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Original Article

Impact of Pre-Operative Severity on Post-Operative Functional Outcomes in Patients with Cervical Myelopathy: A Comparative Analysis Using the Nurick Scale

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ABSTRACT

Cervical myelopathy pertains to the compression of the spinal cord in the neck region. The disease is debilitating in nature, and most cases require surgical intervention to avoid further nerve interference. However, the ability of preoperative myelopathy classification to accurately predict superlative postoperative outcomes remains unknown. **Objective:** To assess the functional outcomes following surgery in patients diagnosed with cervical myelopathy while considering their preoperative Nurick grade. **Methods:** A retrospective cohort study was conducted on a cohort of 80 patients diagnosed with cervical myelopathy that underwent surgical intervention in the hospital. The study reviewed and analyzed the demographic data and recorded the type of surgery among other factors such as follow-up duration. Statistical analysis was conducted using SPSS version 26.0 and a comparative test for correlation with respect to pre and post-surgery Nurick grades was done using cross-tabulation. **Results:** Among 38.75% of cases, surgery was performed on the anterior. A notable improvement in the post-surgery Nurick grade was observed with significant improvement noted in patients with higher preoperative classification. The results had a profound correlation between the two grades before and after surgery as analyzed statistically having a p-value of 0.00. **Conclusions:** Surgical treatments have proven to be quite effective in improving functional outcomes for individuals diagnosed with cervical myelopathy. Patients who had less severe or milder neurological deficits before the surgery experienced the most significant improvement after the procedure. These findings emphasize the significance of preoperative assessment in predicting postoperative outcomes and guiding treatment decisions.

INTRODUCTION

The most common spinal cord disorder in adults is cervical myelopathy, a condition of nontraumatic degeneration. The disease develops when the cervical spinal canal narrows as a result of progressive arthritic/spondylotic disorders and somewhat compresses the spinal cord, causing gradual disability [1]. The perfect time for the management of CSM is still a matter of contention due to the unpredictable nature of the condition. There is a possibility of developing a progressive course of the disease with an increasing level of disability or the disease process may be quiescent. It has previously been believed that surgical decompression stops the progression of myelopathic symptoms but does not improve neurological function. However, recent studies have demonstrated that decompression in the case of CSM leads to an improvement in the patient's functional status and quality of life [2-4]. Recent meta-analysis has shown that the prevalence of asymptomatic spinal cord compression is 24.2% and the prevalence of DCM is 2.3% within geriatric populations. The prevalence of DCM is even higher among the >60 years 35.3% and the ≤60 years 7.4% [5]. Furthermore, this correlates with the circumstantial evidence, pointing to the fact that DCM is the most common cause of spinal cord injury on a global scale, and develops with age [6, 7]. The only method capable of modifying the development of the condition when applied is surgical decompression. It became particularly popular in the last two decades due to the aging of the population [8]. The degree of disease

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severity can be classified and assessed by various systems. The oldest and most widely used classification system is the Nurick classification for myelopathy, instigated in 1972. The classification presents an important tool for disease severity assessment and grading, which is essential for making clinical decisions. In the Nurick classification, patients are subdivided by rank of severity, with Grade 0= asymptomatic, Grade 4= walk with aid, and Grade 5= bedridden [9]. Previous studies have assessed patients' surgical outcomes concerning cervical myelopathy. However, only a few reports have evaluated the status of recovery of cervical myelopathy patients considering the pre-operative Nurick grade. For example, Fehlings and colleagues conducted a prospective study on surgery treatment effects on patients showcasing the classification of myelopathy severity. The study results showed significant improvement in patients across mild to severe disease categories at a 1-year follow-up period [14]. However, these observations point out the need to disaggregate the pre-operative myelopathy classification as it relates to predicting the postoperative outcomes. It is vital to understand how a patient's preoperative condition severity influences postoperative recovery and outcomes. The rationale of the study is to determine if the first preoperative Nurick grade may predict postoperative results by investigating variables that may contribute to functional recovery, pain reduction, and neurological improvement after surgery. The findings of this research may give doctors fresh information on what to anticipate in terms of progression and function restoration after cervical myelopathy surgery, depending on the patient's initial severity.

The goal of the study was to look at the functional results following surgery for cervical myelopathy patients with Nurick Grades 1-2 and 3-4.

