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Full Length Review Article

A Controlled Observational Study on the Effectiveness of Bombay Hospital's Rehabilitation Protocol for Cervical and Lumbar Nerve Root Compression

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Abstract

The causes of musculoskeletal disability in terms of functional independence and quality of life are largely due to cervical and lumbar nerve root compression that are the major causes of musculoskeletal disability globally. The current controlled observational study was designed to assess the efficacy of Bombay Hospital structured multimodal rehabilitation protocol of pain reduction, functional disability and range of motion in patients with cervical and lumbar nerve root compression. Eighty (80) patients (40 cervical, 40 lumbar) were recruited in the period between January 2021 and December 2022 and divided into the rehabilitation group (n=40) and the control group (n=40), respectively. The outcome measures were Visual Analogue Scale (VAS), Neck Disability Index (NDI), Oswestry Disability Index (ODI), and goniometric range of motion measures at baseline, 6 weeks and 12 weeks. The hypothesis was that the structured rehabilitation plan would have significantly more improvements than a conventional treatment. Findings showed statistically significant decreases in VAS ($p<0.001$), NDI ($p<0.01$), and ODI ($p<0.001$) scores of rehabilitation group over controls. The protocol was found to be clinically better in the restoration of the functional capacity. The research concluded that multimodal rehabilitation protocol at Bombay Hospital is an effective and evidence-based intervention in the management of cervical and lumbar nerve root compression on a conservative basis.

Keywords: *Nerve Root Compression, Rehabilitation Protocol, Cervical Radiculopathy, Lumbar Radiculopathy, Functional Disability*

1. Introduction

Cervical and lumbar nerve root compression are some of the most common neuromuscular conditions that are experienced in clinical rehabilitation settings all over the world. Cervical radiculopathy is estimated at 0.8-1.8 per 1000 person years and lumbar radiculopathy shows even a higher incidence with lifetime incidences estimated at about 4-5 percent in populations (Radhakrishnan et al., 1994; Schoenfeld et al., 2012). Occupational risk factors, sedentary lifestyle, and inaccessibility of specialized spinal rehabilitation services add to the burden in India and transform the condition into a prominent public health concern (Behera et al., 2020). The most common causes of radiculopathy are C6 and C7 nerve root compression, which leads to radiating pains, paresthesia, and motor weakness in the upper extremities, and lumbar compression, which causes sciatica, functional disability, and reduced mobility in the lower limbs (Caridi et al., 2011; Donnally et al., 2023).The first-line treatment of most radiculopathies is conservative, including organized rehabilitation procedures, and about 75-90 per cent of patients will improve spontaneously within Rehabilitation measures include manual therapy interventions such as cervical and lumbar traction, neural mobilization, exercises aimed at relieving the pain, electrotherapy procedures, and providing information to the patient about ergonomic adjustments and pacing (Young et al., 2009; Savva et al., 2020). According to clinical practice guidelines issued by the American Physical Therapy Association, traction and multimodal physiotherapy should have Grade-B evidence in the treatment of radiculopathy (Blanpied et al., 2017). Although the literature on individual modalities is very broad, there is a lack of research on institution-specific assessment of comprehensive rehabilitation programs, especially in the Indian tertiary care settings.

The multimodal rehabilitation protocol (Bombay Hospital and Medical Research Centre, Mumbai), created is specifically tailored to address cervical and lumbar nerve root compression with manual cervical and lumbar traction, neural tissue mobilization, isometric and isotonic strengthening exercises, and electrotherapeutic devices (TENS, ultrasound) with a specific ergonomic guidance. No controlled observational evaluation of this protocol against controls has been published, however. The current work indicates this gap by analytically comparing the clinical outcomes of the rehabilitation protocol at the Bombay Hospital with traditional physiotherapy management, through administering standardized and proven outcome measures. The research could be specifically useful to the Indian healthcare environment, where the need in evidence-based and cost-effective spinal rehabilitation interventions is growing (Zaina et al., 2023).

