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Clinical Factors Influencing the Neurological Recovery of Patients Operated for a Cervical Myelopathy at the Teaching Hospital of Bouake

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Abstract

Introduction: Cervical myelopathy is the most common myelopathy among people over 50 of age. Cervicosteoarthritis is the main etiology. The purpose of this work was to identify clinical factors that may influence neurological recovery in patients undergoing surgery for cervical myelopathy in our work setting. **Materials and Methods:** We performed a retrospective analytical study on patients operated on for cervical myelopathy at the teaching hospital of Bouake. The logistic regression model was used to identify the factors influencing post-operative neurological recovery. **Results:** 50 patients' records have been enrolled in this study. The mean age of our patients was 53 years with extremes ranging from 25 to 78 years and 39 of our patients (62%) were male. The mean modified pre-operative JOA score was 11.62 versus 12.94 after the surgery. Age, sex, the number of levels operated on and the duration of the evolution of the signs showed no significant link with neurological recovery. Preoperative mild myelopathy (P = 0.0491) and post-operative functional rehabilitation (P = 0.0459) were identified as factors favouring neurological recovery after cervical myelopathy surgery. **Conclusion:** The good conducts of functional rehabilitation sessions as well as a mild myelopathy were the factors favouring neurological recovery.

Keywords

Spinal Spondylosis, Medullary Compression, Myelopathy

1. Introduction

Cervical myelopathy is a clinical syndrome related to the decrease in the diameter

of the spinal canal; it is the most common myelopathy among people over 50 of age [1]. Cervicarthrosis is the main etiology, but many other pathologies can lead to a significant reduction in the diameter of the spinal canal and spinal cord injury [1]. The natural history of cervical myelopathy is highly variable, but generally clinically results in a metameric syndrome with nerve roots compression signs and/or motor neuron damage and sublesional syndrome with pyramidal, spinothalamic and posterior cordonal signs [1] [2]. The modified JOA score (mJOA) is the clinical score most commonly used to assess the severity of cervical myelopathy [3]. MRI is the paraclinical exam of choice as it allows high-resolution visualization of neural, bone and ligament structures [4].

According to current clinical guidelines, surgery is strongly recommended for moderate (modified JOA score between 12 and 14) and severe (modified JOA score ≤ 11) cervical myelopathy [5].

Traditionally, the primary goal of surgery for cervical myelopathy was to maintain the patient's neurological condition at the time of diagnosis and prevent further deterioration. However, data from the past decade suggests that surgical decompression may improve the neurological condition of the patient [2]. Several studies have been conducted to determine predictors of outcome after surgical decompression for cervical myelopathy [6] [7]. In this regard, the factors associated with an unfavourable clinical outcome are longer duration of clinical signs, severe preoperative myelopathy and to a lesser degree, a high age [7] [8]. However, few African data are available in the literature regarding the determination of factors that may influence the post-operative outcome of cervical myelopathy.

The purpose of this work was to identify clinical factors that may influence neurological recovery in patients undergoing surgery for cervical myelopathy in our work setting.

2. Materials and Methods

2.1. Study Population

We performed a retrospective and analytical study on the files of patients hospitalized and operated on for cervical myelopathy at the teaching hospital of Bouaké during the period from January 1, 2018 to December 31, 2020.

This study has been performed after institutional ethical committee approval.

A total of 130 medical records of patients operated on for cervical myelopathy were consulted. 80 files were not included in the study due to the incomplete nature of these files, the association of cervical spine trauma or the fact that these patients were lost to follow-up.

Thus, only the completed files of patients operated on for cervical myelopathy without association of cervical spine trauma and followed up regularly were included.

The patients included in the study were divided into two groups:

Group 1: patients who showed an improvement in the modified JOA score in

the postoperative follow-up (Neurogical recovery).

Group 2: patients who did not show any improvement (no neurological recovery).

The mean follow-up duration was 6 months (range 3 - 36 months).

