

Effect of Calf Stretching with Core Stabilization Exercises on Ankle Dorsiflexion Strength and Gait in Chronic Post-Laminectomy Syndrome: A Case Report

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Abstract: ***Background:** Post-laminectomy neurological deficits can leave a patient with lower-limb weakness, numbness, poor ankle movement, balance trouble, and a slower gait. Physiotherapy is meant to help bring back strength, mobility, and some independence. This case looks at what happened after a focused physiotherapy programme in a patient with post-laminectomy neurological deficits after PIVD surgery. **Case Presentation:** A 40-year-old man with lumbar PIVD had laminectomy and decompression. After surgery, he had weakness in the left lower limb, less ankle dorsiflexion, sensory changes on the dorsum of the foot, gait difficulty, and low-back pain (NPRS 4/10). His ODI score was 38%, which points to moderate disability. **Intervention:** He took part in an 8-week physiotherapy programme with calf stretching, core stabilization, ankle dorsiflexor strengthening, neuromuscular stimulation, balance training, gait retraining, and functional exercises, plus a home exercise programme. **Results:** Pain dropped from 7-8/10 to 2-3/10, while ankle dorsiflexion increased from 10° to 17° and tibialis anterior strength went from 3+/5 to 5/5. Walking distance rose from 200 m to 800 m. TUG improved from 13 to 9 seconds, and ODI fell from 38% to 7%. About 90–92% of rehabilitation goals were achieved. **Conclusion:** This physiotherapy programme, focusing on calf flexibility, core stability, ankle dorsiflexion strength and gait training, may improve pain, mobility and recovery in chronic neurological deficits after laminectomy. Larger studies with longer follow-up are needed to confirm whether these gains last.*

Keywords: Post laminectomy neurological deficit, Prolapsed intervertebral disc, Lumbar laminectomy, Physiotherapy rehabilitation, Myotomal weakness, Gait training, Muscle strengthening, Functional recovery

1. Background

Laminectomy is spinal surgery that involves the removal of part of the vertebrae to decompress the spinal cord and nerves. The procedure is done for lumbar spinal stenosis, prolapsed intervertebral disc, tumors, and other conditions that require decompression of the spinal cord and nerves. The surgery usually aims to free trapped nerves and reduce pressure on the spinal cord. Nevertheless, some patients present with post laminectomy neurological deficit following the surgery.

The clinical features of post laminectomy neurological deficit include; reduced power, paresthesia, and diminished reflexes among others related to gait and activity of daily living (ADL). The presentation of the signs and symptoms depends on the distribution and the severity of the nerve involvement. Physiotherapy assessment of the patient's myotome and dermatome with emphasis on the lower limbs is usually significant. Physiotherapy management of post laminectomy syndrome patients is recommended and considered safe and effective when initiated within four weeks of laminectomy.

Lumbar disc herniation is a big deal when it comes to physiotherapy. It can really mess with pain levels, muscle strength, sensation, and even how well someone moves their spine and legs. At first, people might just feel localized low-back pain. But then, if there's nerve-root compression, they could start experiencing all sorts of issues like radiating pain, numbness, tingling, or weakness in their legs. It's interesting how the symptoms can vary so much based on which disc is involved. Take the L4–L5 disc, for instance—it often affects the L5 nerve root, leading to weakness in ankle dorsiflexion or the ability to extend the big toe, along with some sensory changes on the top of the foot. All these neurological

problems can really get in the way of daily activities, like walking, climbing stairs, or even just standing for a while.

When evaluating neurological issues in lumbar disc herniation, doctors usually look at a mix of pain distribution, sensory exams, muscle strength tests, and reflex checks. For example, if the L4 area is involved, patients might struggle with knee extension and feel altered sensations on the inner leg. If it's the L5 area affected, they might have trouble with ankle dorsiflexion and big toe extension, plus some sensory changes on the top of the foot. And for S1, it can mean problems with plantarflexion and the outer part of the foot. But here's the thing—these symptoms don't always fit neatly into boxes. It's important to consider everything together, including imaging studies and the overall neurological exam.

2. Aim of the Case Study

The aim of the study to evaluate the clinical response of effect of calf stretching and core stabilization physiotherapy intervention on ankle dorsiflexion strength and gait in chronic post laminectomy syndrome to improve mobility and muscular weakness.

3. Objective

- 1) To evaluate the effectiveness of the physiotherapy programme on the strength of the dorsiflexion muscles at the ankle.
- 2) To evaluate the effectiveness of the physiotherapy programme on the range of motion of the dorsiflexion at the ankle.

