

Research

IMPACT OF SURGICAL APPROACH (ANTERIOR VS POSTERIOR) ON OUTCOMES IN CERVICAL SPONDYLOTIC MYELOPATHY: A META-ANALYSIS

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ABSTRACT

Background: Cervical spondylotic myelopathy (CSM) is the most common cause of non-traumatic spinal cord dysfunction in older adults. While surgical decompression remains the standard treatment for moderate-to-severe disease, the optimal approach (anterior versus posterior) remains debated in multilevel pathology.

Objective: To compare the clinical outcomes of anterior and posterior surgical approaches for CSM through a systematic review and meta-analysis of recent comparative studies.

Methods: A systematic search of PubMed, Scopus, Web of Science, and the Cochrane Library identified studies published between January 2020 and October 2025. Eligible studies compared anterior cervical discectomy and fusion (ACDF) with posterior decompression (laminoplasty or laminectomy or with without fusion). The primary outcomes included the Japanese Orthopaedic Association (JOA) score, Hirabayashi recovery rate, complication rate, revision surgery, and length of hospital stay. A meta-analysis was performed using RevMan 5.4.

Results: Eight studies comprising 13,861 patients met the inclusion criteria of this review. Functional recovery based on the JOA scores showed a non-significant trend favoring anterior surgery (mean difference = 0.30; 95% CI: -0.11 to 0.71; $p = 0.16$; $I^2 = 56\%$). Recovery rates calculated using the Hirabayashi method were also comparable (mean difference = -0.72; 95% CI: -4.65 to 3.20; $p = 0.72$; $I^2 = 1\%$). The overall complication risk did not differ significantly (RR = 0.93; 95% CI: 0.40 to 2.18; $p = 0.87$; $I^2 = 78\%$), although subgroup analysis revealed variation based on the posterior technique. Revision surgery was significantly less frequent in the anterior group (RR, 0.46; 95% CI: 0.40–0.54; $p < 0.00001$; $I^2 = 49\%$). Anterior procedures were also associated with shorter hospital stays (mean difference = -1.75 days; 95% CI: -2.00 to -1.50; $p < 0.00001$; $I^2 = 91\%$).

Conclusion: In CSM, anterior approaches, particularly ACDF, may offer lower revision rates and shorter hospitalization than posterior approaches, with no significant differences in functional recovery or complication rates. These findings support a tailored approach to surgical planning based on anatomical, pathological, and institutional factors.

Keywords: anterior cervical discectomy, cervical spondylotic myelopathy, meta-analysis, posterior decompression

INTRODUCTION

Cervical spondylotic myelopathy (CSM) is the most prevalent cause of non-traumatic spinal cord dysfunction in adults over the age of 55 and is projected to become an increasing global health burden due to population aging.^[1] It arises from degenerative changes in the cervical spine, such as intervertebral disc degeneration, osteophyte formation, ligamentum flavum hypertrophy, and ossification of the posterior longitudinal ligament (OPLL), all of which contribute to spinal canal narrowing and chronic spinal cord compression.^[2] The global prevalence of CSM remains difficult to determine precisely, but imaging studies suggest that cervical spondylosis may be radiographically present in over 85% of individuals above the age of 60, although only a subset develops clinical

myelopathy. In the United States alone, the estimated incidence of surgically treated CSM is approximately 4.04 per 100,000 individuals annually.^[3,4]

Surgical decompression remains the standard of care for patients with moderate-to-severe CSM to prevent further neurological deterioration and achieve functional recovery. The choice between anterior and posterior surgical approaches depends on several anatomical and clinical factors, including the number of involved levels, sagittal alignment, location of the compressive pathology, presence of OPLL, and surgeon's expertise. Anterior approaches, such as anterior cervical discectomy and fusion (ACDF), are typically favored for patients with one- or two-level disease, ventral compression, or cervical kyphosis, whereas posterior decompression techniques,

including laminoplasty or laminectomy with fusion, are generally preferred for patients with multilevel disease, preserved lordosis, or dorsal compression.^[5]

Despite decades of surgical practice and numerous studies, the optimal surgical approach for cervical spondylotic myelopathy remains unclear. Prior meta-analyses have provided conflicting results regarding postoperative neurological recovery, complication rates, and revision surgery between the anterior and posterior approaches. Moreover, many of these studies include heterogeneous populations with mixed etiologies, such as ossification of the posterior longitudinal ligament or non-spondylotic myelopathy, thereby limiting the generalizability of their findings to CSM. In addition, there is a paucity of high-quality evidence addressing functional outcomes, perioperative risks, and long-term reoperation rates in patients with clearly defined cervical spondylotic myelopathy undergoing either anterior or posterior decompression.^[6,7]

This meta-analysis aimed to fill this knowledge gap by systematically reviewing and analyzing studies that directly compared anterior and posterior surgical approaches in patients with cervical spondylotic myelopathy, excluding non-spondylotic etiologies. This study focused on clinically meaningful outcomes, including neurological improvement (assessed using the Japanese Orthopaedic Association [JOA] score), complication rates, revision surgery, and length of hospital stay. Understanding the relative risks and benefits of each approach in a clearly defined CSM population will help guide clinical decision-making, inform surgical planning, and optimize patient outcomes.