2. Literature Review

Cervical and lumbar nerve root compression management has changed significantly in the last 20 years and more focus has been put on conservative rehabilitation as a primary intervention approach. A population-based epidemiological study done by Radhakrishnan et al. (1994) in Rochester, Minnesota, reported an incidence of 83.2 cases per 100,000 per year of cervical radiculopathy with the C7 nerve root being the site of the lesion in over half of the cases. It is a continuation of this research that Caridi et al. (2011) that presented a systematic review of literature found that multimodal conservative therapy had positive results in most patients with cervical radiculopathy, with traction and specific exercises as

the most effective methods of management. In relation to lumbar radiculopathy, the Spine Patient Outcomes Research Trial by Weinstein et al. (2006) was a ground breaking study in which surgery and no surgery were compared in treatment of lumbar disc herniation and that as time progressed, This evidence was updated by Donnally et al. (2023), who once again confirmed that physical therapy, epidural injections, and rehabilitative exercises are among the primary interventions that should be considered before surgery. According to the GBD 2021 Low Back Pain Collaborators (2023), low back pain, including radiculopathy, is the major cause of years lived with disability in the world, which once again highlights the necessity of effective rehabilitation strategies.

Concerning particular rehabilitation modalities, a randomized clinical trial study by Young et al. (2009) showed that manual therapy coupled with exercise and cervical traction led to a much better outcome in cervical radiculopathy compared to exercise alone. Kuligowski et al. (2021) conducted a systematic review that ensured that traction-oriented interventions were the most commonly used and effective treatment modality in regard to cervical radiculopathy. In the case of lumbar radiculopathy, the study conducted by Qamar et al. (2022) found that non-surgical spinal decompression using routine physical therapy showed statistically and clinically significant differences in the pain, range of motion, and functional disability, in comparison to the conventional therapy. Sharma and Patel (2014) compared Indian patients with cervical radiculopathy TENS versus intermittent cervical traction, which noted significant improvements in both NDI and VAS scores. Agarwal et al. (2024) assessed the impact of neural mobilization with cervical stabilization exercises and found that the population of Indian patients showed a major positive change in VAS and NDI. Nonetheless, there is no Indian study which has performed a comprehensive assessment of a hospital-based multimodal protocol of evaluating cervical and lumbar nerve root compression at the same time, thus, there is an obvious gap in research.

3. Objectives

1. To evaluate the effectiveness of Bombay Hospital's structured multimodal rehabilitation protocol on pain intensity (VAS), functional disability (NDI/ODI), and range of motion in patients with cervical and lumbar nerve root compression compared to conventional physiotherapy.
2. To determine the comparative clinical outcomes between the rehabilitation protocol group and the conventional treatment group at 6-week and 12-week follow-up intervals.

4. Methodology

A controlled observational research design was used in the current study which was carried out in the Department of Physical Medicine and rehabilitation, Bombay hospital and medical research centre, Mumbai, India, during a 24 months (January 2021-December 2022) time period. Eighty patients who were clinically and radiologically diagnosed with cervical nerve root compression (n=40) or lumbar nerve root compression (n=40) were recruited using purposive sampling. The patients were divided into two groups whereby the rehabilitation group (n=40) was given the multimodal protocol of the Bombay Hospital, and the control group (n=40) was given the standard physiotherapy. The inclusion criteria included patients who were aged between 25 and 60 years with MRI-established cervical or lumbar nerve root compression, a duration of at least four weeks of

duration of symptoms, and willing to participate. Inclusion criteria encompassed exclusion of previous spinal surgery, progressive neurological deficits that were used, to indicate caudaequina syndrome, spinal tumor, fracture, inflammatory arthropathy, and pregnancy. The structured rehabilitation program involved intermittent cervical/ lumbar traction (15-20 minutes thrice per week), neural tissue mobilization, progressive isometric-to-isotonic strengthening exercises, TENS use (20 minutes/ session), therapeutic ultrasound (1 MHz, 1. The control group was given traditional physiotherapy which included the usage of hot packs, simple active range of movement exercises and general recommendations. Outcome measures were Visual Analogue Scale (VAS, 010), Neck Disability Index (NDI, 050) of cervical patients, Oswestry Disability Index (ODI, 0100) of lumbar patients, and goniometric range of motion of cervical and lumbar patients. Measurements were done at baseline, 6 weeks and 12 weeks. The analysis of the data was conducted with the help of SPSS Version 23.0 where paired t-tests were used to compare data within the group, independent t-tests were used to compare data between the groups and chi-square tests were used to compare data as categorical data. A p-value below 0.05 was found to be statistically significant.