2.2. Studied Parameters

Age, sex, duration of evolution of clinical signs, preoperative mJOA score, functional rehabilitation, Post-op mJOA score and Neurological recovery were the studied variables.

We defined by the presence of neurological recovery as an improvement in the modified JOA score postoperatively compared to the preoperative mJOA score.

The choice of the surgical approach used depended on the predominant side of the compression and the preferences of the surgeon. The posterior approach was chosen in patients with multi-level compression and with preservation of cervical lordosis on plain radiographs. Fusion was performed in case of radiological instability, according to the criteria of White and Panjabi [9].

We calculated the recovery rate of the patients using the formula proposed by Hirabayashi, as follows: (mJOA postoperative − mJOA preoperative)/(17 − mJOA preoperative) × 100 [10].

2.3. Statistical Analysis

We first conducted a univariate analysis to determine a link between the explanatory variables mentioned above and the presence or absence of neurological recovery.

Variables that showed a significant link with the neurological recovery were then included in a logistic regression model to determine the factors influencing neurological recovery. Significance was considered at a P-value ≤ 0.05.

SPSS 25® was used for data collection and analysis.

3. Results

3.1. Patient Population

Out of 130 cervical myelopathy files during our study period, we enrolled 50 files that met our inclusion criteria.

The mean age of our patients was 53 years with extremes ranging from 25 to 78 years and 39 of our patients (62%) were men.

The mean duration of signs before the first consultation was 24.18 months.

The most common reasons for consultation were neck pain (25%), cervicobrachialgia (23%) and gait disorders (22%).

41 of the 50 patients (82%) in our series had neurologically recuperated. This recovery was complete in 31 patients (75.60%) and partial in 10 patients (24.39%). 34 out of 41 (82.92%) of the neurologically recovered patients were under 40 years of age, and 23 out of them (56.09%) were male.

The mean preoperative and postoperative mJOA scores were 11.56 and 12.94, respectively. The mean Hiyabarashi recovery rate was 24.53%.

3.2. Results of Clinical Factors Analysis

The results of the univariate analysis are reported in Table 1.

At the end of this univariate analysis, a mild myelopathy (P = 0.001) and the conduct of a post-operative functional rehabilitation (P = 0.045) were identified as factors favouring neurological recovery and were included in the logistic regression model.

Age (P = 0.325), sex (P = 0.127), number of levels operated (P = 0.724) and duration of evolution of signs (P = 0.285) did not show any significant link with neurological recovery after cervical myelopathy surgery.

After logistic regression analysis, mild myelopathy (OR = 2.734, P = 0.0456) and post-operative conduct of functional rehabilitation sessions (OR = 3.730, P = 0.0491) were significantly related to neurological recovery (Table 2).

Table 1. Univariate analysis.

	Neurological recovery (n = 41)	No Neurological recovery (n = 9)			
Variables			**Exact Fisher**	**Mc Nemar**	**P**
Age					
≥40	7	0	1.78		0.325
40<	34	9			
Sex					
male	23	8	3.368		0.127
female	18	1			
Duration of evolution					
≥06 months	17	3	0.203		0.724
06 months<	14	6			
Levels operated					
1 to 2	23	7	1.447		0.285
More than 2	18	2			
pre op mJOA score					
moderate or severe	31	5		x	0.001
mild	10	4			
Functional rehabilitation					
yes	13	6	3.828		0.045
no	28	3			

Table 2. Logistic regression.

	B	E.S	P	OR	Confidence interval 95% EXP (B)	
					Inferior	Superior
Functional rehabilitation	1.316	0.823	0.00491	3.730	0.743	18.726
Mild pre op myelopathy	−0.470	0.824	0.04569	2.734	0.124	3.145

4. Discussion

Cervical myelopathy is a progressive disease that can cause irreversible damage to the spinal cord. Early diagnosis and treatment are essential to prevent further injury, reduce disability and improve patients' quality of life [11].

