

CERVICAL SPINE

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Return to Work After Surgery for Cervical Radiculopathy: A Nationwide Registry-based Observational Study

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Acknowledgment date: June 5, 2022. First revision date: August 19, 2022. Acceptance date: August 31, 2022.

The Norwegian Registry for Spine Surgery receives funding from the University of Northern Norway and Norwegian health authorities.

The authors report no conflicts of interest.

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DOI: 10.1097/BRS.0000000000004482

Cervical radiculopathy typically causes pain in a radicular pattern in one or both upper extremities, while other symptoms and signs, including sensory loss and motor deficits, may also be present. Although systematic reviews conclude that there is insufficient evidence to support that surgery for cervical radiculopathy is superior to non-operative management in terms of pain relief,^{1,2} surgery is often the choice of treatment for patients with intractable symptoms, persistent pain despite a period of conservative treatment, and severe disabilities.³

Pain scales and a wide range of patient-reported outcome measures (PROMs), typically for functional disability, health-related quality of life, and patients' perceived benefit, are commonly used for measuring the impact of cervical spine surgery.⁴ Cervical spine surgery is generally associated with good clinical outcomes.^{5–7}

Return to work (RTW) is another increasingly used measure of the quality of care. Previous studies have recognized employment status as one of the most important predictors of RTW after spine surgery,⁸⁻¹⁵ suggesting the need for a biopsychosocial approach when managing spine conditions. As the concept of RTW is yet understudied and often poorly defined, and the data collection depends primarily on self-reported cross-sectional feedback, the results in the existing literature have limited external validity.

The aim of this nationwide study was to investigate sick leave patterns among patients undergoing surgery for cervical radiculopathy and identify predictive factors of RTW.

MATERIAL AND METHODS

Reporting is consistent with the STROBE statement.¹⁶ The Regional Committee for Medical Research Ethics in Central Norway approved the study (No. 2016/840), and all participants provided written informed consent. Data from the Norwegian Registry for Spine Surgery (NORspine) and the Norwegian Labour and Welfare Administration (NAV) were linked on an individual level.

Norwegian Registry for Spine Surgery (NORspine)

NORspine is a comprehensive nationwide registry for quality control and research. It provides data on demographics, lifestyle, comorbidity, diagnoses, clinical, and radiological findings, surgical procedures, and complications, as well as PROMs before and after spinal surgery.^{13,17} All centers in Norway performing surgery for cervical spine disorders report to the registry, currently covering ~81% of degenerative cervical procedures.¹⁸ Participation in NORspine registration by providers or patients is not mandated, nor is participation required as a necessary condition for a patient to gain access to health care or for a provider to be eligible for payment. PROMs were collected by questionnaires before surgery and at three and 12 months following surgery.

Norwegian Labour and Welfare Administration (NAV)

Norway has a comprehensive national insurance scheme administered by the Norwegian Labour and Welfare Service (NAV). Economic loss due to sickness and injury is generously compensated. Medical benefits issued by NAV are summarized as follows.

Sickness Benefit (Temporary and Short-term: Partial or Full)

Generally, every member of the society who has worked in Norway continuously for six weeks is entitled to a sickness benefit for the first 12 months of sick leave.

Work Assessment Allowance (Temporary and Long-term: Partial or Full)

Persons who cannot resume work after this period under ongoing medical treatment or with a possibility of improving may apply for a benefit termed work assessment allowance for the next 36 months. In addition, persons may

be entitled to work assessment allowance without working experience if their ability to work is impaired due to illness or injury (*e.g.*, students, handicapped, refugees with health problems).

Sickness benefit and work assessment allowance are exclusive of each other.

Disability Benefit

Disability benefits may be warranted for those permanently disabled to work, either partially or fully. Patients with partial disability benefits are considered actively working, albeit with a reduced work capacity.

Study Population

We considered patients eligible for the study if they were 18 to 60 years old, included in NORspine, diagnosed with cervical radiculopathy, and received a temporary medical benefit on the day of surgery. Patients who did not receive it (*i.e.*, students, homemakers, nonworking, retired, recipients of full disability benefit) were excluded. We collected NORspine data from consecutive patients operated for cervical radiculopathy between January 2012 and December 2018. Our study aimed to investigate occupational status over three years following surgery, and we excluded patients 60 years of age and above and therefore approaching retirement.