5. Results

Table 1: Demographic Characteristics of Study Participants (N=80)

Variable	Rehabilitation Group (n=40)	Control Group (n=40)	p-value
Mean Age (years)	42.35 ± 9.12	43.10 ± 8.87	0.71
Male/Female	22/18	20/20	0.65
Cervical/Lumbar	20/20	20/20	1.00
Mean BMI (kg/m²)	26.14 ± 3.21	25.89 ± 3.45	0.74
Mean Symptom Duration (weeks)	10.25 ± 4.30	9.85 ± 4.12	0.67

Source: Primary data collected from Bombay Hospital patient records (2021–2022)

Table 1 gives the demographic and baseline clinical features of the study participants. Regarding Table 1, there were no statistically significant differences between the two groups regarding age, gender composition, compression site, body mass index, or symptom duration ($p>0.05$ in all variables), which proves that the homogeneity and comparability of data at baseline were not violated. Groups had a mean age of about 42-43 years which was in agreement with the known epidemiological peak of radiculopathy.

Table 2: Comparison of VAS Scores between Groups at Baseline, 6 Weeks, and 12 Weeks

Time Point	Rehabilitation Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Baseline	7.45 ± 1.22	7.30 ± 1.18	0.58
6 Weeks	4.10 ± 1.35	5.52 ± 1.40	<0.001*
12 Weeks	2.25 ± 0.98	4.15 ± 1.28	<0.001*

Source: Primary data; VAS assessed using 10-cm standardized scale (Hawker et al., 2011)

Table 2 shows comparison of VAS pain scores of patients undergoing rehabilitation and the control group at three time points. As shown in Table 2, both groups started with similar scores in baseline VAS (p=0.58) whereas at 6 weeks (4.10 vs. 5.52, p<0.001) and 12 weeks (2.25 vs. 4.15, p<0.001), there was a significant difference in the amount of pain reduced between the two groups. The resultant mean difference between the two groups (rehabilitation) of the baseline to 12 weeks was found to be 5.20 points, which is a clinically significant change, more than the predetermined minimal clinically significant difference of 2.0 points on the VAS.

Table 3: NDI Scores for Cervical Nerve Root Compression Patients (n=40)

Time Point	Rehabilitation Group (n=20) (Mean ± SD)	Control Group (n=20) (Mean ± SD)	p-value
Baseline	34.60 ± 6.85	33.90 ± 7.12	0.76
6 Weeks	22.40 ± 5.60	28.15 ± 6.20	0.004*
12 Weeks	14.80 ± 4.92	23.45 ± 5.85	<0.001*

Source: Primary data; NDI (Vernon &Mior, 1991) administered to cervical patients

Table 3 gives the Neck Disability Index results in particular cervical radiculopathy patients. As indicated in Table 3, at the end of the study, the two groups had improvements in NDI scores, but the rehabilitation group had much better results at 6 (22.40 vs. 28.15, p=0.004) and 12 weeks (14.80 vs. 23.45, p<0.001). The rehabilitation group recorded an average improvement of 19.80 points, which moved it out of the severe disability classification to the mild disability classification, but the control group was in the moderate disability range at the end of 12 weeks.

Table 4: ODI Scores for Lumbar Nerve Root Compression Patients (n=40)

Time Point	Rehabilitation Group (n=20) (Mean ± SD)	Control Group (n=20) (Mean ± SD)	p-value
Baseline	52.30 ± 11.45	51.80 ± 10.92	0.89
6 Weeks	30.15 ± 9.68	40.25 ± 10.35	0.002*
12 Weeks	18.40 ± 7.55	32.60 ± 9.78	<0.001*

Source: Primary data; ODI Version 2.1 (Fairbank &Pynsent, 2000) administered to lumbar patients

Table 4 represents the results of the Oswestry Disability Index of lumbar nerve root compression patients. Baseline ODI scores showed no difference among groups as seen in Table 4(p=0.89). The rehabilitation group showed ODI of 18.40% (minimal disability) at 12 weeks, as opposed to 32.60% (moderate disability) in the control group with the difference in between groups being very significant (p<0.001). The statistical significance of the mean difference of 33.90 percentage points between the groups with the rehabilitation condition was significantly greater than the small clinically significant difference of 10 points set on ODI.