METHODS

The study was conducted in a public hospital situated in Rawalpindi City, Pakistan, and the cohort design was used for retrospective research. The sample of the research included patients who had been diagnosed with CSM and underwent surgery in the chosen hospital from 1st Feb 2023 to 29th Feb 2024. This is the patient group, those of whom had follow-up in the outpatient in the department. The research protocol was approved and certified by the Ethical Committee of Combined Military Hospital, Rawalpindi, vide letter Ser. No. 445. Current study focused on patients who must meet the criteria to be enrolled in the study. Such diagnostic criteria consisted of clinical and MRI evidence of disease, a cornage of C3 to C7, and the age range of 20 to 80 years. We did not include those patients, whose medical records were incomplete or missing, people who were operated on in another hospital, or those who suffered myelopathy because of vascular or connective tissue disorder/infection/trauma/birth defect/untold reasons. Besides excluding individuals whose myelopathy was created as a result of the ossification of the ligamentum longitudinal posterius, or fluorosis, we also excluded certain people. Personal information such as name, age, and gender; and medical history along with diagnosis yielded from the hospital record served as the basis for data collection in every one of the participants. These were the functional impairment levels that were evaluated by medical records reviewing the Nurick grades before and after the surgical intervention. Outcome evaluation was done using the Nurick scale at the end of the follow-up and assessment periods [9]. The statistical analyses were performed using SPSS version 26.0 for Windows. We summarized the categorical variables using frequencies and percentages, and the continuous variables were expressed as means and standard deviations. Chi-square and cross-tabulation analyses were used to compare the functional outcomes before and after surgery.

RESULTS

In the study cohort comprising 80 patients, 32 (40%) were male and 48 (60%) were female. Regarding age distribution, 11 patients (13.75%) were less than 50 years old, 48 (60%) were aged between 50 and 60 years, 13 (25%) fell within the 60 to 80 years age group, and 8 (10%) were above 80 years old. The mean age of the sample was 56.31 ± 8.2 years (Table1).

Table 1: Sociodemographic Characteristics

Variables	N (%)
Gender	
Male	32 (40%)
Female	48 (60%)
Age (Years)	
Less Than 50 Years	11 (13.75%)
50 - 60 Years	48 (60%)
60 - 80 Years	13 (25%)
Above 80 Years	8 (10%)

In the study cohort of 80 patients, 31 (38.75%) underwent anterior surgery, 37 (46.25%) opted for posterior surgery, and 12 (15%) underwent a combined approach. Follow-up durations varied, with 58 patients (72.5%) followed for less than 6 months, 16 (20%) for 6-12 months, and 6 (7.5%) for more than a year (Table 2).

Table 2: Clinical Characteristics of the Study Sample

Variables	N (%)
H/O DMM and HTN	
Yes	68 (85%)
No	12 (15%)

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Surgical Approach	
Anterior	31 (38.75%)
Posterior	37 (46.25%)
Combined	12 (15%)
Follow Up Duration	
Less Than 6 Months	58 (72.5%)
6 - 12 Months	16 (20%)
More Than Year	6 (7.5%)

Pre and Post-Operative Nurick scale

The comparison between pre-operative and post-operative Nurick grades revealed notable findings. Among patients initially classified as Nurick Grade 1 or 2, the pre-operative cohort comprised 29 individuals, which increased to 31 post-operatively. The associated p-value for this comparison was 0.06, suggesting no statistically significant difference between the pre-operative and post-operative grades at the conventional significance level of 0.05. Conversely, in patients with pre-operative Nurick Grade ≥ 3, consisting of 51 individuals pre-operatively, the post-operative count decreased to 49. Here, the p-value was calculated to be 0.04, indicating a statistically significant difference between the pre-operative and post-operative grades at the 0.05 significance level. These findings underscore the influence of pre-operative severity on post-operative outcomes, with a significant improvement observed in patients initially classified as Nurick Grade ≥ 3 (Table 3).

Table 3: Contingency Table of Pre-and Post-Operative Nurick Scale

Nurick Grade	Pre-Operative	Post-Operative	p-Value
Nurick Grade 1 or 2	29	31	0.06
Nurick Grade ≥ 3	51	49	
p-Value	**0.04***		

*= P<0.05

The cross-tabulation between pre-operative and post-operative Nurick grades delineated significant patterns in functional outcomes for patients undergoing surgical intervention for cervical myelopathy. Among those with a pre-operative Nurick grade of II, a substantial majority (93.5%) attained a post-operative grade of I, signifying marked improvement, while only a minority (6.5%) remained in the same grade post-operatively. Patients with a pre-operative grade of III displayed a varied distribution in post-operative outcomes, with 50% retaining their pre-operative grade and the remaining 50% advancing to grade II post-operatively. Notably, individuals with a pre-operative grade of IV experienced notable progress, as 60% reached a post-operative grade of IV and 28% improved to grade III. Conversely, patients with a pre-operative grade of V demonstrated remarkable enhancement, with all cases (100%) achieving a lower post-operative grade (IV). The statistical analysis underscored a significant association between pre-operative and post-operative grades (p-value = 0.00), emphasizing the influence of pre-operative status on postoperative outcomes (Table 4).

