

Postoperative Rehabilitation for Pain and Functional Recovery Following Anterior Cervical Discectomy and Fusion: A Narrative Review

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Abstract: Patients with cervical myelopathy, radiculopathy, and myeloradiculopathy often experience neck and arm pain, neurological impairments, and functional limitations that significantly affect their quality of life. Anterior cervical discectomy and fusion (ACDF) is the most commonly performed surgical procedure to address these conditions. In clinical practice, postoperative rehabilitation is widely recommended following ACDF to enhance recovery. However, the effectiveness of rehabilitation after ACDF remains inconclusive. This review aims to evaluate the efficacy of exercise-based rehabilitation programs after ACDF. We conducted a systematic search of articles concerning rehabilitation after ACDF, published through July 16, 2025. Our inclusion criteria focused on studies examining the effects of postoperative rehabilitation programs following ACDF. Our search identified 753 articles. After screening titles and abstracts, 729 articles that did not fulfill the inclusion criteria were excluded. The remaining 24 articles were further assessed for eligibility, and ultimately, 9 studies were included in this review. Early studies reported limited additional benefits from basic physiotherapy compared to usual postoperative care. However, recent studies employing structured, phase-based rehabilitation programs—including cervical muscle strengthening, postural correction, and home-based exercises—demonstrated significant improvements in pain, disability, and functional outcomes. Rehabilitation programs initiated within 6 weeks after surgery, particularly within the first week, were associated with improved recovery without increased complications. Additionally, nutritional support (eg, vitamin D supplementation) and patient-centered delivery approaches, such as home exercises combined with telephone support, further enhanced outcomes. Rehabilitation programs following ACDF have evolved to become increasingly systematic and comprehensive. Growing evidence supports the beneficial effects of rehabilitation after ACDF. Early structured rehabilitation programs appear to play a crucial role in reducing pain, improving functional outcomes, and enhancing postoperative recovery. Further research is required to better understand the effects of postoperative rehabilitation following ACDF.

Keywords: rehabilitation, exercise, neurosurgical procedures, discectomy

Introduction

Cervical myelopathy involves spinal cord compression at the cervical level, while radiculopathy results from nerve root compression. Myeloradiculopathy combines features of both. Patients with these diagnoses commonly experience neck and arm pain with neurological deficits, which contribute to disability, functional limitations, and reduced quality of life.¹ Patients presenting with progressive deformities, neurologic deficits, instability, or debilitating symptoms refractory to non-operative management may require surgical intervention.²⁻⁴ Among the available cervical spine surgical techniques, anterior cervical discectomy and fusion (ACDF) is the most frequently performed surgical procedure for addressing symptoms caused by cervical herniated discs, cervical stenosis, or cervical spinal instability.⁴

ACDF entails removal of the herniated or degenerative cervical disc compressing the spinal cord or nerve root, followed by fusion of adjacent vertebrae to stabilize the affected segment. After ACDF, many patients experience

postoperative pain and reduced range of motion (ROM) in the cervical spine due to fusion. Prolonged immobilization may also occur, leading to neck muscle atrophy and decreased muscular function.^{3,5,6} Therefore, targeted postoperative rehabilitation is essential to prevent muscle atrophy and deconditioning following surgery, as these problems may not resolve spontaneously and can contribute to incomplete or delayed recovery, or even long-term disability.^{2,7} Targeted interventions such as cervical muscle strengthening and postural correction can improve spinal alignment and neuromuscular control, reduce residual inflammation, and decrease pain. Without appropriate rehabilitation, pain and dysfunction may persist beyond the expected recovery period.

