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Surgical Outcome of Anterior Cervical Discectomy and Fusion for Cervical Spine Myelopathy in Young VS Elderly Patients

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ABSTRACT

Objectives: To measure and compare the frequency of surgical outcome of ACDF in patients with cervical spine myelopathy and to compare its outcome in younger vs elderly patients. **Study Design and Setting:** This Descriptive study was conducted at the Department of Neurosurgery, Ayub Teaching Hospital Abbottabad, Pakistan, from February 2025 to June 2025. **Methodology:** Sixty-two patients, diagnosed cases of CSM, meeting our inclusion criteria were randomly recruited and allocated into younger vs elderly groups based on age. Data were entered on a pre-validated, questionnaire and were followed up post-operatively to check for outcome using the ODOMS criteria, visual analogue scale and rate of complications. **Results:** n=62 patients underwent ACDF for Cervical myelopathy n=32 elderly and n=30 young patients. Degenerative spondylosis was the most common etiological factor causing CSM in elderly (96.9%) while cervical spine stenosis (50.0%) and traumatic aetiologies (30%) were the causes reported in younger lot. Younger patients had more pronounced motor deficit (30%), spastic gait (26.7%) and higher incidence of severe Ranawat classification iiia/b (50%vs 25%). Pre ope mJOA and VAS didn't differ significantly (6.9 vs 8.4 and VAS, 9.5 vs 9.3). Elderly patients achieved comparable or better outcomes than their younger counterparts, with favourable ODOMS grade (Excellent/good) 90.6% vs 73.3% with short hospital stay i.e. (8.6 vs 11.2 +- days). Post ope VAS showed a lower trend toward elderly (2.5 vs 3.03) though the difference didn't reach significance. Complications rate was statistically similar across both groups however respiratory issues were reportedly more common in younger population (16.7% vs 0%). **Conclusion:** Cervical spine myelopathy is as commonly reported in younger as is, in elderly population though the etiological differences are prominent. Younger patients tend to have traumatic pathologies superimposed on already stenosed C spine. That's why younger lot though report early, as compared to their elder counterparts, tends to have poor prognosis with long hospital stay, poor VAS and ODOM and more risk of post-operative complications. While the elderly patients with their co morbidities since are dealt with electively they tend to have an overall better surgical outcome. The study concludes overall favourable outcome for elderly population undergoing ACDF for CSM, and would urge to scan the younger lot electively at an early age with regular follow ups and intensive and multimodal care where and when its needed especially when there's respiratory compromise.

INTRODUCTION

Cervical spine Myelopathy (CSM) is the most common cause of cord compression in elderly population affecting men most commonly in their 6th-7th decade of life(1). Presentation of the disease varies.(2,3) Surgical decompression for moderate to severe cord compression is the mainstay of treatment. Among various approaches anterior cervical discectomy and fusion have gained popularity overtime for its superior results and minimum complication profile as quoted by Q Fei et al(4,5). Age besides many other factors is the main signifier of both the disease course and surgical outcome. Elderly patients typically present with advanced degenerative changes and uncontrolled systemic comorbidities. These factors contribute to increased perioperative risks, slower recovery, and poor surgical outcome overall. Conversely, younger patients generally demonstrate faster postoperative recovery and greater improvements in functional scores, though they remain susceptible to long-term concerns of adjacent level diseases and revision surgeries. Several studies have examined outcomes after ACDF across age groups, but findings remain

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heterogeneous [7]. While improvement is seen in both younger and older patients, the magnitude of neurological and quality-of-life gains tends to be smaller in elderly population, who also experience higher complication profile. However, few studies provide a direct comparative analysis focused on cervical myelopathy in young versus elderly populations, particularly in the region of Indo-Pak precisely in Abbottabad Pakistan.

This study aims to evaluate and compare surgical outcomes and complication profiles of ACDF for cervical myelopathy between younger and elderly patients. Establishing a clear difference will aid Surgeons in prognostication and making optimal surgical decision making.

