

# Adverse Outcomes Following Cervical Fusion in Patients with Rheumatoid Arthritis: A Nationwide Database Study

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**INTRODUCTION:** Rheumatoid arthritis (RA) is a multisystem autoimmune disease where patients are predisposed to developing spinal pathologies, including in the cervical region. Previous national database studies have demonstrated increased perioperative adverse events after orthopedic and lumbar procedures, yet there is limited comparable large-scale data on postoperative outcomes following cervical fusion. Therefore, this study sought to determine the postoperative medical and surgical complications as well as healthcare utilization in RA patients who underwent anterior cervical fusion (ACDF) or posterior cervical fusion (PCF).

**METHODS:** This study utilized PearlDiver, a multi-payer national claims database. Adult patients who underwent ACDF or PCF between 2010 and 2022 were stratified based on the presence of RA diagnosis. Patients were matched in a 1:4 ratio based on age range, gender, and the Elixhauser Comorbidity Index (ECI). Postoperative medical and surgical complications, emergency department (ED) visits, hospital readmissions, need for revision, and mortality rates were evaluated following ACDF and PCF. Relevant diagnostic and procedural codes were captured via the International Classification of Diseases (ICD) and Current Procedural Terminology (CPT) coding. Chi-squared tests and multivariate regression analysis were performed to determine odds ratios (ORs) and 95% confidence intervals (CIs). Statistical significance was defined by  $p < 0.05$ .

## RESULTS:

The study cohorts included 22,088 and 4,703 RA patients with rheumatoid arthritis who underwent ACDF and PCF, respectively. Compared to non-RA matched controls, patients with RA had higher odds of developing 90-day medical and surgical complications as well as increased rates of ED visits and readmissions for both ACDF and PCF. The gap in revision rates between RA patients and non-RA controls was more notable for ACDF (OR: 89.37; 95% CI: 84.73-94.33,  $p < 0.001$ ) than for PCF (OR: 59.06; 95% CI: 52.84-66.18;  $p < 0.001$ ). There were no statistically significant differences in the development of two-year mortality rates postoperatively in either study.

**DISCUSSION AND CONCLUSION:** In this large, retrospective matched cohort study, RA was found to be associated with adverse postoperative outcomes and greater healthcare utilization, including ED visits and readmissions following ACDF and PCF. Of note, the odds of requiring revision were considerably higher in patients who underwent an anterior-based approach compared to PCF. Further research is needed to control for disease severity and involved levels to determine if there is a clinical benefit to posterior fusion in this vulnerable population.

**Table 1** Univariate and Multivariate Analysis of Rates of Medical and Surgical Complications, 2-Year Revision Rates, 30-Day and 90-Day Healthcare Utilization, and 2-Year Mortality in Patients with and without RA Undergoing ACDF.

| 90-Day Postoperative Complications          | Without RA (N = 88276) |       | With RA (N = 22088) |       | Univariate p-value | Multivariate Adjusted OR (95% CI) | Multivariate p-value |
|---------------------------------------------|------------------------|-------|---------------------|-------|--------------------|-----------------------------------|----------------------|
|                                             | N                      | %     | N                   | %     |                    |                                   |                      |
| <b>Medical</b>                              |                        |       |                     |       |                    |                                   |                      |
| Arrhythmia                                  | 6263                   | 7.1%  | 3403                | 15.4% | <0.001             | 2.53 (2.42-2.65)                  | <0.001               |
| Myocardial infarction                       | 417                    | 0.5%  | 250                 | 1.1%  | <0.001             | 2.43 (2.07-2.84)                  | <0.001               |
| CVA                                         | 900                    | 1.0%  | 519                 | 2.3%  | <0.001             | 2.36 (2.12-2.64)                  | <0.001               |
| Atelectasis                                 | 1636                   | 1.9%  | 867                 | 3.9%  | <0.001             | 2.18 (2.01-2.38)                  | <0.001               |
| Respiratory failure                         | 1735                   | 2.0%  | 668                 | 3.0%  | <0.001             | 1.57 (1.43-1.72)                  | <0.001               |
| Pleural effusion                            | 896                    | 1.0%  | 497                 | 2.3%  | <0.001             | 2.27 (2.03-2.53)                  | <0.001               |
| PE                                          | 276                    | 0.3%  | 197                 | 0.9%  | <0.001             | 2.87 (2.39-3.45)                  | <0.001               |
| Urinary retention                           | 1245                   | 1.4%  | 607                 | 2.7%  | <0.001             | 1.99 (1.80-2.20)                  | <0.001               |
| UTI                                         | 4121                   | 4.7%  | 3255                | 14.7% | <0.001             | 3.70 (3.52-3.88)                  | <0.001               |
| Renal failure                               | 1755                   | 2.0%  | 933                 | 4.2%  | <0.001             | 2.27 (2.09-2.47)                  | <0.001               |
| Sepsis                                      | 558                    | 0.6%  | 334                 | 1.5%  | <0.001             | 2.43 (2.12-2.79)                  | <0.001               |
| <b>Surgical</b>                             |                        |       |                     |       |                    |                                   |                      |
| Cervical radiculopathy                      | 15664                  | 17.7% | 8000                | 36.2% | <0.001             | 2.65 (2.56-2.74)                  | <0.001               |
| Spinal cord deficit                         | 1183                   | 1.3%  | 328                 | 1.5%  | 0.10               |                                   |                      |
| Pseudarthrosis (2 Years)                    | 2047                   | 2.3%  | 879                 | 4.0%  | <0.001             | 1.75 (1.61-1.89)                  | <0.001               |
| Revision (2 Years)                          | 1901                   | 2.2%  | 14520               | 65.7% | <0.001             | 89.37 (84.73-94.33)               | <0.001               |
| <b>Postoperative Healthcare Utilization</b> |                        |       |                     |       |                    |                                   |                      |
| ED visit (30 Days)                          | 7116                   | 8.1%  | 4786                | 21.7% | <0.001             | 3.26 (3.13-3.40)                  | <0.001               |
| ED visit (90 Days)                          | 12597                  | 14.3% | 7380                | 33.4% | <0.001             | 3.18 (3.07-3.29)                  | <0.001               |
| Inpatient readmission (30 Days)             | 3994                   | 4.5%  | 3150                | 14.3% | <0.001             | 3.63 (3.45-3.82)                  | <0.001               |
| Inpatient readmission (90 Days)             | 5580                   | 6.3%  | 4696                | 21.3% | <0.001             | 4.19 (4.01-4.38)                  | <0.001               |
| Mortality (2 Years)                         | 108                    | 0.12% | 35                  | 0.2%  | 0.2188             |                                   |                      |