Postoperative rehabilitation aims to improve residual symptoms, enhance recovery, prevent complications, and restore physical and psychosocial functioning. Rehabilitation programs generally consist of patient education and various exercise interventions, including ROM exercises, stretching, and strengthening exercises. They also incorporate gait training, cognitive-behavioral therapy, and multidisciplinary approaches such as motor control adjustments and pain management strategies.² In clinical practice, rehabilitation programs can be delivered through educational sessions, one-on-one therapy, home-based routines, or group training.⁴ Rehabilitation is widely recommended to promote recovery from neurological deficits, enhance sensorimotor function, restore daily activity levels, and support patients' successful return to work, sports, and leisure activities.^{2,4} However, to date, the effectiveness of rehabilitation after ACDF remains inconclusive. Therefore, this review aims to investigate the efficacy of rehabilitation programs after ACDF.

Methods

A systematic review was conducted to investigate the effectiveness of rehabilitation programs following ACDF.

Search Strategy

This review was conducted according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines ([Supplementary 1](#)). The review protocol was registered with the International Platform of Registered Systematic Review Protocols (Registration number: INPLASY 202570070). A comprehensive literature search was conducted using PubMed, Embase, the Cochrane Library, Scopus, and ClinicalTrials.gov to identify relevant studies published up to July 16, 2025. The search strategy included the keywords (“cervical surgery” OR “anterior cervical discectomy and fusion”) AND (“rehabilitation” OR “physiotherapy” OR “physical therapy” OR “postoperative care” OR “neck exercise” OR “exercise therapy”) ([Supplementary 2](#)). Duplicate records were identified and removed using EndNote 20's automated de-duplication tool prior to screening.

Study Selection

Studies examining the effects of rehabilitation programs following ACDF were included. Inclusion criteria were: (1) studies involving patients who had undergone ACDF; (2) studies evaluating rehabilitation after ACDF; and (3) studies reporting pain and disability outcomes.

Exclusion criteria were: (1) studies that did not include rehabilitation after ACDF; (2) animal studies, case reports, reviews, commentaries, and letters; and (3) studies lacking outcomes related to pain or functional disability. There were no restrictions on study design or language. Two independent reviewers (SYY and MCC) screened articles based on titles and abstracts to exclude irrelevant studies. Full-text assessments were then conducted for final inclusion. Any disagreements were resolved through consensus between the reviewers, with input from a third reviewer (YGY) if necessary.

Data Extraction

Data extraction was independently conducted by two reviewers (SYY and MCC) using a standardized data collection form. The following data were recorded in [Table 1](#) for each eligible study: (1) first author's name, (2) year of publication, (3) study design, (4) number of participants, (5) details of exercise and control groups, (6) outcome measures, and (7) treatment results.

Table 1 Characteristics of Included Studies

No.	Author	Year	Study Design	Number of Participants	Type of Exercise	Control Group	Treatment Duration	Follow-Up Period	Evaluation	Results
1	Wibault et al ⁸	2017	RCT	202 (101 vs 100)	SPT involving neck-specific exercises targeting deep neck muscles	Standard approach (routine surgeon visits 6 weeks post-surgery)	20 weeks	3 months, 6 months	Neck muscle endurance, cervical ROM, self-efficacy, pain catastrophizing, pain control	Neck-specific exercises were tolerated by patients after ACDF, but no between-group differences were identified at 6 months post-surgery.
2	Peolsson et al ⁹	2019	RCT	202 (100 vs 101)	SPT involving deep neck muscle exercises, postural control, relaxation, and scapular muscle strengthening exercises	Standard approach (surgeon visits when needed)	12-24 weeks	3, 6, 12, and 24 months	NDI score, pain variables, self-efficacy, HRQoL	SPT provided no additional benefit compared to SA; however, both groups improved significantly over time.
3	Coronado et al ⁵	2020	RCT	30 (15 vs 15)	Early self-directed HEP including walking, ROM exercises, strengthening exercises, and cognitive-behavioral strategies	Usual care (no exercise)	6 weeks	6 weeks, 6 months, and 12 months	NDI, NPRS for pain, Short Form Health Survey (SF-12), and opioid use	The HEP group reported lower levels of neck pain at 6 weeks compared with the usual care group, as well as a lower rate of opioid use at the 12-month follow-up. The HEP was safe and feasible, improving pain catastrophizing, disability, and self-efficacy.
4	McFarland et al ¹⁰	2020	RCT	40 (20 vs 20)	ECS stabilizing training, including posture education, chin tuck, and shoulder exercises	Usual care (no exercise, only education)	12 weeks	6, 12 weeks	NPRS, NPI, CCF-S, CCF-E	Both ECS training and usual care resulted in similar levels of improvement at 6 and 12 weeks following ACDF surgery.
5	Skrobot et al ¹¹	2020	RCT	30 (15 vs 15)	Rehabilitation program combined with Vitamin D supplementation	Placebo group	10 weeks	19 weeks	Balance, postural stability, pressure distribution	Patients who took vitamin D ₃ daily before surgery showed improved postural stability and a lower risk of falls compared with those who did not.