METHODOLOGY

This cross sectional study took place at the department of Neurosurgery, Ayub Teaching Hospital Abbottabad, Pakistan from February 2025 to June 2025, after approval from the institutional review committee (Approval Code/Ref No.RC.EA-2024/280)

Inclusion Criteria

Patients aged 16- 90y presenting to neurosurgery department of Ayub teaching hospital Abbottabad Pakistan of both genders from February 2025 to July 2025, with axial neck pain, radicular pain, paraesthesia's, muscles weakness in upper limbs especially fine hand moments, such buttoning unbuttoning and combing, lower limbs weakness, Gait disturbances, urinary symptoms and or long tract signs pertaining to C spine compressive pathologies, spanning from c1 down to c7 confirmed on MRI C spine, multiplanar, multisequential images were enrolled randomly and assigned into younger and elderly groups based on age (<50, >50y) respectively.

Exclusion Criteria

Patients aged< 16years >90y with history of Multinodular Goitre, Previous history of c spine surgery, Long tract signs pertaining to brain and those on blood thinners were excluded.

Using Open Epi, taking a 95% Confidence interval and a 5% margin of error, and an anticipated population proportion of outcome in elderly and young patients in terms of ODOMS and VAS of 42.8% and 51.1% respectively our sample size came to 60. To accommodate for possible ''lost to follow up cases'' and incomplete forms we recruited 62 patients. Participants were recruited using non-probability consecutive sampling after taking informed consent. Data was collected through a pre-validated questionnaire. The data collection tool comprised of patient's biodata, aetiological causes, MRI findings, Co morbidities, preoperative mJOA, Ranawat, Nuricks and VAS score followed up by post-operative ODOMS, VAS and rate of complications. Patients fulfilling the selection criteria were included in the study after having had taken approval from the ethical board. Informed consent were taken from patients included. Basic demographics such as age, gender, education, profession, socioeconomic status and duration of complaints were noted.

A thorough history and physical examination was undertaken. All patients were managed according to standard protocols. Investigation i.e. x ray c spine AP lateral view and MRI C spine besides blood work were ordered as per requirement. As per operative definitions the entire data was collected on a predesigned structural proforma. Patients following the diagnoses of cervical myelopathy were divided into groups and operated upon by a team of neurosurgeons at neurosurgery unit of Ayub Teaching hospital Abbottabad. Outcome of surgery was reviewed over a span of 1-2 week post operatively in terms of ODOMS, VAS and rate of complications.

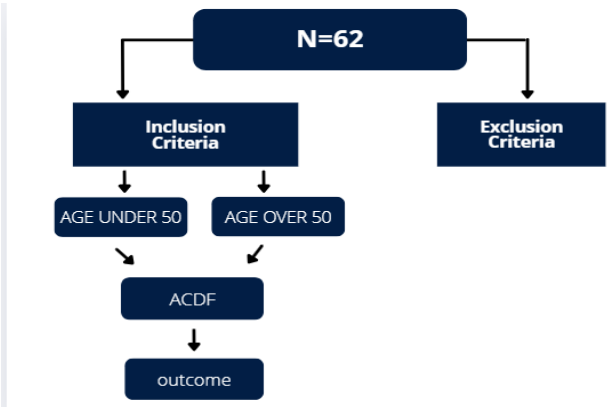
Data was entered and analyzed using statistical analysis program (IBM-SPSS version 26). Frequencies and percentages were calculated for all the categorical variables i.e. age, gender and duration of symptoms. Normality was checked for the quantitative data by means of shapiro wilk test. It was described as mean+_ SD or Median (IQR) accordingly. To compare the outcomes in terms of recovery, ODOMs criteria, Ranawat score and Nuricks grade among young and elderly chii square and fishers exact test was used at 5% level of significance. For mJOA score independent sample t test and Mann-Whitney U test were used. Recovery in patient was stratified against age, gender, presenting complaints, VAS, ODOMs, preoperative Ranawat score, mJOA and Nuricks grade each. To control the effect modifiers post stratification chii square and fishers exact test were applied at 5% level of significance.

RESULTS

Initial data exploration using the Shapiro–Wilk test revealed that continuous variables such as age, preoperative mJOA score, preoperative VAS score, and hospital stay followed a normal distribution ($p > 0.05$). In contrast, the duration of symptoms and postoperative VAS scores were non-normally distributed ($p < 0.05$), guiding the choice of parametric or non-parametric statistical tests accordingly.