The timing of surgery is usually dictated by the degree of neurological severity [12]. Patients with moderate or severe cervical myelopathy are eligible for surgery while those with mild cervical myelopathy may be offered surgery or careful observation [13].

The objectives of this study were to determine the factors favouring neurological recovery after cervical myelopathy surgery in our work setting. The logistic regression analysis in our study revealed mild preoperative myelopathy and conduct of functional rehabilitation sessions as factors favouring neurological recovery.

Unlike other studies in Africa on cervical myelopathy, which were mostly descriptive [14] [15] [16] [17], this study is analytical in scope with the use of a logistic regression model.

According to the results of a systematic review conducted by Tetreault, patients with a high age (over 65 years), as well as a long duration of symptom evolution and more severe preoperative myelopathy, are likely to have poorer surgical outcomes [8].

Concerning the impact of the severity of preoperative myelopathy on the results of surgery; a study conducted by Gao revealed that patients with a preoperative JOA score less than or equal to 9 were 4.84 times more likely to have a worse recovery rate (≤50%) than those with a preoperative JOA score greater than 9 (>50%) [18]. Similarly, studies by Shin and Naruse reported that a lower preoperative JOA score was associated with a decrease in neurological recovery chances greater than 75% (OR = 1.34,) or 50% (OR = 1.64) respectively [19] [20]. Here, we found that only mild cervical myelopathy was significantly associated with neurological recovery (OR = 2.734, P = 0.0456).

Regarding the impact of functional rehabilitation on the results of cervical myelopathy surgery, few studies have been conducted to date [21]. A recent systematic review concluded that there are no randomized controlled clinical trials regarding the post-operative rehabilitation of cervical myelopathy [22].

Only the study conducted by Yap concluded the effect of functional rehabilitation associated with postoperative physiotherapy on the neurological recovery of patients operated on for degenerative cervical myelopathy.

The study concluded that functional rehabilitation improved post-operative functional status [23] but was found to be of low quality because it was a retrospective study with a small sample size and no comparison group.

Our study found a significant link between post-operative neurological recovery and post-operative conduct of functional rehabilitation sessions (P = 0.00491, OR = 3.73). Based on the results of our analysis, post-operative functional rehabilitation would increase the probability of neurological recovery by 3 times.

Also, according to the results of our analysis, age, sex, the number of levels operated as well as the duration of symptom evolution were not identified as factors related to neurological recovery.

Regarding age, a study conducted by SON found similar results to our study with no significant difference in neurological recovery rate in patients over 65 compared to those under 65 [24]. Other authors, on the other hand, have revealed in their studies that age was a factor linked to the rate of neurological recovery [25] [26]. For these authors, neurological recovery is greater after surgery for cervical myelopathy in patients under 65 years of age.

Regarding the duration of symptom evolution, some studies such as ours have not revealed a significant link between this factor and neurological recovery [20] [27] [28] [29]. On the other hand, according to other studies, the duration of symptom evolution has been identified as an important predictor of neurological recovery [8].

More specifically, patients with long standing symptoms were more likely to have a recovery rate of less than 50%. [30] [31] [32].

In this regard, Rajshekhar and Kumar reported that patients with symptoms of less than 12 months were 4.8 times more likely to improve after surgery than those with symptoms of more than 12 months [33].

With respect to sex, most of the studies conducted did not find, as in our study, a significant link between this variable and neurological recovery [8]. The few studies that found a significant link between sex and neurological recovery showed more specifically that male patients were more likely to have an improved post-operative JOA score [30]. But this significant link between sex and neurological recovery was only found after univariate analysis [30].

There are some limitations to this study.

First, this study is based on data collected retrospectively.

Second, the sample size may have been smaller. Although there is no consensus on the appropriate sample size for logistic regression analysis, in some studies 10 events per variable is considered reasonable in a logistic regression analysis [34]. Based on this idea, the sample size of this study, which was 50, can be considered insufficient (6 variables studied). Other retrospective or prospective studies with larger samples are needed to address these limitations and validate the results of this study.

