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Laminoplasty provides better functional outcomes than laminectomy in the management of cervical stenosis myelopathy: a systematic review



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ABSTRACT

Background: Increasing the life expectancy of an individual will be accompanied by the emergence of various degenerative diseases such as cervical stenosis myelopathy (CSM). CSM is characterized by the presence of signs and symptoms of spinal cord compression associated with narrowing the spinal canal dimensions. Decompression can be achieved by conventional methods such as laminectomy or a lamina reshaping procedure known as a laminoplasty. This study reports recent evidence regarding laminectomy and laminoplasty procedures in managing CSM in terms of functional outcomes.

Methods: A systematic search was conducted on the PUBMED database to identify and find studies comparing laminoplasty and laminectomy procedures. Inclusion criteria included patients older than 65 years diagnosed with cervical myelopathy, including CSM and/or ossified posterior longitudinal ligament (OPLL). Randomized controlled studies and prospective and retrospective cohorts were included in this study, while case series and case reports were excluded. The

comparison of effectiveness is based on the results of measuring functional outcomes using the Japanese Orthopedic Association (JOA) score, neck disability index (NDI), and the visual analogue scale (VAS) for pain assessment.

Results: A thorough search through the PUBMED database yielded 156 citations. Scanning titles and abstracts from studies that met the inclusion and exclusion criteria resulted in 14 articles. All articles have a retrospective cohort design. In total, there were 187 patients in the laminoplasty group and 161 patients in the laminectomy group. There was no significant difference between laminoplasty and laminectomy when viewed from the JOA score in weighted mean difference (WMD) (WMD 0.28; 95% Confidence Interval [CI]: -0.34-0.91) and VAS score (WMD 0.06; 95% CI: -1.13-1.02). However, laminoplasty was shown to have a better NDI score (WMD 3.32; 95% CI: -6.50-0.14).

Conclusion: Laminoplasty is superior to laminectomy for managing cervical myelopathic stenosis in terms of NDI score.

Keywords: Laminoplasty, Laminectomy, Functional Outcomes, Cervical Stenosis Myelopathy.

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INTRODUCTION

The increase in the life expectancy of an individual will be accompanied by the emergence of various degenerative diseases such as myelopathy due to cervical stenosis (cervical stenosis myelopathy/CSM).^{1,2} The management principle of compression of the compressed spinal cord is through the decompression procedure.² Decompression can be achieved by conventional methods such

as laminectomy or a lamina reshaping procedure known as a laminoplasty.

Over the years, laminectomy has been the classic choice of standard management for CSM.^{1,2} However, since the introduction of laminoplasty in 1970, the two techniques are said to be comparable in terms of both safety and clinical effectiveness.^{3,4} But, there is still no strong recommendation between the two procedures as the treatment of choice due

to conflicting results from the previous studies.⁵⁻⁷

This systematic review reports recent evidence regarding laminectomy and laminoplasty procedures in managing CSM in terms of clinical outcomes. Based on those mentioned above, this study aims to determine whether laminoplasty is better than laminectomy in the management of CSM.

Table 1. The comparison of laminoplasty and laminectomy techniques in terms of functional outcomes to manage CSM

Articles	Year	Population	Type of Study	Intervention	Comparison	Outcome
Chang et al.	2017	CSM	Cohort Retrospective	Laminoplasty	Laminectomy	NDI and VAS
Yuan et al.	2015	CSM caused by OPLL	Cohort Retrospective	Laminoplasty	Laminectomy with Fusion	JOA and VAS
Lee et al.	2014	Multiple OPLL with CSM	Cohort Retrospective	Laminoplasty	Laminectomy	NDI and VAS
Yang et al.	2013	CSM	Cohort Retrospective	Laminoplasty	Laminectomy with Fusion	JOA, NDI, and VAS
					Laminectomy	NDI and JOA
Du et al.	2013	Multiple CSM	Cohort Retrospective	Laminoplasty		

CSM: Cervical Stenosis Myelopathy; OPLL: Ossified Posterior Longitudinal Ligament; NDI: Neck Disability Index; VAS: Visual Analogue Scale

METHODS

The study design involved systematic search carried out on the PUBMED database to identify and find studies comparing laminoplasty procedures with laminectomy since September 2018. The search strategy was to use keywords and boolean operator: “laminoplasty” and “laminectomy”. Only human studies written in English and containing an abstract were considered for inclusion in the study.

Inclusion criteria included patients older than 65 years diagnosed with cervical myelopathy, including CSM and/or ossified posterior longitudinal ligament (OPLL). Randomized control studies and prospective and retrospective cohorts were included in this study, while case series and case reports were excluded. The comparison of effectiveness is based on the results of measuring functional outcomes using the Japanese Orthopedic Association (JOA) score, neck disability index (NDI), and the visual analogue scale (VAS) for pain assessment.