Surgical Procedures

The surgical approach, the number of operated cervical levels, and the use and type of instrumentation were chosen at the surgeons' discretion.

Outcome Measures

RTW (Primary Outcome)

We defined RTW as being at work at a given time point (*e.g.*, 24 mo) postoperatively with no more medical benefit from NAV following surgery-related sick leave. The definition is dichotomously orientated and does not consider types of work. The concept of "sustained" RTW following surgery for lumbar spine disorders was previously introduced.^{8,15} However, we chose not to adopt this temporal feature since our preliminary analysis did not demonstrate the additional advantage of sustainability in terms of analytical accuracy.

Sick Leave

All doctor-certified sick leave (minimum 20% of the individual employment position) is registered in the Norwegian Labour and Welfare Administration (NAV) database.

Grading of benefits was calculated for each day from one year before to three years after surgery. The *de facto* benefits were grouped into five categories: no medical benefits, partial medical benefits, full sickness benefit, full work assessment allowance, and full disability benefit.

Patient-Reported Outcome Measures

The Neck Disability Index (NDI) is a self-rated questionnaire score developed for patients with neck disabilities.¹⁹ The questionnaire is composed of 10 items: 7 related to activities of daily living, 2 to pain, and 1 to concentration. The sum of the ten items is recalculated into a percentage NDI score from 0 to 100 (no to maximum disability). The minimal clinically important change (MCIC) is ~7.5 percentage points,^{20,21} and substantial clinical benefit (SCB) is ~10 percentage points.^{22,23}

The numeric rating scale (NRS) of pain is a subjective measure of pain in which patients rate their pain on an 11-point scale from 0 (no pain) to 10 (worst imaginable pain). NRS is registered separately for arm and neck pain. MCIC for arm and neck pain NRS^{24,25} is ~1.5. The Global Perceived Effect (GPE) scale is another intuitive, subjective measure of patients' health conditions. Patients answer one single question of how much their condition has changed due to surgery on a 7-point Likert scale. Although the scale aims to rate the experienced change, studies indicate that the patients' current state influences the ratings.^{26,27}

Statistics

Statistical analyses were performed with STATA 16.1 and 17.0 (StataCorp., College Station, TX) and SPSS version 27 (IBM Corporation, IL). The population was divided into two groups, the group that successfully returned to work at 24 months after surgery and the group that did not. We compared the groups for the available variables using a two-sample *t* test for the continuous variables and Pearson χ^2 test for the categorical variables. The variables with a *P*-value <0.001 were selected, if also considered clinically relevant, for further multivariable regression analyses.

Logistic regression analyses were performed with successful RTW as the dependent variable.

Demographic variables, PROMs variables, and numbers of sick days were analyzed in one single model, and odds ratios (OR) were calculated from it.

Missing Data

We excluded patients from NORspine if the most fundamental demographic data were missing. As for NAV data, longitudinal data were available for all recipients of benefits, but we found occasional gaps in longer sick leave periods. Short gaps (<28 d) were replaced with the last registered value under the assumption that the gap was due to a temporary work trial, planned vacation, or missing registration. Longer gaps were left untouched and treated as "periods without medical benefit."

We used the 12-month PROMs data by standard, but the three-month data could equally be used wherever 12-month data were missing. The postoperative changes in PROMs were further dichotomized according to whether they reached the predefined minimal clinically important change. If PROM values were missing from both 12-month and three-month data, the missing changes were treated as unknown.

RESULTS

Among 4586 patients operated for cervical radiculopathy, 3387 were eligible for our study (Fig. 1). In total, 2284 patients (67%) provided PROMs at three and/or 12 months. The majority of patients underwent anterior discectomy with an interbody fixating implant (92.5%) or posterior decompression of nerve roots (5.2%).

