Prognostic Value of Preoperative Nurick Grade and Time with Symptoms in Patients with Cervical Myelopathy and Gait Impairment

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■ OBJECTIVE: **To investigate the prognostic value of preoperative Nurick grade and time with symptoms for gait improvement and recovery in patients with ataxia secondary to cervical myelopathy.**

■ METHODS: **A retrospective chart review of all adult patients who underwent surgical decompression for cervical myelopathy between 1996 and 2013 was performed. Only adults with a Nurick grade of at least 2 or worse were included. Outcome measures included gait improvement and recovery.**

■ RESULTS: **A total of 170 patients were identified. Gait improvement and gait recovery occurred in 57.7% and 45.9% of patients, respectively. Time to improvement occurred as early as 1 month up to 24 months postoperatively. A greater preoperative Nurick grade was associated with lower odds of gait improvement (odds ratio 0.74; 95% confidence interval 0.53–0.99, $P = 0.048$) and gait recovery (odds ratio 0.27; 95% confidence interval 0.17–0.43, $P < 0.001$). The proportion of patients with symptoms for 12 months or less that experienced gait improvement was 71.2%, compared with 36.4% for patients with symptoms for over 12 months ($P < 0.001$). Patients with symptoms for 12 months or less had a 59.6% gait recovery rate, compared to 24.2% in patients with symptoms for over 12 months ($P < 0.001$). Having symptoms for over 12 months was independently associated with lower odds of improvement and recovery.**

■ CONCLUSIONS: **Patients with a greater preoperative Nurick grade and symptoms for more than 12 months may have significantly lower odds of experiencing gait improvement or gait recovery after surgery for cervical myelopathy. This study's conclusion favors early intervention in patients with cervical myelopathy.**

INTRODUCTION

Cervical myelopathy is considered the most common cause of spinal cord dysfunction in the elderly population. Most cases of myelopathy are due to age-related degeneration, in what is known as cervical spondylotic myelopathy (CSM); another possible cause is ossification of the posterior longitudinal ligament (OPLL), which is more common in the East Asian population.[1] One of the clinical features of moderate and severe myelopathy is walking impairment, which is characterized by a slow walking speed, increased step width, decreased step length, altered balance, and spasticity due to an increased tone of flexor and extensor muscles of the lower extremities.[2,3] In 1972, Nurick described a grading system for patients with myelopathy, predominantly based on the degree of disability and difficulty in walking, also known as the Nurick grading system.[4] This system has become one of the most-used grading systems worldwide, providing clinicians with an objective way of assessing severity of disease.

Studies have shown the benefits of surgical decompression for cervical myelopathy in terms of quality of life, disability, and function. However, a subgroup of patients does not experience significant symptom improvement postoperatively.[5] Some studies have shown that the presence of increased intramedullary signal intensity on magnetic resonance imaging, older age, longer time

Key words
- Cervical decompression
- Cervical myelopathy
- Gait impairment
- Nurick grade

Abbreviations and Acronyms
CI: Confidence interval
CSM: Cervical spondylotic myelopathy
JOA: Japanese Orthopedic Association
OPLL: Ossification of the posterior longitudinal ligament
OR: Odds ratio

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experiencing symptoms, smoking, and greater occupancy ratio (ratio of spinal cord to free space in the spinal canal) all are associated with worse outcomes after surgery for cervical myelopathy.[6-9] The purpose of this study was to investigate the association between preoperative Nurick grade and preoperative time with symptoms in relation to gait improvement/gait recovery after surgery for cervical myelopathy.

