

Rehabilitation of Chronic Cervical Spondylolysis with Carpal Tunnel Syndrome using a Multimodal Physiotherapy Approach: A Case Study

Shafiu Abdulganiyu*

Department of Physiotherapy, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, India

Abstract: **Background:** Chronic cervical spondylolysis is a degenerative musculoskeletal condition often associated with neck pain, restricted mobility, and neurological symptoms due to nerve root involvement. When accompanied by carpal tunnel syndrome, patients may experience compounded functional impairment, including upper limb pain, paresthesia, and reduced hand function. Managing such coexisting conditions requires a comprehensive and individualized rehabilitation strategy. **Objective:** This case study aimed to evaluate the effectiveness of a multimodal physiotherapy approach in reducing pain, improving functional mobility, and enhancing upper limb function in a patient with chronic cervical spondylolysis and concurrent carpal tunnel syndrome. **Methods:** A patient presenting with chronic neck pain, radiating upper limb symptoms, and clinically diagnosed carpal tunnel syndrome underwent a structured physiotherapy program over a defined intervention period. The multimodal rehabilitation protocol included therapeutic exercises, cervical stabilization training, neural mobilization, manual therapy, postural correction, ergonomic education, and electrotherapy modalities for pain management. **Outcome measures** included pain intensity, cervical range of motion, hand grip strength, functional status, and patient-reported symptom severity. **Results:** Post-intervention findings demonstrated a significant reduction in pain intensity, improved cervical mobility, enhanced hand function, and decreased paresthesia. Functional performance and daily activity tolerance improved notably, with the patient reporting better postural awareness and reduced symptom recurrence. **Conclusion:** A multimodal physiotherapy approach appears to be an effective conservative management strategy for individuals with coexisting chronic cervical spondylolysis and carpal tunnel syndrome. Integrated rehabilitation targeting both cervical and peripheral nerve dysfunction may lead to meaningful improvements in pain, mobility, and functional independence. Further studies with larger samples are recommended to support these findings.

Keywords: Cervical spondylolysis, Carpal tunnel syndrome, Multimodal physiotherapy, Neural mobilization, Cervical rehabilitation, Degenerative spine disorders.

1. Introduction

Cervical spondylolysis is an uncommon but clinically relevant defect of the pars interarticularis within the cervical vertebrae, often presenting with chronic neck pain, stiffness, altered segmental biomechanics, and neural irritation arising

from structural instability (Lee et al., 2021). Although far less common than its lumbar counterpart, cervical spondylolysis may develop from degenerative or traumatic causes and is frequently exacerbated by postural strain, repetitive loading, and prolonged static neck positions, especially in older adults (Tetreault et al., 2022). Physiotherapy remains the cornerstone of conservative management for such chronic cervical disorders, with primary goals that include pain reduction, restoration of cervical mobility, improvement of neuromuscular coordination, enhancement of scapular stability, and long-term postural correction (Pandita & Kumar, 2023). Evidence supports multimodal physiotherapy—incorporating electrotherapy, flexibility training, strengthening, and patient education—as being more effective than single-modality programs for chronic neck dysfunction (Wu et al., 2020; Bialosky et al., 2018). Therapeutically, targeted activation of deep cervical flexors, scapular stabilizers, and upper limb musculature can reduce mechanical loading and enhance cervical neuromuscular control (Kim & Park, 2023; Kang et al., 2019). Additionally, ergonomic intervention and patient education help minimize daily mechanical stressors and support long-term symptom management (Sharma et al., 2022; Singh & Verma, 2021). The present case integrates these evidence-based principles into a structured multimodal rehabilitation program for managing chronic cervical spondylolysis with associated carpal tunnel syndrome.

2. Case Presentation

The patient was a 27-year-old male patient presented with a six-month history of gradually worsening neck pain and progressive bilateral hand numbness. Initially, during the first 2–3 weeks, she experienced mild neck discomfort that intensified with household activities such as kneading dough and chopping vegetables. Over the next two months, the pain evolved into a persistent dull ache, exacerbated by extended reading, prolonged mobile phone use, and cooking tasks requiring sustained neck flexion. By the fourth month, she began experiencing intermittent nocturnal paraesthesia in both hands, which disturbed her sleep. In the final two months before presentation, her symptoms progressed to constant neck pain

