FUNCTIONAL RESULTS OF SURGICAL TREATMENT OF CERVICAL SPONDYLOTIC MYELOPATHY

RESULTADOS FUNCIONAIS DO TRATAMENTO CIRÚRGICO DA MIELOPATIA ESPONDILÓTICA CERVICAL

RESULTADOS FUNCIONALES DEL TRATAMIENTO QUIRÚRGICO DE LA MIELOPATÍA CERVICAL ESPONDILÓTICA

MARVIN JESUALDO VARGAS UH[1], AMADO GONZÁLEZ MOGA[1], HUGO SANTOS BENITEZ[1], GABRIEL HUERTA HERNANDEZ[1], JUAN ENRIQUE GUZMÁN CARRANZA[1]

1. Department of Spine Surgery, Centro Médico ISSEMyM Ecatepec, Estado de México, México.

ABSTRACT

Objective: To analyze the functional outcome of surgical treatment of cervical spondylotic myelopathy. Methods: A retrospective study involving 34 patients with CSM, operated from January 2014 to June 2015. The neurological status was assessed using the Nurick and modified Japanese Orthopedic Association (mJOA) scales preoperatively and at 12 months. Sex, age, time of evolution, affected cervical levels, surgical approach and T2-weighted magnetic resonance hyperintense signal were also evaluated. Results: A total of 14 men and 20 women participated. The mean age was 58.12 years. The average progression time was 12.38 months. The preoperative neurological state by mJOA was mild in 2 patients, moderate in 16 and severe in 16, with a mean of 11.44 points. The preoperative Nurick was grade II in 14 patients, grade III in 8, grade IV in 10 and grade V in 2. The T2-weighted hyperintense signal was documented in 18 patients (52.9%). The functional outcome according to the mJOA recovery rate was good in 15 patients (44.1%) and poor in 19 (55.9%). The degree of Nurick recovery was good in 20 (58.8%) and poor in 14 (41.2%). Conclusions: Decompressive surgery of the spinal cord has been shown to be effective in the treatment of cervical spondylotic myelopathy in well-selected patients. Although it is suggested that there are certain factors that correlate with functional outcome, we believe that more prospective randomized studies should be conducted to clarify this hypothesis.

Keywords: Spinal cord compression; Cervical spondylosis; Myelopathy; Decompression surgical.

RESUMO

Objetivo: Analisar o resultado funcional do tratamento cirúrgico da mielopatia espondilótica cervical. Métodos: Estudo retrospectivo envolvendo 34 pacientes com MEC submetidos a cirurgia de janeiro de 2014 a junho 2015. O estado neurológico foi avaliado utilizando as escalas de Nurick e da Japanese Orthopaedic Association modificada (mJOA) no pré-operatório e aos 12 meses. Sexo, idade, tempo de evolução, níveis cervicais afetados, via de acesso cirúrgico e sinal de hiperintensidade na ressonância magnética ponderada em T2 também foram avaliados. Resultados: Foram incluídos 14 homens e 20 mulheres. A média de idade foi 58,12 anos. O tempo médio de progressão foi 12,38 meses. O estado neurológico pré-operatório por mJOA foi leve em 2 pacientes, moderado em 16 e grave em 16, com média de 11,44 pontos. O Nurick pré-operatório foi de grau II em 14 pacientes, grau III em 8, grau IV em 10 e grau V en 2. O sinal de hiperintensidade em T2 foi documentado em 18 pacientes (52,9%). O resultado funcional de acordo com a taxa de recuperação mJOA foi bom em 15 pacientes (44,1%) e ruim em 19 (55,9%); o grau de recuperação de Nurick foi bom em 20 (58,8%) e ruim em 14 (41,2%). Conclusões: A cirurgia descompressiva da medula espinal demonstrou ser eficaz no tratamento de mielopatia espondilótica cervical em pacientes bem selecionados. Embora se sugira que há certos fatores que se correlacionam com o resultado funcional, acreditamos que mais estudos prospectivos e randomizados devem ser conduzidos para esclarecer esta hipótese.

