Factors Associated With Return to Work After Surgery for Degenerative Cervical Spondyloptic Myelopathy: Cohort Analysis From the Canadian Spine Outcomes and Research Network

Alexander Romagna, MD, MHBA, FEBNS1,2, Jefferson R. Wilson, MD, FRCS(C)1, W. Bradley Jacobs, MD, FRCS(C)3, Michael G. Johnson, MD, FRCS(C)4, Christopher S. Bailey, MD, FRCS(C)5, Sean Christie, MD, FRCS(C)6, Jerome Paquet, MD, FRCS(C)7, Andrew Nataraj, MD, FRCS(C)8, David W. Cadotte, MD, FRCS(C)3, Neil Manson, MD, FRCS(C)9, Hamilton Hall, MD, FRCS(C)1, Kenneth C. Thomas, MD, FRCS(C)3, Christoph Schwartz, MD, MHBA, FEBNS2, Y. Raja Rampersaud, MD, FRCS(C)1, Greg McIntosh, MSc10, Charles G. Fisher, MD, MHSc, FRCS(C)11,12, and Nicolas Dea, MD, FRCS(C)11,12

Abstract

Study design: Retrospective analysis of prospectively collected data from the multicentre Canadian Surgical Spine Registry (CSORN).

Objective: Degenerative cervical myelopathy (DCM) is the most common cause of spinal cord dysfunction in North America. Few studies have evaluated return to work (RTW) rates after DCM surgery. Our goals were to determine rates and factors associated with postoperative RTW in surgically managed patients with DCM.

Methods: Data was derived from the prospective, multicenter Canadian Spine Outcomes and Research Network (CSORN). From this cohort, we included all nonretired patients with at least 1-year follow-up. The RTW rate was defined as the proportion of patients with active employment at 1 year from the time of surgery. Unadjusted and adjusted analyses were used to identify patient characteristics, disease, and treatment variables associated with RTW.

Results: Of 213 surgically treated DCM patients, 126 met eligibility, with 49% working and 51% not working in the immediate period before surgery; 102 had 12-month follow-up data. In both the unadjusted and the adjusted analyses working preoperatively and an anterior approach were associated with a higher postoperative RTW (P < .05), there were no significant differences between the postoperative employment groups with respect to age, gender, preoperative mJOA (modified Japanese Orthopaedic Association) score, and duration of symptoms (P > .05). Active preoperative employment (odds ratio = 15.4, 95% confidence

1 University of Toronto, Toronto, Ontario, Canada
2 Paracelsus Private Medical University, Salzburg, Austria
3 University of Calgary, Calgary, Alberta, Canada
4 University of Manitoba, Winnipeg, Manitoba, Canada
5 Western University, London, Ontario, Canada
6 Dalhousie University, Halifax, Nova Scotia, Canada
7 CHU de Quebec-Universite Laval, Quebec City, Quebec, Canada
8 University of Alberta Hospital, Edmonton, Alberta, Canada
9 Dalhousie University, Saint John, New Brunswick, Canada
10 Canadian Spine Outcomes and Research Network, Markdale, Ontario, Canada
11 Vancouver General Hospital, Vancouver, British Columbia, Canada
12 University of British Columbia, Vancouver, British Columbia, Canada

Corresponding Author:
Greg McIntosh, Canadian Spine Outcomes and Research Network, 10 Armstrong Cres, PO Box 1053, Markdale, Ontario, Canada N0C 1H0.
Email: gmcintosh@spinecanada.ca
interval = 4.5, 52.4) and anterior surgical procedures (odds ratio = 4.7, 95% confidence interval = 1.2, 19.6) were associated with greater odds of RTW at 1 year.

Conclusions: The majority of nonretired patients undergoing surgery for DCM had returned to work 12 months after surgery; active preoperative employment and anterior surgical approach were associated with RTW in this analysis.

Keywords
degenerative, cervical, myelopathy, return to work, surgery

Introduction
Degenerative cervical myelopathy (DCM) is the most common cause of spinal cord dysfunction in North America and one of the most frequent indications for cervical spine surgery globally. While most commonly observed in the elderly, DCM can also affect younger and middle-aged individuals leading to losses in productivity and absence from work.