METHODS

Study Design

This systematic review and meta-analysis compared the clinical and radiological outcomes of anterior and posterior surgical approaches for cervical spondylotic myelopathy (CSM). The research methodology followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency and reproducibility.^[8]

Eligibility Criteria

The inclusion criteria comprised peer-reviewed original comparative studies published between January 2020 and December 2025 that investigated the surgical treatment of CSM using either anterior or posterior decompression approaches, with or without fusion. Only studies involving adult patients (≥ 18 years) and reporting at least one of the primary outcomes (Japanese Orthopaedic Association [JOA] score, recovery rate, complication rate, or revision surgery rate) were included. The secondary outcomes evaluated were the neck disability index, length of hospital stay, and radiological findings. Eligible study designs included randomized controlled trials, prospective cohort studies, and retrospective cohort studies. Studies were excluded if they focused on cervical myelopathy resulting from trauma, infection, neoplasm, rheumatologic disease,

or ossification of the posterior longitudinal ligament (OPLL); if they lacked a comparative design; if they were case reports, reviews, letters, or conference abstracts; or if they did not provide extractable outcome data.

Search Strategy

A systematic literature search was performed across four major databases: PubMed, Scopus, Web of Science, and the Cochrane Library from inception to October 2025. A combination of Medical Subject Headings (MeSH) and free-text terms was used, including "cervical spondylotic myelopathy," "anterior cervical discectomy and fusion," "posterior decompression," "laminoplasty," "laminectomy," "reoperation," "complications," and "JOA score," combined using Boolean operators AND/OR. Search filters were applied to restrict the results to English-language articles published between 2020 and 2025. In addition, the reference lists of key studies and review articles were manually searched to ensure comprehensive coverage.

Study Selection

All retrieved records were screened by two independent reviewers. The selection process involved an initial title and abstract screening, followed by a full-text appraisal for final eligibility. Disagreements regarding study inclusion were resolved through discussion and consensus among the authors. When consensus was not reached, adjudication was performed by a third, senior reviewer.

Data Extraction

Relevant data were extracted using a predefined, standardized data extraction sheet. The extracted information included the first author, publication year, country, study design, sample size of comparison groups, patient demographics, number of operated cervical levels, type of surgical procedure, duration of follow-up, and all reported outcome parameters. Data extraction was independently performed and cross-checked by two reviewers to minimize extraction bias.

Risk of Bias Assessment

The Newcastle–Ottawa Scale (NOS) was used to evaluate the methodological quality of observational studies across the domains of selection, comparability, and exposure or outcome assessment. Studies with a score of seven or higher were considered high quality. Two reviewers independently completed the quality assessment, and discrepancies were resolved by consensus.

Statistical Analysis

Quantitative synthesis was performed using Review Manager (RevMan) version 5.4 software. For continuous variables, including JOA scores and length of stay, pooled mean differences (MD) or standardized mean differences (SMD) with 95% confidence intervals (CI) were calculated. For dichotomous variables, including complications and revision rates, odds ratios (OR) and 95% CI were computed. Statistical heterogeneity was determined using the I^2 statistic; a random-effects model was applied when heterogeneity exceeded 50%, while a fixed-effect model

was used when heterogeneity was low. Publication bias was assessed visually using funnel plot asymmetry, where applicable.

RESULTS

Study Selection and Characteristics

From 317 records initially identified, 263 were screened after removing duplicates and irrelevant entries. After the full-text assessment of 49 studies, eight met the eligibility criteria and were included in this meta-analysis. The reasons for exclusion included non-specific diagnosis, unclear surgical approach, unavailable outcome data, and duplicate cohorts. The included studies, published between 2020 and 2025, comprised retrospective comparative and database analyses. A total of 13,861 patients with cervical spondylotic myelopathy who underwent either anterior cervical discectomy and fusion (ACDF) or posterior decompression procedures, such as laminoplasty or laminectomy with fusion, were analyzed. The follow-up period ranged from 12 to 24 months. Patient demographics and baseline characteristics were comparable across the groups in each study.