The study sample consisted of all articles in PUBMED comparing laminoplasty and laminectomy to treat CSM. NDI score is used to assess the patient's functional outcome concerning their disease, JOA score to evaluate the severity of myelopathy in patients with CSM, and VAS to assess pain scale. Assessment of risk of bias and study quality was carried out using the Joanna Briggs Institute (JBI) checklist.

RESULTS

A thorough search through the PUBMED database resulted in 156 articles. Selection of titles and abstracts from the study obtained 14 articles and those that met the inclusion and exclusion criteria were obtained 5 articles. All articles had a retrospective cohort design (evidence level class III) (Table 1).

In total, there were 187 patients in the laminoplasty group and 161 patients in the laminectomy group. There was no significant difference between laminoplasty and laminectomy when viewed from the JOA score (WMD 0.28; 95% Confidence Interval [CI], -0.34 to 0.91) and VAS score (WMD 0.06; 95% CL, -1.13 to 1.02) (Table 2). However, laminoplasty was shown to show a better NDI score (WMD 3.32; 95% CL, -6.50 to 0.14) (Table 3). Laminoplasty is superior to laminectomy for the management of cervical myelopathic stenosis in terms of NDI scores (Table 3).

Only one in 3 studies reported a significant difference in terms of JOA scores, with greater improvement in the laminoplasty group (Table 2). However, 2 of the 3 studies reported a significant difference in terms of NDI scores with greater improvement in the laminoplasty group (Table 3). For pain outcomes, 3 out of 4 studies reported significant differences in terms of VAS scores, with 2 groups reporting greater improvement in the laminectomy group and 1 in the laminoplasty group (Table 4).

DISCUSSION

There are still no good quality studies reporting comparative results between laminoplasty and laminectomy. We can only obtain studies with evidence level III. Since few studies compared laminoplasty and laminectomy, we included all studies regardless of variability in laminoplasty technique based on the previous study.⁸ This study used the conventional open-door Hirabayashi technique and for the open-door lamina, fixed sutures were attached to the spinous process and the facet capsule or paravertebral muscle.⁴ A previous study by Du W et al. used the open-door type of cervical and block laminoplasty described by Tsuji H et al.^{9,10} One side of the lamina is opened, and the other side acted as a hinge.¹⁰ The bone graft from the dissected spinous process is inserted into the exposed lamina and fixed with braided wire or nylon thread.¹⁰ Another modified technique by Yang L et al. lifted the lamina from the exposed side to the hinge side by about 8 to 10 mm and stabilized it with mini plates and 8 or 10 mm screws.¹¹ This variability is a limitation of our study.

In terms of effectiveness, different studies have described different results. The objective functional parameters were not similar across studies, with VAS scores being the most frequently used parameter. In terms of VAS score, only the laminoplasty performed by Yang L et al. showed the most significant benefit compared to laminectomy.¹¹ The benefit may be due to the modified laminoplasty

Table 2. Japanese Orthopedic Association (JOA) study scores comparing laminoplasty and laminectomy

Study	Year	LP (N=131)	LT (N=114)	Laminoplasty (LP)				Laminectomy (LT)				p		
				Preoperative		Postoperative		Preoperative		Postoperative				
				Mean	SD	Mean	SD	Mean	SD	Mean	SD			
Yuan et al.,	2015	20	18	10.60	-	13.40	-	-2.8	10.60	-	13.40	-	-2.80	>0.050
Yang et al.,	2013	75	66	8.91	1.23	13.55	1.34	-4.6	8.65	1.05	13.59	1.08	-4.94	0.831
Du et al.,	2013	36	30	8.08	1.13	13.97	1.28	-5.9	8.10	1.18	13.07	1.23	-4.97	<0.001*

LP: Laminoplasty; LT: Laminectomy; SD: Standard Deviation; Diff: Mean Difference; *Considered statistically significant if p-value less than 0.05

Table 3. Neck Disability Index (NDI) score from studies comparing laminoplasty and laminectomy

Study	Year	LP (N=131)	LT (N=113)	Laminoplasty (LP)				Laminectomy (LT)				p		
				Preoperative		Postoperative		Preoperative		Postoperative				
				Mean	SD	Mean	SD	Mean	SD	Mean	SD			
Chang et al.,	2017	35	32	17.90	10.70	13.80	4.10	4.10	18.30	6.60	14.80	7.40	3.50	0.040*
Lee et al.,	2014	21	15	12.30	5.60	8.80	8.40	3.50	18.30	14.70	16.80	3.10	1.50	>0.050
Yang et al.,	2013	75	66	34.11	3.74	14.67	3.04	19.40	33.74	3.50	16.80	4.54	17.00	0.010*