(Continued)

Table 1 (Continued).

No.	Author	Year	Study Design	Number of Participants	Type of Exercise	Control Group	Treatment Duration	Follow-Up Period	Evaluation	Results
6	Coronado et al ¹²	2021	PCO	8	Telephone-supported HEP including daily walking, deep breathing, distraction techniques, cervical and upper body exercises	No direct control group (case series study)	6 weeks	6 weeks and 6 months	NDI, NRS for pain, Tampa Scale of Kinesiophobia, Pain Catastrophizing Scale, and Pain Self-Efficacy Questionnaire	Patients who undertook the telephone-supported HEP showed significant improvements in pain catastrophizing, disability, and overall pain levels.
7	Cerezci et al ¹³	2022	ROS	40 (20 vs 20)	Structured rehabilitation programs organized into different time periods (education, nape-neck curve exercises, cervical tilt exercises, strengthening exercises)	No exercises	6 months	6 months	ODI, VAS, C2-7 cervical lordosis angle	Significant differences were observed in VAS and ODI values at 6 months for patients who received rehabilitation compared with the control group.
8	Rahman et al ¹⁴	2024	ROS	66	Rehabilitation programs involving cervical ROM exercises, stabilization exercises, gait training, upper-limb strengthening exercises, and occupational therapy	No rehabilitation	Variable durations depending on rehabilitation participation	3, 6, 12 months	mJOA, NDI, SF-36 PCS scores	Postsurgical rehabilitation resulted in improved outcomes within the first postoperative year. Early initiation of postsurgical rehabilitation therapy (<42 days) was associated with greater improvement in SF-36 PCS and mJOA scores at the 12-month follow-up compared with delayed rehabilitation initiation (>42 days after surgery).
9	Wang et al ¹⁵	2025	RCT	60 (27 vs 33)	Early cervical functional exercise progressing from contraction exercises to isometric and resistance exercises	No exercise	Varied based on study period	1 week, 1 month, and 6 months	VAS, NDI, JOA, intervertebral stability	The CFE group showed improvements in postoperative pain and function without affecting fusion stability.

Abbreviations: ACDF, anterior cervical discectomy and fusion; CCF-E, craniocervical flexor endurance; CCF-S, craniocervical flexor strength; CFE, cervical functional exercise; ECS, early cervical spine; HEP, home exercise program; mJOA, modified Japanese Orthopaedic Association scores; NDI, Neck Disability Index; nRCT, non-randomized controlled trial; NPRS, numeric pain rating scale; ODI, Oswestry Disability Index; PCS, physical component summary; POS, prospective observational study; RCT, randomized controlled trial; ROM, range of motion; ROS, retrospective observational study; SPT, structured postoperative physiotherapy; VAS, visual analog pain scale.

Quality Assessment

Risk of bias was independently assessed by two reviewers (SY and MCC). For randomized controlled trials, the revised RoB 2 tool was used to evaluate randomization, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported result; most studies exhibited high risk in outcome measurement and reporting. For non-randomized studies, the ROBINS-I tool was used, with notable risk in confounding and outcome measurement domains. Judgments were classified as “low risk”, “moderate risk”, or “high risk”. Reviewer discrepancies were resolved through discussion until consensus was achieved.