CVA, Cerebrovascular accident; PE, Pulmonary embolism; UTI, Urinary tract infection; ED, Emergency Department.

**Table 2** Univariate and Multivariate Analysis of Rates of Medical and Surgical Complications, 2-Year Revision Rates, 30-Day and 90-Day Healthcare Utilization, and 2-Year Mortality in Patients with and without RA Undergoing PCF.

| 90-Day Postoperative Complications          | Without RA (N = 18734) |       | RA (N = 4703) |       | Univariate p-value | Multivariate Adjusted OR (95% CI) | Multivariate p-value |
|---------------------------------------------|------------------------|-------|---------------|-------|--------------------|-----------------------------------|----------------------|
|                                             | N                      | %     | N             | %     |                    |                                   |                      |
| <b>Medical</b>                              |                        |       |               |       |                    |                                   |                      |
| Arrhythmia                                  | 3131                   | 16.7% | 1284          | 27.3% | <0.001             | 1.96 (1.81-2.11)                  | <0.001               |
| Myocardial infarction                       | 243                    | 1.3%  | 97            | 2.1%  | <0.001             | 1.61 (1.26-1.85)                  | <0.001               |
| CVA                                         | 482                    | 2.6%  | 214           | 4.6%  | <0.001             | 1.82 (1.54-2.14)                  | <0.001               |
| Atelectasis                                 | 1237                   | 6.6%  | 489           | 10.4% | <0.001             | 1.65 (1.47-1.84)                  | <0.001               |
| Respiratory failure                         | 1290                   | 6.9%  | 372           | 7.9%  | 0.816              | 1.16 (1.03-1.31)                  | 0.017                |
| Pleural effusion                            | 887                    | 4.7%  | 295           | 6.3%  | <0.001             | 1.35 (1.17-1.54)                  | <0.001               |
| PE                                          | 158                    | 0.8%  | 62            | 1.3%  | 0.003              | 1.57 (1.16-2.10)                  | 0.003                |
| Urinary retention                           | 1017                   | 5.4%  | 347           | 7.4%  | <0.001             | 1.40 (1.23-1.58)                  | <0.001               |
| UTI                                         | 2053                   | 11.0% | 1062          | 22.6% | <0.001             | 2.45 (2.25-2.66)                  | <0.001               |
| Renal failure                               | 1197                   | 6.4%  | 485           | 10.3% | <0.001             | 1.73 (1.55-1.94)                  | <0.001               |
| Sepsis                                      | 422                    | 2.3%  | 175           | 3.7%  | <0.001             | 1.68 (1.40-2.01)                  | <0.001               |
| <b>Surgical</b>                             |                        |       |               |       |                    |                                   |                      |
| Cervical radiculopathy                      | 2702                   | 14.4% | 1442          | 30.7% | <0.001             | 2.66 (2.47-2.86)                  | <0.001               |
| Spinal cord deficit                         | 1303                   | 7.0%  | 319           | 6.8%  | 0.70               |                                   |                      |
| Pseudarthrosis (2 Years)                    | 1047                   | 5.6%  | 587           | 12.5% | <0.001             | 2.45 (2.20-2.73)                  | <0.001               |
| Revision (2 Years)                          | 431                    | 2.3%  | 2703          | 57.5% | <0.001             | 59.06 (52.83-66.18)               | <0.001               |
| <b>Postoperative Healthcare Utilization</b> |                        |       |               |       |                    |                                   |                      |
| ED visit (30 Days)                          | 1783                   | 9.5%  | 1297          | 27.6% | <0.001             | 3.74 (3.44-4.06)                  | <0.001               |
| ED visit (90 Days)                          | 3197                   | 17.1% | 1587          | 33.7% | <0.001             | 3.30 (3.07-3.55)                  | <0.001               |
| Inpatient readmission (30 Days)             | 2728                   | 14.6% | 1438          | 30.6% | <0.001             | 2.64 (2.45-2.85)                  | <0.001               |
| Inpatient readmission (90 Days)             | 3344                   | 17.8% | 1855          | 39.4% | <0.001             | 3.10 (2.89-3.33)                  | <0.001               |
| Mortality (2 Years)                         | 79                     | 0.4%  | 18            | 0.4%  | 0.806              |                                   |                      |

CVA, Cerebrovascular accident; PE, Pulmonary embolism; UTI, Urinary tract infection; ED, Emergency Department.