ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Spine

Editor
Nancy E. Epstein, MD
Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook

SNI
Open Access

Review Article

Review of laminoplasty versus laminectomy in the surgical management of cervical spondylotic myelopathy

Riccardo Paracino, Maria Rossella Fasinella, Fabrizio Mancini, Alessandra Marini, Mauro Dobran

Department of Neurosurgery, Università Politecnica delle Marche, Ancona, Marche, Italy.

E-mail: Riccardo Paracino - r.paracino@gmail.com; Maria Rossella Fasinella - rossella.fasi@gmail.com; Fabrizio Mancini - niccolomancini@libero.it; Alessandra Marini - marini.alessandra.am@gmail.com; *Mauro Dobran - dobran@libero.it

***Corresponding author:**
Mauro Dobran,
Department of Neurosurgery,
Università Politecnica delle
Marche, Ancona, Marche, Italy.

dobran@libero.it

Received : 03 November 2020
Accepted : 08 January 2021
Published : 03 February 2021

DOI
10.25259/SNI_788_2020

Quick Response Code:

ABSTRACT

Background: We reviewed the literature comparing the indications/efficacy of laminectomy (LA) with or without fusion versus laminoplasty (LP) in the treatment of cervical spondylotic myelopathy (CSM).

Methods: We identified 14 studies in PubMed/Medline to include in our analysis. Outcomes were assessed utilizing the Japanese Orthopaedic Association (JOA) score, visual analog scale (VAS), Neck Disability Index, and Nurick scale. Variables studied included ossification of the posterior longitudinal ligament (OPLL), cervical range of motion (ROM), the C2-C7 sagittal Cobb angle, the Ishihara index, and the Hirabayashi scale. Patients with cervical trauma/fracture, infection, or tumor were excluded from the study.

Results: In these 14 studies, there were no significant differences between LA and LP groups in terms of preoperative versus postoperative: JOA scores (e.g., including the improvement rate), VAS scores, and ROM. However, the LA patients demonstrated greater postoperative cervical lordosis versus those in the LP group.

Conclusion: At present, there are no guidelines for choosing LA versus LP for treating CSM. Factors that should be considered when choosing one procedure over the other should include the patients' preoperative clinical status, the type of CSM, the pathological extent of OPLL, and whether there is a sufficient cervical lordotic curvature.

Keywords: Cervical laminectomy, Cervical laminoplasty, Cervical spondylotic myelopathy, Open-door laminoplasty

INTRODUCTION

Multilevel cervical spondylotic myelopathy (CSM) is largely attributed to spondyloarthrosis (e.g., including disc disease, spurs, and osteophytes), congenital cervical canal stenosis, and/or ossification of the posterior longitudinal ligament (OPLL). The surgical decompression for CSM may include either laminectomy (LA) with/without fusion versus laminoplasty (LP).[3,4,7] Here, we performed a systematic review of the literature comparing these two techniques for managing CSM.

MATERIALS AND METHODS

In the literature, we identified 14 prospective/retrospective studies involving at least 20 adults with CSM undergoing LA versus LP (e.g., including meta-analysis using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses from PubMed [MEDLINE]) [Figure 1]. Two reviewers

(R.P. and M.R.F.) independently reviewed all abstracts, and full-text articles outcomes were measured using the following; Japanese Orthopaedic Association (JOA) score, neck visual analog scale (VAS), Neck Disability Index (NDI), Nurick scale, and SF36v2 scores (36-Item Short Form Survey). Clinical variables studied included OPLL, cervical range of motion (ROM), C2-C7 sagittal Cobb angle, the Ishihara index, and the Hirabayashi scale. Those within histories of trauma/fractures, infections, or tumors were eliminated [Table 1].