Results

The initial search yielded 753 articles using the specified terms. After screening titles and abstracts based on predefined inclusion criteria, 729 articles were excluded. The remaining 24 articles were subsequently assessed for eligibility, resulting in the exclusion of 15 studies for the following reasons: 7 were review articles and case reports, 5 did not focus on exercise programs after cervical spine surgery, and 3 lacked sufficient outcome data. Ultimately, nine articles examining the effect of rehabilitation after ACDF were included in this review (Figure 1).^{5,8-15} A summary of the study characteristics is provided in Table 1.

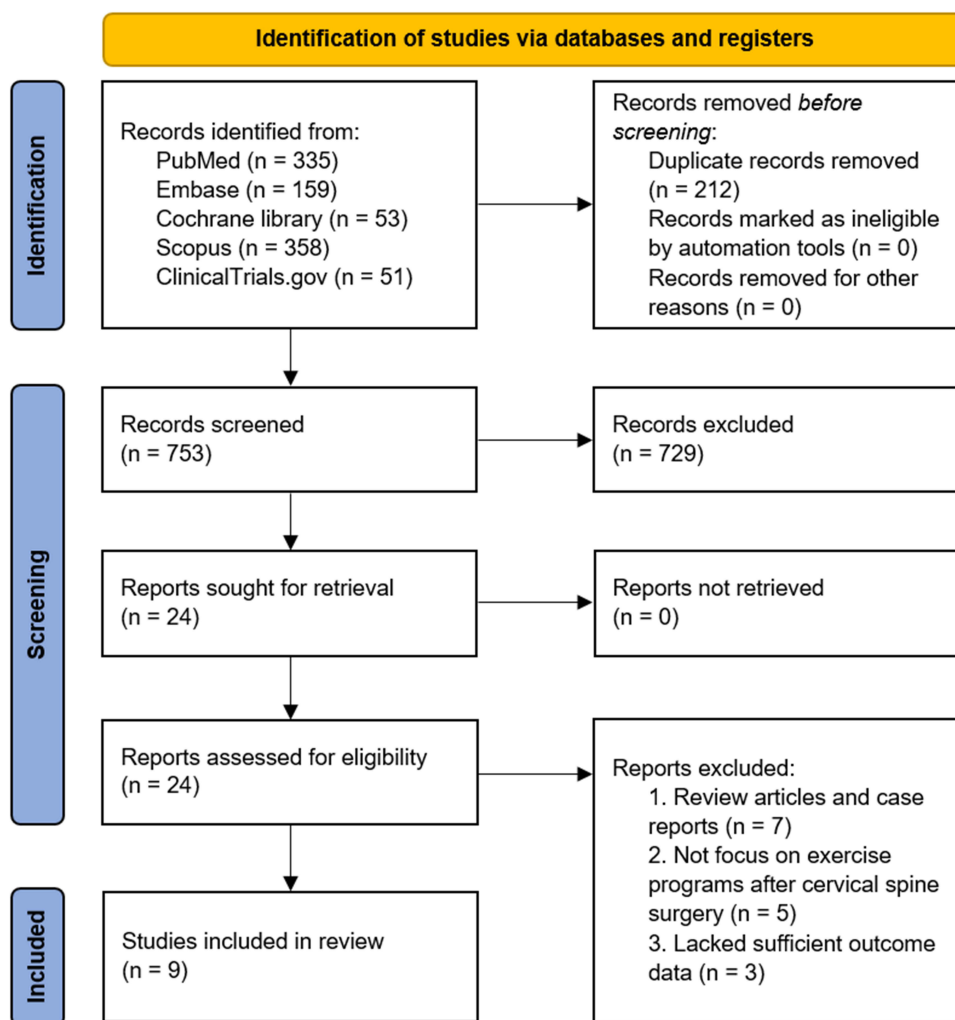


Figure 1 Flowchart depicting the search results.