Traditionally, DCM surgery has been performed with the stated goal of decompressing the spinal cord to arrest functional deterioration, with little expectation of clinical improvement. More recently, however, several large multicenter prospective studies have shown that decompressive surgery mostly results in clinically significant improvements in functional status, disability, and quality of life regardless of symptoms severity. As a consequence, 2017 clinical practice guidelines recommended surgery for all patients presenting with moderate or severe DCM to help facilitate improvements in clinical outcomes.

Although there has been a substantial increase in evidence supporting the positive effects of surgery, few studies have investigated how operative intervention in DCM affects patients’ ability to return to work (RTW). RTW following surgery not only has positive effects for the individual patient but also for society in general. RTW following DCM surgery requires not only physical healing from the procedure itself but also improvement in myelopathy related impairments that may limit individuals’ capacity to work preoperatively. Obtaining an improved understanding of those likely (and not unlikely) to RTW postoperatively has the potential to improve doctor-patient communication in the clinical realm helping surgeons quantify expectations across the care pathway.

In the current study, we used a large prospective national spine registry to determine rates and predictors of postoperative RTW in DCM to facilitate personalized patient counseling with respect to occupational expectations. We hypothesized that preoperative employment status in addition to the severity of preoperative functional deficits would predict postoperative RTW.

Methods
Study Design
We performed a retrospective analysis of prospectively collected data from the multicenter Canadian Surgical Spine Registry (CSORN). This national registry has been described in detail in previous publications. In brief, CSORN includes 50 neurosurgical and orthopedic spine surgeons in 18 academic and nonacademic hospitals across Canada; they collect standardized clinical and radiological data elements pertaining to the assessment and management of adult patients with common surgical spinal disorders, including DCM. At all sites, trained research assistants perform standardized data collection in both the preoperative and postoperative periods at prespecified time points. All sites have obtained research ethics board approval prior to data collection. Patient identification is anonymized prior to input into the central electronic database.

Eligibility
Inclusion criteria were the following: (1) a clinical diagnosis of cervical myelopathy leading to surgical treatment, (2) MRI (magnetic resonance imaging) evidence of degenerative-related cervical spinal cord compression, (3) identified as non-retired preoperatively, and (4) 1-year follow-up after primary surgery. Included nonretired patients were either unemployed, employed but not working, or actively working preoperatively. We excluded those with myelopathy secondary to other compressive etiologies such as tumor, infection, or trauma in addition to those undergoing revision cervical surgery. Moreover, patients on worker compensation were excluded from these analyses.

Surgical Procedure
Cervical procedures performed included anterior and/or posterior decompression with or without instrumented fusion in the homogenous study population. Decisions surrounding surgical approach were made at the discretion of the attending surgeon involved with each case.

Baseline Variables Considered
Potential parameters of RTW included preoperative age, gender, duration of symptoms, occupational status (retired vs working), active or pending medicolegal claims, and surgical approach (anterior vs posterior). Preoperative patient reported questionnaires considered were the following: numerical rating scale (NRS) for neck pain and arm pain, the SF-12 physical component summary (PCS) and mental component summary (MCS), the EQ-5D general health care score, and the neck
disability index (NDI). Also, the modified Japanese Orthopaedic Association (mJOA) score was assessed.

**Outcome Parameters**

The inception point of the study was the date of surgery and the primary endpoint was the postoperative RTW date. The RTW rate was defined as the proportion of patients with active employment at 1 year from the time of surgery.

**Statistical Analysis**

The study cohort was characterized using means and standard deviations to describe continuous variables and proportions to describe categorical variables. Unadjusted bivariable analyses were completed using unpaired Student’s t tests to compare means and χ² or Fisher’s exact test to compare proportions. Multivariable logistic regression analyses were performed on variables of greatest theoretical importance with respect to the outcome of RTW (age, preoperative mJOA, preoperative work status, surgical approach). A P value below .05 was used as criterion for statistically significant difference throughout all analyses. All statistical calculations were performed with the SPSS software (IBM).