Patterns of NAV Benefits

Figure 2 shows the dynamics of sick leave benefits throughout the follow-up. One year before surgery, the proportion of recipients of any benefit was 25.1%. The number increased steadily towards surgery, primarily due to an increase in the short-term sickness benefit. By one week before surgery, 70.0% of all the patients received some sort of medical benefits. Following surgery, the number of recipients fell rapidly. Half of the operated patients returned to work within four months. The decline reached a plateau at ~12 months, by which time 66.9% had returned to work. By the end of the follow-up at 36 months, the proportion of medical benefit recipients was 28.3%, almost equivalent to one year before surgery (25.1%).

Outcome Data

Demographic and clinical data are summarized in Table 1. While 3387 patients constituted the primary cohort of the study, PROMs data were available from a subgroup of 2284 responders (67.4% of the primary cohort), as summarized in Table 2. We performed χ^2 test of RTW outcome against responders/non-responders and retrieved an insignificant *P*-value of 0.064.

The patients were divided into two groups, those who achieved RTW and those who did not. The proportions of females and those without a college education were higher in the group that did not RTW. Work assessment allowance was more common among the non-RTW group than the RTW group (37.4% vs. 7.5%).

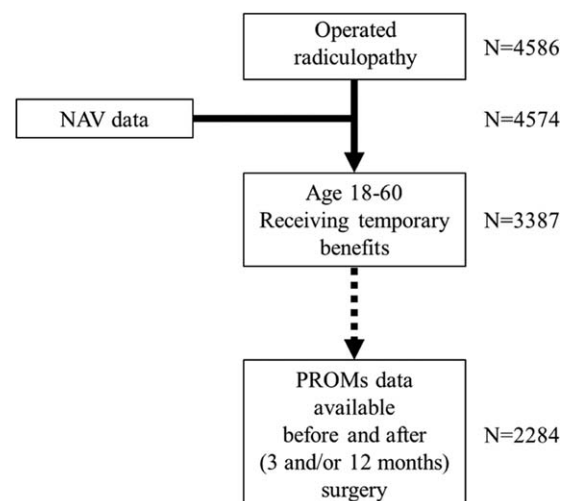


Figure 1. Flow diagram with study enrollment and follow-up. PROMs indicates patient-reported outcome measures.

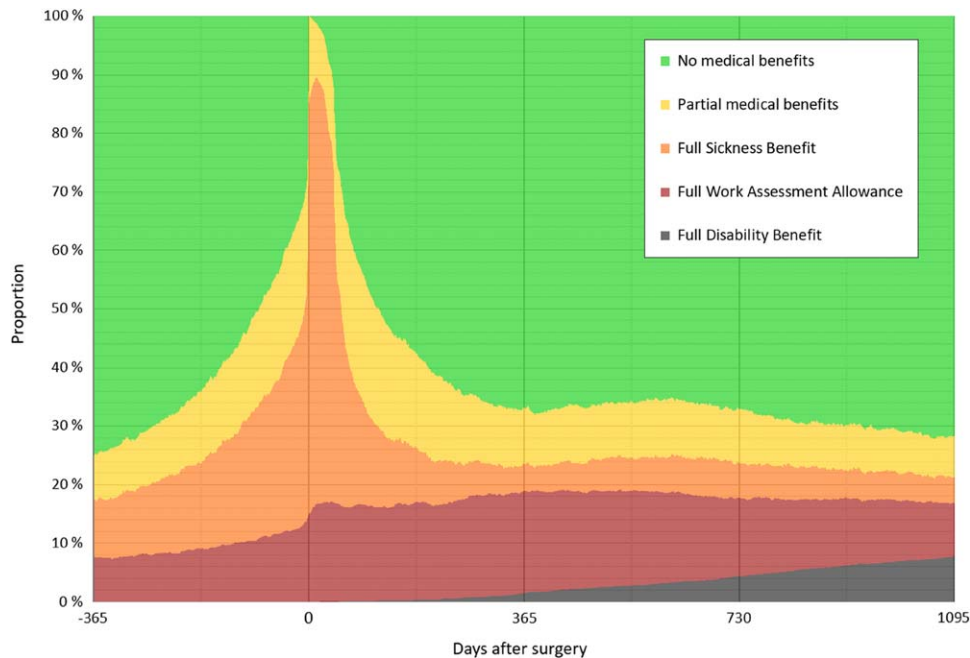


Figure 2. Proportion of medical benefit receivers over time from one year before to three years after surgery.