Descritores: Compressão da medula espinal; Espondilose cervical; Mielopatia; Descompressão cirúrgica.

RESUMEN

Objetivo: Analizar el resultado funcional del tratamiento quirúrgico de la mielopatía cervical espondilótica. Métodos: Se realizó un estudio retrospectivo que incluyó 34 pacientes con MCE, intervenidos de enero 2014 a junio 2015. Se evaluó el estado neurológico utilizando las escalas de Nurick y de la Japanese Orthopaedic Association modificada (mJOA) en el período preoperatorio y a los 12 meses. Sexo, edad, tiempo de evolución, niveles cervicales afectados, abordaje quirúrgico y el signo de hiperintensidad en IRM potenciada en T2 también fueron evaluados. Resultados: Se intervinieron 14 hombres y 20 mujeres. La edad promedio fue 58,12 años. El tiempo de evolución promedio fue de 12,38 meses. El estado neurológico preoperatorio mJOA fue leve en 2 pacientes, moderado en 16 y severo en 16, con promedio de 11,44 puntos. El Nurick preoperatorio fue grado II en 14 pacientes, grado III en 8, grado IV en 10 y grado V en 2. El signo de hiperintensidad en T2 se documentó en 18 pacientes (52,9%). El resultado funcional según la tasa de recuperación mJOA fue bueno en 15 pacientes (44,1%) y malo en 19 (55,9%); según el grado de recuperación de Nurick fue bueno en 20 (58,8%) y malo en 14 (41,2%). Conclusiones: La cirugía descompresiva de la medula espinal ha mostrado ser efectiva en el tratamiento de la mielopatía cervical espondilótica en pacientes bien seleccionados. Aunque se sugiere que existen ciertos factores que se correlacionan con el resultado funcional, creemos que deberían realizarse más estudios prospectivos y randomizados para aclarar ésta hipótesis.

Descriptores: Compresión de la médula espinal; Espondilosis cervical; Mielopatía; Descompresión quirúrgica.

Study conducted at the Centro Médico ISSEMyM Ecatepec, Department of Spine Surgery, Estado de México, México.
Correspondence: Centro Médico ISSEMyM Ecatepec, Departamento de Cirugía de Columna Vertebral, Avenida del trabajo s/n, Colonia. El Carmen, Estado de México, Mexico. drmarvinvargas@hotmail.com

http://dx.doi.org/10.1590/S1808-185120171602172279 Received on 11/21/2016, accepted on 03/08/2017

INTRODUCTION

Cervical spondylotic myelopathy (CSM) is the most common form of spinal cord dysfunction in patients aged over 55 years.[1] It may manifest with a wide range of signs and symptoms, such as changes in gait, decreased fine motor ability of the hands, decreased muscle strength, loss of sensitivity, and bladder dysfunction.[2] Its clinical course may include periods of remission and periods of progressive neurological deterioriation.[3] Although recent studies have established that surgical decompression of the spinal cord is an effective treatment option in these patients[4,5] and that it can, at least, slow down the progression and even promote functional recovery,[6,7] there is still controversy concerning the predictive factors of the postsurgical result.[8-11]

The objective of this study is to evaluate the functional result of surgical treatment of patients with cervical spondylotic myelopathy.

METHODS

A descriptive, longitudinal, observational study was conducted at the Centro Médico ISSEMyM Ecatepec, during the period January 1 to June 16, 2015. A total of 34 patients with cervical spondylotic myelopathy were recruited, who were operated on at the spine surgery service.

For the evaluation of preoperative functional neurological state, the Nurick scale was used, as well as the modified scale of the Japanese Orthopaedic Association (mJOA) by Benzel et al. The postsurgical functional result was evaluated through the Nurick and mJOA scales at 12 months.

The mJOA recovery rate was also defined, using the Hirabayashi method (postsurgical mJOA-presurgical mJOA)/(18-presurgical mJOA) x 100. A satisfactory result was considered as one where the mJOA recovery rate was equal to or greater than 50%, and insufficient if it was less than 50%. Similarly, the result was defined as good if an increase in functional grade on the Nurick scale was produced, and bad if it remained the same or worsened.