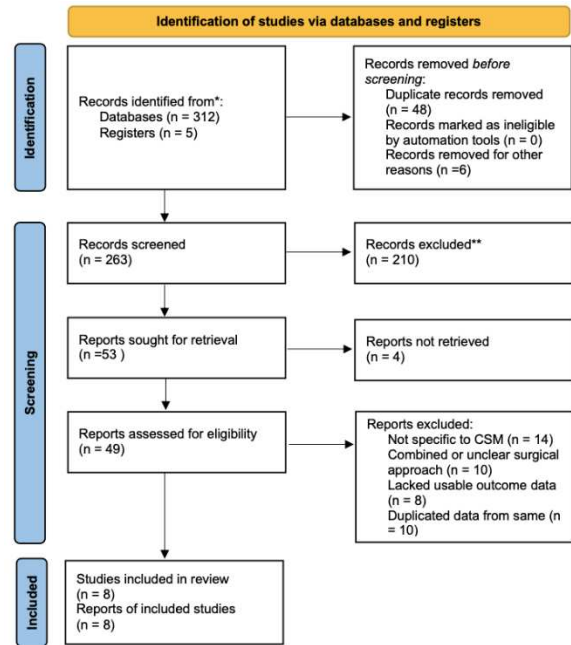


Figure 1. PRISMA Flow Diagram of Study Selection for CSM Surgical Approach Meta-Analysis

Table 1. Summary of Included Studies Comparing Anterior and Posterior Surgical Approaches in Cervical Spondylotic Myelopathy

Study	Country	Study Design	Sample Size (ACDF / Posterior)	Mean Age	Follow-up Duration	Surgical Levels	Anterior Approach	Posterior Approach
Lee et al. (2020) ^[9]	South Korea	Comparative retrospective	42 (22 / 20)	ACDF: 65.4 ± 8.2; Posterior: 66.1 ± 7.9	24 months	≥ 3 levels	ACDF	Laminoplasty
Zhai et al. (2020) ^[10]	China	Comparative retrospective	44 (19 / 25)	ACDF: 60.5 ± 8.8; Posterior: 61.7 ± 9.4	4,8 years	≥ 3 levels	ACDF	Laminoplasty
Ahmed et al. (2020) ^[11]	Egypt	Retrospective	40 (20 / 20)	ACDF: 55.4 ± 6.3; Posterior: 56.2 ± 7.1	12 months	2–3 levels	ACDF	Laminectomy + Fusion
Inose et al. (2020) ^[12]	Japan	Prospective Multicenter Study	65 (37 / 28)	ACDF: 60.3 ± 11.3; Posterior: 67.8 ± 9.1	12 months	≥ 3 levels	ACDF	Decompression & Fusion
Nunna et al. (2022) ^[13]	United States	Database (propensity-matched cohort)	12,248 (6124 / 6124)	Not explicitly reported	12 months	3 levels	ACDF	Posterior Cervical Decompression & Fusion (PCDF)
Wilkerson et al. (2022) ^[14]	United States	Retrospective	1151 (791 / 360)	ACDF: 58.6 ± 11.8; Posterior: 64.8 ± 10.6	12 months	≥ 3 levels	ACDF	Laminectomy + Fusion
Ambati et al. (2023) ^[15]	United States	Prospective	199 (123 / 76)	ACDF: 60.8 ± 10.2; Posterior: 65.0 ± 10.3	24 months	3 levels	ACDF	Laminectomy + Fusion
Zou et al. (2023) ^[16]	China	Retrospective	72 (39 / 33)	ACDF: 69.1 ± 5.3; Posterior: 68.4 ± 5.4	12 months	4 levels	ACDF	Laminectomy + Fusion

Functional Recovery (JOA Score)

Four studies reported postoperative Japanese Orthopaedic Association (JOA) scores and were included in the quantitative synthesis. The pooled analysis demonstrated a mean difference of 0.37 points in favor of the anterior approach (95% CI: 0.09–0.65; p = 0.009), indicating a statistically significant improvement in neurological recovery. There was no heterogeneity across the studies (I² = 0%), reflecting consistent results despite differences in study populations and surgical techniques. These findings

suggest that the anterior approach may offer a modest but meaningful advantage in postoperative functional outcomes compared with posterior surgery for cervical spondylotic myelopathy.