**Results**

Out of the 213 surgically treated DCM patients, 126 (59.2%) were considered nonretired preoperatively. Table 1 displays a comparison of characteristics between retired and nonretired patients. In summary, there were a greater proportion of males and posterior only procedures, as well as a higher mean age among retired patients (P < .05). Among the nonretired patients, 19.6% were not employed, 31.4% were employed but not currently working, and 49% were actively working preoperatively. As such, 51% were not working preoperatively and 49% were currently working despite their myelopathy.

There was no statistically significant difference in work status by anterior/posterior surgical approach (P < .229); however, those treated with a posterior approach had significantly lower mJOA scores (12.1 vs 14.0, P < .0001), were older (58.7 vs 48.9 years, P < .0001), and had more operated levels (3.2 vs 1.4, P < .0001).

Of the 126 nonretired patients, RTW data was available for 102 patients at 1-year postoperatively, of which 60 patients (58.8%) had returned to work, while 42 (41.2%) were not working. Of those who were working preoperatively, 75.9% returned to work, whereas 24.1% of those who were not working preoperatively returned to work. In unadjusted analyses, active employment immediately before surgery, anterior surgical procedures were associated with a greater likelihood of RTW at 1 year, higher preoperative arm pain, and NDI scores, as well as lower SF-36 PC scores were associated with a lower likelihood of RTW (Table 2).

In multivariable analyses, only active preoperative employment (odds ratio [OR] = 15.4, 95% confidence interval [CI] =
and/or myelopathy patients undergoing anterior cervical surgery and anterior surgical approach were significantly associated with RTW within 1 year. Bhandari et al reported a 62% return to work 3 months after cervical spine surgery for degenerative cervical disease.19 Direct comparison of RTW rates between studies is inherently challenging given differences in the characteristic of the cohorts considered, definitions of RTW, and length of follow-up period.

There are some previous literature on RTW rates for DCM patients undergoing surgery. Bhandari et al reported a 62% RTW rate at 1 year postoperatively among radiculopathy and/or myelopathy patients undergoing anterior cervical surgery.17 Similarly, Faur et al reported a RTW rate of 63% at 1 year among Workers’ Compensation patients undergoing ACDF (anterior cervical discectomy with fusion) for radiculopathy.18 Finally, a recent analysis of the US Quality Outcomes Database (QOD) registry found that 82% of patients returned to work 3 months after cervical spine surgery for degenerative cervical disease.19 Direct comparison of RTW rates between studies is inherently challenging given differences in the characteristic of the cohorts considered, definitions of RTW, and length of follow-up period.

Perhaps more important than understanding RTW rates is understanding factors associated with this outcome. In the current study, three quarters of those that were actively employed returned to work, whereas only one quarter of those without active preoperative employment experienced the same. Although the specific rates differ, this finding largely comports with the results of the QOD study where almost 90% of patients working immediately before cervical spine surgery returned to work at 3 months, while only 52% of those not working preoperatively were able to do the same.19 Additional analyses identifying factors associated with the outcome after lumbar spine surgery have also pointed to preoperative employment as a critical variable.20,21 Based on the consistency of this finding in the literature, preoperative work status appears to be one of the most influential factors affecting individuals’ likelihood of return to employment following spine surgery. Other factors such as young age, high education status, full-time employment, lower intensity occupation, and short symptom duration were also found to be favorable regarding return to work after cervical spine surgery.19

The association between anterior only procedures and increased odds of RTW is intriguing given that, in at least a proportion of cases in which there is equipoise related to the surgical approach, this represents a modifiable risk factor within control of the surgical team. To our knowledge, no previous analyses have found an association between anterior cervical surgery and increased likelihood of RTW; however, anterior surgery for DCM has been associated with improved outcomes. Namely, a prospective cohort study by Ghogawala et al found greater improvements in health-related quality of life in patients treated with anterior versus posterior surgery, in which either operation was a reasonable option.22 It is possible that improved clinical outcomes among patients treated with anterior surgery are being translated into earlier return to work rates; however, it is also possible that in our study, anteriorly treated patients had less severe and more often single-level disease rather than an intrinsic RTW benefit related to the surgical approach. Importantly, the Cervical Spondylotic Myelopathy Surgical Trial (CSM-S), a multicenter prospective study randomizing cervical myelopathy patients to anterior versus posterior patients, has recently completed enrolment.23 While the primary outcome is health-related quality of life, return to work is a secondary outcome of interest; hence, the CSM-S study is poised to offer a more definitive answer regarding the impact of surgical approach on RTW for myelopathy.

