

# **Is there a role for post-operative physiotherapy in Degenerative Cervical Myelopathy (DCM)? A systematic review.**

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## ***Key words:***

Cervical Myelopathy, Spondylosis, Cervical Stenosis, Disc Herniation, Ossification Posterior Longitudinal Ligament, Degeneration, Physical therapy

## ***Running Title***

*Post-operative physiotherapy in Degenerative Cervical Myelopathy*

***Word Count: 1659***

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The authors declare no conflicts of interest.

## **Abstract**

**BACKGROUND:** Degenerative Cervical Myelopathy (DCM) is estimated to be the commonest cause of spinal cord dysfunction worldwide, with treatment largely limited to surgery. Physiotherapy is often provided as part of post-operative rehabilitation with an unclear evidence base.

**OBJECTIVE:** To review peer-reviewed literature relating to post-operative physiotherapy for DCM, to determine efficacy in improving clinical outcome and recovery.

**DATA SOURCES:** MEDLINE, EMBASE, CENTRAL, PEDro, ISRCTN registry, WHO ICTRP and Clinicaltrials.gov. References and citations of relevant articles were searched.

**METHODS:** A systematic search was conducted in accordance with PRISMA guidelines (PROSPERO CRD42016039511) from the origins of the databases till 15<sup>th</sup> February 2018. Included were all studies investigating physiotherapy as an intervention after surgical treatment of DCM to determine effect on clinical outcome and recovery. Study quality was determined using the Grades of Recommendation, Assessment, Development and Evaluation guidelines.

**RESULTS:** 287 records identified through tailored systematic searches, after removing duplicates. After screening, only one investigated post-operative rehabilitation using physiotherapy for DCM, however this was retrospective with no controls. This study suggested that rehabilitation including physiotherapy improved post-operative recovery. There is currently only one registered trial investigating the use of post-operative physiotherapy for DCM.

**CONCLUSIONS:** The literature provides insufficient evidence to make any evidence-based recommendations regarding post-operative physiotherapy use in DCM.

## Introduction

Degenerative cervical myelopathy is cervical spinal cord compression and dysfunction from spinal stenosis due to degeneration of the cervical spine (bone, joints, discs or ligaments). This includes cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament. Degenerative cervical myelopathy is thought to be the leading cause of acquired spinal cord compromise.<sup>1</sup> As a degenerative pathology, its occurrence is associated with age and therefore its prevalence is expected to rise.<sup>2</sup> Symptoms are varied, ranging from mild pain to loss of digital dexterity, imbalance, frequent falls, incontinence and in some cases tetraplegia.

Physiotherapy is a standard of care following many neurological injuries including spinal cord injury as part of neurorehabilitation programmes.<sup>3,4</sup> It has been associated with improved functional outcomes in both acute and chronic spinal cord injury.<sup>3,5-7</sup> In degenerative cervical myelopathy, it is primarily used for non-operative management of mild cases, but is also used to facilitate mobility and manage disability post-operatively.<sup>8,9</sup> Although there is often some functional recovery primarily in upper limb function after surgical decompression, this tends to be incomplete with patients retaining lifelong disabilities<sup>10-13</sup>. Physiotherapy may prove particularly beneficial in optimising recovery when further spinal cord injury is prevented by surgical decompression.<sup>14</sup>

In previous reviews of the literature on the surgical management of degenerative cervical myelopathy, we identified much heterogeneity in the reporting of study design, sample characteristics and outcomes, and proposed the development of a consensus minimum dataset.<sup>15,16</sup> In this article, our primary objective is to review the evidence available for providing physiotherapy after surgical decompression in degenerative cervical myelopathy.

We will also review the surgical trials collated in our previous reviews to establish whether a standard for postoperative care exists.