- 3) To evaluate the effectiveness of the physiotherapy programme on core stability and lumbopelvic stability by stabilizing the program.
- 4) To evaluate the effectiveness of the physiotherapy programme on the balance and functional mobility of the patient during standing and walking.
- 5) To evaluate the effectiveness of the physiotherapy programme on the reduction of the difficulty in functional activities including; walking, climbing, and sit-stand activities.
- 6) The study will also be used to determine whether there is an improvement in the ankle dorsiflexion strength and gait after the physiotherapy programme.

4. Case Description and Physiotherapy Assessment

A 40-year-old man was diagnosed with lumbar PIVD at L4–L5, causing compression of the left nerve root. He had low-back pain spreading into the left leg, with numbness and weakness. Since the symptoms continued and neurological signs were present, he underwent an L4–L5 laminectomy and decompression. After surgery, he was referred to physiotherapy for remaining weakness in the left leg, mild sensory changes, pain, and trouble walking for long periods or climbing stairs. The patient reported low-back pain that sometimes shot into the left leg, with pain rated 7–8/10 on the NPRS at first. Hip and knee movement stayed within functional limits, although left ankle dorsiflexion was a bit limited at 10° compared with 18° on the right. Mild weakness and some sensory loss showed up mostly in the L5 area, especially over the top of the left foot and the great toe.

On observation, he was alert, cooperative, and able to move around independently. The lumbar surgical scar had healed well, without infection. His gait was slightly abnormal: the left foot cleared the ground less during swing, and heel walking was mildly difficult. He also walked with a guarded posture during assessment.

Overall, the picture fits moderate post-laminectomy neurological deficits after L4–L5 PIVD. The main problems were left leg weakness, less ankle dorsiflexion, mild sensory change, and a difficult gait. Physiotherapy was set up to build strength, improve mobility and balance, and help with walking and daily function.

5. Findings

Preoperative MRI showed an L4–L5 disc protrusion in the lumbosacral spine. On the left side, it compressed the nerve root and narrowed both the neural foramen and lateral recess. There were also mild degenerative changes in the lumbar spine, although these were less important. The scan matched the patient's symptoms: left-sided radicular pain, altered sensation, and weakness in the lower limb. This made the findings clinically meaningful rather than just incidental imaging changes. Taken together, the MRI and examination supported proceeding with an L4–L5 laminectomy and nerve-root decompression. The imaging did not show widespread disease, but it identified a clear area that could explain the patient's problems quite well.

Uniqueness of the Case

The uniqueness of this case study in the patient with post laminectomy involves combining effect of calf stretching with core stabilization exercises to deal with patient pain, ankle dorsiflexion weakness and poor gait.

Intervention

The patient attended physiotherapy for six weeks, five times a week, with each session lasting about 60 minutes. Treatment mainly included calf stretching, core stabilization, ankle dorsiflexion strengthening, and gait training. Other modalities were used mostly to ease symptoms.

6. Phase I- Week 1–2

During the first phase, treatment aimed to control pain, loosen the calf, and improve basic muscle activation.

- TENS: Continues mode, 80–100 Hz, pulse width 100 µs, was applied around the lumbar and affected symptomatic region for 15 minutes.
- Moist hot pack: Applied for 10 minutes before stretching when tightness was present.
- Calf stretching: Gastrocnemius and soleus stretches were held for 20–30 seconds, repeated three times.
- Core activation used abdominal bracing and pelvic tilts, with 10 repetitions.
- Ankle dorsiflexion involved active range-of-motion, also 10 repetitions. Gentle weight shifting and basic gait training were added.
- Muscle Stimulation– was used on the tibialis anterior to help activate the dorsiflexors and support active strengthening NMES 15 min/session, 35 Hz, 200 µs, 10 sec ON/30 sec OFF, with passive/assisted dorsiflexion.

7. Phase II- Week 3–4

This phase targeted core stability, calf flexibility, and ankle dorsiflexion strength.

- TENS was used only for pain, at 80–100 Hz, 100 µs, for 15 minutes.
- Calf stretching lasted 30 seconds for 3 repetitions.
- Core work included abdominal bracing, pelvic tilts, and bridging, with 10–12 repetitions for 2–3 sets.
- Theraband-resisted dorsiflexion used the same repetition and set range.
- Balance work used weight shifting and supported single-leg standing for 20–30 seconds, repeated three times. Gait practice addressed heel strike, foot clearance, and step length for 10–15 minutes.
- NMES 15–20 min/session, 40 Hz, 250 µs, with active dorsiflexion during stimulation.