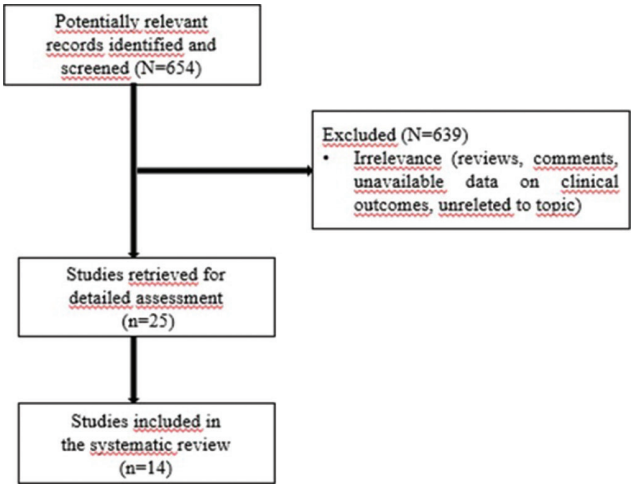

Figure 1: Flow diagram of study selection.

Comparison of clinical results

Clinical outcome

There is some disagreement regarding which procedure, the LP versus LA, results in better clinical outcomes. In Heller's *et al*. study, there were no statistically significant

Table 1: Studies comparing laminoplasty with laminectomy with or without fusion: characteristic of included studies.

Study	Surgery	Demographic	Follow-up	Reported outcome
Heller *et al*., 2001[6] Laminoplasty versus laminectomy and fusion for multilevel cervical myelopathy.	Laminoplasty Laminectomy with fusion	Laminoplasty: 13 Laminectomy with fusion: 13	Laminoplasty: 26.2 months Laminectomy with fusion: 25.5 months	Nurick scale Sagittal alignment Ishihara index
Kaminsky *et al*., 2004[7] Operative treatment of cervical spondylotic myelopathy and radiculopathy: a comparison of laminectomy and laminoplasty at 5 year average follow-up	Laminoplasty Laminectomy	Laminoplasty: 20 Laminectomy: 22	Both procedures: 5 years	Nurick scale Radiological parameters
Blizzard *et al*., 2016[1] Laminoplasty versus laminectomy with fusion for the treatment of spondylotic cervical myelopathy: short-term follow-up	Laminoplasty Laminectomy and fusion	Laminoplasty: 41 Laminectomy and fusion: 31	Laminoplasty: 19.2 months Laminectomy and fusion: 18.2 months	JOA VAS NDICervical sagittal alignment Cervical ROM Complications
Lee *et al*., 2016[11] Expansive laminoplasty versus laminectomy alone versus laminectomy and fusion for cervical ossification of the posterior longitudinal ligament: is there a difference in the clinical outcome and sagittal alignment?	Laminoplasty Laminectomy Laminectomy with fusion	Laminoplasty: 21 Laminectomy: 15 Laminectomy with fusion: 21	Both procedures: 24 months	NDI VAS Cobb angle C2–C7
Yuan *et al*., 2015[15] Clinical and functional outcomes of laminoplasty and laminectomy.	Laminoplasty Laminectomy	Laminoplasty: 20 Laminectomy: 18	Both procedures: 12 months	JOA VAS Cervical ROM
Stephens *et al*., 2017[14] Laminoplasty does not lead to worsening axial neck pain in the properly selected patient with cervical myelopathy: a comparison with laminectomy and fusion	Laminoplasty Laminectomy and fusion	Laminoplasty: 85 Laminectomy and fusion: 52	Both procedures: 18.5 months	mJOA VAS NDI Radiological parameters

(Contd...)

