

## Original Article

## Long-term clinical and radiological follow-up after laminectomy for cervical spondylotic myelopathy

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### Abstract

**Background:** The role of laminectomy in the surgical treatment of cervical spondylotic myelopathy (CSM) is established even though postoperative cervical sagittal balance changes and a risk for long-term instability have been described. The aim of the present study is to investigate its clinical efficacy and the radiological outcome in the long-term.

**Methods:** The authors retrospectively reviewed consecutive cases of patients with CSM, who underwent cervical laminectomy between 1995 and 2010 at the Hospital São João ( $n = 106$ ). Clinical files were consulted, and the patients reassessed in order to collect information on complaints, previous neurological deficits, surgery and its complications. Subjective and objective clinical evaluation (by three myelopathy scores) and imaging studies were undertaken in order to assess the long-term cervical sagittal curvature and presence of instability.

**Results:** After applying exclusion criteria, 57 patients were able to complete the follow-up. A favorable statistically significant difference was obtained when comparing clinical scores. Ninety-one percent of patients were satisfied with the outcome of the surgery. Only 1 patient developed kyphosis according to Ishihara index and none according to the method of Matsumoto. Four patients developed subclinical cervical instability. No clinical-imaging correlation was found.

**Conclusions:** If patients are properly selected cervical laminectomy without additional instrumentation is effective in offering a clinical improvement to patients with CSM with a low incidence of clinically significant radiological deterioration.

**Key Words:** Cervical laminectomy, cervical spondylotic myelopathy, kyphosis

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### INTRODUCTION

The aims of the present study are to investigate the long-term efficacy and safety of stand-alone cervical laminectomy in patients with cervical spondylotic myelopathy (CSM) and to investigate the radiological outcome related thereto.

Laminectomy has assumed an irreplaceable role in preventing symptomatic progression of CSM but

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emerging alternative procedures filed controversy among surgeons.<sup>[1,3]</sup> The most described drawback regarding posterior cervical decompression by laminectomy involves the induction of kyphotic changes in the postoperative cervical sagittal balance with increased risk for long-term instability; therefore some authors recommend complementary fusion as a preventive strategy significantly increasing the cost of the procedure, operative time, blood loss, and adds specific risks for complications.<sup>[2,5,6]</sup>

## MATERIALS AND METHODS

### Study design

In this retrospective analysis consecutive patients with the diagnosis of CSM who underwent cervical laminectomy at the Department of Neurosurgery of the Hospital São João during a period from January 1<sup>st</sup>, 1995 to December 31<sup>st</sup>, 2010 were enrolled. Cases with the acute progression of myelopathy due to other causes, insufficient follow-up, posterior instrumentation and/or fusion in addition to laminectomy were excluded. A total of 106 were enrolled in the study. According to exclusion criteria 49 patients were ruled out; the remaining 57 were admitted to the protocol and 47 of these did long-term X-rays.

The preoperative evaluation relied on the revision of medical records and imaging on file. Patients were re-evaluated through a clinical interview at a minimum of 3 years after the surgery. The Ethics Committee of the Hospital approved the study protocol, and all patients signed an informed consent.

### Clinical evaluation

Functional assessment was performed by applying the modified Japanese Orthopaedic Association (mJOA) Score, the European myelopathy score (EMS) and the myelopathy disability index (MDI).<sup>[8]</sup> The mean population preoperative functional status was evaluated by mJOA scale: The preoperative functional status was also calculated for four groups of patients based on age ( $\leq 70$  vs.  $> 70$  years), duration of symptoms ( $\leq 12$  vs.  $> 12$  months), sex and number of intervention levels ( $\leq 3$  vs.  $> 3$ ). Of these, only duration of symptoms achieved significant results: Patients with more than 12 months of the symptomatic period had worse preoperative functional status than those with more recent complaints. Other population general characteristics are shown in Table 1.

A subjective evaluation was additionally performed by asking the patient to grade groups of symptoms as comparatively better, stable or worse with regarding the preoperative status.

Variables that could be related to the outcome, as well as long-term clinical-imaging correlation, were also

**Table 1: Population general characteristics**

	Median	Range	n (%)
Age (follow-up; years)	68	47-94	-
Age (intervention; years)	61	36-89	-
Follow-up (months)	73	42-166	-
Duration of symptoms (months)	12	1-180	-
Sex			
Male	-	-	34 (59.6)
Female	-	-	23 (40.4)
Number of levels			
2	-	-	5 (8.8)
3	-	-	17 (29.8)
4	-	-	24 (42.1)
5	-	-	8 (14.0)
6	-	-	3 (5.3)

investigated in order to better understand the impact of the surgical procedure in different groups of patients.

### Radiological evaluation

Both the Ishihara index and the angle of cervical lordosis according to the method of Matsumoto were calculated from pre- and post-operative X-rays.<sup>[8,9]</sup> The presence of segmental instability was also assessed in additional dynamic X-rays, as defined by a translation of more than 2 mm in the sagittal plane of two adjacent vertebral bodies occurring upon motion.<sup>[8]</sup> Magnetic resonance imaging was used for confirmation of the diagnosis of CSM and to screen for intramedullary T2 hyperintensity.

To avoid bias, all radiological measurements were performed blindly 3 times by the same investigator and averaged.

