26 subjects. The study concluded that there was a significant difference in the thickness of the trunk muscles, mainly the external oblique, internal oblique and transverse abdominis [13]. Similar results were reported in a study conducted by Cho M, which compared the effects of modified wall squats and bridge exercises over six weeks. This study found significant changes in the thickness of internal oblique and transverse abdominis muscles after the modified wall squat exercise programme [14]. Although the current case study did not evaluate muscle thickness pre- and postintervention, the reduction in pain and improvement in the functional disability score suggest that there might be improvements in the activity of the lumbar stabilisers.

Another study by Sany SA et al., demonstrated the benefits of moderate-intensity aerobic exercise in reducing pain and functional disability in patients with chronic LBP [7]. This aligns with the current study, where the combination of wall squats and treadmill walking resulted in further improvements in functional disability as well as pain in chronic non specific LBP patient.

The possible mechanisms for the reduction in pain and functional disability include increased abdominal muscle activity, which minimises compensatory actions such as lumbar lordosis by relatively reducing the actions of the erector spinae and multifidus muscles. The exercise protocol may have stimulated the release of endogenous opioids, contributing to pain relief and an increased pain tolerance level [15]. The combination of wall squats and treadmill walking improved both muscle strength and endurance, resulting in enhanced neuromuscular coordination, which enables more efficient movement patterns and reduces pain-provoking movements. [Table/Fig-5] shows a comparative evaluation between the findings and improvements in the present case along with studies conducted in the past [7,12-14].

Study/ Author	Population/ Intervention	Outcome measures	Results	Comparison with current case
Rhyu HS et al., [12]	60 subjects with Low Back Pain (LBP); 6 weeks of I-Zer isometric vs. mat exercises	Pain intensity, muscle activity	Isometric exercise reduced pain intensity and improved muscle activity	Current case observed similar pain and disability reduction with four weeks of wall squats and treadmill walking.
Jeong JG and Park JC, [13]	26 subjects; wall squat exercise	Thickness of trunk muscles	Significant increase in the thickness of external oblique, internal oblique and transverse abdominis	Current case did not measure muscle thickness but implied lumbar stabiliser activity improvement based on reduced pain and improved functional scores.
Cho M, [14]	Subjects performing six weeks of modified wall squats vs. bridge exercises	Muscle thickness	Significant increase in internal oblique and transverse abdominis thickness with wall squats	Similar improvements in functional outcomes in the current case, though muscle thickness was not directly evaluated.
Sany SA et al., [7]	Moderate-intensity aerobic exercise in chronic LBP patients	Pain and functional disability	Reduced pain and functional disability	Current case corroborates this finding, showing similar benefits with combined aerobic and strengthening exercises.
Current study	22-year-old female with chronic non specific LBP; four weeks of wall squats and treadmill walking	NPRS and ODI scales	Significant reduction in pain severity and functional disability	Aligns with findings of previous studies, confirming efficacy of strengthening and aerobic exercises in managing chronic LBP.

[Table/Fig-5]: Comparison between the current case and previous studies [7,12-14].

CONCLUSION(S)

This case study concludes that the combination of wall squat exercises and moderate-intensity aerobic exercise, such as treadmill walking, had a significant impact on pain and functional disability in a patient suffering from non specific chronic LBP. As the patient's pain score was high at baseline, any other isotonic or functional exercise could have provoked increased pain intensity, potentially leading the patient to discontinue the exercise programme. In the long term, as the pain level decreases, more functional or strengthening exercises can be implemented and tested in further studies. This case contributes to the growing body of evidence supporting physiotherapy as a vital component in the management of chronic LBP and emphasises the need for individualised treatment approaches.

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