METHODS

Data Source

This study received institutional review board approval. Following this, a retrospective database review was performed to identify all adult neurosurgical patients who underwent surgical treatment (anterior, posterior, or combined approaches) for cervical myeloradiculopathy between the years 1996 and 2013. The initial cohort consisted of 1400 patients. Only patients who had preoperative gait impairment were included ($n = 313$). This was assessed based on the Nurick grading system, which is categorized as follows: grade 0: signs/symptoms of root involvement but no evidence of spinal cord dysfunction; grade 1: signs of spinal cord dysfunction but no difficulty in walking; grade 2: mild impairment in gait not preventing employment; grade 3: gait impairment that prevents employment; grade 4: gait impairment requiring assistance (such as use of cane or walker); and grade 5: requires a wheelchair or is bedbound.[4] Thus, only patients with a Nurick grade of 2 or greater were included.

The Nurick score was calculated retrospectively by 2 independent researchers. Upon calculation of preoperative scores, investigators were blinded to postoperative outcomes. Patients with coexisting conditions such as cerebral palsy, multiple sclerosis, Parkinsonism, severe lumbar spinal stenosis causing neurogenic claudication, stroke, dystonia, and other neurologic diseases were excluded, given that these may affect ambulation ($n = 35$). Patients with follow-up for less than 24 months were then excluded ($n = 108$), and the final analytic sample consisted of 170 patients.

Surgical approach was chosen by each attending surgeon based on individual patient characteristics. For patients with predominant anterior disease, an anterior approach was chosen. For patients with multisegmental compression or older age, among others, a posterior approach was chosen. For patients with focal kyphotic deformity or significant anterior/posterior disease, a combined approach was performed.

Covariates and Outcome Measures

Data such as patient age, sex, preoperative Nurick grade, time with symptoms, diagnosis (CSM or OPLL), surgical approach, number of decompressed levels, symptom improvement, and postoperative Nurick grade were ascertained from clinical and operative notes. Anterior approaches included anterior cervical discectomy and fusion with or without corpectomy; posterior approaches involved laminectomy with instrumented stabilization. The 2 outcome measures examined in this study were gait improvement and gait recovery; gait improvement was defined as a decrease in Nurick grade of at least 1 point and gait recovery was defined as final Nurick grade of either 0 or 1 (no difficulty walking).

Table 1. Characteristics of 170 Patients with Gait Impairment Secondary to Cervical Myelopathy

Parameter	Value
Age, median (range)	61 (31–82)
Sex, male	115 (67.7%)
Preoperative Nurick grade, median (range)	2 (2–5)
Time with symptoms, median months (range)	12 (0.25–180)
Symptoms for more than 12 months	66 (38.8%)
Diagnosis	
CSM	153 (90.0%)
OPLL	17 (10.0%)
Comorbidities	
Coronary artery disease	9 (5.3%)
Diabetes	27 (15.9%)
Obesity	16 (9.4%)
Smoker	33 (19.4%)
No. decompressed levels (median, range)	3 (1–7)
Surgical approach	
Anterior	47 (27.7%)
Posterior	112 (65.9%)
Combined	11 (6.4%)
Postoperative Nurick grade, median (range)	2 (0–5)
Gait improvement	98 (57.7%)
Gait recovery	78 (45.9%)
Time to improvement, median months (range)	6 (range: 1–24)

CSM, cervical spondylotic myelopathy; OPLL, ossification of the posterior longitudinal ligament.

Statistical Analysis

Descriptive statistics are presented as medians with ranges. First, patients were grouped based on the preoperative Nurick grade, and outcomes were compared via the χ^2 test. Second, patients were grouped based on time with symptoms—symptoms for 12 months or less and symptoms for more than 12 months[9]; the χ^2 test also was used. In addition, time was examined as a continuous variable, and results are presented as odds ratio (OR) with 95% confidence interval (CI). The association between other covariates and gait improvement/recovery also was assessed in univariate and multivariate models. All factors with a $P < 0.200$ on univariate analysis were included in the multivariate analysis. Statistical significance was set at $P < 0.05$. All analyses were done in STATA 12 SE (Stata Corp, College Station, Texas, USA).

RESULTS

A total of 170 patients with gait impairment secondary to cervical myelopathy (Nurick grade of at least 2) operated on by