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

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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].

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

![Figure 1: Flow diagram of study selection.](image)

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          | Laminoplasty: 13| Laminoplasty: 26.2 months | Nurick scale                         |
| Laminoplasty versus laminectomy and fusion for multilevel cervical myelopathy. | Laminectomy with fusion | Laminectomy with fusion: 13 | Laminectomy with fusion: 25.5 months | Sagittal alignment |
| Kaminsky et al., 2004[7]      | Laminoplasty          | Laminoplasty: 20| Both procedures: 5 years | Ishihara index                        |
| Operative treatment of cervical spondylotic myelopathy and radiculopathy: a comparison of laminectomy and laminoplasty at 5 year average follow-up | Laminectomy          | Laminectomy: 22   |                                      |                        |
| Blizzard et al., 2016[8]      | Laminoplasty          | Laminoplasty: 41| Laminoplasty: 19.2 months | Nurick scale                         |
| Laminoplasty versus laminectomy with fusion for the treatment of spondylotic cervical myelopathy: short-term follow-up | Laminectomy and fusion | Laminectomy and fusion: 31 | Laminectomy and fusion: 18.2 months | Sagittal alignment |
| Lee et al., 2016[9]           | Laminoplasty          | Laminoplasty: 21| Both procedures: 24 months | JOA                                   |
| 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? | Laminectomy          | Laminectomy: 15   |                                      | VAS | Cervical sagittal alignment |
| Yuan et al., 2015[10]         | Laminoplasty          | Laminoplasty: 20| Both procedures: 12 months | VAS                                   |
| Clinical and functional outcomes of laminoplasty and laminectomy. | Laminectomy          | Laminectomy: 18 |                                      | NDI                                   |
| Stephens et al., 2017[11]     | Laminoplasty          | Laminoplasty: 85| Both procedures: 18.5 months | mJOA                                  |
| Laminoplasty does not lead to worsening axial neck pain in the properly selected patient with cervical myelopathy: a comparison with laminotomy and fusion | Laminectomy and fusion | Laminectomy and fusion: 52 |                                      | VAS | Radiological parameters |

(Contd...)
differences in the Nurick score between LP and LA with fusion groups, although those undergoing LA/fusion had higher complication rates. Other authors have agreed with these findings [Table 2]. 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
| Study                        | Outcome                  | LP          | LA          | P-value  |
|-----------------------------|--------------------------|-------------|-------------|----------|
| **Heller et al. (2001)**    | Nurick scale             | 2.3         | 2.2         | <0.001   |
|                             | Preoperative             | 1.1         | 1.5         |          |
|                             | Ishihara index           | 0.9         | 0.09        | <0.001   |
|                             | Postoperative            | 0.9         | 0.09        |          |
| **Kaminsky et al. (2004)**  | Nurick scale             | 2.44        | 3.09        | <0.0001  |
|                             | Preoperative             | 1.48        | 2.5         |          |
|                             | VAS                      | 7.7         | 4.7         | 0.018    |
|                             | Preoperative             | 3.2         | 4.4         | 0.14     |
| **Blizzard et al. (2016)**  | NDI                      | 20.29       | 19.84       | 0.89     |
|                             | Preoperative             | 14.76       | 16.67       | NR       |
|                             | JOA score                | 14.36       | 14          | 0.23     |
|                             | Preoperative             | 16.46       | 16.36       | NR       |
|                             | VAS                      | 4.25        | 4.71        | 0.79     |
|                             | Preoperative             | 3.56        | 3.18        | NR       |
|                             | ROM                      | 39.35       | 38.14       | 0.7      |
|                             | Preoperative             | 30.53       | 10.34       | NR       |
| **Lee et al. (2014)**       | JOA score                | 14.0 (2.8)  | 12.4 (2.9)  | NR       |
|                             | Preoperative             | 13.6 (3.4)  | 13.1 (1.2)  | NR       |
|                             | VAS                      | 3.4 (3.5)   | 2.9 (2.8)   | NS       |
|                             | Preoperative             | 3.0 (2.8)   | 1.3 (1.7)   | NS       |
|                             | NDI                      | 12.3        | 17.9        | NR       |
|                             | Preoperative             | 8.8         | 13.8        | NR       |
|                             | Cervical lordosis        | 14.2 (5.8)  | 10.0 (11.6) | NR       |
|                             | Preoperative             | 8.0 (7.9)   | 5.1 (12.0)  | NR       |
| **Yuan et al. (2015)**      | JOA                      | 10.2        | 10.3        | NR       |
|                             | Preoperative             | 13.8        | 14          |          |
|                             | VAS                      | 4.8         | 4.5         | NR       |
|                             | Preoperative             | 1.8         | 2.5         |          |
| **Stephens et al. (2017)**  | JOA score                | 13          | 12          | <0.0001  |
|                             | Preoperative             | 15.6        | 14.5        | <0.0001  |
|                             | Neck VAS                 | 1.8         | 3.3         | 0.031    |
|                             | Preoperative             | 1.6         | 1.3         | NS       |
|                             | NDI                      | 35          | 43          | 0.03     |
|                             | Preoperative             | 28          | 39          | NS       |
|                             | C2–C7 sagittal Cobb angle| 12.7        | 4           | 0.0001   |
|                             | Preoperative             | 9.8         | 2.7         | <0.0001  |

*(Contd...)*
| Study | Outcome | LP | LA | P-value |
|-------|---------|----|----|---------|
| Chang et al. (2017) | NDI | 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) | JOA score | 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 |
| Lau et al. (2017) | JOA score | 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 |
| | Recovery rate (Hirabayashi) | Preoperative | 52.8±11.9 % | 60.8±18.8% | <0.05 |
| Karademir et al. (2017) | JOA score | 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 |
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.
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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.

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