5. Conclusions

We identified factors promoting neurological recovery in our study of mild myelopathy and the postoperative conduct of functional rehabilitation sessions.

Age, duration of symptom development and gender, although they have been identified as contributing factors in several studies, have not been identified with this one. We believe that future prospective or retrospective studies with larger samples could better specify the weight of each factor in our work context.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Brunon, J., Nuti, C., Duthel, R., Fotso, M.J. and Dumas, B. (2005) Myélopathies Cervicales. *EMC-Neurologie*, **2**, 383-402. https://doi.org/10.1016/j.emcn.2005.01.003

[2] Badhiwala, J.H., Ahuja, C.S., Akbar, M.A., Witiw, C.D., Nassiri, F., Furlan, J.C., Curt, A., Wilson, J.R. and Fehlings, M.G. (2020) Degenerative Cervical Myelopathy—Update and Futures Directions. *Nature Reviews Neurology*, **16**, 108-124. https://doi.org/10.1038/s41582-019-0303-0

[3] Kopjar, B., Tetreault, L., Kalsi-Ryan, S. and Fehlings, M. (2015) Psychometric Properties of the Modified Japanese Orthopaedic Association Scale in Patients with Cervical Spondylotic Myelopathy. *Spine*, **40**, E23-E28. https://doi.org/10.1097/BRS.0000000000000648

[4] Nouri, A., Martin, A.R., Mikulis, D. and Fehlings, M.G. (2016) Magnetic Resonance imaging Assessment of Degenerative Cervical Myelopathy: A Review of Structural Changes and Measurement Techniques. *Neurosurgery Focus*, **40**, E5. https://doi.org/10.3171/2016.3.FOCUS1667

[5] Fehlings, M.G. (2018) Current Knowledge in Degenerative Cervical Myelopathy. *Neurosurgery Clinics of North America*, **29**, 10-14. https://doi.org/10.1016/j.nec.2017.09.021

[6] Witiw, C.D., Tetreault, L.A., Smieliauskas, F., Kopjar, B., Massicotte, E.M. and Fehlings, M.G. (2017) Surgery for Degenerative Cervical Myelopathy: A Patient-Centered Quality of Life and Health Economic Evaluation. *The Spine Journal*, **17**, 15-25. https://doi.org/10.1016/j.spinee.2016.10.015

[7] Tetreault, L.A., Côté, P., Kopjar, B., Arnold, P. and Fehlings, M.G. (2015) A Clinical Prediction Model to Assess Surgical Outcome in Patients with Cervical Spondylotic Myelopathy: Internal and External Validations Using the Prospective Multicenter AOSpine North American and International Datasets of 743 Patients. *The Spine Journal*, **15**, 388-397. https://doi.org/10.1016/j.spinee.2014.12.145

[8] Tetreault, L., Palubiski, L.M., Kryshtalskyj, M., Idler, R.K., Martin, A.R., Ganau, M., *et al.* (2018) Significant Predictors of Outcome Following Surgery for the Treatment of Degenerative Cervical Myelopathy: A Systematic Review of the Literature. *Neurosurgery Clinics of North America*, **29**, 115-127. https://doi.org/10.1016/j.nec.2017.09.020

[9] White, A.A. and Panjabi, M.M. (1987) Update on the Evaluation of Instability of the Lower Cervical Spine. *Instructional Course Lectures*, **36**, 513-520.