## **Methods**

### ***Is there any evidence relating to post-operative physiotherapy in degenerative cervical myelopathy?***

A systematic search of MEDLINE [Ovid], EMBASE [Ovid], CENTRAL, PEDro, ISRCTN registry, WHO International Clinical Trials Registry Platform and Clinicaltrials.gov, was conducted in accordance with PRISMA guidelines (PROSPERO CRD42016039511).<sup>17</sup> Databases were searched from their origin to 15<sup>th</sup> February 2018 using a tailored search strategy (Supplementary Material) for all studies investigating physiotherapy as an intervention after surgical treatment of degenerative cervical myelopathy, and concluding an effect on clinical outcome and recovery. Titles and abstracts were screened for relevance. References and citations of full-text articles were screened for additional eligible articles using Scopus. Two investigators (AB and BD) independently reviewed the full text articles to apply the inclusion and exclusion criteria and came to agreement through discussion. Clinical studies of any design were included if participants suffering from degenerative cervical myelopathy had undergone surgical decompression and were receiving post-operative physiotherapy. Articles were excluded if they were of non-English text, they contained no data on evaluation of the efficacy of post-operative physiotherapy, or were studies of animals or cadavers. Study quality was determined using the Grades of Recommendation, Assessment, Development and Evaluation framework.<sup>18</sup>

### ***Is there a standard for post-operative care in degenerative cervical myelopathy surgical trials and does this include physiotherapy?***

## **What about:**

For our previous systematic review a search of MEDLINE and EMBASE was completed using the search strategy ['Cervical'] AND ['Myelopathy']. Interventional studies, reported in English, exclusively concerning degenerative cervical myelopathy were included to consider the reporting of baseline characteristics (REF) and outcomes (REF). The strategy can be reviewed in more detail in the aforementioned references. The included studies were re-examined for details post-operative care, particularly post-operative physiotherapy. Data extracted using a piloted extraction template.

From one of our other previous systematic reviews separate to the one detailed above, we collated 105 clinical trials of surgery as a treatment for degenerative cervical myelopathy, having searched MEDLINE and EMBASE using the search strategy ['Cervical'] AND ['Myelopathy'].<sup>15,16</sup> Each article was examined for details of post-operative care, particularly post-operative physiotherapy. Data extracted using a piloted extraction template.

## **Results**

### ***Is there any evidence relating to post-operative physiotherapy in degenerative cervical myelopathy?***

Of the 287 articles identified through our search after removing duplicates, five were shortlisted for full-text review based on abstract and title.<sup>19-23</sup> Although the study by Razack et al. involved post-operative rehabilitation, there was no further information on what this meant and its efficacy was not commented on.<sup>21</sup> Only one of the studies concluded on the effect of post-operative physiotherapy on degenerative cervical myelopathy clinical outcome and recovery.<sup>23</sup> The screening process is summarised in the PRISMA flowchart (Figure 1).

The included record was a retrospective study of 21 individuals with cervical spondylotic myelopathy who received surgical treatment and post-operative rehabilitation including

physiotherapy. Outcome was assessed in terms of a disability classification, activities of daily living, mobility status and the Medical Research Council grading of muscle power.<sup>23</sup>

The study concluded that rehabilitation improved post-operative functional status. The study was deemed to be of low quality due to being a retrospective study with low sample size and no comparative group.

There are two registered randomised controlled trials on clinicaltrials.gov which are planning to investigate the efficacy of post-operative rehabilitation in degenerative cervical myelopathy. One (NCT02842775) is currently in the early recruitment stage and will be assessing the effects of post-operative physiotherapy for balance control and the second (NCT03320759) is not currently recruiting but will assess the effects of post-operative occupational therapy.

***Is there a standard for post-operative care in degenerative cervical myelopathy surgical trials and does this include physiotherapy?***

Of the 105 surgical trials identified in this systematic review, post-operative care was detailed in 32 (30%), largely relating to the use of cervical collars (28, 27%). 'Neck exercises' were reported by six (6%), but only one of these mentioned physiotherapy specifically<sup>24</sup>. Less common were surgical drains (2, 2%), courses of dexamethasone (4, 4%) and/or diuretics (2, 2%).

**Discussion**

We found no studies evaluating the effectiveness of physiotherapy for degenerative cervical myelopathy after surgical decompression. Only one study was identified, which claimed that post-operative rehabilitation improved functional status.<sup>23</sup> However, this was a retrospective study with no comparative controls. The study was therefore deemed of very low quality<sup>18</sup>

It is apparent from our assessment of surgical trials in degenerative cervical myelopathy that a standard for post-operative care does not exist.