Patients who returned to work were more likely to be nonsmokers, not suffer from anxiety and depression, and have less comorbidity. They also had significantly fewer days of sick leave during the year preceding surgery, the majority of the patients having <90 days compared with over 270 days for those who did not RTW.

The group that returned to work two years after surgery had a significantly less baseline disability (NDI 37.8 ± 14.2) than the group that did not (NDI 45.9 ± 13.1) ($P < 0.001$). The differences in the degree of baseline pain were also statistically significant but not clinically important (mean NRS arm 6.1 ± 2.4 vs. 6.6 ± 2.3 , mean NRS neck 5.6 ± 2.5 vs. 6.6 ± 2.2). Generally, larger proportions of patients who returned to work achieved minimal clinically important changes (MCIC) in function and pain. This is reflected in the GPE scale (much better or complete recovery 78.0% vs. 45.2%) ($P < 0.001$).

Regression Analyses

The summary of the results is presented in Table 3. Not receiving work assessment allowance presurgery was moderately associated with RTW with an OR of 1.93 (95% CI: 1.40–2.66, $P < 0.001$). Both male sex, college education, and nonsmoking status also reached a significant level of 0.05, but their ORs were even less prominent. NDI improvement by 7.5 percentage points equivalent to MCIC was the only clinical factor associated with RTW, with an OR of 2.17 (95% CI: 1.69–2.78, $P < 0.001$). NDI improvement to the level of substantial clinical benefit (10 points) gave a similar OR (2.2 vs. 2.2) in a separate analysis.

Sick leave during the last year before surgery had a significant effect on RTW, while its impact was dependent on the number of sick days. Sick days of 90 or less had an OR of 4.54 (95% CI: 3.42–6.03), considerably higher than OR for 90 to

180 sick days or any other variables tested in the regression analysis. A post hoc analysis of variance (ANOVA) of the four sick-leave categories (≤ 90 , 90–180, 180–270, > 270) against baseline NDI gave a P -value of < 0.001 . Although the sick-leave categories and baseline NDI showed a positive linear trend with increasing means from 36.8 to 45.9, the OR for each category was barely changed after adjustment for baseline NDI (4.5 vs. 3.9, 2.0 vs. 1.9, and 1.4 vs. 1.4, respectively).

DISCUSSION

We investigated the patterns and predictors for returning to work following cervical radiculopathy surgery in the working population. Approximately half of the patients returned to work within four months, and the positive trend continued throughout the first year, by which 66.9% had returned to work. After that, the recovery was slow, yet the proportion of the patients fully at work three years after surgery was almost equivalent to one year before surgery. We found the number of sick days 90 or less during the last year before surgery to be the strongest predictor of returning to work two years later, independent of preoperative disability level measured by NDI.

Knowledge about RTW after surgery for degenerative cervical disorders is limited. Previous studies have used heterogeneous design and patient populations, varying definitions of RTW, and conducted in different health policy contexts.²⁸ Therefore, interpretation of the results and their application in clinical practice has been challenging.

The authors underlined the importance of nonclinical and work-related factors for RTW following surgery of the cervical spine. Bhandari *et al*¹⁰ retrospectively analyzed the data collected at office visits of 45 consecutive patients. The RTW rate was 62% by one year, and they concluded that the duration of preoperative sick leave and