The Effect of Rehabilitation After ACDF

The effectiveness of rehabilitation after ACDF has been reported in nine studies.^{5,8–15} These studies investigated the impact of rehabilitation on various outcomes, including pain relief, ROM, functional recovery, and overall quality of life following surgery.

An early study by Wibault et al compared the effects of structured postoperative physiotherapy (SPT) with a standard approach (SA) in patients who underwent ACDF or posterior cervical foraminotomy.⁸ The SPT program included neck-specific exercises targeting the deep neck muscles, while the SA consisted of routine surgeon visits 6 weeks post-surgery and general advice to contact primary healthcare centers if needed. The SA did not include any specific rehabilitation or physiotherapy program. Both programs began 6 weeks after surgery and continued for 20 weeks. Although SPT was more effective than SA in reducing pain catastrophizing, it did not demonstrate significant additional benefits in functional outcomes. Peolsson et al also reported that a 12–24-week SPT program involving deep neck muscle exercises, postural control, relaxation, and scapular muscle strengthening exercises (100 patients) did not yield superior long-term outcomes compared to the SA group (101 patients).⁹ Patients in the SA group did not receive regular postoperative rehabilitation programs and sought additional postoperative treatments starting 6 weeks after surgery only if they felt further care was necessary. No significant differences in outcomes were observed at the 2-year follow-up. Similarly, McFarland et al found that patients receiving ECS (early cervical spine stabilizer) training (20 patients), which included posture education, chin tuck, and shoulder exercises, demonstrated improvements in pain and disability similar to those receiving usual care.¹⁰ Patients in the usual care training group did not engage in exercises but received education on proper posture, cervical collar use, proper body mechanics, and precautions during transfers and ambulation. These early studies reported minimal benefits of postoperative rehabilitation therapy compared with standard postoperative care.

In contrast to these earlier findings, recent studies have demonstrated beneficial effects of rehabilitation programs after cervical spine surgery. These recent programs were more specifically and systematically designed compared to those of the earlier studies. In 2022, Cerezci et al evaluated the effects of a post-ACDF rehabilitation program on pain management and cervical alignment.¹³ This program was systematically structured and comprehensively organized into distinct periods, providing a more precise framework for determining the most beneficial exercises at each stage of recovery. The post-ACDF rehabilitation program consisted of four phases. In the preoperative evaluation and active resting phase (0–3 weeks), patients received surgery-related education and supervised mobilization on the first postoperative day. They also received instruction to maintain proper posture and avoid lifting, bending, and cervical hyperextension. During the early protective phase (4–8 weeks), patients began performing pain-free neck exercises. In the dynamic phase (8 weeks to 6 months), cervical tilt and core stretching exercises were gradually introduced, along with participation in a customized kinetic chain strengthening program. Afterward, patients resumed sports activities in the return-to-sport phase (after 6 months). Patients who completed the 6-month physical therapy program (20 patients) showed significant improvements in pain (visual analog scale) and disability (Oswestry Disability Index) compared to those who did not (20 patients). These findings suggest that structured postoperative rehabilitation programs play a critical role in optimizing recovery outcomes for patients undergoing ACDF.

In 2024, Rhaman et al also reported beneficial effects of rehabilitation among patients with degenerative compressive myelopathy who underwent cervical decompression surgery with or without fusion (27 patients via anterior approach, 36 patients via posterior approach).¹⁴ The effects of various rehabilitation programs, including cervical ROM exercises, stabilization exercises, gait training, upper-limb strengthening exercises, and occupational therapy, were assessed in this study. Postsurgical rehabilitation led to improved outcomes within the first year after surgery in a cohort of 66 patients included in the analysis. The study also revealed that early postsurgical rehabilitation therapy (initiated within 6 weeks postoperatively) was associated with greater improvements in SF-36 PCS (36-Item Short Form Health Survey, Physical Component Summary) and mJOA (modified Japanese Orthopaedic Association) scores at the 12-month follow-up compared to delayed rehabilitation initiated beyond 6 weeks. These findings emphasized that early, comprehensive rehabilitation programs can reduce pain and disability and facilitate recovery after ACDF.