Sex, age, duration of the symptoms, levels of compression and hyperintense signal in T2-weighted magnetic resonance imaging were also evaluated.

STATISTICAL ANALYSIS

For the statistical analyses, the software program SPSS, version 23.0 for Windows, was used. The categorical variables were summarized as frequencies and percentages, and the continuous variables as means and standard deviations. The Student's *t* test was used to compare the quantitative variables, and the Chi Squared test to compare the qualitative variables.

RESULTS

A total of 14 men (41.2%) and 20 women (58.8%) underwent the surgical procedure. The age range was from 40 to 82 years, (mean of 58.12, standard deviation 10.68). The mean time of evolution was 12.38 months, (range 6-19, standard deviation 3.41). (Table 1)

In 5 patients (14.7%) one level was affected; in 20 (58.8%), 2 levels and in 9 (26.5%) 3 or more levels. The most affected level was C5-C6, in 25 patients (73.5%).

The hyperintense signal in T2 was present in 18 patients (52.9%) and absent in 16 (47.1%). The anterior approach was used in 32 patients (94.1%), the posterior in 1 (2.9%) and combined in 1 (2.9%). The mJOA preoperative neurological status was classified as mild in 2 patients (5.9%), moderate in 16 (47.1%) and severe in 16 (47.1%), with a mean of 11.44 points (range 4-15 and standard deviation 2.50).

The mJOA postoperative neurological status at 12 months was classified as mild in 14 patients (41.2%), moderate in 12 (35.3%) and severe in 8 (23.5%), with a mean of 13.38 points (range 5-17, standard deviation 2.96).

The Student's t test indicated a statistically significant difference between the preoperative and postoperative mJOA scores (p=0.000). Thus, it was demonstrated that the patients had a lower mJOA score (M=11.44, DE=2.501) before the surgical treatment, and this score improved after the treatment (M=13.38, DE=2.965) t(33)=-10.296, p<0.05). (Table 2)

The preoperative Nurick grade was II in 14 patients (41.2%), III in 8 (23.5%), IV in 10 (29.4%) and V in 2 (5.9%).

The postoperative Nurick grade at 12 months was I in 13 patients (38.2%), II in 5 (14.7%), III in 7 (20.6%), IV in 6 (17.6%) and V in 3 (8.8%).

There was a statistically significant relationship between preoperative and postoperative Nurick grades, measured by the Chi Squared x2 (12)=69.94, p=0.000. (Table 3)

This functional result following the mJOA recovery rate was good in 15 patients (44.1%) and poor in 19 (55.9%) with a mean recovery of 37.53%.

The functional result, according to the Nurick recovery grade, was good in 20 (58.8%) and poor in 14 (41.2%).

Table 1. Quantitative descriptive statistics.

Statistics						
		Age	**Months of evolution**	**Preoperative mJOA score**	**Postoperative mJOA score at 12 months**	**mJOA recovery rate**
N	Valid	34	34	34	34	34
	Lost	0	0	0	0	0
Mean		58.12	12.38	11.44	13.38	37.5385
Median		56.00	12.00	12.00	13.5	37.5
Mode		53	10	10[a]	16	50.00
Standard Deviation		10.685	3.411	2.501	2.965	23.59280
Variance		114.168	11.637	6.254	8.789	556.62
Range		42	13	11	12	75.00
Minimum		40	6	4	5	0.00
Maximum		82	19	15	17	75.00

a. There are multiple modes. The smallest value is shown.

Table 2. Student's t test

Student's *t* test				
		N	**Correlation**	**Sig.**
Par 1	Preoperative mJOA score & postoperative mJOA score at 12 months	34	0.933	0.000

Paired tests and samples									
		Paired differences					**t**	**gl**	**Sig. (bilateral)**
		Median	**Standard Deviation**	**Mean standard of error**	**95% confidence interval of the difference**				
					Lower	**Upper**			
Par 1	Preoperative mJOA score & postoperative mJOA score at 12 months	-1.941	1.099	0.189	-2.325	-1.558	-10.296	33	0.000

Table 3. Correlation between preoperative and postoperative Nurick grades.