Table 1: *(Continued)*

Study	Surgery	Demographic	Follow-up	Reported outcome
Chang *et al*., 2017[2] Selective laminectomy for cervical spondylotic myelopathy: a comparative analysis with laminoplasty technique	Laminoplasty Laminectomy	Laminoplasty: 32 Laminectomy: 35	Both procedures: 18.4±6.9 months	JOA VAS NDI Intraoperative complications
Lee *et al*., 2017[12] Which technique is better option for C3 segment in multilevel open-door laminoplasty of the cervical spine? Laminectomy versus laminoplasty.	Laminoplasty Laminectomy	Laminoplasty: 54 Laminectomy: 39	Both procedures: 12 months	JOA
Fehlings *et al*., 2017[3] Laminectomy and fusion versus laminoplasty for the treatment of degenerative cervical myelopathy: results from the AO Spine North America and International prospective multicenter studies	Laminoplasty Laminectomy and fusion	Laminoplasty: 100 Laminectomy and fusion: 166	Both procedures: 12 months	mJOA Nurick grade NDI Hospitalization complication
Lau *et al*., 2017[10] Laminoplasty versus laminectomy with posterior spinal fusion for multilevel cervical spondylotic myelopathy: influence of cervical alignment on outcomes	Laminoplasty Laminectomy and fusion	Laminoplasty:101 Laminectomy and fusion: 44	Both procedures: 17.03 months	Nurick VAS
Karademir *et al*., 2017[9] the comparison of hemilaminectomy and laminoplasty procedures in the surgical treatment of cervical spondylotic myelopathy	Laminoplasty Laminectomy and fusion	Laminoplasty: 21 Laminectomy and fusion: 21	Both procedures: 24 months	JOA VAS Radiological parameters
Ha *et al*., 2019[5] Comparison of clinical and radiological outcomes in cervical laminoplasty versus laminectomy with fusion in patients with ossification of the posterior longitudinal ligament	Open-door laminoplasty Laminectomy with fusion	Laminoplasty: 49 Laminectomy with fusion: 42	Both procedures: 24 months	Radiological parametersROM JOA score VAS Neck Disability Index
Kang *et al*., 2019[8] Progression of cervical ossification of posterior longitudinal ligament after laminoplasty or laminectomy with posterior fixation	Open-door laminoplasty Laminectomy with fusion	Laminoplasty: 36 Laminectomy with fusion: 14	Laminoplasty: 37.6±16.8 months Laminectomy with fusion: 28.9±20.8	Radiological parameters ROM complications
Li *et al*., 2020[13] Clinical recovery after 5 level of posterior decompression spine surgeries in patients with cervical spondylotic myelopathy: a retrospective cohort study	French-Laminoplasty Open-door laminoplasty Laminectomy	French-Laminoplasty: 110 Open-door laminoplasty: 110 Laminectomy: 110	Each procedure: 3 years	Rankin scale Postoperative complication Nurick scale Spinal cord volumes Radiological parameters

differences in the Nurick score between LP and LA with fusion groups, although those undergoing LA/fusion had higher complication rates.[6] Other authors have agreed with these findings [Table 2].[1,4,9] However, to the contrary in Kaminsky's *et al*. study, myelopathy improved in 44% of LP patients versus 18% following LA, leading to the conclusion

Table 2: Studies comparing LP with LA with or without fusion: comparison of clinical results.