The most recent study by Wang et al demonstrated that early cervical functional exercise (CFE), initiated on the third day after ACDF, effectively improved cervical pain and dysfunction.¹⁵ The CFE program began within 7

postoperative days, initially emphasizing contraction exercises (hand stretching, fist clenching, flexion and extension exercises, performed twice daily) before progressing to isometric exercises (cervical flexion, extension, left lateral flexion, and right lateral flexion exercises). Exercise programs were individualized and adjusted according to each patient's condition. One week after surgery, isometric exercises were restricted to a cervical ROM of 15°, progressively increasing to 35° in all directions by 1 postoperative month. Resistance training commenced at 2 months post-surgery. The CFE group (27 patients) experienced less neck pain 1 month after surgery, as measured by visual analog scale, and demonstrated greater postoperative functional recovery, as assessed by Japanese Orthopedic Association scores at 1 and 6 months, compared to the usual care group (33 patients), who received routine postoperative care including cervical collar use, pain management, and movement precautions. Traditionally, rehabilitation has been initiated 4–6 weeks after surgery; however, this study suggested that structured rehabilitation programs implemented as early as possible may yield superior outcomes. Rehabilitation programs specifically designed and structured to minimize injury risk according to the recovery stage appear to positively influence recovery following ACDF.

Other Rehabilitative Approaches Affecting Recovery After ACDF

Additionally, some studies have explored factors influencing postoperative recovery after ACDF. Skrobot et al investigated the role of vitamin D supplementation in postoperative recovery among patients undergoing anterior cervical interbody fusion.¹¹ Their study examined the effects of a comprehensive rehabilitation program that included preoperative vitamin D supplementation (3200 IU daily) along with postural education, isometric exercises, strengthening exercises, proprioception training, and balance exercises. Participants were divided into two groups: one receiving vitamin D supplementation and the other not. The results showed that patients who took daily vitamin D3 before surgery exhibited improved postural stability and a lower risk of falls compared to those who did not. These benefits may be attributed to vitamin D's action through the vitamin D receptor, enhancing muscle strength, facilitating muscle cell regeneration, and reducing apoptosis. Additionally, vitamin D reduces proinflammatory cytokines and inflammation, thereby supporting tissue recovery. Nutritional support with vitamin D may thus enhance the effectiveness of rehabilitation programs after surgery by improving balance and postural stability.

Patients can also benefit from home-based rehabilitation programs. Coronado et al investigated the benefits of early rehabilitation through a self-directed home exercise program (HEP).⁵ The HEP incorporated daily walking, range-of-motion exercises, and strengthening exercises to promote mobility and reduce postoperative stiffness within the first 6 weeks after ACDF. Patients in the HEP group reported lower levels of neck pain at 6 weeks compared to the usual care group, which received pain medication and a cervical collar without exercise, as well as a lower rate of opioid use at the 12-month follow-up. Building on these findings, Coronado et al conducted a follow-up study to further assess the impact of early rehabilitation.¹² This study evaluated a telephone-supported HEP implemented during the first 6 weeks after ACDF in a smaller cohort consisting of eight patients. The program provided structured guidance through weekly telephone consultations with physical therapists, who offered support and modifications tailored to each patient's recovery progress. The findings demonstrated significant improvements in pain catastrophizing, disability, and overall pain levels, further reinforcing the benefits of initiating rehabilitation during the early postoperative period. Rehabilitation does not necessarily have to be provided in a hospital setting; home-based rehabilitation can also be effective, contributing to pain reduction and promoting recovery. This suggests that patient self-management and active participation in rehabilitation programs are important factors in recovery.