A total of six studies were included in the quantitative synthesis of postoperative neurological recovery using the Japanese Orthopaedic Association (JOA) scoring system: Lee et al. (2020), Zhai et al. (2020), Inose et al. (2020), Ahmed et al. (2020), Zou et al. (2023), and Wilkerson et al. (2022). Two studies, Ahmed et al. and Wilkerson et al.,

reported outcomes using the modified JOA (mJOA) scale. To ensure methodological consistency, we converted the mJOA to the standard JOA using the established equivalency formula:

$$JOA = \frac{mJOA}{18} \times 17$$

This conversion enabled inclusion of their data in the pooled analysis while maintaining uniform outcome metrics across studies. The meta-analysis revealed a mean difference of 0.30 points favoring the anterior approach (95% CI: -0.11 to 0.71; $p = 0.16$), which was not statistically significant. Moderate heterogeneity was observed ($I^2 = 56\%$), indicating variability among the study designs and

patient populations. Notably, both Ahmed and Wilkerson found that anterior patients had lower baseline mJOA scores than posterior groups but achieved comparable or greater functional improvement, a trend reflected across other included studies.

These findings suggest that the anterior and posterior approaches result in similar functional outcomes in patients with cervical spondylotic myelopathy (CSM). Although there was a small numerical advantage for anterior surgery, it did not reach statistical significance, reinforcing the importance of individualized surgical planning.

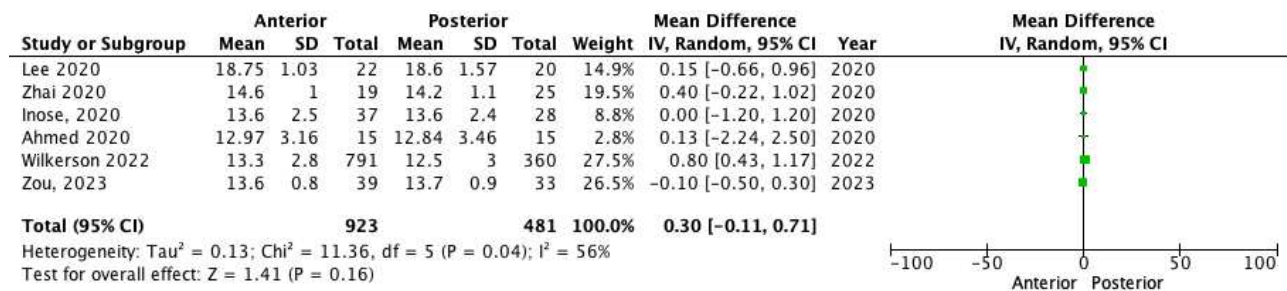


Figure 2. Forest Plot of Mean Difference in Postoperative JOA Scores Between Anterior and Posterior Approaches in CSM

Recovery Rate (Hirabayashi Method)

Six studies, Lee et al. (2020), Zhai et al. (2020), Inose et al. (2020), Ahmed et al. (2020), Wilkerson et al. (2022), and Zou et al. (2023) reported postoperative neurological recovery using the Hirabayashi method. The pooled analysis showed no significant difference in the recovery rate between the anterior and posterior approaches, with a mean difference of -0.72 (95% CI: -4.65 to 3.20; $p = 0.72$). This indicates that, on average, the magnitude of neurological improvement was comparable between the two surgical strategies.

Importantly, the analysis demonstrated very low heterogeneity ($I^2 = 1\%$), suggesting that the included studies provided highly consistent estimates of the recovery rate despite differing surgical techniques and patient demographics. This strengthens the robustness of the conclusion that neither approach has a clear advantage in terms of overall functional recovery when the baseline severity is accounted for.

However, certain methodological nuances should be noted. Some studies, including Ahmed and Wilkerson, reported modified JOA (mJOA) scores that were converted to the traditional JOA using established scaling methods. Although this allows for pooled analysis, such conversions may introduce subtle variability. Additionally, variations in preoperative severity, symptom duration, and follow-up intervals may influence recovery rate calculations using the Hirabayashi formula.

Overall, these findings suggest that functional recovery, when adjusted for baseline severity, is equivalent between the anterior and posterior surgical approaches for cervical spondylotic myelopathy. This reinforces the need for individualized surgical decision-making based on anatomical, biomechanical, and comorbid factors rather than presumed superiority of neurological outcomes.