8. Phase III- Week 5–6

The final phase targeted functional strength, efficient walking, and independence.

- Calf stretches lasted 30 seconds for three repetitions.
- Core work included bridging, modified dead-bugs and functional core exercises, 12–15 repetitions for three sets.
- Dorsiflexion was trained with progressive theraband resistance and heel walking, also 12–15 repetitions for three sets.

- Dynamic balance involved weight shifts, reaching and controlled stepping for 10 minutes.
- Gait practice covered heel-to-toe walking, longer distances and stairs for 15–20 minutes.
- Functional work used sit-to-stand and step-ups, 10–12 repetitions for two sets.
- NMES 20 min/session, 45–50 Hz, 250–300 μ s, combined with resisted dorsiflexion and functional gait training.

9. Results

After 6 weeks of physiotherapy, the patient improved a lot in pain, ankle movement, muscle strength, and walking. Pain dropped from 7-8/10 to 2-3/10 on the NPRS. Ankle dorsiflexion ROM went from 10° to 17°, and tibialis anterior strength improved from 3+/5 to 5/5. Extensor hallucis longus strength also rose, from 3+/5 to 4+/5.

The functional gains were hard to miss. Walking distance increased from 200 m to 800 m. The TUG score fell from 13 to 9 seconds, which points to better mobility. The ODI score dropped from 38% to 7%, showing much less disability. Overall, the 6-week intervention led to clear clinical and functional improvement, especially in ankle dorsiflexion strength and gait.

Pre- and Post-Treatment Findings

Measure	Pre-treatment	Post-treatment	Improvement
NPRS pain	7-8/10	2-3/10	75–100%
Ankle dorsiflexion ROM	10°	17°	70%
Tibialis anterior strength	3+/5	5/5	40% improvement in MMT grade
Extensor hallucis longus	3+/5	4+/5	Moderate improvement
Walking distance	200 m	800 m	75% improvement in functional endurance
TUG	13 sec	9 sec	31% improvement
ODI	38%	7%	82% reduction in disability

Outcome Measures

Outcome	Measure	Purpose
Ankle dorsiflexion strength	Manual Muscle Testing (MMT)	To assess tibialis anterior strength
Ankle dorsiflexion ROM	Goniometer	To measure improvement in ankle mobility
Gait	10-Metre Walk Test (10MWT)	To assess walking speed
Functional mobility	Timed Up and Go (TUG)	To assess mobility and gait-related function
Pain	Numeric Pain Rating Scale (NPRS)	To monitor pain intensity
Disability	Oswestry Disability Index (ODI)	To assess low-back-related functional disability

10. Discussion

This case showed that calf stretching with core stabilization, plus ankle dorsiflexor strengthening and gait training, improved pain, ankle dorsiflexion, muscle strength, and walking ability in chronic post-laminectomy syndrome. The

findings line up with Snowdon and Peiris, who reported good effects of postoperative physiotherapy on pain and function. Kavitate and Kanase also found better mobility and functional independence after strengthening, ROM, sensory re-education, and functional training.

Compared with those studies, this case was more focused. It targeted calf flexibility, core stability, tibialis anterior stimulation, and gait, so the work was aimed at ankle dorsiflexion strength and walking rather than general recovery. The improvement may reflect natural neurological recovery, but the progressive physiotherapy probably mattered too.

11. Limitations

The factors that limit the interpretation of the findings in this case report include;

- Single patient study
- Short term follow up
- Natural neurological recovery
- Limited objective neurological investigations such as electromyography (EMG) and nerve conduction volume (NCV)
- Different spinal levels and severity among the patients

12. Conclusion

This case emphasizes the importance of individualized physiotherapy intervention for patients presenting with post laminectomy neurological deficit. A treatment program that involved strengthening, range of motion, sensory re-education, balance and gait retraining, and functional training was used depending on the patient's presentation. The patient was able to improve significantly with respect to pain, muscle strength, mobility, and function.

13. Future Scope

The present case report can become the basis for further study that will involve determining the effectiveness of calf stretching and core stability training on the gait pattern and the function of the lower limbs. The findings from the present study can be generalized to the larger population and will be helpful in inspiring future research studies. Further validation studies that will support the findings of the present study should include a bigger sample size and a randomized control trial design.

The following studies should entail a comparison between the effects of calf stretching, core stability, and their combination on the function of the lower limbs and gait pattern. The intervention used in the present case study can be explored to determine whether the combination of stretching and core stability is more effective than either of the two interventions. It will be possible to estimate the changes in muscle strength, ankle mobility, gait speed, balance, and other related functions.

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