Cross Table preoperative Nurick grade vs. postoperative Nurick grade at 12 months							
Count							
		Postoperative Nurick grade at 12 months					
		I	II	III	IV	V	Total
Preoperative Nurick grade	II	13	1	0	0	0	14
	III	0	4	4	0	0	8
	IV	0	0	3	6	1	10
	V	0	0	0	0	2	2
Total		13	5	7	6	3	34

Chi squared test			
	Value	gl	Asymptomatic signification (bilateral)
Pearson's Chi squared test	69.943[a]	12	0.000
Verisimilitude ratio	65.420	12	0.000
Linear-by-linear association	29.617	1	0.000
N of valid cases	34		

a. In 19 Boxes (95.0%) a count lower than 5 is expected. The minimum expected count is 18.

Symmetrical measurements			
		Value	Approximate signification
Nominal by Nominal	Phi	1.434	0.000
	V de Cramer	0.828	0.000
	Contingency coefficient	0.820	0.000
N of valid cases		34	

There was a correlation between statistically significant functional result according to the Nurick recovery grade and the mJOA functional score, according to the Hirabayashi recovery rate (Table 4).

No statistically significant associations were found between sex (p= 0.119), approach route (p=0.432) and the functional result measured according to the Hirabayashi recovery rate.

There was a statistically significant association between the hyperintense signal in T2 in the magnetic resonance images and the mJOA functional result (p=0.000). (Table 5)

There was a statistically significant association between the number of cervical levels affected and the mJOA functional result mJOA (p=0.008). (Table 6)

There was a statistically significant association between the preoperative mJOA scale (p=0.000) and the mJOA functional result (Table 7)

A statistically significant correlation was found between age and mJOA score at 12 postoperative months; this relationship was inverse moderate linear. rPearson -0.509 (p=0.002). (Table 8 and Figure 1)

A statistically significant correlation was found between the preoperative mJOA score and the mJOA score at 12 postoperative months; this relationship was positive linear. rPearson 0.933 (p=0.000). (Table 9 and Figure 2)

Finally, there was no statistically significant relationship between time of evolution and final mJOA score. rPearson 0.051 (p=0.774). (Table 10 and Figure 3)

DISCUSSION

The clinical course of cervical spondylotic myelopathy may include periods of inactivity with gradual worsening;[2,12] however, a gradual progression of neurological dysfunction may follow in more constant form.[3,4]

Being able to predict which patients will have a stable disease and which patients will worsen remains a challenge.[13]

A Cochrane review of controlled, randomized studies of the role of surgery in patients with cervical spondylotic myelopathy led to the conclusion that the immediate results of the surgery were superior to

Table 4. Correlation between Nurick recovery grade and Hirabayashi recovery rate.

Cross Table functional Nurick result vs. functional mJOA result.				
Count				
		mJOA functional result		
		Satisfactory	Insufficient	Total
Nurick functional result	Satisfactory	15	5	20
	Insufficient	0	14	14
Total		15	19	34

Chi squared tests					
	Value	gl	Asymptomatic significance (bilateral)	Exact significance (bilateral)	Exact significance (unilateral)
Pearson's Chi squared	18.789[a]	1	0.000		
Correction of continuity[b]	15.871	1	0.000		
Verisimilitude ratio	24.169	1	0.000		
Fisher's exact test				0.000	0.000
Linear-by-linear association	18.237	1	0.000		
N of valid cases	34				

a. In 0 Boxes (0.0%), a count of less than 5 is expected. The minimum expected count is 6.18.
b. Only calculated for a 2x2 table.

Symmetrical measurements			
		Value	Approximate signification
Nominal by Nominal	Phi	0.743	0.000
	V de Cramer	0.743	0.000
	Coefficient of contingency	0.597	0.000
N of valid cases		34	

Table 5. Correlation between the hyperintense signal in T2 and the mJOA functional result.