*Corresponding author: shafiu.abdulganiyu@gmail.com

rated 7/10 on the Numeric Pain Rating Scale, accompanied by increased hand numbness during fine-motor tasks, prompting medical consultation. Clinical examination revealed forward head posture, rounded shoulders, and cervical paraspinal tenderness graded 2+, with restricted cervical range of motion—particularly in extension and rotation. Manual muscle testing indicated 4/5 strength in deep cervical flexors and scapular retractors, and neurological assessment showed intact reflexes and dermatomes; however, Phalen's test was positive bilaterally, indicating median nerve compression. Radiographs demonstrated straightening of cervical lordosis, reduced intervertebral disc height, and osteophytic changes without evidence of fracture or congenital anomaly, while nerve conduction studies confirmed moderate bilateral median nerve compression. Based on clinical and diagnostic findings, the final diagnosis was chronic cervical spondylolysis with moderate bilateral carpal tunnel syndrome.

3. Interventions

The physiotherapy rehabilitation for cervical spondylolysis was structured in a four-week phase-wise approach. In the acute phase (Week 1), interventions focused on pain reduction and gentle cervical activation using hot packs, conventional TENS, cervical isometrics, chin tucks, scapular setting, tendon gliding, median nerve mobilization, and wrist range of motion exercises. The subacute phase (Week 2) aimed to improve flexibility, scapular stability, and neural mobility through targeted muscle stretches, scapular retraction, finger opposition, grip strengthening, and progressed median nerve gliding. In the strengthening and functional phase (Week 3), exercises included resisted rows, wall push-ups, bridging, theraband wrist strengthening, postural correction, and fine-motor functional tasks to enhance cervical and scapular stability as well as hand function. Finally, the dynamic and return-to-activity phase (Week 4) emphasized trunk control, dynamic balance, endurance, and functional independence using cervical active range of motion with resistance, scapular Y/T/W exercises, core activation, dynamic balance tasks, functional reach activities, and gradual work or daily activity simulation.



Fig. 1.



Fig. 2.

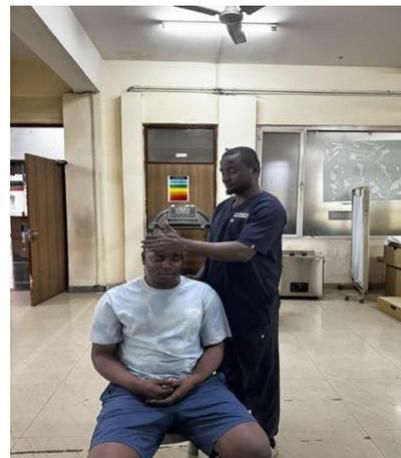


Fig. 3.



Fig. 4.

4. Result

Following 15 supervised physiotherapy sessions, the patient demonstrated significant improvements across all assessed clinical outcomes. Pain intensity, measured using the Numeric Pain Rating Scale (NPRS), decreased from 7/10 to 2/10, reflecting a clinically meaningful reduction. Cervical range of motion increased in all planes, with flexion improving from 53° to 60°, extension from 35° to 40°, right lateral flexion from 25° to 33°, left lateral flexion from 20° to 25°, right rotation from 50° to 54°, and left rotation from 45° to 50°. Grip strength showed a marked increase from 12 kg to 18 kg, representing a

Table 1
Phase-wise rehabilitation interventions (15 Days)

Phase/Days	Goals	Therapeutic interventions	Repetition/Duration
Phase 1 (Day 1-5) Acute Phase	Reduce pain Decrease muscle guarding. Initiate cervical activation	Hot pack: 10-15 min TENS (conventional): 8-10 min Cervical isometrics: 3 sets x 10 reps x 10-sec hold Chin tucks: 3 sets x 10 reps Scapular setting: 2 sets x 10 reps x 5-sec hold Tendon gliding: 2 sets x 10 reps Median nerve mobilization: 2 sets x 10 reps (pain-free) Wrist ROM: 10-12 reps each direction	Hot pack: 10-15 min TENS: 8-10 min Isometrics/Chin tucks: as prescribed ROM/gliding: as above Family training: Daily, 10 mins.
Phase 2 (Day 6-10) Subacute Phase	Improve flexibility Enhance scapular stability Promote neural mobility	Upper trapezius stretch: 3 x 20sec Levator scapulae stretch: 3 x 20sec Scapular retraction: 3 sets x 12 reps Finger opposition: 2 sets x 10 reps Grip strengthening (soft ball): 3 sets x 15 reps Median nerve gliding (progressed): 2 sets x 10-12 reps	Stretching: 20-sec hold x 3 reps Strengthening: 2-3 sets (as listed) Nerve gliding: 2 sets x 10-12 reps
Phase 3 (Day 11-15) Strengthening and Functional Retraining Phase	Improve cervical & scapular stability Enhance fine motor control Restore functional hand performance	Resisted rows: 3 sets x 12 reps Wall push-ups: 3 sets x 10 reps Postural correction (wall alignment): 3 x 10-sec holds Bridging: 3 sets x 10 reps Theraband wrist strengthening: 3 sets x 12 reps Fine-motor tasks (buttoning, coin picking): 5-7 min	Strengthening: 3 sets each Postural drills: 10-sec holds x 3 Functional tasks: 5-7 min

50% improvement. These outcomes collectively indicate better cervical mobility and improved neuromuscular performance following the structured, phase-wise physiotherapy program.