Study	Outcome	LP	LA	*P*-value
Heller *et al*. (2001)[6]Retrospective cohort	Nurick scale			
	Preoperative	2.3	2.2	<0.001
	Postoperative	1.1	1.5	
	Ishihara index			
	Preoperative	0.9	0.09	<0.001
	Postoperative	0.9	0.09	
Kaminsky *et al*. (2004)[7]	Nurick scale			
Retrospective cohort	Preoperative	2.44	3.09	<0.0001
	Postoperative	1.48	2.5	
	VAS			
	Preoperative	7.7	4.7	0.018
	Postoperative	3.2	4.4	0.14
Blizzard *et al*. (2016)[1]	NDI			
Retrospective cohort	Preoperative	20.29	19.84	0.89
	Postoperative	14.76	16.67	NR
	JOA score			
	Preoperative	14.36	14	0.23
	Postoperative	16.46	16.36	NR
	VAS			
	Preoperative	4.25	4.71	0.79
	Postoperative	3.56	3.18	NR
	ROM			
	Preoperative	39.35	38.14	0.7
	Postoperative	30.53	10.34	NR
Lee *et al*. (2014)[11]	JOA score			
Retrospective cohort	Preoperative	14.0 (2.8)	12.4 (2.9)	NR
	Postoperative	13.6 (3.4)	13.1 (1.2)	NR
	VAS			
	Preoperative	3.4 (3.5)	2.9 (2.8)	NS
	Postoperative	3.0 (2.8)	1.3 (1.7)	NS
	NDI			
	Preoperative	12.3	17.9	NR
	Postoperative	8.8	13.8	NR
	Cervical lordosis			
	Preoperative	14.2 (5.8)	10.0 (11.6)	NR
	Postoperative	8.0 (7.9)	5.1 (12.0)	NR
Yuan *et al*. (2015)[15]	JOA			
Prospective cohort	Preoperative	10.2	10.3	NR
	Postoperative	13.8	14	
	VAS			
	Preoperative	4.8	4.5	NR
	Postoperative	1.8	2.5	
Stephens *et al*. (2017)[14]	JOA score			
Retrospective cohort	Preoperative	13	12	<0.0001
	Postoperative	15.6	14.5	<0.0001
	Neck VAS			
	Preoperative	1.8	3.3	0.031
	Postoperative	1.6	1.3	NS
	NDI			
	Preoperative	35	43	0.03
	Postoperative	28	39	NS
	C2–C7 sagittal Cobb angle			
	Preoperative	12.7	4	0.0001
	Postoperative	9.8	2.7	<0.0001

(Contd...)

Table 2: *(Continued)*

Study	Outcome	LP	LA	*P*-value
Chang *et al*. (2017)[2]	NDI			
Retrospective cohort	Preoperative	18	18.3	0.040
	Postoperative	14	15	NR
	Neck VAS			
	Preoperative	3.4	2.8	0.036
	Postoperative	2.7	1.7	NR
	ROM			
	Preoperative	17	20	0.036
	Postoperative	15	10	NR
Lee *et al*. (2017)[12]	JOA score			
Retrospective cohort	Preoperative	11	12	<0.05
	Postoperative	16.5	16	<0.05
	Neck VAS			
	Preoperative	6.5	6.3	0.05
	Postoperative	3.5	2.5	0.05
	ROM			
	Preoperative	44.3	43.7	0.8
	Postoperative	33.8	44.6	0.02
Fehlings *et al*. (2017)[3]	mJOA score			
Retrospective cohort	Preoperative	11.5	12.3	0.03
	Postoperative	3.5	2.4	0.01
	Nurick index			
	Preoperative	3.6	3.4	0.23
	Postoperative	1.6	1.1	0.08
	NDI			
	Preoperative	42	39	0.37
	Postoperative	14	10	0.2
Lau *et al*. (2017)[10]	JOA score			
Retrospective cohort	Preoperative	13	12	<0.0001
	Postoperative	15.6	14.5	<0.0001
	Neck VAS			
	Preoperative	1.8	3.3	0.031
	Postoperative	1.6	1.3	NS
	NDI			
	Preoperative	35	43	0.03
	Postoperative	28	39	NS
	C2–C7 sagittal Cobb angle			
	Preoperative	12.7	4	0.0001
	Postoperative	9.8	2.7	<0.0001
Karademir *et al*. (2017)[9]	Recovery rate	52.8±11.9 %	60.8±18.8%	<0.05
Retrospective cohort	(Hirabayashi)			
Ha *et al*. (2019) [5]	JOA score			
Retrospective cohort	Preoperative	12.67	12.24	0.9
	Postoperative	15.06	14.67	0.10
	ROM			
	Preoperative	38	40	0.4
	Postoperative	33	22	0.0006
	NDI			
	Preoperative	23.06	25.17	0.25
	Postoperative	11.82	16.40	16.40
	C2–C7 Sagittal Cobb angle			
	Preoperative	13	15	0.8
	Postoperative	10	11	0.6

(Contd...)