Risk of Bias

Of the six RCTs assessed using the RoB 2 tool,^{5,8–11,15} one study was rated as having some concerns regarding risk of bias,¹⁰ while five were judged to have an overall high risk of bias.^{5,8,9,11,15} Among these, four studies showed low risk of bias for selection of reported results,^{5,8–10} whereas four exhibited high risk of bias for outcome measurement (Figure 2A).^{5,8,9,15}

Only one non-randomized study was evaluated using the ROBINS-I tool.¹³ It demonstrated low risk of bias in participant selection, intervention classification, deviations from intended interventions, and missing data. However, it

(A) Randomized controlled trials

(B) Non-randomized controlled trial

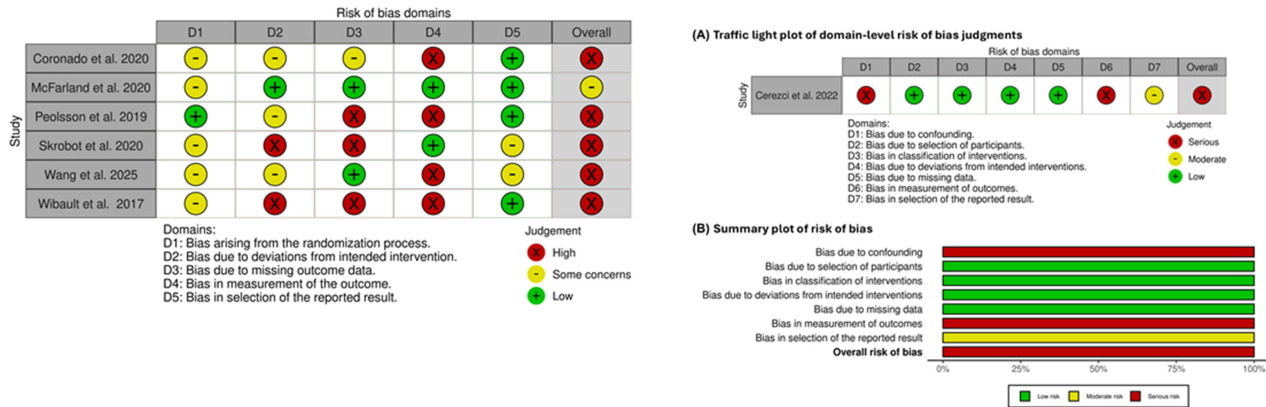


Figure 2 Methodological quality assessment for (A) randomized controlled trials and (B) non-randomized controlled trials.

was rated as having serious risk of bias due to confounding and outcome measurement, resulting in an overall serious risk of bias (Figure 2B).

Two studies were excluded from risk-of-bias assessment: one was a case series,¹² and the other lacked a comparison group,¹⁴ rendering them unsuitable for risk-of-bias evaluation.

Discussion

The findings of the included studies suggest that structured rehabilitation programs may play an important role in the recovery of patients who have undergone ACDF. Specifically, these programs have been found to be effective in reducing pain levels, enhancing functional mobility, and improving overall physical performance.

Rehabilitation programs targeting cervical muscles progress from non-resistance exercises to isometric and, subsequently, isotonic and kinetic chain exercises with gradually increasing resistance.⁸ Reduced neck muscle endurance has been reported to cause prolonged pain and increased disability, possibly due to impaired function resulting from decreased endurance.¹⁶ Additionally, a strong relationship between weakness of the deep neck and trapezius muscles and axial neck pain has been described in a previous study.¹⁷ Isometric exercises of the neck and trapezius muscles can improve local blood circulation, prevent muscle atrophy, and promote muscle hypertrophy. Moreover, isometric exercises can help recovery by reducing muscle swelling and pain sensitization (Figure 3).¹⁸ Progressive cervical muscle strengthening training helps prevent disuse and increases neck muscle endurance, ultimately contributing to pain reduction.¹⁹