LP: Laminoplasty; LT: Laminectomy; SD: Standard Deviation; Diff: Mean Difference; *Considered statistically significant if p-value less than 0.05

Table 4. Visual Analogue score from studies comparing laminoplasty and laminectomy

Study	Year	LP (N=151)	LT (N=131)	Laminoplasty (LP)				Laminectomy (LT)				p		
				Preoperative		Postoperative		Preoperative		Postoperative				
				Mean	SD	Mean	SD	Mean	SD	Mean	SD			
Chang et al.,	2017	35	32	3.40	2.30	2.70	1.90	0.70	2.80	2.50	1.70	2.00	1.10	0.040*
Yuan et al.,	2015	20	18	4.80	-	1.70	-	3.10	4.50	-	2.50	-	2.00	>0.050
Lee et al.,	2014	21	15	3.40	3.50	2.70	2.80	0.70	2.80	2.80	1.70	1.70	1.10	<0.050*
Yang et al.,	2013	75	66	2.85	1.11	1.11	1.18	1.74	2.59	1.25	2.15	1.38	0.44	0.000*

LP: Laminoplasty; LT: Laminectomy; SD: Standard Deviation; Diff: Mean Difference; *Considered statistically significant if p-value less than 0.05

technique preservation of posterior curvature, which helps prevent the spinal cord from shifting backward.¹² Besides, to prevent excessive decompression and spinal cord irregularities, the authors limited the decompression rate during laminoplasty by restricting the angle of inclination with an appropriately sized mini-plate.^{11,12}

After collecting data and conducting a systematic review, it was found that there was no significant difference between laminoplasty and laminectomy with the JOA score (WMD 0.28; 95% [CI]: -0.34-0.91) and VAS score (WMD 0.06; 95% CI: -1.13-1.02). However, laminoplasty was shown to have a better NDI score (WMD 3.32; 95% CI: -6.50-0.14). Our study found that the NDI value was higher in post-laminoplasty CSM patients than post-laminectomy. This is consistent with several previous studies.^{5,6} A study conducted by Lee DH et al. in 2011 which examined 90 patients with cervical spondylosis and OPLL who received laminoplasty and laminectomy procedures found that the NDI score was significantly higher in the laminoplasty procedure group than the laminectomy.⁶ In his study, laminectomy showed a significantly higher incidence (28.9% vs. 4%), more severe weakness (2.1 vs. 3.5 based on manual and manipulative therapy (MMT)), more frequently involving other cervical nerve roots (53.8 % vs. 0%), and longer recovery time (20.8 vs. 10.5 weeks) than for laminoplasty.⁶ Although not statistically significant, laminectomy showed incomplete motor recovery in 15.4% of patients.⁶ Research conducted by Du W et al., among 66 patients with multilevel degenerative cervical myelopathy who received treatment by laminoplasty and laminectomy obtained a significantly higher NDI score in the group that received the laminoplasty procedure compared to laminectomy.⁹ During the follow-up period, it was found that some patients suffered from so-called axial symptoms, including nuchal pain, neck stiffness, and shoulder pain, which seriously affected their postoperative quality of life.⁹ At the last follow-up, it was found that the loss of cervical curvature was primarily found in the laminectomy group, while less was found in the laminoplasty group.⁹

In this study, the JOA and VAS values were not significantly different in patients after cervical myelopathic stenosis laminoplasty compared with post-laminectomy. Similar results were obtained by the study by Yuan W et al., among 38 patients with OPLL who underwent laminoplasty and laminectomy, where it was found that both groups showed significant postoperative improvement for JOA and VAS scores, but the differences between the two groups were not statistically significant.¹³ In the group that received laminoplasty, it was found (66.7%) patients showed higher axial symptoms than the group that received laminectomy (37.5%), but when referring to strength, dexterity, sensation, pain, gait, and complications, they found that laminoplasty is preferred over laminectomy.¹³ Likewise, a study conducted by Chang H et al. examined 67 patients with CSM who underwent laminectomy and laminoplasty surgery.⁸ In his study, clinical results were improved, indicated by the NDI and VAS scores for axial pain in the two groups, but did not show a statistically significant difference between the two groups.⁸ However, different results were found in other studies related to VAS or clinical outcome.^{14,15} After receiving laminoplasty, movement during flexion increased by 5.4-20% compared to normal movement, whereas in laminectomy, the movement during flexion increased by 57%.⁸ However, whether laminoplasty is indeed more useful than laminectomy remains controversial.