TABLE 1. Summary of Patient Characteristics According to Return-to-Work Status

| Demographic and clinical characteristics | | | |
|--|--------------------------|----------------------|-------------------|
| Variables | Returned to work at 2 yr | | P |
| | No, n = 1117 | Yes, n = 2270 | |
| Mean age at surgery (\pm SD) | 47.8 (\pm 7.0) | 47.4 (\pm 7.3) | 0.199 |
| Age at operation, n (%) | | | 0.243 |
| < 40 | 151 (13.5) | 345 (15.2) | |
| 40–50 | 514 (46.0) | 1549 (45.6) | |
| 50–60 | 452 (40.5) | 890 (39.2) | |
| Sex (female) | 618 (55.3) | 965 (42.5) | < 0.001 |
| Education (college degree) | 332 (30.4) | 941 (42.3) | < 0.001 |
| Employed | 734 (65.7) | 2022 (89.1) | < 0.001 |
| Work assessment allowance | 418 (37.4) | 170 (7.5) | < 0.001 |
| Tobacco use, n (%) | | | |
| Smoker | 438 (39.9) | 628 (28.2) | < 0.001 |
| Obesity (BMI \geq 30) | 261 (24.4) | 480 (21.6) | 0.075 |
| Comorbidity, n (%) | | | |
| Hypertension | 97 (8.7) | 207 (9.1) | 0.677 |
| Cardiovascular disease | 40 (3.6) | 50 (2.2) | 0.019 |
| Diabetes mellitus | 38 (3.4) | 75 (3.3) | 0.881 |
| Chronic neurological disease | 12 (1.1) | 16 (0.7) | 0.264 |
| Anxiety/depression | 63 (5.6) | 36 (1.6) | < 0.001 |
| ASA \geq 3, n (%) | 45 (4.2) | 46 (2.1) | 0.001 |
| Pain > 1 yr, n (%) | 669 (60.8) | 1383 (62.2) | 0.464 |
| Sick days before surgery,* | 223.2 (\pm 123.2) | 108.8 (\pm 109.5) | < 0.001 |
| \leq 90, n (%) | 221 (19.8) | 1260 (55.5) | |
| 90–180, n (%) | 208 (18.6) | 484 (21.3) | |
| 180–270, n (%) | 168 (15.0) | 244 (10.8) | |
| > 270, n (%) | 520 (46.6) | 282 (12.4) | |

Bold values indicate statistically significant P < 0.05.

**Number of days with temporary medical benefit during the last year before surgery.*

ASA indicates American Society of Anesthesiology Physical Status Classification System score; BMI, body mass index.

postoperative neck pain negatively impact postoperative work status. Devine *et al*¹¹ selected solely the patients employed at baseline from a large clinical database. The authors reported that 3854 of 4689 patients (82.2%) had returned to work within three months of surgery. Among the multiple predictors they found, “currently not working” had the most substantial impact, followed by “workers’ compensation.” Faour *et al*²⁹ retrospectively studied data of 1927 patients with cervical radiculopathy collected from an extensive administrative database for workers’ compensation claims. The authors defined successful RTW as a stable “at work” status for six months within three years after surgery. They reported that 62.9% had returned to work. Psychological evaluation and permanent disability before surgery were the two significant negative predictors.

Although we observed a substantial improvement in disability and pain after surgery in all groups, the rate of RTW among the same population was disproportionately lower than expected from the clinical improvement. Female gender,

lower education, being unemployed, and receiving long-term medical benefits had considerably negative associations with RTW. These findings suggest that the patients may benefit from individual counseling starting before surgery in collaboration with employers and the local labor offices.

Fewer days of sick leave were strongly associated with successful RTW. The impact of sick days was striking. Therefore, the length of patients’ sick leave should be determined when assessing surgical indications if the main objective of the treatment is RTW. More research is needed to explore causal inferences. For instance, whether RTW can be linked to a shorter duration of sickness *per se* or to other possible confounders, such as more specific patient characteristics, economy, or employer and workplace factors.

Strengths and Limitations

Using two nationwide registries with a large study population ensures high external validity. In particular, the administrative data had complete coverage for the eligible participants

TABLE 2. Summary of Patient-reported Outcome Measures According to Return-to-Work Status