Table 2
Pre and Post intervention outcomes

Outcome Measure	Pre-Treatment	Post-Treatment
NPRS (Pain)	7/10	3/5
Cervical Flexion	53°	60°
Cervical Extension	35°	40°
Right Lateral Flexion	25°	33°
Left Lateral Flexion	20°	25°
Right Rotation	50°	54°
Left Rotation	45°	50°
Grip Strength	12 Kg	18 Kg

5. Discussion

This case study explored the clinical outcomes of a multimodal physiotherapy intervention in the management of chronic cervical spondylolysis with coexisting carpal tunnel syndrome. The findings suggest that an integrated rehabilitation approach addressing both cervical spine dysfunction and peripheral nerve involvement can produce meaningful improvements in pain, mobility, and functional performance.

The reduction in neck pain and improvement in cervical range of motion observed in this case may be attributed to the combined effects of manual therapy, cervical stabilization exercises, and postural correction. Chronic cervical spondylolysis often leads to segmental instability, muscular imbalance, and altered biomechanics, which can perpetuate pain and functional limitations. Targeted strengthening and stabilization exercises likely enhanced neuromuscular control and reduced mechanical stress on cervical structures, thereby improving mobility and reducing symptom severity.

Improvement in hand function and reduction in paresthesia indicate the effectiveness of neural mobilization and local carpal tunnel interventions. Carpal tunnel syndrome involves compression of the median nerve, often resulting in sensory disturbances and decreased grip strength. Neural gliding techniques may have facilitated nerve excursion and reduced intraneural pressure, while ergonomic education likely minimized repetitive strain and mechanical irritation. Addressing proximal factors, such as cervical nerve root irritation and postural dysfunction, may also have contributed to symptom relief, highlighting the importance of treating the kinetic chain rather than isolated regions.

The coexistence of cervical pathology and peripheral nerve compression presents a clinical scenario consistent with the concept of double crush syndrome, where proximal nerve compromise increases susceptibility to distal entrapment. The positive outcomes observed support the rationale that comprehensive treatment of both proximal and distal sites of neural involvement can enhance recovery more effectively than localized treatment alone.

Functionally, the patient demonstrated improved tolerance for daily activities and enhanced postural awareness. These changes underscore the role of patient education and self-management strategies in long-term rehabilitation. Behavioral modifications, including ergonomic adjustments and activity pacing, are essential in preventing recurrence and sustaining therapeutic gains.

Despite these encouraging results, several limitations should be considered. As a single-case study, the findings cannot be generalized to broader populations. The absence of long-term follow-up limits the ability to determine the durability of

treatment effects. Additionally, the relative contribution of each intervention component cannot be isolated, given the combined nature of the rehabilitation program.

Future research should include larger sample sizes, controlled study designs, and long-term follow-up to evaluate sustained outcomes. Comparative studies examining multimodal versus single-modality interventions would also help clarify optimal treatment strategies. Objective neurophysiological measures could further strengthen the understanding of mechanisms underlying functional improvement.

Overall, this case supports the clinical value of a multimodal physiotherapy approach in managing complex presentations involving both cervical spine degeneration and peripheral nerve entrapment. A comprehensive, patient-centered rehabilitation strategy appears to promote meaningful improvements in pain, function, and quality of life.

6. Conclusion

This case study demonstrates that a multimodal physiotherapy approach can be an effective conservative management strategy for patients with chronic cervical spondylolysis accompanied by carpal tunnel syndrome. The integrated rehabilitation program, combining therapeutic exercise, manual therapy, neural mobilization, postural correction, ergonomic training, and electrotherapy, contributed to meaningful reductions in pain, improved cervical mobility, enhanced hand function, and better overall functional performance.

Addressing both proximal cervical dysfunction and distal peripheral nerve compression appears essential in managing complex presentations involving combined spinal and entrapment-related pathology. The results highlight the importance of a comprehensive, individualized, and patient-centered rehabilitation program that targets biomechanical, neurological, and functional components simultaneously.