Currently, physiotherapy use in degenerative cervical myelopathy is weakly evidenced only in mild cases as part of non-operative management.<sup>8,9</sup> There have been no previous reviews of post-operative rehabilitation in degenerative cervical myelopathy. Whilst no evidence was found to support post-operative physiotherapy in degenerative cervical myelopathy, promising data from other forms of spinal cord injury, both acute and chronic alongside the preclinical evidence, suggests this is worth exploring further.<sup>3,5-7</sup> The potential benefit of post-operative physiotherapy may not just be restricted to improvement in overall function. In a recent imaging study, the fat content of neck muscles in people with degenerative cervical myelopathy was found to differ and its distribution related to pain scores.<sup>25</sup> This raises the possibility that physiotherapy may improve pain, an outcome highly valued by people with degenerative cervical myelopathy.<sup>15</sup>

Commissioning of neurorehabilitation worldwide is challenged by its evidence base and with the increasing financial demands on healthcare systems, further clinical investigation is required.<sup>4</sup> The unclear benefit or harm of post-operative physiotherapy must be clarified. Enhancing recovery post-operatively in degenerative cervical myelopathy has been a relatively recent research focus but represents a major unmet clinical need.<sup>10</sup> This has led to both the CSM-PROTECT trial (NCT01257828) and the soon to start RECEDE-Myelopathy, both investigating the potential neurological benefits of a medical adjuvant to surgical decompression to enhance functional recovery. If these trials deliver results, it will further focus attention on standards of post-operative care.

Post-operative physiotherapy is currently used in degenerative cervical myelopathy, however its underreporting in interventional trials, as identified here, has greatly limited any

consideration of its clinical impact. The development of a standardized reporting process would support this area of research, both in terms of interventions and outcomes, to generate knowledge and inform future high quality clinical trials of post-operative physiotherapy in degenerative cervical myelopathy. A similar process is underway for acute Spinal Cord Injury. This would be a natural extension to our aims of developing a consensus minimum dataset for treatment studies in degenerative cervical myelopathy.

While it is possible that some records may have been missed by the search strategy used, this risk has been mitigated by searching references and citations of relevant records captured and consulting experts in the field. The systematic review of surgical trials in degenerative cervical myelopathy was limited to a period of 20 years, so will not capture potentially relevant studies outside this.<sup>15,16</sup> Although this will reduce the number of studies identified, arguably, it is the recent studies that are more relevant to current research practice.

In conclusion, we are unable to make an evidence-based recommendation for or against the use of post-operative physiotherapy in degenerative cervical myelopathy, as there are no studies evaluating its effectiveness. Moreover, there is no standard for post-operative care in the surgical trials reviewed. With significant promise in the field of spinal cord injury, further research is required to determine if there is a role for post-operative physiotherapy in degenerative cervical myelopathy.

### **Clinical message**

- There are no controlled studies evaluating whether physiotherapy causes benefit, harm or neither after surgical decompression in patients with degenerative cervical myelopathy. Therefore, there is insufficient evidence to make evidence-based recommendation regarding this.

## Conflict of Interest Statement, and source of funding

The authors declare that there is no conflict of interest.