### Statistical analysis

For statistical analysis, paired and independent *t*-tests were used when comparing a binomial categorical variable with a numeric variable. When studying two numerical variables Spearman correlation was used (namely to ascertain clinical-radiological relationship). Levene test was used to assess the homogeneity of variances. A *P* value below 0.05 was considered significant. Box plots and error bar graphs were used. Data was processed using SPSS Statistics® version 22.0 (Armonk, NY: IBM Corp.) software on Microsoft Windows®.

## RESULTS

All applied scores indicate a significantly improved long-term functional status – higher mJOA (13.0 vs. 14.7;  $P < 0.001$ ) and EMS (13.6 vs. 15.4;  $P < 0.001$ ) scores and lower MDI score (9.3 vs. 5.7;  $P < 0.001$ ). After long-term follow-up (mean: 6.3 years) 91% of patients ( $n = 52$ ) reported being satisfied with the outcome of surgery and 93% ( $n = 53$ ) said that if they could go back in

time they would again go through it. The mean imaging follow-up was 6.4 years (standard deviation 3.1). The mean postoperative Ishihara index was 19.3 (lordotic). According to this method, only 1 patient (2%) had kyphosis at long-term follow-up (-4.6). The mean long-term lordosis estimated by the method of Matsumoto was 19.4°. According to this method, no patient developed a kyphotic angle. Subclinical segmental instability was found in 7% of patients after long-term follow-up ( $n = 4$ ). Among patients who had preoperative exams data was not conclusive regarding a progressive tendency towards kyphosis (according to Ishihara index, variation was  $-0.37$  versus Matsumoto angle, a variation of  $+ 0.94$ ).

### Complications

Only 9% of patients experienced surgical complications ( $n = 5$ ): Two cases of superficial surgical wound infection (handled under conservative management) and three transient postoperative C5 radiculopathies. No patient was re-operated due to iatrogenic deformity.

### Correlations

Duration of symptoms correlated with higher functional outcome according to mJOA, EMS, and MDI scores. Patients with symptoms for over 12 months reach lower long-term score values when comparing with patients with symptoms for <1-year (13.7 vs. 15.4). However, there was no significant difference in the variation of functional status. No correlation could be established between other studied variables and clinical/radiological outcome.

## DISCUSSION

This retrospective study evaluated long-term (minimum of 3 years) results of patients who underwent cervical laminectomy for CSM. All functional outcome scales used yielded a significant improvement in clinical status after an average of over 6 years of follow-up that is in favor of the long-term effectiveness of the procedure. Furthermore, over 90% of patients were satisfied with the outcome that favors the effect of the surgery on their daily lives. The effectiveness of cervical laminectomy as a decompressive technique has been documented repeatedly; in literature clinical improvement after cervical laminectomy ranges from 42% to 92% which is in agreement with our results.<sup>[7]</sup> Several comparative studies between procedures have already been done; in one of these Hamanishi and Tanaka reported on their experience with 69 patients with CSM (34 were judged as unstable on preoperative radiographs and underwent laminectomy and fusion and remaining 35 patients who underwent laminectomy alone) and did not observe any significant difference in functional status between the groups.<sup>[2]</sup>

The primary concern when using laminectomy without adjuvant arthrodesis relates to the development of long-term cervical kyphosis and instability; several studies have reported this delayed deterioration with an incidence of kyphotic deformity between 14% and 47% and thus quite higher than assessed in the present study (2%).<sup>[6,7]</sup> Our results suggest that these imaging abnormalities are limited and may not justify such a concern as long as the selection of patients is adequate and the surgical technique is meticulous, as described by Kaptain *et al.* who reported on 46 patients undergoing laminectomy who had pre- and post-operative radiographic and concluded that the development of a postoperative deformity (kyphosis) was more than twice as likely in patients with a “straight” preoperative spine (loss of lordosis) than in those with a normal lordosis.<sup>[4]</sup>

We found no clinical-radiological correlation that is in accordance with the previous literature.<sup>[4,7]</sup> Duration of symptoms was identified as a predisposing variable since patients with asymptomatic period over 12 months reached lower long-term mean score values. However, there is no significant difference in the functional status variation (since such patients had a more severe disease before intervention) and surgery enables a functional improvement concerning myelopathy regardless disease progression time. Investigation in this area would be interesting in order to find the accurate point in disease history where the intervention is beneficial but not precocious.

Regarding complications we identified a rate of 9% comprising postoperative C5 radiculopathy and superficial wound infection that is, consistent with the literature;<sup>[8]</sup> these rates strengthen the role of cervical laminectomy as a safe procedure with low morbidity. Posterior cervical fusion is associated with specific potential complications that could be avoided by stand-alone laminectomy: Lad *et al.* retrospectively reviewed a total of 2385 patients with decompression only and 620 patients with fusion and found that complication rates of the initial procedure hospitalization and at 90 days were significantly higher for those who underwent laminectomy with fusion comparing with those who underwent laminectomy alone.<sup>[5]</sup> Although nonsignificant, they identified a higher rate of reoperation (17.4% vs. 12.2%) and increased total procedure costs (\$107,056 vs. \$100,471) in patients with instrumented surgery.

An insurmountable limitation of this study relates to its retrospective character although we tried to overcome the risk of collecting biased information by comparing multiple records. Prospective controlled studies are likely to give more strength to our conclusions, yet these findings may be helpful in substantiating surgical decisions.

## CONCLUSIONS

Given an adequate preoperative selection of patients with CSM it does not appear necessary to routinely adjunct instrumentation to laminectomy in order to achieve clinical improvement or appropriate radiological outcomes in the long-term. However, prospective controlled studies are needed to support this conclusion.

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## Conflicts of interest

There are no conflicts of interest.

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