Although the findings are encouraging, they are limited to a single case. Further research involving larger populations, controlled study designs, and long-term follow-up is needed to establish the generalizability and sustained effectiveness of

multimodal physiotherapy interventions in similar clinical conditions. Overall, this case supports the role of integrated physiotherapy in improving functional outcomes and quality of life in patients with coexisting cervical and upper limb neuropathic disorders.

References

- [1] M. Al-Subahi, D. Kumar, and M. Alqahtani, "Neuromuscular effects of cervical stabilization exercises," *Journal of Musculoskeletal Rehabilitation*, vol. 27, no. 3, pp. 210–218, 2020.
- [2] J. E. Bialosky, J. M. Beneciuk, and M. D. Bishop, "Unraveling the mechanisms of manual therapy: Modeling an approach," *J. Orthop. Sports Phys. Ther.*, vol. 48, no. 1, pp. 8–18, 2018. pubmed.ncbi.nlm.nih.gov/29111111/
- [3] Y. Chen, L. Wang, and H. Xu, "Neural mobilisation for upper limb neuropathies," *J. Hand Ther.*, vol. 34, no. 2, pp. 180–189, 2021.
- [4] T. Chiu, E. Law, and T. Chiu, "Ergonomic factors in neck disorders," *Applied Ergonomics*, vol. 74, pp. 45–52, 2019.
- [5] C. Fernández-de-Las-Peñas, J. Dommerholt, and R. Gerwin, "Trigger points in cervical pain," *Curr. Pain Headache Rep.*, vol. 24, no. 6, pp. 1–10, 2020.
- [6] R. Gupta, N. Sharma, and M. Ali, "Neural mobilization in neuropathies," *Journal of Manual Therapy*, vol. 32, no. 2, pp. 115–124, 2024.
- [7] D. Harrison, P. Oakley, and D. Harrison, "Cervical postural correction review," *Journal of Clinical Chiropractic*, vol. 31, no. 1, pp. 55–63, 2023.
- [8] M. Johnson, "Mechanisms of TENS in pain relief," *Pain Management*, vol. 12, no. 4, pp. 299–307, 2022.
- [9] J. Kang, H. Lee, and J. Park, "Scapular stabilisation in neck dysfunction," *Physiother. Res. Int.*, vol. 24, no. 3, pp. 1–10, 2019.
- [10] S. Kim and J. Park, "Cervical isometrics and posture," *J. Phys. Ther. Sci.*, vol. 35, no. 5, pp. 421–428, 2023.
- [11] D. Lee, M. Choi, and S. Han, "Cervical spondylolysis: Management review," *J. Orthop. Res.*, vol. 39, no. 4, pp. 678–687, 2021.
- [12] A. Miller, J. Thompson, and K. Richards, "Effects of thermal therapy on cervical tension," *Rehabilitation Science*, vol. 15, no. 2, pp. 75–83, 2020.
- [13] S. Pandita and R. Kumar, "Exercise therapy in cervical spondylosis," *Physiother. Theory Pract.*, vol. 39, no. 1, pp. 56–66, 2023.
- [14] A. Patel and D. Roy, "Multimodal physiotherapy effects in cervical disorders," *Indian Journal of Rehabilitation Sciences*, vol. 18, no. 1, pp. 45–52, 2024.
- [15] H. Rahman, P. Singh, and R. Yadav, "Rehabilitation for median nerve compression," *Journal of Neurological Physiotherapy*, vol. 10, no. 4, pp. 212–220, 2022.
- [16] K. Sharma, R. Verma, and A. Singh, "Patient education and chronic neck pain," *Physiother. Pract. Res.*, vol. 43, no. 2, pp. 98–106, 2022.
- [17] P. Singh and R. Verma, "Ergonomic rehabilitation strategies," *International Journal of Physiotherapy*, vol. 8, no. 3, pp. 175–182, 2021.
- [18] J. Smith, L. Johnson, and R. Edwards, "Biomechanics of cervical loading," *Spine Biomechanics Review*, vol. 12, no. 2, pp. 60–72, 2020.
- [19] L. Tetreault *et al.*, "Degenerative cervical disease," *The Spine Journal*, vol. 22, no. 6, pp. 1014–1022, 2022. [aofoundation+1](https://doi.org/10.1016/j.spinee.2022.05.011)
- [20] World Health Organization, *Global Musculoskeletal Rehabilitation Framework*. Geneva, Switzerland: World Health Organization, 2023.