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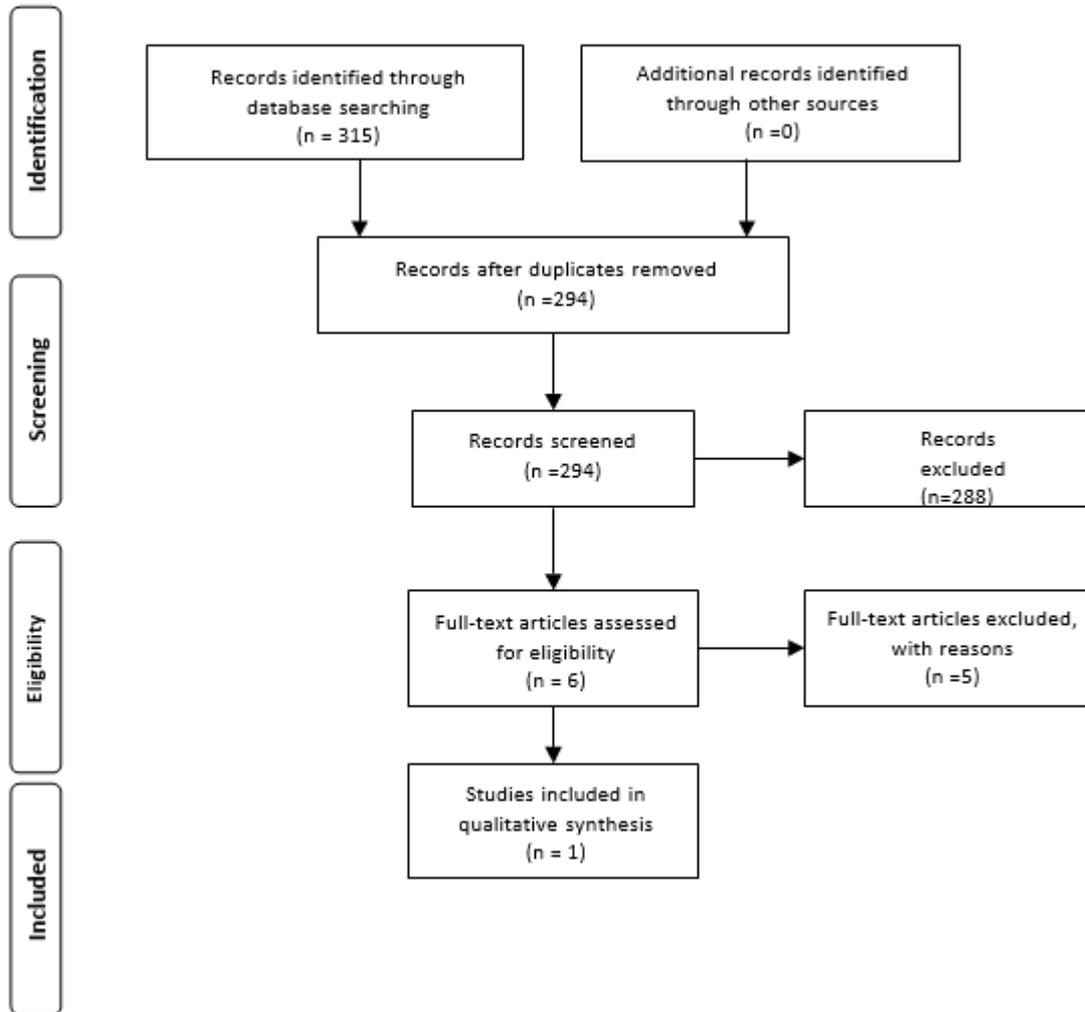


Figure 1: PRISMA flow diagram<sup>17</sup>

## Supplementary Material: Search Strategy and PRISMA Checklist

### Search strategy

#### MEDLINE

1. exp Neck/
2. neck.ti,ab.
3. exp Cervical Vertebrae/
4. or/1-3
5. exp Spinal Cord Compression/
6. exp Spinal Osteophytosis/
7. spondylosis/
8. (cervical adj5 (compress\$ or stenosis or herniat\$ or degenerat\$ or decompress\$)).ti,ab.
9. myelopathy.mp.
10. (myeloradiculopathy or radiculomyelopathy).mp.
11. or/5-10
12. Postoperative Care/
13. exp physical therapy modalities/
14. (physical therap\$ or physiotherap\$).tw.
15. exp exercise therapy/
16. rh.fs.
17. exp rehabilitation/ or exp occupational therapy/
18. (rehabilitat\$ or occupational therap\$).tw.
19. or/12-18
20. randomized controlled trial.pt.
21. controlled clinical trial.pt.
22. randomized controlled trials.sh.