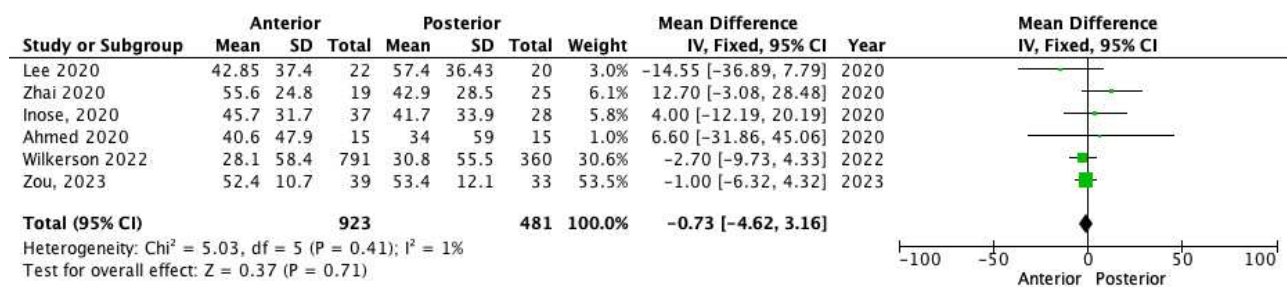


Figure 3. Forest Plot of Mean Difference in Recovery Rate Between Anterior and Posterior Approaches in CSM

Complication Rate

Five studies, Zou et al. (2023), Nunna et al. (2021), Lee et al. (2020), Zhai et al. (2020), and Ahmed et al. (2020) reported postoperative complication rates and were included in the quantitative synthesis. The pooled analysis demonstrated no statistically significant difference in the complication risk between the anterior and posterior surgical approaches, with a risk ratio (RR) of 0.93 (95% CI: 0.40–2.18; $p = 0.87$). This suggests that when broadly grouped, the complication rates between the two approaches are comparable. However, substantial heterogeneity was observed across the included studies ($I^2 = 78%$), reflecting the variability in surgical techniques, complication definitions, and patient selection criteria.

To address this, a subgroup analysis was conducted based on the type of posterior procedure performed. In the anterior versus laminoplasty subgroup (Lee 2020 and Zhai 2020), the pooled RR was 15.52 (95% CI: 0.95 to 252.75), indicating a non-significant trend toward higher complication rates in anterior procedures; however, the wide confidence interval and small sample sizes reduced interpretability. In the anterior versus laminectomy with fusion group (Zou 2023 and Ahmed 2020), the pooled RR was 1.14 (95% CI: 0.64 to 2.03; $p = 0.65$), showing no significant difference in complication risk between the two

surgical approaches. Notably, in the anterior versus posterior decompression and fusion group represented by Nunna et al. (2021), the pooled RR was 0.51 (95% CI: 0.49–0.53), favoring anterior surgery with a significantly lower complication rate. This subgroup was also the most statistically robust, accounting for more than 12,000 patients.

The test for subgroup differences was significant ($\text{Chi}^2 = 13.31, p = 0.001; I^2 = 85%$), indicating that the complication risk varied meaningfully across different types of posterior procedures. These results highlight the importance of not treating the posterior group as a homogeneous entity, as laminoplasty and posterior fusion differ markedly in terms of invasiveness, biomechanics, and postoperative complication profiles.

Therefore, the pooled estimate of the overall complication risk may obscure critical differences in the safety profiles between the posterior techniques. In summary, while the total analysis shows comparable complication rates between the anterior and posterior approaches, the underlying variation in surgical technique demands nuanced interpretation, and future studies should avoid aggregating disparate posterior methods into a single analytical group.