[10] Hirabayashi, K., Miyakawa, J., Satomi, K., Maruyama, T. and Wakano, K. (1981) Operative Results and Postoperative Progression of Ossification among Patients with Ossification of Cervical Posterior Longitudinal Ligament. *Spine*, **6**, 354-364. https://doi.org/10.1097/00007632-198107000-00005

[11] The Lancet Neurology (2019) A Focus on Patient Outcomes in Cervical Myelopathy. *The Lancet Neurology*, **18**, 615. https://doi.org/10.1016/S1474-4422(19)30168-1

[12] Fehlings, M.G., Kwon, B.K. and Tetreault, L.A. (2017) Guidelines for the Management of Degenerative Cervical Myelopathy and Spinal Cord Injury: An Introduction to a Focus Issue. *Global Spine Journal*, **7**, S6-S7. https://doi.org/10.1177/2192568217701714

[13] Severino, R., Nouri, A. and Tessitore, E. (2020) Degenerative Cervical Myelopathy: How to Identify the Best Responders to Surgery? *Journal of Clinical Medicine*, **9**, Article 759. https://doi.org/10.3390/jcm9030759

[14] Sanoussi, S., Sani, R., Djomo, T.F.M. and Bawa, M. (2003) prise en charge du Pott lombaire par abord postéro-latéral. *E-mémoires de l'académie nationale de chirurgie*, **2**, 18-21.

[15] Diomandé, M., Tano, M., Eti, E. and Kouakou, M.N. (2015) Myélopathies cervicarthrosiques: Aspects épidémiologiques et cliniques au Centre Hospitalier Universitaire de Cocody à Abidjan, Côte d'Ivoire. *La Revue Médicale de Madagascar*, **5**, 501-504.

[16] Konate, M.B. (2021) LA prise en charge de la myelopathie cervicarthrosique dans le service de neurochirurgie au CHU Gabriel Toure. Universite Des Sciences Des Techniques et Des Technologies De Bamako, Bamako.

[17] Loembe, P.M. (2004) Myélopathies cervicarthrosiques invalidantes. Résultats à long terme de 18 patients opérés par voie antérieure au Gabon. *African Journal of Neurological Sciences*, **23**. https://doi.org/10.4314/ajns.v23i1.7549

[18] Gao, R., Yang, L., Chen, H., Liu, Y., Liang, L. and Yuan, W. (2012) Long Term Results of Anterior Corpectomy and Fusion for Cervical Spondylotic Myelopathy. *PLOS ONE*, **7**, e34811. https://doi.org/10.1371/journal.pone.0034811

[19] Naruse, T., Yanase, M., Takahashi, H., Horie, Y., Ito, M., Imaizumi, T., *et al.* (2009) Prediction of Clinical Results of Laminoplasty for Cervical Myelopathy Focusing on Spinal Cord Motion in Intraoperative Ultrasonography and Postoperative Magnetic Resonance Imaging. *Spine*, **34**, 2634-2641. https://doi.org/10.1097/BRS.0b013e3181b46c00

[20] Shin, J.-W., Jin, S.-W., Kim, S.-H., Choi, J.-I., Kim, B.-J., Kim, S.-D. and Lim, D.-J. (2015) Predictors of Outcome in Patients with Cervical Spondylotic Myelopathy Undergoing Unilateral Open-Door Laminoplasty. *Korean Journal of Spine*, **12**, 261-266. https://doi.org/10.14245/kjs.2015.12.4.261

[21] Boerger, T.F., Hyngstrom, A.S., Furlan, J.C., Kalsi-Ryan, S., Curt, A., Kwon, B.K., *et al.* (2022) Developing Peri-Operative Rehabilitation in Degenerative Cervical Myelopathy [AO Spine RECODE-DCM Research Priority Number 6]: An Unexplored Opportunity? *Global Spine Journal*, **12**, 97S-108S. https://doi.org/10.1177/21925682211050925

[22] Badran, A., Davies, B.M., Bailey, H.M., Kalsi-Ryan, S. and Kotter, M.R. (2018) Is There a Role for Postoperative Physiotherapy in Degenerative Cervical Myelopathy? A Systematic Review. *Clinical Rehabilitation*, **32**, 1169-1174. https://doi.org/10.1177/0269215518766229

[23] Yap, K.B., Lieu, P.K., Chia, H.P., Menon, E.B. and Tan, E.S. (1993) Outcome of Pa-

tients with Cervical Spondylotic Myelopathy Seen at a Rehabilitation Centre. *Singapore Medical Journal*, **34**, 237-240.