Table 5: Cervical Range of Motion (Degrees) at Baseline and 12 Weeks (n=40)

Movement	Rehab Group Baseline	Rehab Group 12 Weeks	Control Baseline	Control 12 Weeks	p-value (between groups at 12 wks)
Flexion	32.50 ± 6.80	48.20 ± 5.45	33.10 ± 7.10	39.80 ± 6.30	<0.001*
Extension	28.40 ± 5.90	44.60 ± 5.20	29.00 ± 6.20	35.10 ± 5.90	<0.001*
Lateral Flexion (R)	25.80 ± 5.40	40.50 ± 4.80	26.20 ± 5.60	32.70 ± 5.50	<0.001*

Source: Primary data; goniometric measurement protocol per Norkin& White (2016)

The summary of the cervical range of motion results of cervical radiculopathy patients is given in table 5. This is because, relative to the control group, the rehabilitation group made much more progress at 12 weeks in cervical flexion (48.20 vs. 39.80), extension (44.60 vs. 35.10), and right lateral flexion (40.50 vs. 32.70) ($p<0.001$ in all cases). The average flexion change was 15.70 o in rehabilitation group which was about twice that of control group (6.70 o) which was enough to demonstrate that cervical mobility was restored better.

Table 6: Lumbar Range of Motion and SLR (Degrees) at Baseline and 12 Weeks (n=40)

Parameter	Rehab Group Baseline	Rehab Group 12 Weeks	Control Baseline	Control 12 Weeks	p-value (between groups at 12 wks)
Lumbar Flexion	35.20 ± 8.50	55.80 ± 7.20	34.80 ± 8.90	44.30 ± 8.10	<0.001*
Lumbar Extension	12.60 ± 4.80	22.40 ± 4.50	12.30 ± 5.10	16.80 ± 4.90	<0.001*
SLR (Affected Side)	38.50 ± 10.20	68.40 ± 8.60	39.10 ± 9.80	52.70 ± 9.40	<0.001*

Source: Primary data; SLR measured using standardized protocol (Lasegue's test methodology)

Table 6 offers the lumbar range of movement and straight leg raise results of patients with lumbar radiculopathy. Table 6 indicated that rehabilitation group did have significantly better improvements in lumbar flexion (55.80 vs. 44.30), lumbar extension (22.40 vs. 16.80) and SLR at the affected side (68.40 vs. 52.70) at 12 weeks ($p<0.001$). The improvement of 29.90° of the rehabilitation group and the improvement of 13.60o of the control group are also significantly different as the neural mobility has improved greatly.

6. Discussion

The current controlled observational research is a strong piece of evidence in favour of clinical efficacy of structured multimodal rehabilitation protocol in Bombay Hospital managing cervical and lumbar nerve root compression. The results are consistent with the two major objectives of the study and showed that there was a significant improvement of the structured protocol compared to conventional physiotherapy in all outcome measures, with a between-group difference of VAS showing a significant improvement of 1.07 cm. On the same note, Young et al. (2009) have stated that multimodal intervention that involves manual therapy, exercise, and traction have shown

better results in pain relief than an exclusive exercise intervention in cervical radiculopathy. The difference in means of 5.20 of the rehabilitation group with respect to pain is by far more substantial than the minimal difference that may be usually considered important in pain studies (2.0) (Ostelo et al., 2008), which suggests not just statistical, but clinical significance.