23. random allocation.sh.
24. double blind method.sh.
25. single-blind method.sh.
26. clinical trial.pt.
27. exp clinical trials as topic/
28. (clin\$ adj25 trial\$).ti,ab.
29. ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj25 (blind\$ or maske\$)).tw.
30. placebos.sh.
31. placebo\$.ti,ab.
32. random\$.ti,ab.
33. research design.sh.
34. pragmatic clinical trial.pt.
35. comparative study.pt.
36. randomi#ed.ti,ab.
37. randomly.ab,ti.
38. trial.ab,ti.
39. groups.ab.
40. exp Cohort Studies/
41. cohort\$.ti,ab.
42. comparative\$.ti,ab.
43. prospective\$.ti,ab.
44. or/20-43
45. (animal not human).sh.
46. 44 not 45
47. 4 and 11 and 19 and 46

EMBASE

1. Clinical Article/
2. exp Clinical Study/
3. Clinical Trial/
4. Controlled Study/
5. Randomized Controlled Trial/
6. Major Clinical Study/
7. Double Blind Procedure/
8. Multicenter Study/
9. Single Blind Procedure/
10. Phase 3 Clinical Trial/
11. Phase 4 Clinical Trial/
12. crossover procedure/
13. placebo/
14. or/1-13
15. allocat\$.mp.
16. assign\$.mp.
17. blind\$.mp.
18. (clinic\$ adj25 (study or trial)).mp.
19. compar\$.mp.
20. control\$.mp.
21. cross?over.mp.
22. factorial\$.mp.
23. follow?up.mp.
24. placebo\$.mp.
25. prospectiv\$.mp.
26. random\$.mp.
27. ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj25 (blind\$ or mask\$)).mp.

28. trial.mp.
29. (versus or vs).mp.
30. or/15-29
31. 14 and 30
32. human/
33. Nonhuman/
34. exp Animal/
35. Animal Experiment/
36. 33 or 34 or 35
37. 32 not 36
38. 31 not 36
39. 37 and 38
40. 38 or 39
41. exp Neck/
42. neck.mp.
43. exp Cervical Spine/
44. exp Cervical Spondylosis/
45. or/42-44
46. Spinal Cord Compression/
47. myelopathy.mp.
48. exp Myeloradiculopathy/
49. radiculomyelopathy.mp.
50. or/46-49
51. exp Surgery/
52. surgery.mp.
53. surgical.mp.
54. or/51-53

55. exp Physiotherapy/
56. exp Rehabilitation/
57. exp Exercise/
58. physical therapy.mp.
59. exercise.mp.
60. rehabilitation.mp.
61. physiotherapy.mp.
62. or/55-61
63. 40 and 45 and 50 and 54 and 62

#### CENTRAL

1. MeSH descriptor Neck, this term only
2. MeSH descriptor Neck Pain, this term only
3. (neck)
4. MeSH descriptor Cervical Vertebrae explode all trees
5. (#1 OR #2 OR #3 OR #4)
6. MeSH descriptor Spinal Cord Compression explode all trees
7. MeSH descriptor Spinal Osteophytosis explode all trees
8. myelopathy
9. radiculomyelopathy
10. myeloradiculopathy
11. (#6 OR #7 OR #8 OR #9 OR #10)
12. MeSH descriptor Surgery explode all trees
13. MeSH descriptor Surgical Procedures, Operative explode all trees
14. surgery
15. surgical
16. (#12 OR #13 OR #14 OR #15)

17. MeSH descriptor Physical Therapy (Speciality) explode all trees
18. MeSH descriptor Physical Therapy Modalities explode all trees
19. physical therapy
20. physiotherapy
21. MeSH descriptor Exercise explode all trees
22. Exercise
23. MeSH descriptor Rehabilitation explode all trees
24. Rehabilitation
25. (#17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24)
26. (#5 AND #11 AND #16 AND #25)

Clinicaltrials.gov

1. Cervical Myelopathy AND (physical therapy OR physiotherapy OR exercise OR rehabilitation)

ISRCTN registry (<http://www.isrctn.com/editAdvancedSearch>)

1. Cervical Myelopathy AND (physical therapy OR physiotherapy OR exercise OR rehabilitation)

*World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP)*  
(<http://apps.who.int/trialsearch/>)

1. Cervical Myelopathy AND (physical therapy OR physiotherapy OR exercise OR rehabilitation)

PEDro (<https://www.pedro.org.au/>)

1. Cervical Myelopathy AND (physical therapy OR physiotherapy OR exercise OR rehabilitation)

## PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	NA

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	NA
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	NA

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	NA
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	NA
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA

<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	7
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	8, 9
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	7-9
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	10