[24] Son, D.K., Son, D.W., Song, G.S. and Lee, S.W. (2014) Effectiveness of the Laminoplasty in the Elderly Patients with Cervical Spondylotic Myelopathy. *Korean Journal of Spine*, **11**, 39-44. https://doi.org/10.14245/kjs.2014.11.2.39

[25] Nakashima, H., Tetreault, L.A., Nagoshi, N., Nouri, A., Kopjar, B., Arnold, P.M., *et al.* (2016) Does Age Affect Surgical Outcomes in Patients with Degenerative Cervical Myelopathy? Results from the Prospective Multicenter AOSpine International Study on 479 Patients. *Journal of Neurology, Neurosurgery & Psychiatry*, **87**, 734-740. https://doi.org/10.1136/jnnp-2015-311074

[26] Inose, H., Hirai, T., Yoshii, T., Kimura, A., Takeshita, K., Inoue, H., *et al.* (2021) Predictors Associated with Neurological Recovery after Anterior Decompression with Fusion for Degenerative Cervical Myelopathy. *BMC Surgery*, **21**, Article No. 144. https://doi.org/10.1186/s12893-021-01147-w

[27] Karpova, A., Arun, R., Davis, A.M., Kulkarni, A.V., Massicotte, E.M., Mikulis, D.J., *et al.* (2013) Predictors of Surgical Outcome in Cervical Spondylotic Myelopathy. *Spine*, **38**, 392-400. https://doi.org/10.1097/BRS.0b013e3182715bc3

[28] Kato, Y., Iwasaki, M., Fuji, T., Yonenobu, K. and Ochi, T. (1998) Long-Term Follow-up Results of Laminectomy for Cervical Myelopathy Caused by Ossification of the Posterior Longitudinal Ligament. *Journal of Neurosurgery*, **89**, 217-223. https://doi.org/10.3171/jns.1998.89.2.0217

[29] Sun, L.-Q., Li, Y.-M., Wang, X. and Cao, H.-C. (2015) Quantitative Magnetic Resonance Imaging Analysis Correlates with Surgical Outcome of Cervical Spondylotic Myelopathy. *Spinal Cord*, **53**, 488-493. https://doi.org/10.1038/sc.2014.204

[30] Nakashima, H., Yukawa, Y., Ito, K., Machino, M., Kanbara, S., Morita, D., *et al.* (2012) Prediction of Lower Limb Functional Recovery after Laminoplasty for Cervical Myelopathy: Focusing on the 10-s Step Test. *European Spine Journal*, **21**, 1389-1395. https://doi.org/10.1007/s00586-012-2241-z

[31] Zhang, J.T., Meng, F.T., Wang, S., Wang, L.F. and Shen, Y. (2015) Predictors of Surgical Outcome in Cervical Spondylotic Myelopathy: Focusing on the Quantitative Signal Intensity. *European Spine Journal*, **24**, 2941-2945. https://doi.org/10.1007/s00586-015-4109-5

[32] Zhang, J.T., Wang, L.F., Wang, S., Li, J. and Shen, Y. (2016) Risk Factors for Poor Outcome of Surgery for Cervical Spondylotic Myelopathy. *Spinal Cord*, **54**, 1127-1131. https://doi.org/10.1038/sc.2016.64

[33] Rajshekhar, V. and Kumar, G.S.S. (2005) Functional Outcome after Central Corpectomy in Poor-Grade Patients with Cervical Spondylotic Myelopathy or Ossified Posterior Longitudinal Ligament. *Neurosurgery*, **56**, 1279-1285. https://doi.org/10.1227/01.NEU.0000159713.20597.0F

[34] El Sanharawi, M. and Naudet, F. (2013) Comprendre la régression logistique. *Journal Français d'Ophtalmologie*, **36**, 710-715. https://doi.org/10.1016/j.jfo.2013.05.008