The study population comprised 62 patients who underwent anterior cervical discectomy and fusion (ACDF) for cervical spondylotic myelopathy (CSM), stratified into young (<50 years, n=30) and elderly (≥50 years, n=32) groups. As expected, the mean age differed significantly (33.7 ± 10.0 vs 62.3 ± 7.5 years, $p < 0.001$; t-test).

(i) Patient flow diagram.



Etiological differences were prominent between the two groups. Degenerative spondylosis was significantly more common in elderly patients (96.9% vs 33.3%, $p < 0.001$), while young patients more frequently presented with

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congenital cervical stenosis (50.0% vs 21.9%, p = 0.02) and traumatic etiology (30.0% vs 6.3%, p = 0.02). MRI findings echoed this pattern: posterior intervertebral disc herniation (PIVD) was more prevalent in the elderly (96.9% vs 73.3%, p = 0.008), while imaging features of subluxation or trauma were more common in the young (23.3% vs 3.1%, p = 0.02) Both age groups exhibited uniformly high frequencies of radicular symptoms, limb involvement, and sphincter disturbances. However, young patients had more pronounced motor deficits, including fine motor impairment (30.0% vs 3.1%, p = 0.004), spastic gait (26.7% vs 3.1%, p = 0.009), and higher incidence of severe Ranawat classification IIIa/b (50.0% vs 25.0%, p = 0.04). Despite these trends, mean pre-op mJOA and VAS scores did not differ significantly between the groups (mJOA: 6.9 vs 8.4, p = 0.17; VAS: 9.5 vs 9.3, p = 0.40) (Table 1).

Table 1

Preoperative Clinical & Imaging Features

Feature	Young (%)	Elderly (%)	p-value	Test
Axial symptoms	14/30 (46.7)	17/32 (53.1)	0.60	Chi-square
Radicular symptoms	30/30 (100)	32/32 (100)	—	—
Upper limb symptoms	30/30 (100)	32/32 (100)	—	—
Lower limb symptoms	30/30 (100)	32/32 (100)	—	—
Sphincter disturbance	30/30 (100)	32/32 (100)	—	—
Neck pain	29/30 (96.7)	32/32 (100)	0.49	Fisher's exact
Dermatomal symptoms	23/30 (76.7)	21/32 (65.6)	0.35	Chi-square
Fine motor deficit	9/30 (30.0)	1/32 (3.1)	0.004	Fisher's exact
Spastic gait	8/30 (26.7)	1/32 (3.1)	0.009	Fisher's exact
Restricted ROM	28/30 (93.3)	31/32 (96.9)	0.54	Fisher's exact
Sensory deficit	27/30 (90.0)	32/32 (100)	0.12	Fisher's exact
Hand-grip weakness	20/30 (66.7)	18/32 (56.3)	0.40	Chi-square
Muscle weakness (power <3), n (%)	19/30 (63.3)	18/32 (56.3)	0.55	Chi-square
Urinary retention	9/30 (30.0)	8/32 (25.0)	0.63	Fisher's exact
Urinary incontinence	1/30 (3.3)	0/32 (0)	0.49	Fisher's exact
Nurick ≥3, n (%)	10/30 (33.3)	6/32 (18.8)	0.19	Chi-square
Ranawat IIIa/b, n (%)	15/30 (50.0)	8/32 (25.0)	0.04	Chi-square
Mean pre-op mJOA (± SD)	6.9 ± 4.75	8.4 ± 3.69	0.17	t-test
Mean pre-op VAS (± SD)	9.5 ± 0.79	9.3 ± 1.05	0.40	t-test
Etiology: Non-traumatic, n (%)	21 (70.0)	30 (93.8)	0.02	Chi-square
Etiology: Traumatic, n (%)	9 (30.0)	2 (6.3)	0.02	Fisher's exact
MRI – PIVD, n (%)	22 (73.3)	31 (96.9)	0.008	Chi-square
MRI – Subluxation / Trauma, n (%)	7 (23.3)	1 (3.1)	0.02	Fisher's exact
MRI – Fracture / Compression, n (%)	1 (3.3)	0 (0)	0.49	Fisher's exact