Table 2: *(Continued)*

Study	Outcome	LP		LA	*P*-value
Kang *et al.* (2019)[8]	ROM				
Retrospective cohort	Preoperative	34.7		30.7	0.326
	Postoperative	21.6		15.9	0.087
	C2–C7 sagittal Cobb angle				
	Preoperative	7.3		12.9	0.095
	Postoperative	1.9		3.8	0.171
Li *et al.* (2020)[13]	Nurick scale	French-door	Open-door		
Retrospective cohort	Preoperative	2.82	2.84	2.88	NS
	Postoperative	2.76	2.71	2.79	NS
	C2–C7 sagittal Cobb angle				
	Preoperative	14.71	13.91	14.45	NS
	Postoperative	14.12	12.71	14.31	NS

LA: Laminectomy, LP: Laminoplasty, JOA: Japanese Orthopaedic Association, VAS: Visual analog scale, NDI: Neck Disability Index, ROM: Range of motion

that LP was more clinically effective than LA with fewer complications [Table 2].[7]

NDI

Lee *et al*. assessed functional improvement using the NDI score following LP versus LA; they found no significant differences for NDI between the two groups ($P = 0.84$).[11] Alternatively, Stephens *et al*. found statistically significant improvement in NDI scores for LP patients versus LA patients undergoing fusions [Table 2].[14]

Neck pain

Lee *et al*. and Yuan *et al*. documented no significant differences in clinical outcomes and VAS score for LP versus LA.[11,15] Alternatively, Kaminsky *et al*. focused on the greater benefits and lower postoperative neck pain scores with LP, while Lee *et al*. documented greater improvement of neck pain utilizing LA [Table 2].[7,12]

Cervical ROM

Ha *et al*. study found significantly greater ROM preservation in flexion, extension, and side bending for those undergoing LP versus LA with fusion ($P = 0.0006$).[5] Alternatively, Chang *et al*. documented no differences in preoperative Cobb angle/ROM between the two cohorts [Table 2].[2]

Cervical alignment

Lau *et al*. documented that preoperative and postoperative C2–C7 sagittal vertical and cervical Cobb angle were similar between patients undergoing LP versus LA ($P = 0.454$).[10] However, the studies by Lee *et al*. and Lee *et al*. both reported a significant loss of cervical lordosis overtime following both operations [Table 2].[11,12]

OPLL progression

Lee *et al*. showed no significant difference in OPLL progression after LP (45.5%) versus LA (52.5%), while Kang *et al*. showed the faster OPLL progression for LA with fusion [Table 2].[8,11]

Relative postoperative lordosis for LP versus LA

Some authors found statistically significant differences regarding the postoperative preservation of cervical lordosis and ROM for LP versus LA.[12,13] Kang *et al*. found that the final C2–C7 lordosis decreased in the LA group and in the LP group and the mean magnitude of these changes was larger in the LA group, but was not statistically significant.[8]

CONCLUSION

Although there are no present guidelines for choosing to treat CSM utilizing either LA versus LP, surgeons should play close attention to patients' preoperative clinical status, the type of CSM present, (e.g., with/without stenosis/OPLL), and whether the cervical lordotic curvature has been preserved.