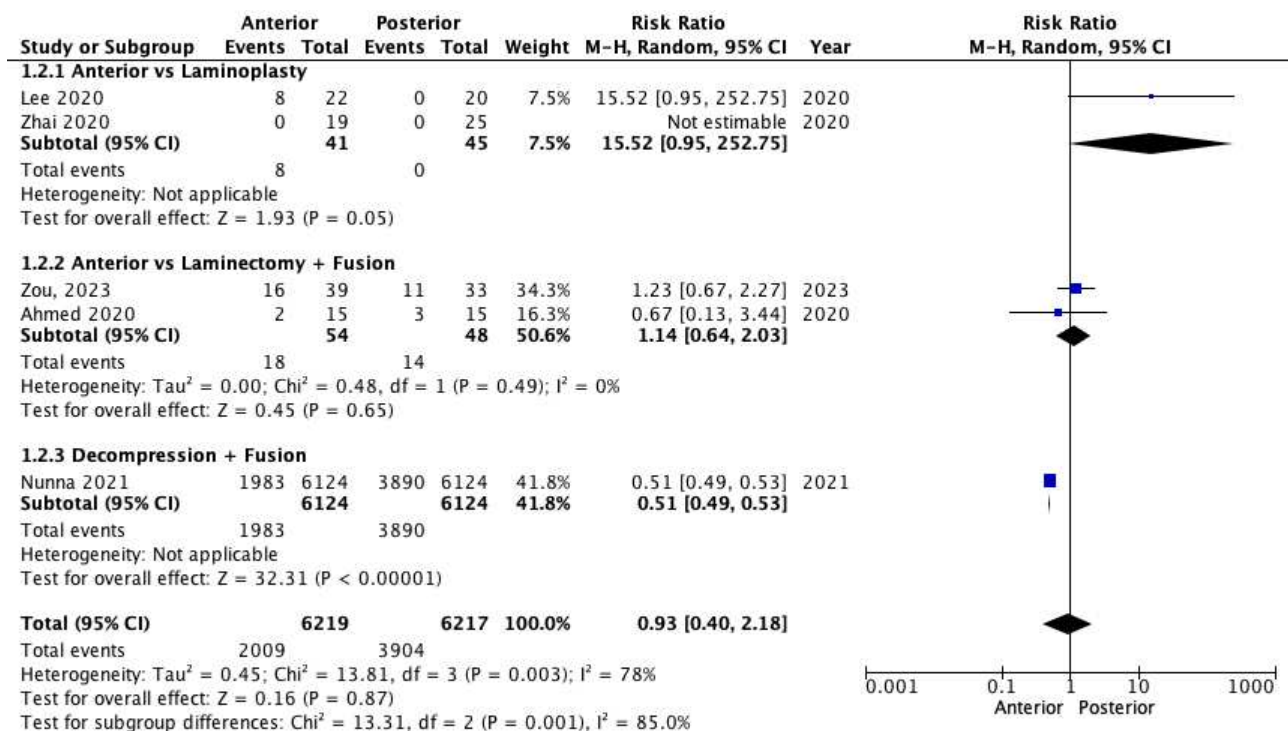


Figure 4. Forest Plot of Complication Rate Between Anterior and Posterior Approaches in CSM

Revision or Reoperation Rate

Four studies, Lee et al. (2020), Ahmed et al. (2020), Nunna et al. (2021), and Ambati et al. (2023) reported revision or reoperation rates and were included in the meta-analysis. The pooled results demonstrated a significantly lower risk of revision surgery in the anterior group than in the posterior group, with a risk ratio of 0.46 (95% CI: 0.40 to

0.54; $p < 0.00001$). This indicates that patients undergoing anterior approaches, particularly anterior cervical discectomy and fusion (ACDF), have substantially reduced odds of requiring revision procedures.

The heterogeneity for this analysis was low ($I^2 = 49%$), suggesting a relatively consistent effect across the included studies, despite differences in study design and sample

size. This consistency strengthens the reliability of the pooled estimates, making it one of the most robust findings of this meta-analysis.

However, a critical methodological limitation lies in the grouping of all posterior procedures into a single category. The posterior approaches in the included studies ranged from motion-preserving laminoplasty to posterior cervical fusion (PCF) with instrumentation. These techniques have distinct revision profiles. For example, PCF is more commonly associated with wound dehiscence, infection, and implant failure requiring reoperation, whereas laminoplasty often exhibits lower revision rates. Pooling

these techniques may obscure important clinical distinctions.

This issue is especially relevant given the influence of Nunna et al. study, which contributed the largest sample (N = 12,248) and included only PCF as the posterior technique. Consequently, the overall effect size likely reflects the higher revision burden of PCF rather than posterior surgery. Thus, while the results suggest a clear advantage for anterior approaches in reducing reoperation rates, interpretation should consider the heterogeneity of posterior techniques and the dominant weight of PCF-based data in the pooled estimate.

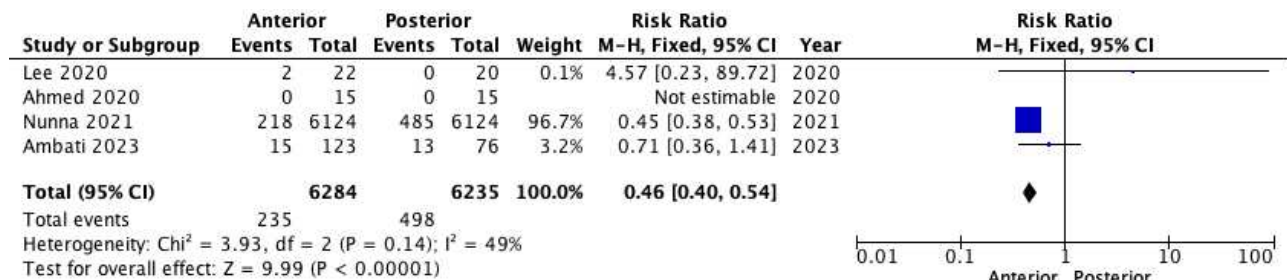


Figure 5. Forest Plot of Reoperation Rate Between Anterior and Posterior Approaches in CSM