| Patient-reported outcome measures (PROMs) | | | |
|--|--------------------------|---------------|---------|
| Variables | Returned to work at 2 yr | | P |
| | No, n = 777 | Yes, n = 1507 | |
| Baseline PROMs | | | |
| Neck Disability Index (±SD) | 45.9 (±13.1) | 37.8 (±14.2) | < 0.001 |
| Arm pain NRS (±SD) | 6.6 (±2.3) | 6.1 (±2.4) | < 0.001 |
| Neck pain NRS (±SD) | 6.6 (±2.2) | 5.6 (±2.5) | < 0.001 |
| Changes after surgery > minimal clinically important change, n (%) | | | |
| ΔNeck Disability Index > 7.5 | 429 (55.2) | 1205 (80.0) | < 0.001 |
| ΔArm pain NRS > 1.5 | 470 (60.5) | 1191 (79.0) | < 0.001 |
| ΔNeck pain NRS > 1.5 | 398 (51.2) | 1054 (69.9) | < 0.001 |
| Global Perceived Effect scale score after surgery, n (%) | | | |
| 1. Complete recovery | 55 (7.1) | 366 (24.4) | |
| 2. Much better | 296 (38.1) | 805 (53.6) | |
| 3. Slightly better | 223 (28.7) | 252 (16.8) | |
| 4. Unchanged | 79 (10.2) | 50 (3.3) | |
| 5. Slightly worse | 59 (7.6) | 25 (1.7) | |
| 6. Much worse | 41 (5.3) | 4 (0.3) | |
| 7. Worse than ever | 24 (3.1) | 1 (0.1) | |

*Bold values indicate statistically significant P < 0.05.
NRS indicates numeric rating scale.*

throughout the study period. Another strength is the detailed data that enabled the graphical demonstration of the day-to-day course of patients' work status without missing data. Our outcome is based on the medical benefit payment record, and therefore a reduction in benefit is an indirect measure of RTW. This approximation is commonly used in the RTW literature and is likely to hold in our population.^{30–32}

Missing data for PROMs are a concern, but a previous NORspine study showed no difference in outcomes between responders and nonresponders.¹³ There was no difference in RTW ratios between responders and nonresponders in our study, a finding consistent with previous studies indicating that nonresponders did not bias outcome evaluation of PROMs.^{13,33,34}

TABLE 3. Summary of Regression Analyses

| Multivariable logistic regression | | | | |
|---|------|--------------|--------------|---------|
| Variables | OR | Lower 95% CI | Upper 95% CI | P |
| Male sex | 1.50 | 1.27 | 1.79 | < 0.001 |
| College education | 1.37 | 1.14 | 1.64 | 0.001 |
| Employed | 1.62 | 1.26 | 2.08 | < 0.001 |
| Receiving only short-term benefit* | 1.93 | 1.40 | 2.66 | < 0.001 |
| Nonsmoking | 1.30 | 1.08 | 1.55 | 0.005 |
| ΔNeck Disability Index > 7.5 | 2.17 | 1.69 | 2.78 | < 0.001 |
| ΔArm pain NRS > 1.5 | 1.18 | 0.92 | 1.51 | 0.195 |
| ΔNeck pain NRS > 1.5 | 1.23 | 0.97 | 1.56 | 0.090 |
| No. sick days during the last year before surgery | | | | |
| ≤ 90 | 4.54 | 3.42 | 6.03 | < 0.001 |
| 90–180 | 2.00 | 1.49 | 2.68 | < 0.001 |
| 180–270 | 1.41 | 1.04 | 1.92 | 0.028 |
| > 270 (reference) | | | | |

*Bold values indicate statistically significant P < 0.05.
*As opposed to receiving long-term benefit.
NRS indicates numeric rating scale; OR, odds ratio.*

Still, our results must be cautiously interpreted since we do not know the exact reasons for nonresponse.

One limitation is the lack of data on social factors, including types of occupation, and the detailed psychological profile of each patient. We recommend that such data are included in the future studies.

CONCLUSION

This nationwide study shows that 71.7% of working patients operated for cervical radiculopathy returned to work within three years of surgery. The lower number of preoperative sick days of 90 or less, regardless of preoperative disability, was the strongest predictor, whereas clinical improvement had less impact on RTW. Our results demonstrate that successful surgery alone does not guarantee RTW.

➤ Key Points

- ❑ RTW is increasingly used as a measure of the quality of health care.
- ❑ Sick leave patterns and predictors of return to work after surgery for degenerative cervical radiculopathy were evaluated using data from a nationwide registry for spine surgery and the national insurance scheme.
- ❑ We included a working population of 3387 patients. Half of the patients returned to work within four months of surgery. RTW ratio at three years was 71.7%.
- ❑ The strongest predictor of RTW was fewer sick days before surgery. Clinical improvement after surgery had a lesser impact on RTW.

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