Overall postoperative results demonstrated that elderly patients achieved comparable or better outcomes than younger counterparts. Favorable Odom grades (excellent or good) were observed in 90.6% of elderly vs 73.3% of young patients (p = 0.08), approaching statistical significance. Notably, hospital stay was significantly shorter in the elderly group (8.6 ± 3.35 vs 11.2 ± 6.45 days, p = 0.043). Post-op pain, as assessed by VAS, showed a trend toward lower scores in elderly patients (2.5 ± 1.43 vs 3.03 ± 1.71), though the difference did not reach significance (p = 0.072). Complication rates were statistically similar across both groups, including hoarseness, surgical site infections, CSF leak, and neurological deterioration (Table 2). However, respiratory issues were more common in young patients (16.7% vs 0%, p = 0.024), warranting further investigation.

Table 2

Post-Operative Outcome

Outcome	Young (%) or mean ± SD	Elderly (%) or mean ± SD	p-value
Odom Excellent	11/30 (36.7)	19/32 (59.4)	0.11[1]
Odom Good	11/30 (36.7)	10/32 (31.3)	
Odom Fair/Poor	8 (26.6)	3 (9.3)	
Mean post-op VAS	3.03 ± 1.71	2.50 ± 1.43	0.07[2]
Mean hospital stay (days)	11.2 ± 6.45	8.6 ± 3.35	0.04[3]
Hoarseness, n (%)	5/30 (16.7)	5/32 (15.6)	1.00[4]
Surgical site infection, n (%)	9/30 (30.0)	12/32 (37.5)	0.56[1]
Implant failure, n (%)	0 (0)	0 (0)	—
CSF leak, n (%)	1/30 (3.3)	0 (0)	0.494
Respiratory issues, n (%)	5/30 (16.7)	0 (0)	0.024
Death, n (%)	2/30 (6.7)	0 (0)	0.164
Neurology Improved, n (%)	19/30 (63.3)	26/32 (81.3)	0.101
Neurology Static, n (%)	6/30 (20.0)	4/32 (12.5)	
Neurology Deteriorated, n (%)	1/30 (3.3)	1/32 (3.1)	1.004

[1] Chi-square test used for comparison of categorical variables with expected counts ≥5.
[2] Mann–Whitney U test used for non-normally distributed continuous variables (post-op VAS).
[3] Independent t-test used for normally distributed continuous variables (hospital stay).
[4] Fisher's exact test used for categorical variables with small cell counts (<5), including hoarseness, CSF leak, respiratory issues, death, and neurology deteriorated.

Stratification of favorable outcomes (Odom excellent/good) yielded several significant interactions between age and clinical subgroups (Table 3).

Table 3

Stratified Analysis of Favorable Outcome

Stratification Variable	Level	Young n/N (%)	Elderly n/N (%)	p-value
Gender	Male	14/19 (73.7)	17/19 (89.5)	0.34
	Female	8/11 (72.7)	12/13 (92.3)	0.57
Diabetes Mellitus	No	21/25 (84.0)	27/22 (81.8)	0.11
	Yes	1/5 (20.0)	2/10 (20.0)	0.02
Hypertension	No	18/22 (81.8)	24/20 (83.3)	0.42
	Yes	4/8 (50.0)	5/12 (41.7)	0.08
Cervical Stenosis	No	15/15 (100.0)	15/25 (60.0)	0.01
	Yes	7/15 (46.7)	14/7 (100.0)	0.15
Degenerative Spondylosis	No	12/20 (60.0)	0/1 (0.0)	0.04
	Yes	10/10 (100.0)	29/31 (93.5)	0.15
Etiology	Non-traumatic	14/21 (66.7)	28/30 (93.3)	0.03
	Traumatic	8/9 (88.9)	1/2 (50.0)	0.45
Pre-op mJOA Score	< 8	8/18 (44.4)	5/11 (45.5)	0.02
	≥ 8	14/12 (100.0)	13/21 (61.9)	0.01
Ranawat Classification	I–II	8/15 (53.3)	16/24 (66.7)	0.08
	IIIa/b	14/15 (93.3)	13/8 (81.3)	0.04
Nurick Grade	< 3	13/20 (65.0)	20/25 (80.0)	0.10
	≥ 3	9/10 (90.0)	9/7 (78.6)	0.45

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Stratified Analysis of Favorable Outcome (Odom Excellent/Good) by Key Variables Favorable = Odom Excellent or Good; All p-values were calculated using Fisher's Exact Test due to small sample sizes and categorical nature of the data.