Rehabilitation programs can also help correct postural abnormalities in patients who have undergone ACDF. Many patients who require ACDF exhibit cervical spinal misalignment, such as loss of cervical lordosis, a flattened cervical curve, or reverse kyphosis.²⁰ Efforts should be made to restore proper cervical alignment to prevent further degeneration or damage to adjacent spinal segments following ACDF. Rehabilitation programs focused on strengthening weakened muscles and correcting spinal misalignment may reduce stress on spinal structures and decrease the mechanical burden on adjacent tissues. Therefore, rehabilitation should be considered an essential component of postoperative care to improve neck and upper extremity pain, as well as neck disability scores.²¹

Structured rehabilitation programs typically include patient education, lifestyle modifications, pain management, gait training, and various types of exercises, such as ROM-testing stretching and strengthening exercises. These programs can be distinguished according to different recovery phases based on timing. Early postoperative rehabilitation typically emphasizes pain management and gentle mobilization. Muscle strengthening exercises are subsequently introduced after the first month, particularly to improve cervical alignment and postural stability. Rehabilitation then progresses to more active neck exercises, typically initiated after two months to ensure stability and safety during recovery. The goals of rehabilitation are to strengthen the cervical musculature, enhance overall physical fitness, and improve posture and body



Figure 3 Example of an isometric cervical extension exercise (interlaced fingers placed behind the head and gently pressing the head [extending the neck] backward during exhalation without movement of the head or hands).

mechanics. Improved physical function may also facilitate neuroplasticity and enhance neurological recovery in cases of severe injury.²² Given that pain and mobility impairments may persist long-term after ACDF,¹⁴ structured rehabilitation programs organized according to recovery phases should be designed to rebuild neck muscle strength and endurance, as well as to restore function in patients following ACDF.²³

Moreover, recent studies have indicated that earlier rehabilitation leads to more favorable outcomes. Studies have reported that patients beginning rehabilitation within 6 weeks—some as early as 1 week postoperatively—had better outcomes compared to those who began later.^{14,15} Early rehabilitation is particularly important in reducing fear of movement and pain, encouraging patients to safely resume physical activity, and optimizing recovery outcomes. Because pain and reduced function can significantly impact physical activity and quality of life, postoperative rehabilitation plays an essential role in preventing long-term functional decline and disability. Therefore, an early, phase-based, structured, and comprehensive rehabilitation approach appears critical for optimizing postoperative outcomes following ACDF.

Regarding safety, major surgery-related complications such as subluxations and revision surgery have not been reported in most studies (only 1 out of 66 patients in one study,¹⁴ and none in others).^{5,15} Early rehabilitation programs following ACDF appear to be both safe and effective in improving clinical outcomes for patients. Patients who began postoperative rehabilitation programs as early as 2 weeks,⁵ or even within 1 week,¹⁵ did not report postoperative surgical complications. These findings suggest that the benefits of rehabilitation after surgery may outweigh potential risks of complications.

This review has several limitations that should be considered. First, the sample sizes in the included studies were relatively small, limiting the generalizability of findings. Second, varying exercise interventions were used, making it difficult to determine the most effective exercise type for postoperative recovery. Standardized exercise protocols should, therefore, be developed to allow better comparison. Third, outcome measures differed among studies, and most studies exhibited a high risk of bias, particularly in outcome measurement domains. Addressing these limitations in future research will improve the quality of evidence and recommendations for postoperative rehabilitation after cervical spine surgery.

Conclusion

Rehabilitation programs following ACDF have become increasingly systematic and comprehensive. Although available studies are limited in number and variable in methodological quality, they consistently indicate potential benefits of rehabilitation after ACDF. Early structured rehabilitation programs appear to play a crucial role in reducing pain,

improving function, and enhancing postoperative recovery. Further research is needed to better understand the effects of postoperative rehabilitation following ACDF.

Funding

This work was supported by the National Research Foundation of Korea grant funded by the Korean government (MSIT) (No. RS-2023-00219725).

Disclosure

The authors report no conflicts of interest in this work.

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