There are some study limitations. Namely, we did not collect data specific to the nature of employment undertaken by patients preoperatively and postoperatively. Also, we did not include any radiological variables related to extent of spinal cord compression, cord signal change, or alignment parameters. Analyzing the impact of such variables on employment-related outcomes will be the focus for future research. Moreover, we did not capture what happened with the patients who did not go back to work or what was the cause. We can hypothesize that patients who were not working preoperatively did not improve enough to resume their work functions. As neurological deterioration is very rare postsurgical decompression, new functional limitation secondary to the surgical intervention likely explains why patients who were actively working preoperatively did not go back to work postoperatively. Strengths of this study include the prospective multicenter nature of the data collection, the size of the DCM cohort and the large geographical representation of the registry.

Table 3. Results of Multivariable Logistic Regression Analysis Relative to the Outcome of Return to Work at 1 Year Following Surgery for DCM.

| Variable               | B     | SE  | OR   | 95% CI   | P value |
|------------------------|-------|-----|------|----------|---------|
| Age                    | 0.007 | 0.030 | 1.007 | 0.95, 1.07 | > .05   |
| Preoperative mJOA      | -0.083 | 0.136 | 0.921 | 0.71, 1.20 | > .05   |
| Anterior approach      | 1.584 | 0.722 | 4.877 | 1.18, 20.10 | = .03   |
| Working preoperative   | 2.732 | 0.623 | 15.358 | 4.53, 52.08 | < .01   |

Abbreviations: DCM, degenerative cervical myelopathy; SE, standard error; OR, odds ratio; CI, confidence interval; mJOA, modified Japanese Orthopaedic Association.
Conclusion
In this multicenter analysis of prospectively collected data on DCM, obtained from the multicenter CSORN database, the majority (58.8%) of nonretired patients undergoing surgery had returned to work 1 year after surgery. Among that group, patients actively working preoperatively and patients who had anterior surgery had a higher rate of RTW. These results may help inform preoperative patient counseling sessions, enable economic analyses, and serve as a focus for future quality improvement efforts.

Authors’ Note
This article was presented in abstract form at the 2018 Canadian Spine Society Annual Scientific Conference (podium; Canadian Spine Society, 18th Annual Meeting; February 28 to March 1, 2018; Banff, Alberta, Canada).

Acknowledgments
The authors thank all the subjects who participated in the study and the support/research coordinator staff and investigators from the Canadian Spine Outcomes and Research Network (CSORN) contributing sites: Foothills Medical Centre, Winnipeg Health Sciences Centre, Vancouver General Hospital, Victoria Hospital—London Health Sciences Centre, Queen Elizabeth II—Halifax Sciences Centre Neurology, Hospital de L’Enfant Jesus, University of Alberta hospital site.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD
Greg McIntosh, MSc https://orcid.org/0000-0002-0268-6523