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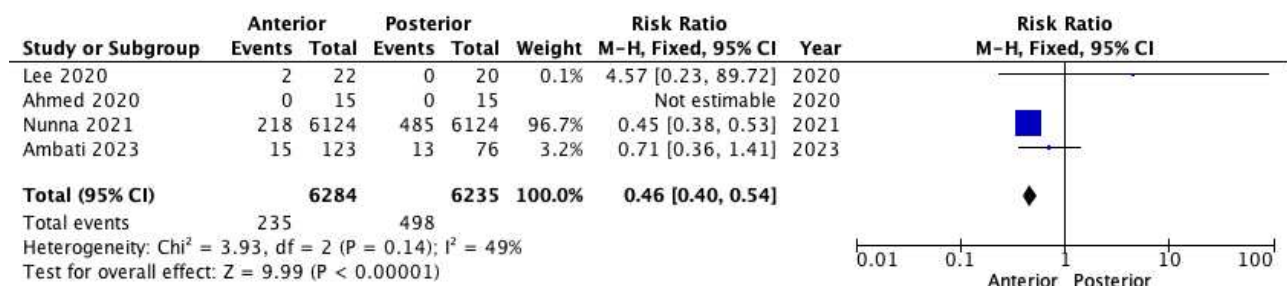


Figure 5. Forest Plot of Reoperation Rate Between Anterior and Posterior Approaches in CSM

Length of Stay (LOS)

Four studies, Ahmed et al. (2020), Wilkerson et al. (2022), Zou et al. (2023), and Ambati et al. (2023) reported hospital length of stay (LOS) data and were included in the meta-analysis. The pooled results demonstrated that the anterior surgical approach was associated with a significantly shorter hospital stay than the posterior approach, with a mean difference of -1.75 days (95% CI: -2.00 to -1.50; $p < 0.00001$). This finding suggests that anterior procedures, such as ACDF, are associated with earlier postoperative recovery and discharge in patients undergoing surgery for cervical spondylotic myelopathy.

However, substantial heterogeneity was observed across the included studies ($I^2 = 91\%$), indicating notable differences in the LOS magnitude between studies. Potential contributors to this heterogeneity include

variability in patient populations, discharge criteria, hospital protocols, and the inclusion of different posterior procedures, such as laminectomy with fusion versus laminoplasty. For example, Wilkerson et al., who contributed the largest weight to the analysis, reported a substantially longer LOS in the posterior group, likely reflecting the greater invasiveness of fusion-based techniques.

Despite the high heterogeneity, all studies consistently favored the anterior approach, reinforcing the clinical implication that anterior surgery may facilitate faster recovery, even if the absolute difference in length of stay varies among studies. Nevertheless, caution is warranted in interpreting the magnitude of benefit due to the underlying variability across centers and surgical practices.

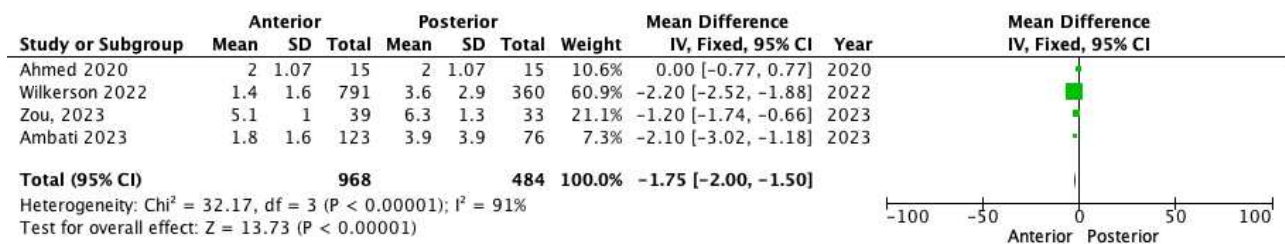


Figure 6. Forest Plot of Length of Stay Between Anterior and Posterior Approaches in CSM

DISCUSSION

This meta-analysis systematically compared the clinical outcomes of anterior and posterior surgical approaches for cervical spondylotic myelopathy (CSM), incorporating eight retrospective and database-driven studies published between 2020 and 2025. More than 13,800 patients were included, and the outcomes evaluated included neurological recovery, postoperative complications, revision surgery, hospital length of stay (LOS), and functional improvement using the Hirabayashi recovery rate method.