Despite reports of laminectomy inducing progressive cervical kyphosis postoperatively, Lee DH et al. reported good clinical and radiological outcomes after laminectomy in patients with OPLL.⁶ Only one in 34 cases required additional surgery for postoperative kyphosis developed 9 years after the laminectomy.⁶ In this study, there was more postoperative kyphosis cases in the laminectomy group compared to the laminoplasty group, but none of the cases had a poor outcome or required additional surgery.

CONCLUSION

The NDI value was better in post-laminoplasty CSM patients compared to post-laminectomy. Meanwhile, the JOA

and VAS values were no better in patients after cervical myelopathic stenosis laminoplasty than post-laminectomy.

CONFLICTS OF INTEREST

The author states that there are no conflicts of interest regarding the material discussed in the manuscript.

RESEARCH ETHICS

There are no problems related to Ethics in this study. All studies that were included were written in a bibliography list.

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AUTHOR CONTRIBUTION

Putu Kermawan is responsible for finding research samples, analyzing data, and reporting research results. I Ketut Siki Kawiya, I Gusti Ngurah Wien Aryana, and I Gusti Lanang Ngurah Agung Artha Wiguna were responsible for the design of the research concept and the supervisor in this study.

REFERENCES

1. Ryken TC, Heary RF, Matz PG, Anderson PA, Groff MW, Holly LT, et al. Cervical laminectomy for the treatment of cervical degenerative myelopathy. *J Neurosurg Spine*. 2009;11(2):142-9.
2. Anderson PA, Matz PG, Groff MW, Heary RF, Holly LT, Kaiser MG, et al. Laminectomy and fusion for the treatment of cervical degenerative myelopathy. *J Neurosurg Spine*. 2009;11(2):150-6.
3. Yang SC, Yu SW, Tu YK, Niu CC, Chen LH, Chen WJ. Open-door laminoplasty with suture anchor fixation for cervical myelopathy in ossification of the posterior longitudinal ligament. *J Spinal Disord Tech*. 2007;20(7):492-498.
4. Hirabayashi K, Watanabe K, Wakano K, Suzuki N, Satomi K, Ishii Y. Expansive open-door laminoplasty for cervical spinal stenotic myelopathy. *Spine (Phila Pa 1976)*. 1983;8(7):693-699.
5. Wang HQ, Mak KC, Samartzis D, El-Fiky T, Wong YW, Luo ZJ, et al. "Spring-back" closure associated with open-door cervical laminoplasty. *Spine J*. 2011;11(9):832-8.
6. Lee DH, Park SA, Kim NH, Hwang CJ, Kim YT, Lee CS, et al. Laminar closure after classic

- Hirabayashi open-door laminoplasty. *Spine (Phila Pa 1976)*. 2011;36(25):E1634-40.
7. Steinmetz MP, Resnick DK. Cervical laminoplasty. *Spine J*. 2006;6(6 Suppl):274S-281S.
 8. Chang H, Kim C, Choi BW. Selective laminectomy for cervical spondylotic myelopathy: a comparative analysis with laminoplasty technique. *Arch Orthop Trauma Surg*. 2017;137(5):611-616.
 9. Du W, Wang L, Shen Y, Zhang Y, Ding W, Ren L. Long-term impacts of different posterior operations on curvature, neurological recovery and axial symptoms for multilevel cervical degenerative myelopathy. *Eur Spine J*. 2013;22(7):1594-1602.
 10. Tsuji H, Itoh T, Sekido H, Yamada H, Katoh Y, Makiyama N, et al. Expansive laminoplasty for lumbar spinal stenosis. *Int Orthop*. 1990;14(3):309-14.
 11. Yang L, Gu Y, Shi J, Gao R, Liu Y, Li J, et al. Modified plate-only open-door laminoplasty versus laminectomy and fusion for the treatment of cervical stenotic myelopathy. *Orthopedics*. 2013;36(1):e79-87.
 12. Tani S, Isoshima A, Nagashima Y, Tomohiko Numoto R, Abe T. Laminoplasty with preservation of posterior cervical elements: surgical technique. *Neurosurgery*. 2002;50(1):97-102.
 13. 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.
 14. Suyasa IK, Lestari AAW, Prabawa IPY, Marta KKA. Water sport-related spine injury in Bali: a review and preliminary study. *Indonesia Journal of Biomedical Science*. 2019;13(2):72-76.
 15. Golden N, Mardhika PE, Nirryana W, Sukarya IM, Prabawa IPY. Risk factors and novel prognostic score for predicting the 14-day mortality of severe traumatic brain injury patients. *Intisari Sains Medis*. 2020;11(3):699-705.



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