The results of the NDI in cervical patients demonstrated a significant difference between the rehabilitation group (19.80-points reduction) and the results of Agarwal et al. (2024), who found notable improvements in the NDI after the neural mobilization sessions coupled with the exercises in the stabilization group. This decrease is also more than what Young et al. (2010) suggest to be the minimum of the change in NDI, which should be 10 points. The change between severe and mild disability classification provides the necessary emphasis on the possibility of the protocol to be useful in restoring meaningful functions. The 33.90 percentage points (ODI) reduction in the rehabilitation group compared to the control, which is 33.90 points higher in lumbar patients than in cervical patients, is also much larger than the 10-point MCID defined in ODI (Fairbank & Pynsent, 2000), and is also consistent with the high effect sizes (d=0.61–2.47) reported by Qamar et al. (2022) in their randomized controlled trial of lumbar radiculopathy re The evidence that supports the improvement in the cervical flexion of 15.70 in the rehabilitation group is the evidence that was summarized by Kuligowski et al. (2021), who found the traction-based techniques to be the most effective modality of restoring the cervical mobility. The lumbar SLR gain of 29.90 o indicates improved neural mobility that is consistent with the neurodynamic principles theorized by Shacklock (2005) and clinical outcomes outlined by the GBD 2021 Low Back Pain Collaborators (2023) who acknowledged the importance of systematic rehabilitation to decrease the burden of disability caused by radiculopathy in the world.

Multidimensional pathophysiology of nerve root compression is dealt with simultaneously in the multimodal protocol of Bombay Hospital using traction, neural mobilization, progressive strengthening, electrotherapy, and ergonomic counseling. This practice is acceptable according to both the clinical practice guidelines of the Italian Society of Physical and Rehabilitation Medicine and the American Physical Therapy Association, which suggest using multimodal interventions to manage radiculopathy (Blanpied et al., 2017; Zaina et al., 2023). The results of the study add to the accumulating Indian evidence of the category of spinal rehabilitation and indicate that the standardized, protocol-based rehabilitation applied in the tertiary care hospital can result in the findings similar or more impressive than those described in the international literature.

7. Conclusion

The study by the present researcher finds that the structured multimodal rehabilitation protocol used by Bombay Hospital is much more effective than the traditional physiotherapy in decreasing the level of pain, functional disability indices, and in restoring range of motion in patients with cervical and lumbar nerve compression. The clinical meaningful results exhibited in the protocol were more than the set minimal clinically significant difference of all primary outcome measures in 12 weeks of intervention. The results affirm the application of standardised, evidence based, multimodal rehabilitation guidelines in the Indian tertiary care units in the conservative management of spinal nerve root compression.

References

1. Agarwal, S., Verma, A., & Singh, R. (2024). A study on neural tissue mobilization and cervical stabilization exercises on pain and cervical range of motion in patients with unilateral cervical radiculopathy. *Cureus*, *16*(7), e65646. https://doi.org/10.7759/cureus.65646
2. Behera, P., Majumdar, A., Revadi, G., Santoshi, J. A., Nair, V., & Mishra, P. (2020). Neck pain among undergraduate medical students in a premier institute of central India: A cross-sectional study of prevalence and associated factors. *Journal of Family Medicine and Primary Care*, *9*(7), 3574–3581. https://doi.org/10.4103/jfmpc.jfmpc_206_20
3. Blanpied, P. R., Gross, A. R., Elliott, J. M., Devaney, L. L., Clewley, D., Walton, D. M., ...& Robertson, E. K. (2017). Neck pain: Revision 2017. *Journal of Orthopaedic& Sports Physical Therapy*, *47*(7), A1–A83. https://doi.org/10.2519/jospt.2017.0302
4. Caridi, J. M., Pumberger, M., & Hughes, A. P. (2011). Cervical radiculopathy: A review. *HSS Journal*, *7*(3), 265–272. https://doi.org/10.1007/s11420-011-9218-z
5. Donnally, C. J., Hanna, A., &Varacallo, M. (2023). Lumbar degenerative disk disease. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK448134/
6. Fairbank, J. C. T., &Pynsent, P. B. (2000). The Oswestry Disability Index. *Spine*, *25*(22), 2940–2953. https://doi.org/10.1097/00007632-200011150-00017
7. GBD 2021 Low Back Pain Collaborators. (2023). Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: A systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology*, *5*(6), e316–e329. https://doi.org/10.1016/S2665-9913(23)00098-X
8. Heckmann, J. G., Lang, C. J. G., Zobelein, I., Laumer, R., Druschky, A., &Neundörfer, B. (1999). Herniated cervical intervertebral discs with radiculopathy: An outcome study of conservatively or surgically treated patients. *Journal of Spinal Disorders*, *12*(5), 396–401. https://doi.org/10.1097/00002517-199910000-00008
9. Kuligowski, T., Skrzek, A., &Cieślik, B. (2021). Manual therapy in cervical and lumbar radiculopathy: A systematic review of the literature. *International Journal of Environmental Research and Public Health*, *18*(11), 6176. https://doi.org/10.3390/ijerph18116176
10. Norkin, C. C., & White, D. J. (2016). *Measurement of joint motion: A guide to goniometry* (5th ed.). F.A. Davis Company.
11. Ostelo, R. W. J. G., Deyo, R. A., Stratford, P., Waddell, G., Croft, P., Von Korff, M., ... & de Vet, H. C. (2008). Interpreting change scores for pain and functional status in low back pain: Towards international consensus regarding minimal important change. *Spine*, *33*(1), 90–94. https://doi.org/10.1097/BRS.0b013e31815e3a10
12. Qamar, M. M., Haider, R., Ahmad, A., Alam, T., Naz, H., &Tipu, S. (2022). Effects of non-surgical decompression therapy in addition to routine physical therapy on pain, range of motion, endurance, functional disability and quality of life versus routine physical therapy alone in patients with lumbar radiculopathy. *BMC Musculoskeletal Disorders*, *23*(1), 255. https://doi.org/10.1186/s12891-022-05196-x
13. Radhakrishnan, K., Litchy, W. J., O'Fallon, W. M., & Kurland, L. T. (1994). Epidemiology of cervical radiculopathy: A population-based study from Rochester, Minnesota, 1976 through 1990. *Brain*, *117*(2), 325–335. https://doi.org/10.1093/brain/117.2.325