Table 4: Detailed Cross-Tabulation of Pre-and Post-Operative Nurick Scale

Grade	Post-Operative Nurick Grade						p-Value
	I	II	III	IV	V	Total	
II	29	2	0	0	0	31	**0.00***
III	0	9	9	0	0	18	
IV	0	0	7	15	3	25	
V	0	0	0	0	6	6	
Total	29	11	16	15	9	80	

*= P<0.05

DISCUSSION

The findings of the present study regarding pre and post-operative Nurick scale grades align with previous research, corroborating the notion that surgical intervention significantly improves functional outcomes in patients with cervical myelopathy. The observed shift towards lower post-operative Nurick grades among patients with higher pre-operative grades underscores the effectiveness of surgical management in mitigating neurological deficits. This is consistent with the findings of Morio *et al.*, and Curick *et al.*, who reported substantial neurological improvement post-surgery [15, 16]. Cervical myelopathy is prevalent among the elderly population, typically affecting individuals over 40 years of age. In this study, data from 80 cases of cervical myelopathy undergoing surgical decompression and fusion were analyzed, with the majority of patients falling within the 50 to 60-year age range. The increased incidence of cervical myelopathy in middle-aged individuals may be attributed to lifestyle modifications. Consistent with current study findings, Abraham *et al.*, and Zhang *et al.*, also reported a higher prevalence of CSM among individuals aged 40 to 60 years [17, 18]. The treatment of CSM remains a subject of ongoing debate, largely due to the limited understanding of its natural progression [19, 20]. Nonetheless, existing literature suggests a consensus regarding the notion that a briefer duration of symptoms and less severe neurological impairment before surgery are associated with improved postoperative outcomes [21]. According to Hirai *et al.*, surgical interventions have been identified as effective measures in halting the progression of the disease. These interventions typically involve either anterior or posterior approaches. Their study demonstrated a noteworthy 85% improvement in neurological status among patients, accompanied by a reduction in the mean Nurick [22]. Morio *et al.*, reported neurological improvement in over 70% of patients, whereas Clarke *et al.*, observed neurological improvement in 85% of their patient cohort [15, 16].

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Additionally, Wilberg *et al.*, conducted a study involving 99 cases of CSM and found that 80% of patients experienced neurological improvement post-surgery, with a remarkable 95% prevention of myelopathy progression [23]. The severity of preoperative symptoms in patients with cervical myelopathy has a significant impact on their functional outcomes after surgery. Research has indicated that various factors, such as the curvature of the spine before surgery, the length of time symptoms have been present, the preoperative mJOA scale, the presence of certain MRI signal intensities, and changes in the Cervical Sagittal Vertical Axis (cSVA), can all influence the recovery process [24-26]. Patients with myelopathy who undergo Anterior Cervical Discectomy and Fusion (ACDF) tend to experience less favorable outcomes compared to non-myelopathic patients. They could be at a higher risk of needing further surgical procedures and hospital readmissions [27]. A limitation of present study was that, although the levels of implants used were similar across all groups, we did not collect information on the specific components used in individual cases. A growing body of research indicates that certain low-profile implants might significantly influence patient outcomes more than previously believed. Not having a control group is another potential constraint; nevertheless, we aimed to conduct a direct comparison among individuals diagnosed with CSM based on symptom severity rather than against healthy individuals. Fehlings *et al.*, have even suggested that the inclusion of patients who may deteriorate and require surgery could introduce confounding factors into prospective studies involving CSM patients when control groups are employed [14].

CONCLUSIONS

The current evidence examining the correlation between the severity of cervical myelopathy before surgery and patient-reported outcomes after surgery serves as the foundation for the present investigation. At present, a universally accepted approach regarding the management of benign myelopathy is lacking; however, surgical intervention is advised for patients afflicted with moderate-to-severe disease. It is noteworthy that 93.5% of patients who had a pre-operative Nurick grade of II achieved a lower grade of I post-operatively, demonstrating remarkable improvement. Nevertheless, a significant proportion of patients who had pre-operative grades III, IV, and V demonstrated discernible patterns of improvement, culminating in lower grades after the procedure. The statistical analysis revealed a statistically significant correlation (p-Value = 0.00) between the grades before and after the operation, indicating that the pre-operative condition significantly affects the outcomes after the procedure. These results show how surgical intervention might enhance functional results for cervical myelopathy patients, especially those with less severe neurological impairments before surgery.

Authors Contribution

Conceptualization: MS
Methodology: MS, WBS
Formal analysis: SAQ, SI, WA
Writing, review and editing: AUM

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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