Ethical approval

All procedures performed underwent IRB Approval (any extra information in tables) with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Blizzard DJ, Caputo AM, Sheet CZ, Klement MR, Michael KW, Isaacs RE, *et al*. Laminoplasty versus laminectomy with fusion for the treatment of spondylotic cervical myelopathy: Short-term follow-up. Eur Spine J 2017;26:85-93.
2. Chang H, Ki C, Choi BW. Selective laminectomy for cervical spondylotic myelopathy: A comparative analysis with laminoplasty technique. Arch Orthop Trauma Surg 2017;137:611-6.
3. Dobran M, Mancini F, Paracino R, Lattanzi S, di Somma L, Nasi D, *et al*. Laminectomy versus open-door laminoplasty for cervical spondylotic myelopathy: A clinical outcome analysis. Surg Neurol Int 2020;11:73.
4. Fehlings MG, Santaguida C, Tetreault L, Arnold P, Barbagallo G, Defino H, *et al*. Laminectomy and fusion versus laminoplasty for the treatment of degenerative cervical myelopathy: Results from the AOSpine North America and international prospective multicenter studies. Spine J 2017;17:102-8.
5. Ha Y, Shin JJ. Comparison of clinical and radiological outcomes in cervical laminoplasty versus laminectomy with fusion in patients with ossification of the posterior longitudinal ligament. Neurosurg Rev 2020;43:1409-21.
6. Heller JG, Edwards CC, Murakami H, Rodts GE. Laminoplasty versus laminectomy and fusion for multilevel cervical myelopathy: An independent matched cohort analysis. Spine (Phila Pa 1976) 2001;26:1330-6.
7. Kaminsky SB, Clark CR, Traynelis VC. Operative treatment of cervical spondylotic myelopathy and radiculopathy. A comparison of laminectomy and laminoplasty at five year average follow-up. Iowa Orthop J 2004;24:95-105.
8. Kang MS, Kim KH, Park JY, Kuh SU, Chin DK, Kim KS, *et al*. Progression of cervical ossification of posterior longitudinal ligament after laminoplasty or laminectomy with posterior fixation. Clin Spine Surg 2019;32:363-8.
9. Karademir M, Kucuk A, Ulutabanca H, Selcuklu A, Menku A, Tucer B. The comparison of hemilaminectomy and laminoplasty procedures in the surgical treatment of cervical spondylotic myelopathy. Turk Neurosurg 2017;27:74-84.
10. Lau D, Winkler EA, Than KD, Chou D, Mummaneni PV. Laminoplasty versus laminectomy with posterior spinal fusion for multilevel cervical spondylotic myelopathy: Influence of cervical alignment on outcomes. J Neurosurg Spine 2017;27:508-17.
11. Lee CH, Jahng TA, Hyun SJ, Kim KJ, Kim HJ. Expansive laminoplasty versus laminectomy alone versus laminectomy and fusion for cervical ossification of the posterior longitudinal ligament: Is there a difference in the clinical outcome and sagittal alignment? Clin Spine Surg 2016;29:E9-15.
12. Lee GW, Cho CW, Shin JH, Ahn MW. Which technique is better option for C3 segment in multilevel open-door laminoplasty of the cervical spine?: Laminectomy versus laminoplasty. Spine (Phila Pa 1976) 2017;42:E833-40.
13. Li Q, Han X, Wang R, Zhang Y, Liu P, Dong Q. Clinical recovery after 5 level of posterior decompression spine surgeries in patients with cervical spondylotic myelopathy: A retrospective cohort study. Asian J Surg 2020;43:613-24.
14. Stephens BF, Rhee JM, Neustein TM, Arceo R. Laminoplasty does not lead to worsening axial neck pain in the properly selected patient with cervical myelopathy: A comparison with laminectomy and fusion. Spine (Phila Pa 1976) 2017;42:1844-50.
15. Yuan W, Zhu Y, Liu X, Zhu H, Zhou X, Zhou R, *et al*. Postoperative three-dimensional cervical range of motion and neurological outcomes in patients with cervical ossification of the posterior longitudinal ligament: Cervical laminoplasty versus laminectomy with fusion. Clin Neurol Neurosurg 2015;134:17-23.

How to cite this article: Paracino R, Fasinella MR, Mancini F, Marini A, Dobran M. Review of laminoplasty versus laminectomy in the surgical management of cervical spondylotic myelopathy. Surg Neurol Int 2021;12:44.