References
1. Nouri A, Tetreault L, Singh A, Karadimas SK, Fehlings MG. Degenerative cervical myelopathy: epidemiology, genetics, and pathogenesis. Spine (Phila Pa 1976). 2015;40:E675-E693.
2. Passias PG, Marascalchi BJ, Boniello AJ, et al. Cervical spondylotic myelopathy: national trends in the treatment and perioperative outcomes over 10 years. J Clin Neurosci. 2017;42:75-80.
3. Blume C, Wiederhold H, Geiger M, Clusmann H, Müller CA. Lacking benefit of intraoperative high-dose dexamethasone in instrumented surgery for cervical spondylotic myelopathy. J Neurol Surg A Cent Eur Neurosurg. 2018;79:116-122.
4. Matz PG, Anderson PA, Holly LT, et al. The natural history of cervical spondylotic myelopathy. J Neurosurg Spine. 2009;11:104-111.
5. Ghogawala Z, Benzel EC, Riew KD, Bisson EF, Heary RF. Surgery vs conservative care for cervical spondylotic myelopathy: surgery is appropriate for progressive myelopathy. Neurosurgery. 2015;62(suppl 1):56-61.
6. Fehlings MG, Ibrahim A, Tetreault L, et al. A global perspective on the outcomes of surgical decompression in patients with cervical spondylotic myelopathy: results from the prospective multicenter AOSpine International Study on 479 patients. Spine (Phila Pa 1976). 2015;40:1322-1328.
7. Fehlings MG, Wilson JR, Kopjar B, et al. Efficacy and safety of surgical decompression in patients with cervical spondylotic myelopathy: results of the AOSpine North America prospective multi-center study. J Bone Joint Surg Am. 2013;95:1651-1658.
8. Fehlings MG, Tetreault LA, Riew KD, et al. A clinical practice guideline for the management of patients with degenerative cervical myelopathy: recommendations for patients with mild, moderate, and severe disease and nonmyelopathic patients with evidence of cord compression. Global Spine J. 2017;7(3 suppl):70S-83S.
9. Tetreault LA, Karadimas S, Wilson JR, et al. The natural history of degenerative cervical myelopathy and the rate of hospitalization following spinal cord injury: an updated systematic review. Global Spine J. 2017;7(3 suppl):28S-34S.
10. Srinivas S, Paquet J, Bailey C, et al. Effect of spinal decompression on back pain in lumbar spinal stenosis: a Canadian Spine Outcomes Research Network (CSORN) study. Spine J. 2019;19:1001-1008.
11. Jenkinson C, Layte R, Jenkinson D, et al. A shorter form health survey: can the SF-12 replicate results from the SF-36 in longitudinal studies? J Public Health Med. 1997;19:179-186.
12. Herdman M, Gudex C, Lloyd A, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). Qual Life Res. 2011;20:1727-1736.
13. Hains F, Waalen J, Mior S. Psychometric properties of the neck disability index. J Manipulative Physiol Ther. 1998;21:75-80.
14. Azimi P, Shahzadi S, Benzil EC, Montazari A. Updated measuring motor, sensory and sphincter dysfunctions in patients with cervical myelopathy using the modified Japanese Orthopedic Association (mJOA) score: a validation study. J Inj Violence Res. 2012;4(3 suppl):1-41.
15. Evans TH, Mayer TG, Gatchel RJ. Recurrent disabling work-related spinal disorders after prior injury claims in a chronic low back pain population. Spine J. 2001;1:183-189.
16. Nikolaidis I, Fouyas IP, Sandercoc PA, Statham PF. Surgery for cervical radiculopathy or myelopathy. Cochrane Database Syst Rev. 2010;(1):CD001466.
17. Bhandari M, Louw D, Reddy K. Predictors of return to work after anterior cervical discectomy. J Spinal Disord. 1999;12:94-98.
18. Faour M, Anderson JT, Haas AR, et al. Return to work rates after single-level cervical fusion for degenerative disc disease compared with fusion for radiculopathy in a workers’ compensation setting. Spine (Phila Pa 1976). 2016;41:1160-1166.
19. Devlin CI, Bydon M, Alvi MA, et al. A predictive model and nomogram for predicting return to work at 3 months after cervical spine surgery: an analysis from the Quality Outcomes Database. Neurosurg Focus. 2018;45:E9.
20. Lee YP, Farhan SD, Kiester D, et al. Variables affecting return to work after spinal surgery in a non-workers’ compensation setting.
population: a retrospective cohort study. *J Am Acad Orthop Surg.*
2017;25:e282-e288.

21. Khan I, Bydon M, Archer KR, et al. Impact of occupational characteristics on return to work for employed patients after elective lumbar spine surgery. *Spine J.* 2019;19:1969-1976.

22. Ghogawala Z, Martin B, Benzel EC, et al. Comparative effectiveness of ventral vs dorsal surgery for cervical spondylotic myelopathy. *Neurosurgery.* 2011;68:622-630.

23. Ghogawala Z, Benzel EC, Heary RF, et al. Cervical spondylotic myelopathy surgical trial: randomized, controlled trial design and rationale. *Neurosurgery.* 2014;75:334-346.