Cross Table hyperintense signal in T2 MRI vs. mJOA functional result				
Count				
		mJOA functional result		
		Satisfactory	Insufficient	Total
Hyperintense signal in T2 MRI	Yes	2	16	18
	No	13	3	16
Total		15	19	34

Chi squared tests					
	Value	gl	Asymptomatic signification (bilateral)	Exact signification (bilateral)	Exact signification (unilateral)
Pearson's Chi squared	16.902[a]	1	0.000		
Correction of continuity[b]	14.177	1	0.000		
Verisimilitude ratio	18.662	1	0.000		
Fisher's exact test				0.000	0.000
Linear-by-linear association	16.405	1	0.000		
N of valid cases	34				

a. In 0 Boxes (0.0%), a count of less than 5 is expected. The minimum expected count is 6.18.
b. Only calculated for a 2x2 table.

Symmetrical measurements			
		Value	Approximate signification
Nominal by Nominal	Phi	-0.705	0.000
	Cramer's V	0.705	0.000
	Contingency coefficient	0.576	0.000
N of valid cases		34	

Table 6. Correlation between the number of cervical levels affected and the mJOA functional result.

Cross table cervical levels affected vs. mJOA functional result				
Count				
		mJOA functional result		
		Satisfactory	**Insufficient**	**Total**
Cervical levels affected	1	3	2	5
	2	12	8	20
	3 or more	0	9	9
Total		15	19	34

Chi squared tests			
	Value	**gl**	**Asymptomatic signification (bilateral)**
Pearson's Chi squared	9.663[a]	2	0.008
Verisimilitude ratio	6.606	2	0.001
Linear-by-linear association	18.237	1	0.010
N of valid cases	34		

a. In 3 Boxes (50.0%) a count of less than 5 is expected. The minimum expected count is 2.21

Symmetrical measurements			
		Value	**Approximate signification**
Nominal by Nominal	Phi	0.533	0.008
	Cramer's V	0.533	0.008
	Contingency coefficient	0.47	0.008
N of valid cases		34	

Table 7. Correlation between preoperative mJOA score and mJOA functional result.

Cross table preoperative mJOA vs. mJOA functional result				
Count				
		mJOA functional result		
		Satisfactory	**Insufficient**	**Total**
Preoperative mJOA	Mild (>15 pts)	2	0	2
	Moderate (12 - 15 pts)	12	4	16
	Severe (<12 pts)	1	15	16
Total		15	19	34

Chi squared tests			
	Value	**gl**	**Asymptomatic signification (bilateral)**
Pearson's Chi squared	18.029[a]	2	0.000
Verisimilitude ratio	21.186	2	0.000
Linear-by-linear association	16.571	1	0.000
N of valid cases	34		

a. 2 Boxes (33.3%) a count of less than 5 is expected. The minimum expected count is 88.

Symmetrical measurements			
		Value	**Approximate signification**
Nominal by Nominal	Phi	0.728	0.000
	Cramer's V	0.728	0.000
	Contingency coefficient	0.589	0.000
N of valid cases		34	

Table 8. Correlation between age and postoperative mJOA score.

Correlaciones			
		Age	**Postoperative mJOA score at 12 months**
Age	Pearson's correlation	1	-0.509*
	Sig. (bilateral)		0.002
	N	34	34
Postoperative mJOA score at 12 months	Pearson's correlation	-0.509*	1
	Sig. (bilateral)	0.002	
	N	34	34

*. The correlation is significant at a level of 0.05 (bilateral).

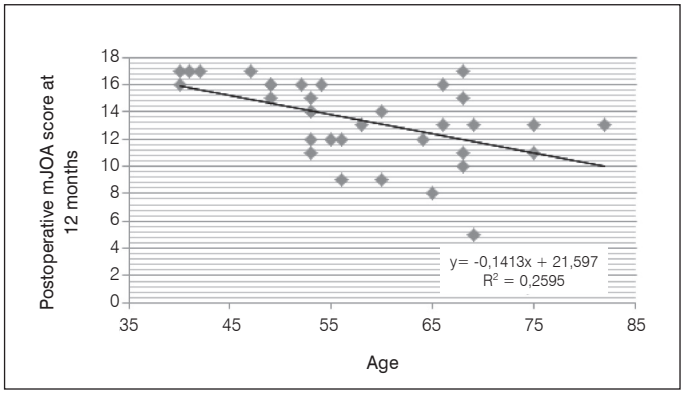

Figure 1. Correlation between age and postoperative mJOA score.