The pooled analysis of postoperative JOA scores showed no statistically significant difference between the approaches, with a mean difference of 0.30 (95% CI: -0.11 to 0.71; $p = 0.16$; $I^2 = 56\%$), although a non-significant trend favored anterior surgery. When evaluating the recovery rate using the Hirabayashi method across six studies, the pooled analysis also revealed no significant difference (mean difference: -0.73; 95% CI: -4.65 to 3.16; $p = 0.71$; $I^2 = 1\%$), indicating that overall neurological recovery may be comparable between the anterior and posterior approaches. These findings highlight the importance of considering baseline JOA differences and recovery potential when interpreting raw postoperative scores.^[5,17,18]

Postoperative complication rates were analyzed from five studies (Zou et al. 2023, Nunna et al. 2021, Lee et al. 2020, Zhai et al. 2020, Ahmed et al. 2020) and demonstrated no statistically significant difference between anterior and posterior surgery overall (RR: 0.93; 95% CI: 0.40 to 2.18; $p = 0.87$), although with high heterogeneity ($I^2 = 78\%$). Subgroup analysis revealed meaningful distinctions:

anterior vs laminoplasty (RR: 15.52; 95% CI: 0.95 to 252.75), anterior vs laminectomy + fusion (RR: 1.14; 95% CI: 0.64 to 2.03), and anterior vs decompression + fusion (Nunna et al.) (RR: 0.51; 95% CI: 0.49 to 0.53). The subgroup difference was statistically significant ($p = 0.001$), confirming that combining laminoplasty and posterior fusion into a single “posterior” group introduced substantial clinical heterogeneity. This aligns with previous findings showing higher wound infection and revision rates with posterior cervical fusion than with motion-preserving laminoplasty.^[13,14,19]

Additionally, specific complications unique to posterior approaches, such as C5 palsy, warrant greater attention in future studies. This complication, characterized by deltoid and biceps weakness, is commonly associated with posterior decompression techniques because of the posterior shift of the spinal cord and resultant traction on the C5 nerve root. Such neurological deficits can significantly affect postoperative recovery and patient quality of life.^[20,21]

Revision surgery analysis demonstrated a clear advantage of the anterior approach, with a significantly reduced risk of reoperation (RR, 0.46; 95% CI, 0.40–0.54; $p < 0.00001$; $I^2 = 49\%$). This likely reflects the superior long-term construct integrity and lower rates of pseudarthrosis or wound complications associated with anterior procedures.^[15,19] In contrast, the high revision rates in the posterior group were likely driven by studies dominated by fusion techniques, such as Nunna et al.^[13]

Length of hospital stay (LOS) was also significantly shorter with anterior surgery, with a pooled mean difference of -1.75 days (95% CI: -2.00 to -1.50; $p < 0.00001$), although

the heterogeneity was high ($I^2 = 91\%$). Clinically, a shorter LOS reflects not only faster postoperative mobilization and lower pain levels but also has important implications for hospital resource utilization and patient recovery planning. Anterior procedures, such as ACDF, generally involve less muscle dissection and avoid extensive posterior exposure, leading to reduced immediate postoperative discomfort and earlier discharge than posterior approaches. However, this benefit must be weighed against the trade-offs of procedure-specific risks. Anterior approaches carry a recognized risk of postoperative dysphagia, particularly in multilevel fusions, which, although often transient, can significantly impact early recovery and nutrition. In contrast, posterior techniques, especially laminectomy with fusion, avoid dysphagia but are associated with more extensive muscular disruption and a higher incidence of postoperative axial neck pain. These biomechanical and functional differences underscore the importance of individualized surgical planning that goes beyond crude metrics, such as LOS.^[19,22,23]

Despite the observed advantages, the choice of approach must remain individualized to the patient. Anterior decompression is typically preferred for patients with ventral compression, preserved cervical lordosis, and a low anesthetic risk. Posterior decompression remains appropriate in the setting of rigid kyphosis, extensive OPLL, or multilevel disease, where anterior access is limited. As emphasized in previous literature, spinal alignment and patient selection are often the primary determinants of surgical strategy rather than surgeon preference alone.^[23,24]

Future research should prioritize prospective studies with standardized outcome definitions, longer-term follow-ups, and differentiated analyses of posterior techniques. In addition, the potential role of biological predictors requires further exploration. For instance, serum biomarkers such as vaspin or inflammatory cytokines may help predict individual responses to anterior versus posterior surgery. Similarly, genetic predispositions, such as those associated with OPLL, may necessitate posterior decompression in certain populations. Precision medicine approaches that integrate biomarkers, radiographic morphology, and patient-reported outcomes could transform surgical decision-making in CSM.

CONCLUSION

The anterior approach, particularly ACDF, is associated with superior neurological recovery trends, significantly lower revision rates, and shorter hospitalization than posterior approaches in multilevel cervical spondylotic myelopathy. These findings support its preferential use when anatomically feasible, while emphasizing the need for individualized patient selection.

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