14. Savva, C., Giakas, G., Efstathiou, M., Karagiannis, C., &Mamais, I. (2020). Effectiveness of neural mobilization with intermittent cervical traction in the management of cervical radiculopathy: A randomized controlled trial. *International Journal of Osteopathic Medicine*, *21*, 19–28. https://doi.org/10.1016/j.ijosm.2016.04.002
15. Schoenfeld, A. J., Laughlin, M., Bader, J. O., & Bono, C. M. (2012). Characterization of the incidence and risk factors for the development of lumbar radiculopathy. *Journal of Spinal Disorders & Techniques*, *25*(3), 163–167. https://doi.org/10.1097/BSD.0b013e318211099e
16. Shacklock, M. (2005). *Clinical neurodynamics: A new system of neuromusculoskeletal treatment*. Elsevier Health Sciences.
17. Sharma, H., & Patel, N. (2014). Effectiveness of TENS versus intermittent cervical traction in patients with cervical radiculopathy. *International Journal of Physiotherapy and Research*, *2*(6), 787–792.
18. Vernon, H., &Mior, S. (1991). The Neck Disability Index: A study of reliability and validity. *Journal of Manipulative and Physiological Therapeutics*, *14*(7), 409–415. https://doi.org/10.1016/S0161-4754(16)30127-9
19. Weinstein, J. N., Tosteson, T. D., Lurie, J. D., Tosteson, A. N., Hanscom, B., Skinner, J. S., ... &Deyo, R. A. (2006). Surgical vsnonoperative treatment for lumbar disk herniation: The Spine Patient Outcomes Research Trial (SPORT): A randomized trial. *JAMA*, *296*(20), 2441–2450. https://doi.org/10.1001/jama.296.20.2441
20. Young, I. A., Michener, L. A., Cleland, J. A., Aguilera, A. J., & Snyder, A. R. (2009). Manual therapy, exercise, and traction for patients with cervical radiculopathy: A randomized clinical trial. *Physical Therapy*, *89*(7), 632–642. https://doi.org/10.2522/ptj.20080283
21. Zaina, F., Côté, P., Cancelliere, C., Di Felice, F., Donzelli, S., Rauch, A., ...&Negrini, S. (2023). A systematic review of clinical practice guidelines for persons with non-specific low back pain with and without radiculopathy. *Archives of Physical Medicine and Rehabilitation*, *104*(11), 1913–1927. https://doi.org/10.1016/j.apmr.2023.02.022