Table 9. Correlation between preoperative and postoperative mJOA scores.

Correlations			
		Preoperative mJOA Score	**Postoperative mJOA score at 12 months**
Preoperative mJOA score	Pearson's correlation	1	0.933**
	Sig. (bilateral)		0.000
	N	34	34
Postoperative mJOA score at 12 months	Correlación de Pearson	0.933**	1
	Sig. (bilateral)	0.000	
	N	34	34

**. La correlación es significativa en el nivel 0,05 (bilateral).

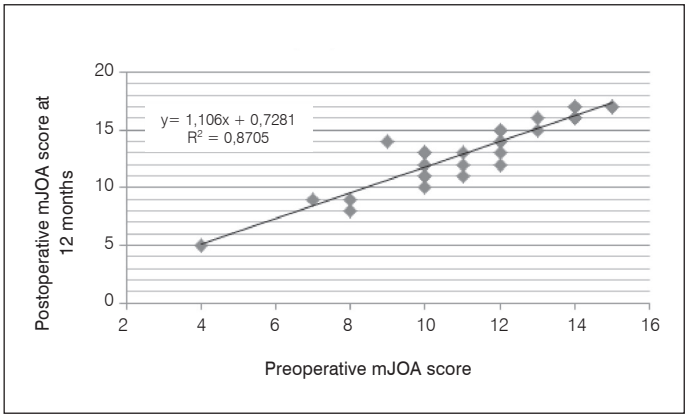

Figure 2. Correlation between preoperative and postoperative mJOA scores.

Table 10. Correlation between time of evolution and postoperative mJOA score.

Correlations			
		Time of evaluation	**Postoperative mJOA score at 12 months**
Time of evolution	Pearson's correlation	1	0.051
	Sig. (bilateral)		0.774
	N	34	34
Postoperative mJOA score at 12 months	Pearson's correlation	0.051	1
	Sig. (bilateral)	0.774	
	N	34	34

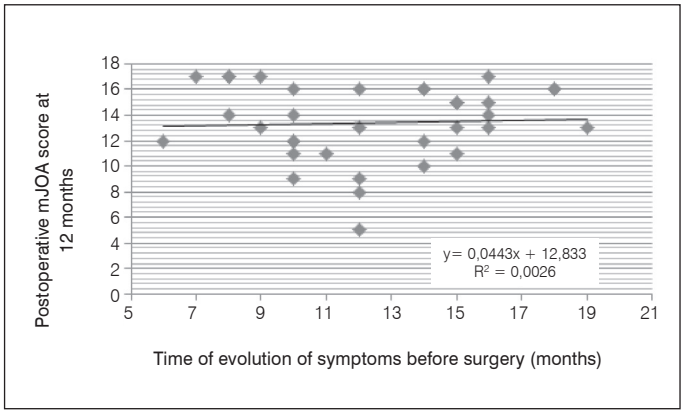

Figure 3. Correlation between time of evolution and postoperative mJOA score.

conservative management in terms of pain, debility and loss of sensitivity, but no differences were found beyond the first year.[14] Another study demonstrated that timely surgical treatment alters the prognosis in patients treated in the first year after the start of symptoms.[15] This is consistent with the results of our study, in which we found that there is a statistically significant improvement in patients who received surgical treatment, and that this improvement is positively associated with age and mJOA score at the time of surgery. It was also documented that patients who did not present the hyperintense signal in T2, and those who were affected at 2 levels, had better clinical results. Other factors, such as time of evolution, surgical approach used, and sex, showed no correlation with the postsurgical result.