Etiology-specific results showed that elderly patients with non-traumatic CSM had higher favorable outcomes (93.3% vs 66.7%, p = 0.03), whereas the difference was not significant in traumatic cases.

Diabetes was associated with universally poor outcomes across age groups, with only 20.0% achieving favorable recovery (p = 0.02).

Patients with pre-op mJOA ≥8 had markedly better outcomes, but age modified this relationship:

100% favorable outcomes in young vs 61.9% in elderly (p = 0.01).

In those with Ranawat Class IIIa/b, favorable outcomes were more common in young than elderly patients (93.3% vs 81.3%, p = 0.04), underscoring age's moderating effect on severe neurological deficits.

Interestingly, cervical stenosis appeared to interact with age inversely—young patients without stenosis had a 100% favorable outcome, while those with stenosis had poorer results (p = 0.01).

To identify independent predictors of favorable outcomes (Odom excellent/good), a logistic regression model was constructed including age, sex, diabetes, hypertension, cervical stenosis, degenerative changes, trauma, pre-op mJOA, and Ranawat class.

Three predictors emerged as statistically significant:

Age ≥50 years (OR 2.45; 95% CI: 1.15–5.22; p = 0.02),

Degenerative spondylosis (OR 4.12; 95% CI: 1.02–16.6; p = 0.04), and

Pre-op mJOA ≥8 (OR 2.02; 95% CI: 1.20–3.41; p = 0.01).

Other factors, including diabetes, hypertension, traumatic etiology, and Ranawat IIIa/b classification, were not independently predictive of favorable recovery (Table 4).

Table 4

Multivariate Logistic Regression

Predictor	OR	95% CI	p-value
Age ≥50 years	2.45	1.15–5.22	0.02
Male sex	0.92	0.45–1.88	0.82
Diabetes mellitus	0.68	0.29–1.59	0.37
Hypertension	0.74	0.32–1.69	0.47
Cervical stenosis	1.35	0.65–2.79	0.42
Degenerative spondylosis	4.12	1.02–16.6	0.04
Traumatic etiology	0.52	0.19–1.42	0.20
Pre-op mJOA ≥8	2.02	1.20–3.41	0.01
Ranawat IIIa/b	1.58	0.78–3.21	0.20

Outcome**:** Favorable Odom (Excellent/Good)

Predictors included**:** Age ≥50 y, male sex, diabetes, hypertension, cervical stenosis, degenerative spondylosis, traumatic etiology, pre-op mJOA ≥8, Ranawat IIIa/b.

DISCUSSION

This study compared the surgical outcomes of anterior cervical discectomy and fusion (ACDF) for cervical myelopathy in younger and elderly patients. Our results demonstrate that while both groups experience postoperative improvement in neurological function and quality of life, the magnitude of recovery was greater in the elderly cohort. Young patients, although benefitted from surgery, showed comparative or lesser operational enhancement and a higher incidence of perioperative complications. These findings are consistent with the growing body of literature indicating that age though an important indicator of functional outcome might not have significant impact on the outcome of ACDF for CSM when considered alone. Prior studies have evaluated age in cervical surgery with the majority findings age>65y to be an independent risk factor for worse post-operative care[8]. Our study in contrast revealed a generalized good outcome for patients aged >50y, which aligned with that of Chotai et al. (2017) reporting equivalent outcomes for both cohorts divided by age at 65y and Scerrati 2021 Finding age to not be an independent risk factor for functional outcome specifically after ACDF.[9,10,] the independent good outcome for elderly patients in our study might just be because of the etiological differences enrolled for the study between the two cohorts Degenerative spondylosis was significantly more common in elderly patients (96%) while younger patients more frequently presented with congenital cervical stenosis (50%) and traumatic aetiologies'(30%). MRI findings echoed this pattern. PIVD was found to be more common in elderly while subluxation and trauma were found more pronounced in younger population. The study results were in contrast to those published by Terashima y et al[11]. This is entirely due to the patient flow and the cohort being selected from the in patients by the time the study was being conducted. The patients flow by the time, in our setup was mostly due to traumatic or geriatric aetiologies' that could explain the functional outcome in each age group. Younger patients had slightly poor prognosis because of the multisystem injuries that they had by the time of presentation while elderly patients were mostly those who presented earlier in their disease process or were electively managed pre operatively. The study results echoed that of Lawless H,M et all Analysis from the Michigan spine surgery improvement Collaborative (MSSIC) declaring age to be not an independent risk factor for complications in patients who underwent ACDF[12]