CONCLUSIONS

Decompression surgery of the spine has proven effective in the treatment of cervical spondylotic myelopathy in well-selected patients, although there are certain factors that are correlated with the functional result, we believe that further prospective and randomized studies are needed to confirm this hypothesis.

All authors declare no potential conflict of interest related to this article.

CONTRIBUTION OF THE AUTHORS: This manuscript is an institutional study involving five authors. Each author made significant individual contributions to the manuscript. MJVU and AGM were the main contributors to the writing of the manuscript, while AGM, GHH and JEGC performed the surgical interventions, as well as the clinical follow-up, and recruited the patients for the study. VM collected the database and performed the statistical analyses. SH. contributed with the literature review and review of the manuscript.

REFERENCES

1. Lebl DR, Hughes A, Cammisa FP Jr, O'Leary PF. Cervical spondylotic myelopathy: pathophysiology, clinical presentation, and treatment. HSS J. 2011;7(2):170-8.
2. Lebl DR, Bono CM. Update on the dagnosis and management of cervical spondylotic myelopathy. J Am Acad Orthop Surg. 2015;23(11):648-60.
3. Nouri A, Tetreault L, Singh A, Karadimas SK, Fehlings MG. Degenerative cervical myelopathy: epidemiology, genetics, and pathogenesis. Spine (Phila Pa 1976). 2015;40(12):E675-93.
4. Rao RD, Gourab K, David KS. Operative treatment of cervical spondylotic myelopathy. J Bone Joint Surg Am. 2006;88(7):1619-40.
5. Klineberg E. Cervical spondylotic myelopathy: a review of the evidence. Orthop Clin North Am. 2010;41(2):193-202.
6. Chen J, Liu Z, Zhong G, Qian L, Li Z, Chen B, et al. Surgical treatment for cervical spondylotic myelopathy in elderly patients: a retrospective study. Clin Neurol Neurosurg. 2015;132:47-51.
7. Mummaneni PV, Kaiser MG, Matz PG, Anderson PA, Groff MW, Heary RF, et al. Cervical surgical techniques for the treatment of cervical spondylotic myelopathy. J Neurosurg Spine. 2009;11(2):130-41.
8. Pumberger M, Froemel D, Aichmair A, Hughes AP, Sama AA, Cammisa FP, et al. Clinical predictors of surgical outcome in cervical spondylotic myelopathy: an analysis of 248 patients. Bone Joint J. 2013;95-B(7):966-71.
9. Alafifi T, Kern R, Fehlings M. Clinical and MRI predictors of outcome after surgical intervention for cervical spondylotic myelopathy. J Neuroimaging. 2007;17(4):315-22.
10. Tetreault L, Kopjar B, Côté P, Arnold P, Fehlings MG. A clinical prediction rule for functional outcomes in patients undergoing surgery for degenerative cervical myelopathy: analysis of an international prospective multicenter data set of 757 subjects. J Bone Joint Surg Am. 2015;97(24):2038-46.
11. Karpova A, Arun R, Davis AM, Kulkarni AV, Massicotte EM, Mikulis DJ, et al. Predictors of surgical outcome in cervical spondylotic myelopathy. Spine (Phila Pa 1976). 2013;38(5):392-400.
12. Toledano M, Bartleson JD. Cervical spondylotic myelopathy. Neurol Clin. 2013;31(1):287-305.
13. Rhee JM, Shamji MF, Erwin WM, Bransford RJ, Yoon ST, Smith JS, et al. Nonoperative management of cervical myelopathy: a systematic review. Spine (Phila Pa 1976). 2013;38(22 Suppl 1):S55-67.
14. Fouyas IP, Statham PF, Sandercock PA. Cochrane review on the role of surgery in cervical spondylotic radiculomyelopathy. Spine (Phila Pa 1976). 2002;27(7):736-47.
15. Zhang YZ, Shen Y, Wang LF, Ding WY, Xu JX, He J. Magnetic resonance T2 image signal intensity ratio and clinical manifestation predict prognosis after surgical intervention for cervical spondylotic myelopathy. Spine (Phila Pa 1976). 2010;35(10):E396-9.