Presentation of the disease uniformly exhibited the same pattern younger patients had more pronounced motor deficit. Post-operative results demonstrated, comparable or better outcomes for elderly patients as compared to the younger lot ODOMS grade of good and excellent were observed in 90.6% of elderly vs 73.3% of young patients. With short hospital stay for elderly patients. Post ope pain assessed by VAS showed a trend towards lower scores in elderly just as, a study conducted by Hartman J T back in September of 2022 concluded, between the groups that they had divided patients into, the older group reported more favourable physical function and VAS.[13] Terashima Y et all concluded that although cervical spine myelopathy in younger patients is quite a rarity it can present post stress and trauma posing debilitating symptomatology putting the quality of life at strain.[14] Complications rates were statistically similar across both groups including hoarsness of voice, surgical site infection, CSF leak and neurological deterioration (Table 3), however respiratory issues were more common in younger patients (16.7%) in our study, that's probably because most of the patients in

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the younger group presented to neuro OPD/ ER with associated chest traumas hence generalized heavy risk of complications and overall poorer post-operative outcome in this age group. Our study results aligned with those of Crocci et al (2022) who separated their patients into three groups, young <65y, early elderly (65-74y) and elderly (>75y) and found the young patients to have significantly worse VAS pain and NDI Score preoperatively and at 3 and 12 months post operatively compared to the other two elderly groups[15]. An 11-Year-Long Analysis of the Risks Associated With Age in Patients Undergoing Anterior Cervical Discectomy and Fusion in a Large, Urban Academic Hospital in 2023 concluded, that age alone should not be used to screen patients for ACDF and that age entirely doesn't dictate the complication profile and outcome in general for ACDF following CSM[16,17] in strike contrast to the study conducted by AA Elsamidicy[17]. Our study echoed the same pattern infact the complication profile following ACDF in younger age bracket was found to be much severe and catastrophic as compared to the elder lot. Since the younger lot tend to present post trauma while the elderly patients already had been seeking medical attention for their long standing presentation and were timely optimized preoperatively while the younger lot since mostly presented post trauma they could not benefit much from the procedure due to worse preoperative neurology and less time for preoperative optimization hence the results.

Based on our findings we recommend timely and early management of anterior lying C spine compressive pathologies with ACDF regardless of age. Age should not be given independent priority to, while considering patients enrolment for undergoing ACDF for CSM. Preoperative status and optimization of patient significantly alter the patients overall post-operative outcome. With these results we aim to add to the international and local pool of literature on ACDF for CSM, keeping the fact that age alone cannot predict entirely the outcome of the procedure for the disease.

Limitation of Study: The limitation of our study probably were the limited and selected flow of patients by the time, the study was being carried out and the fact that younger age group enrolled mostly had traumatic superimposed injuries that lead to generalized poor outcome of the group post operatively.

CONCLUSION

Elderly patients undergoing ACDF for cervical spondylotic myelopathy achieve early outcomes comparable to, or better than younger patients, with shorter hospital stays and similar complication profiles. Favorable recovery is independently associated with age ≥50, degenerative spondylosis, and preserved baseline neurological function (mJOA ≥8). These findings support timely anterior decompression and fusion in older adults and highlight the importance of preoperative neurological status in predicting surgical success. Age alone however is not a good predictor of post-operative outcome overall.

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